NATURE RESERVES OF THE SHIRE OF TOODYAY

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WESTERN AUSTRALIAN NATURE RESERVE MANAGEMENT PLAN NO. 6

(DRAFT)

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A. GENERAL INTRODUCTION

This draft plan is part of the "Western Australian Nature Reserve Management Plan" series, in which provision is made for each number in the series to be published as a "Draft", then as a "Revised Draft" for Wildlife Authority and Ministerial approval, and finally in its approved form. The main reason for producing draft management plans is to provide for full consultation with the public and at the same time encourage public comment.

In this plan two sets of management prescriptions are used. The first gives a nature reserve a particular status, either as a "Key Site" or "Wildlife Refuge", and the second determines the access classification of the area.

1. NATURE RESERVE STATUS

KEY SITE

The key site concept is based on recognition of representative areas of natural and semi-natural environments. Four types of key site status can be recognised:

Key Site-Ecosystem Management

This is the most widely applied status, and it is given to nature reserves containing representative samples of the State's flora and fauna communities.

Key Site - Species Management

This status is given to nature reserves set aside for rare species of animals and plants, or to protect breeding sites, particularly of colonial and ground-nesting birds and waterfowl.

Key Site - Wilderness Management

This status is given to areas which have been minimally influenced by man's activity and where such activities should continue to be minimised.

Key Site - Specified Management

This category covers nature reserves where a particular use may be a major management consideration, such as research areas, waterfowl shooting areas and nature reserves with high recreation values.

WILDLIFE REFUGE

Nature reserves which are important reservoirs of plants and animals, but do not warrant designation as key sites,

are recognised as Wildlife Refuges. These may contain plant species poorly represented in the State's nature reserves, or the plant species present may complement a larger gene pool held in other reserved Crown land (e.g. State Forest, National Park). Wildlife Refuges may provide breeding sites for birds and tree-dwelling marsupials, food sources for migratory and nomadic bird species, or refuge for macropods.

2. ACCESS CLASSIFICATION

Whole, or part, of a nature reserve may be classified as prohibited, restricted, limited, shooting, hunting or unlimited access areas (as defined in the Wildlife Conservation Act, 1950 as amended). In this Plan LIMITED ACCESS AREAS and UNLIMITED ACCESS AREAS are the only two classifications used. A LIMITED ACCESS AREA can be freely entered on foot but not by a vehicle of any kind, unless authorized by the Conservator of Wildlife.

This draft plan is in nine parts:

PART 1 is divided into two sections "A. GENERAL INTRODUCTION" and "B. THE SHIRE OF TOODYAY". The former clarifies the management prescription terms used in this document and details the structure of the remaining parts. The latter includes a summary of the biophysical attributes of Toodyay Shire, and of the nine nature reserves located in this administrative area.

PARTS 2 to 8 discuss the individual nature reserves. Each part is split into two sections, "A. THE RESERVE" and "B. PLAN FOR MANAGEMENT". Section A expands upon the biophysical attributes of the nature reserve, as well as outlining its history and nature conservation values. Section B deals with the management objectives and policies which will be implemented during the currency of the Plan.

PART 9 contains general considerations and conclusions. An important facet of this final section is the discussion of the management of the Toodyay nature reserves in their regional context: physical, biological, historical and cultural.

Throughout this Plan structural vegetation categories follow Muir (1977). Muir's classification system uses structural vegetation categories, which are based on life form/height class and canopy cover (App. I). The life form/height classes range from "trees > 30 m" to "mosses, liverwort", with intermediate forms including mallees, shrubs, mat plants, bunch grass, and sedges. Canopy cover is divided into four categories: dense, mid-dense, sparse and very sparse. An example of this classification system is Jarrah/Marri WOODLAND over Dryandra carduacea OPEN SCRUB over LOW SEDGES.

The scientific and common names used for mammals throughout the text are according to the Australian Museum Mammal Index (Sept. 1980) amd Ride (1980). Reptiles and frogs are named according to the scientific and common names given by the Western Australian Museum and Cogger (1975).

B. THE SHIRE OF TOODYAY

Toodyay is the northernmost of four Shires (Beverley, York, Northam and Toodyay) which encompass the fertile upper reaches of the Avon River Valley. It has an area of 1 683 km^2 and supports a resident population of 1 490 people (Australian Bureau of Statistics 1981). There are nine nature reserves in the Shire, all of which are vested in the Western Australian Wildlife Authority (WAWA). Between them they support samples, though sometimes quite small, of each of the main habitats characteristic of the region. Several also contain features of historic importance and a number are used to a limited extent by the public for recreation and study.

The Toodyay area was among the first to be settled during the earliest phase of the expansion of agriculture east of the Darling Scarp. The first selections in the Toodyay area were taken up in 1836 (Erickson 1974). The subsequent progress of land development, summarised in Appendix I, provides a valuable historical context to the present day pattern of land-use, which includes the areas set aside as nature reserves and which are the subjects of this Plan.

Compared to many other parts of the State the developed landscape of the Toodyay region is relatively mature. This maturity is a product of the long history of the Shire and of a multiplicity of environmental factors which have combined to ensure that development has been cognisant of the values of the natural features of the Shire. As a result conservation areas within the Shire are recognised as part of a total environment: physical, biological and cultural.

The primary purpose of this plan is to set down individual programmes for managing the conservation values of the Toodyay nature reserves. The plan follows the pattern established in Crook (1981) and Crook et al. (1982) of treating, as a group, nature reserves in particular Local Authority districts. This approach provides an environmental context, permitting comparison of reserves and facilitating development of complementary management prescriptions for the nature reserves in the "series". In addition it has some purely administrative advantages. Finally, a Shire plan is immediately applicable to the broader task of land-use planning, which is a primary function of Local and State Government in Western Australia and based on Local Authority units in country areas. Recognition of this application of management plans helps further the dual principle that nature reserves are part of the total environment and that nature conservation is a matter of interest to the whole community.

1. CLIMATE

The climate of the Toodyay region is characterised by high winter rainfall and dry, hot summers. The summers are occasionally relieved by short periods of heavy rain of tropical cyclonic origin. The mean monthly maximum and minimum temperatures are 34°C and 16°C respectively for

summer. In winter they are 18°C and 5°C respectively. (Data collected at Northam, approximately 22 km south-east of Toodyay.)

Rainfall varies widely from place to place in the Shire from an annual mean maximum of ca 750 mm in the west to an annual mean of 450 mm in the east (Fig. 1). This gradient is the result of increasing distance from the coast and is associated with a variation from year to year in any one place of as much as 15-20 per cent (Gardener 1942).

Thus the Shire straddles two climatic zones as defined by Bagnovis and Gaussen (1957), viz: Warm Mediterranean, characterised by five to six "dry" months (in which potential evapo-transpiration exceeds precipitation) and Dry Warm Mediterranean, which is characterised by seven to eight "dry" months. In the south-west of Western Australia the boundary between these zones corresponds roughly with the 500 mm isohyet and therefore nearly bisects the Shire (Fig. 1).

The seasonal pattern, variability and gradient of rainfall from west to east are the most significant factors of climate influencing vegetation growth patterns and are of major importance as determinants of vegetation types and their distribution within the Shire. Nature reserves such as Moondyne in the west and Wongamine in the east, for example, have a 50-70 per cent difference in rainfall and equally distinct differences in growing periods. Moondyne lies near the edge of the Jarrah (E. marginata) forest belt while Wongamine is characterised by Wandoo (E. wandoo) woodlands and contains a small stand of Salmon Gum (E. salmonophloia).

2. GEOMORPHOLOGY

Geomorphic differences are another major factor responsible for the diversity of habitats within the Shire of Toodyay. The Shire contains part of the Darling Plateau which has an elevation of approximately 300 m in this region. In the western part of the Shire the plateau is based on very durable granitic rocks while in the east it overlies softer heavily weathered rocks (Fig. 2). The geomorphological development of the region clearly reflects these differences in basement material.

The western part of the Shire is characterised by gently undulating heavily lateritised surfaces incised by steep-sided stream valleys (Fig. 2). The valleys are fringed by laterite breakaways and their valley slopes are eroded to expose outcrops of the underlying granite. These characteristics of the western part of the plateau are well represented in Moondyne Nature Reserve.

Moving east, to the limits of the granitic intrusion into metamorphic rock (principally migmatite and gneiss), the old plateau surface persists as a series of "headlands" and isolated mesaform hills. These are fringed by

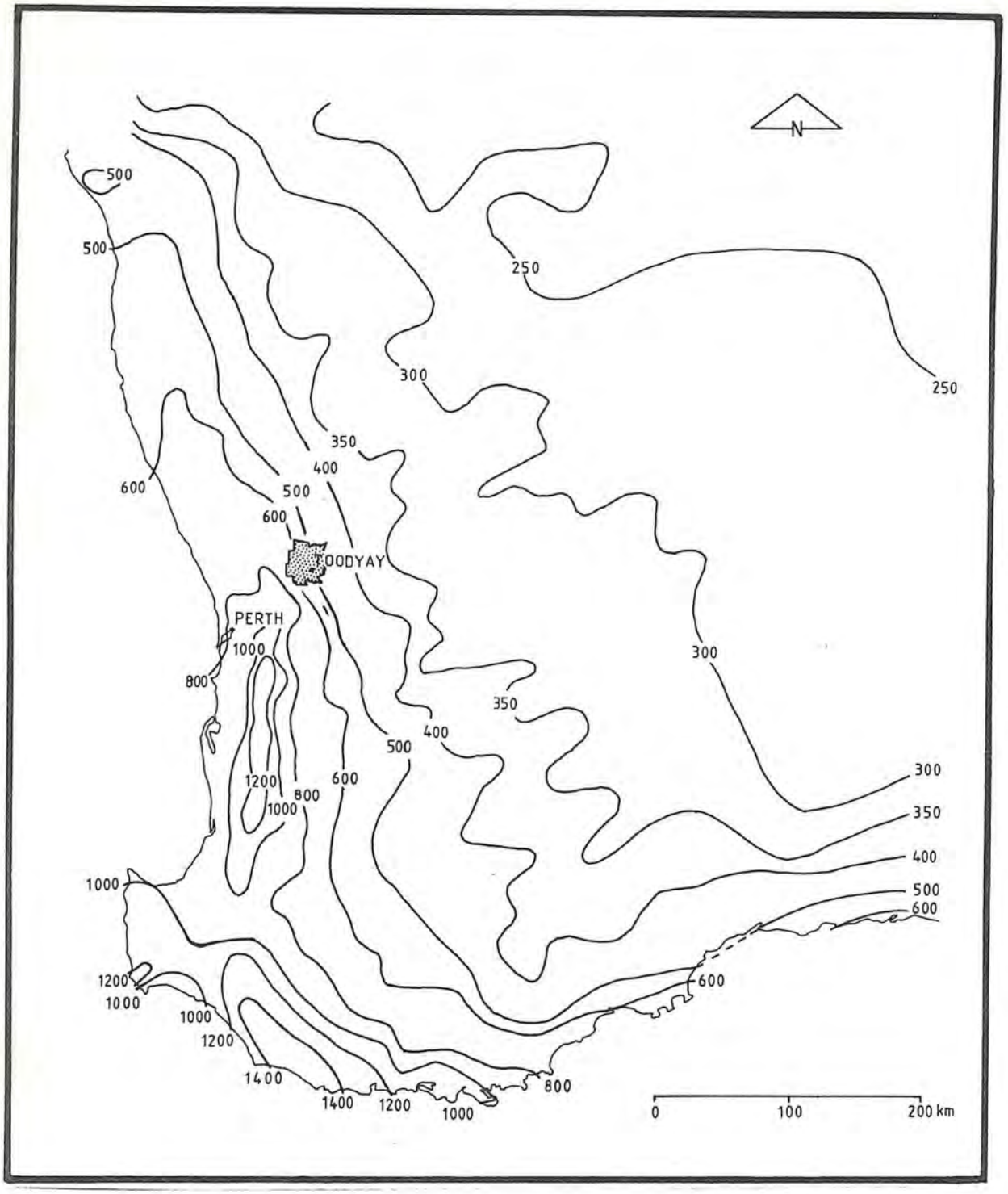


Figure 1. Location of the Shire of Toodyay within the south-west of Western Australia, and its relationship to annual isohyets.

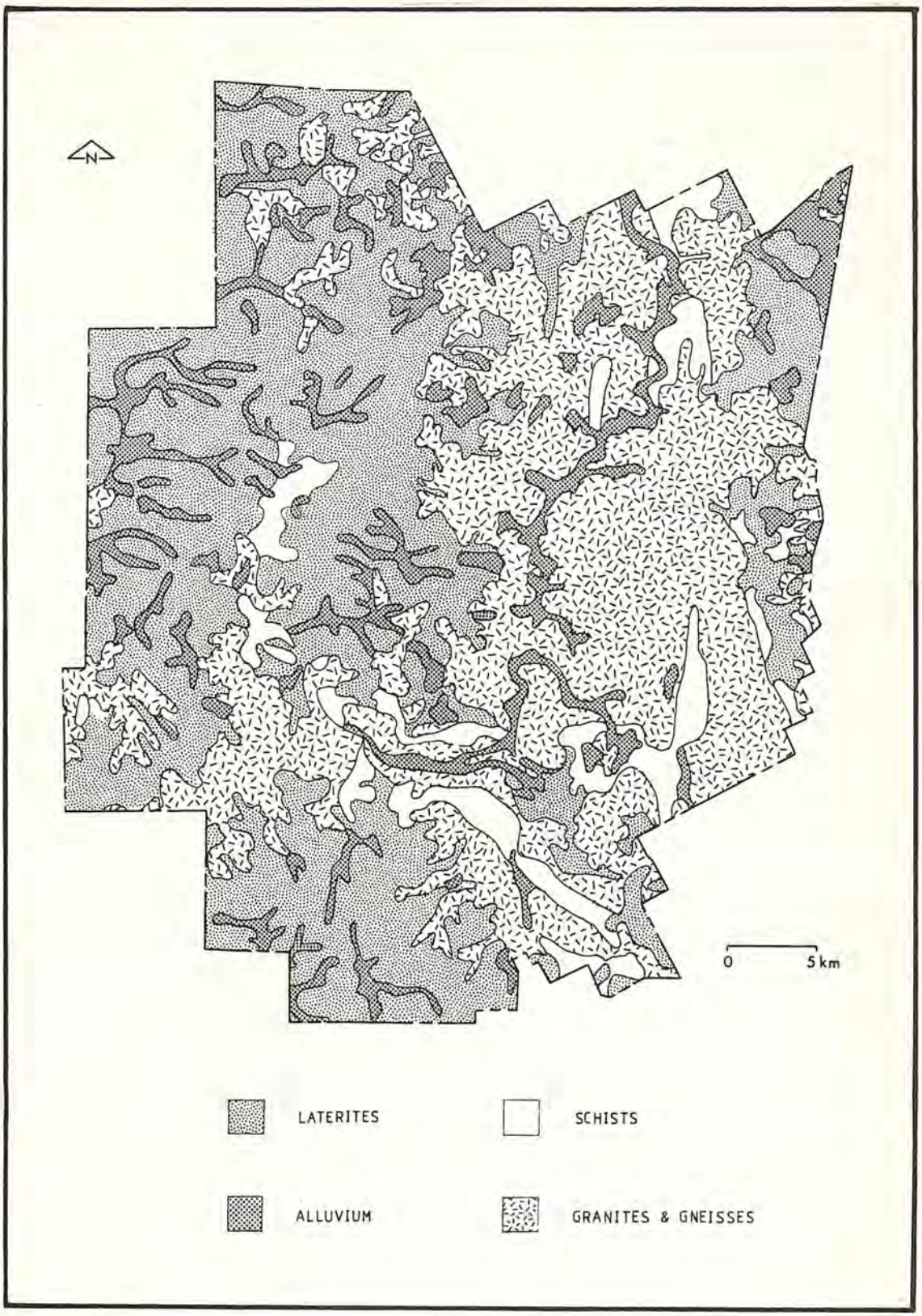


Figure 2. Geology of the Shire of Toodyay.

breakaways and separated by mature valleys which are mor. gently sloping than their counterparts further west. There are three nature reserves (Rugged Hills, Flat Rock Gully and Poison Gully) in this central "Hills Region", each centred on an area of higher ground complete with fringing breakaways and limited portions of lower valley slopes.

The Hills Region marks the western limit of the agriculturally most useful land in the Shire. The agricultural area eastwards is characterised by undulating low hills and broad, gently-sloping valleys. The Avon River Valley is a dominant feature of this region. Most of the land is cleared but two small nature reserves, Wattening and Bewmalling, give some indication of the original vegetation of these valley lowlands.

Some remnants of lateritic uplands persist in this area; part of one is represented in Wongamine Nature Reserve. Wongamine also contains a small area of aeolian sandplain, a feature which is characteristic of the catchment of the Mortlock River and restricted to the north-east corner of the Shire.

3. SOILS

The soil associations in the Shire broadly follow the patterns of geomorphology which clearly reflect the changes in basement materials.

On the uneroded plateau surface grey, yellow and red podsolised or leached soils predominate. These soils contain a large percentage of laterite gravels and have an earthy or sandy matrix. The steeply incised valleys of the plateau carry red earths among massive outcrops of the basement granite.

In the gently undulating terrain of the central and eastern areas a variety of predominantly duplex soils occur. The amount of gravel in these profiles increases in the higher parts of the landscape.

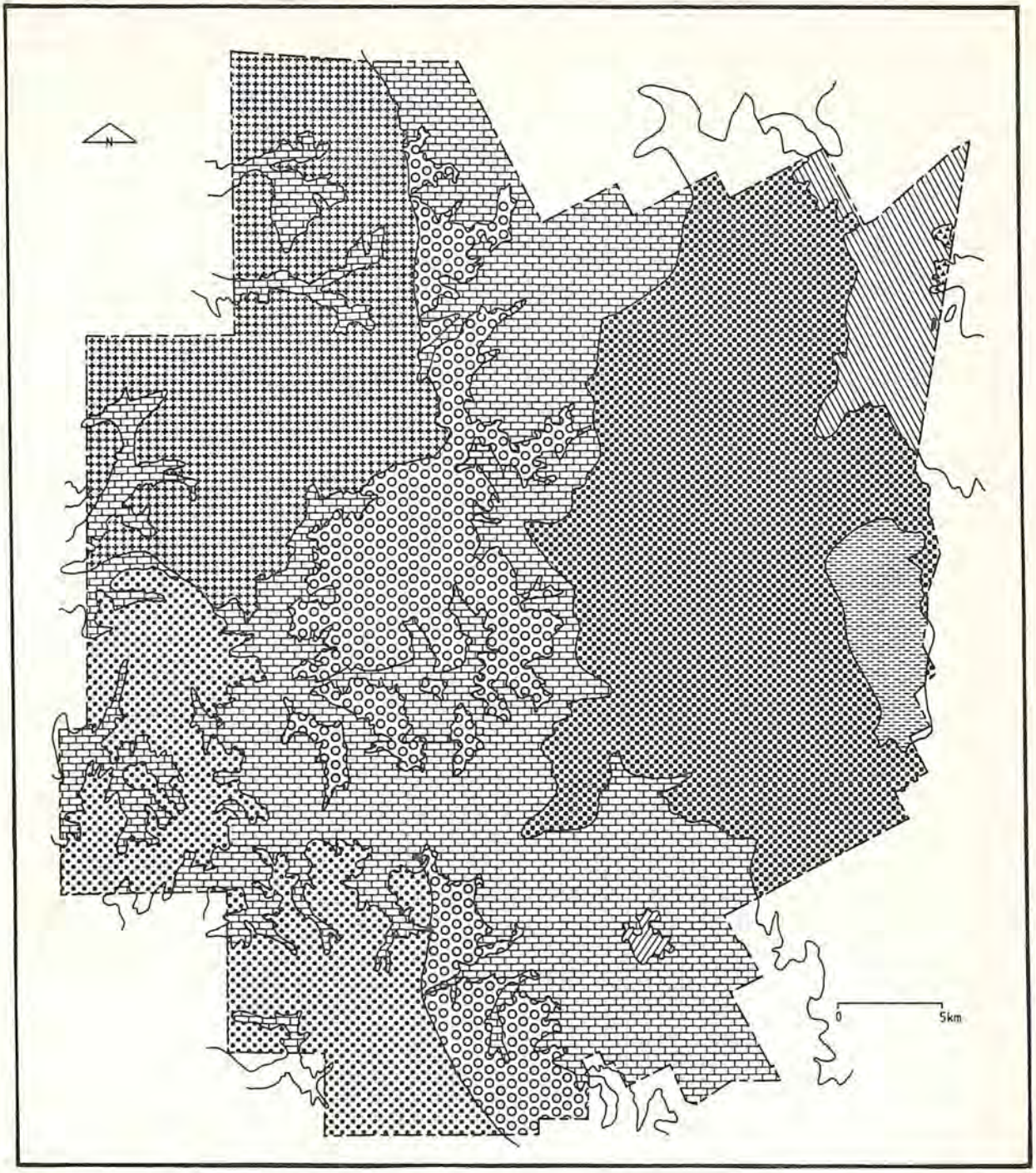
In the north-east sandy soils predominate.

4. VEGETATION

The vegetation of the Toodyay Shire has been mapped at a broad scale (1:250 000) by Beard (1978), who distinguished nine vegetation associations within the Shire (Fig. 3). These are, from higher to lower in the landscape sequence, and in order of occurrence with decreasing rainfall, as follows:

a. Jarrah/Marri (*Eucalyptus marginata*/*E. calophylla*) forest

b. Jarrah/Marri/Wandoo (*E. wandoo*) woodland



Wandoo, York Gum and Salmon Gum woodland

York Gum woodland

Jarrah, Marri and Wandoo woodland

Jarrah and Wandoo woodland

Marri and Wandoo woodland

Jarrah, Wandoo and Powderbark woodland

Jarrah/Marri forest

Scrub/Heath sandplain

Wandoo woodland

Figure 3. Vegetation of the Shire of Toodyay.

c. Jarrah/Wandoo/Powderbark (E. accedens) woodland

d_1. Marri/Wandoo woodland

d_2. Jarrah/Wandoo woodland

e. York Gum (E. loxophleba) woodland

f. Wandoo woodland

g. Wandoo/Salmon Gum (E. salmonophloia)/York Gum woodland

h. Mixed scrub/heathland

The Jarrah/Marri forest and Marri/Wandoo woodlands occur together in the highest rainfall area in the south-west of the Shire. This area marks the north-easternmost occurrence of Jarrah dominated forest. With the decline in rainfall in a northerly and easterly direction Jarrah forest grades into a series of more open woodlands in which Jarrah and Marri are joined by Wandoo and Powderbark.

Lower in the landscape sequence the close interaction of climate and physiography have resulted in a succession from Marri and Wandoo dominated woodlands in the western part of the Shire, to York Gum woodlands (and sandplain heaths) in the east.

Distribution limits of several forest and woodland eucalypts accompany the successions of vegetation in the Shire. Jarrah, a species of major importance in Moondyne Nature Reserve, has a restricted occurrence as a dominant species in Rugged Hills Nature Reserve, and is a species of minor importance in Poison Gully and Flat Rock Gully Nature Reserves, both of which are to the north of Rugged Hills. Jarrah is absent from Wongamine, the easternmost nature reserve in the Shire.

Marri/Wandoo woodlands are a feature of the central part of Toodyay Shire, and it is here that the Marri reaches the easternmost limit of its distribution in the region. Marri is found with Jarrah in forest formations in Moondyne, and in more open woodland stands in Poison Gully, Flat Rock Gully and Rugged Hills. Like Jarrah, Marri is absent from Wongamine Nature Reserve.

The three central Hills Region nature reserves (Rugged Hills, Poison Gully and Flat Rock Gully) are close to the north-western limit of occurrence of Brown Mallet (Eucalyptus astringens). This species is either locally dominant or found in association with Powderbark in each of the three reserves.

York Gum (E. loxophleba), a dominant woodland species in the wheatbelt, once occurred extensively throughout the Avon valley. However it is now represented only in minor stands which are isolated remnants of its former

distribution. Flat Rock Gully Nature Reserve is the westernmost nature reserve within the Shire which contains York Gum woodland.

Salmon Gum (E. salmonophloia) is a second woodland species characteristic of the wheatbelt which extends into the Toodyay Shire. An area of Salmon Gum woodland is present on Wongamine Nature reserve, on the eastern boundary of both the nature reserve and the Shire.

Several other minor woodland and forest eucalypts are found near their geographic limits in the Shire. Outlying populations of Swan River Blackbutt (E. patens) and Drummond's gum (E. drummondii), both of which prefer a moist climate, are found on the "Springs" nature reserves, Goonaring and Beelaring. Drummond's Gum also occurs on Flat Rock Gully Nature Reserve. The other western Nature Reserve, Moondyne, carries a small population of the River Gum (E. camaldulensis) a species generally found only to the north of Geraldton.

The succession of eucalypts is primarily the result of climatic, overlain by physiographic, changes from west to east across the Shire.

These same two factors have ensured the development of a very diverse flora containing many species near the limits of their geographic range. Together the nine nature reserves contain representative samples of most of the flora found within the Shire, and are of inestimable biological value both individually and as a group.

5. FAUNA

The wide range of vegetation types across Toodyay Shire support a diverse fauna. The Toodyay Naturalists' Club has recorded 153 bird species occurring in six different habitat types within a 20 km radius of Toodyay townsite (App. IV). Three of these habitats, York Gum/Jam, Wandoo woodland and Jarrah/Marri are well represented on nature reserves and therefore the birds listed as occurring in these habitats are likely to be similarly well represented in these areas.

The Toodyay Naturalists' Club, in addition to compiling a comprehensive bird list, has recorded other fauna sighted in the Shire (App. V).

6. LAND USE

Land alienation began earlier in the Toodyay region than in most other parts of the State and, although the period since the Second World War has been characterised by an upsurge of new land development, there remains a readily discernible relationship between the original settlement pattern and present land use. One component of this pattern is the nature reserve series, and Appendix I "The History of Land Use in the Shire of Toodyay" discusses this joint development.

Toodyay is in the west-central part of the sheep and cereal growing belt of Western Australia. Agricultural and pastoral activities are carried out intensively in the eastern half of the Shire, generally on land lying east of the 500 mm isohyet (Fig. 1). On most of this land, especially in the Avon Valley area, the emphasis is on stock grazing. Some grain is grown with more than half of the area under crop being devoted to coarse grain production for stock feed (Table 1).

Because of its close proximity to Perth, land in Toodyay Shire is being increasingly sought for recreational uses, including rural homesites and hobby farms. The area's scenic attractions and historic associations reinforce this demand and ensure a regular flow of tourists.

Private holdings, which are predominantly rural, make up 64.9 percent of the Shire's area. Of the remainder, 20.2 percent is occupied by State Forest, 6.2 percent is Commonwealth land used for army training, and the balance of 8.7 percent is in Crown reserves of other tenures and purposes. The nine WAWA nature reserves contribute 21 percent to the area of Crown reserves within the Shire, and therefore occupy 1.8 percent of the Shire's total area. Most of the Government controlled land lies in the western part of the Shire.

7. THE RESERVES

The nine nature reserves in the Shire of Toodyay (Table 2) which are vested in WAWA form the "system of nature reserves" that is considered under this plan of management (Fig. 4).

The Shire also contains the Avon Valley National Park (4430 ha) and substantial areas of State forest parts of which are also managed for nature conservation purposes. The remaining Crown reserves consist of small areas set aside for a variety of purposes and they are either unvested or vested in the Local Authority.

A brief description of each of the nature reserves follows. The remainder of this plan deals in detail with the individual management of these areas and with their management as a group.

Moondyne Nature Reserve (Reserve No. A30191)

Moondyne is the largest nature reserve in the Shire of Toodyay, and has an area of 1991 ha. It is the westernmost of the nine reserves, and is the principal nature reserve in the central, higher rainfall (800-1400 mm per year) area of the northern Darling Range between Chittering in the north and Mt Cook in the south.

The reserve lies about the junction of Plunkett and Sapper Roads north of the Avon River and Bald Hill and about 13 km

TABLE 1 : RURAL LAND UTILIZATION, 1980-1981 SEASON

LAND UTILIZATION	
	NUMBER
Active rural establishments	174
	AREA (ha)
Crops	17 809
Sown pasture	55 486
Balance of establishments	24 131
TOTAL AREA OF ESTABLISHMENTS	97 426
Crops-	
Wheat	7 563
Oats	2 566
Barley	7 693
Hay	1 657
Fruit	2
Vines	46
	NUMBER
Stock	
Sheep	404 084
Cattle -	
Beef	6 362
Dairy	35

Source: Australian Bureau of Statistics, 1981.

TABLE 2 : THE NATURE RESERVES OF THE SHIRE OF TOODYAY

RESERVE NUMBER	RESERVE NAME	PURPOSE	AREA (HA)	VESTED AUTHORITY
529	Beelaring	Conservation of Flora and Fauna	40	WAWA
659	Goonaring	Conservation of Flora and Fauna	53	WAWA
21429	Rugged Hills	Conservation of Flora and Fauna	252	WAWA
19900	Poison Gully	Conservation of Flora and Fauna	87	WAWA
22096	Flat Rock Gully	Conservation of Flora and Fauna	386	WAWA
30306	Bewmalling	Conservation of flora and Fauna	39	WAWA
2393	Wattening	Conservation of Flora and Fauna	40	WAWA
33697	Wongamine	Conservation of Flora and Fauna	213	WAWA
A30191	Moondyne	Conservation Flora and Fauna	1991	WAWA

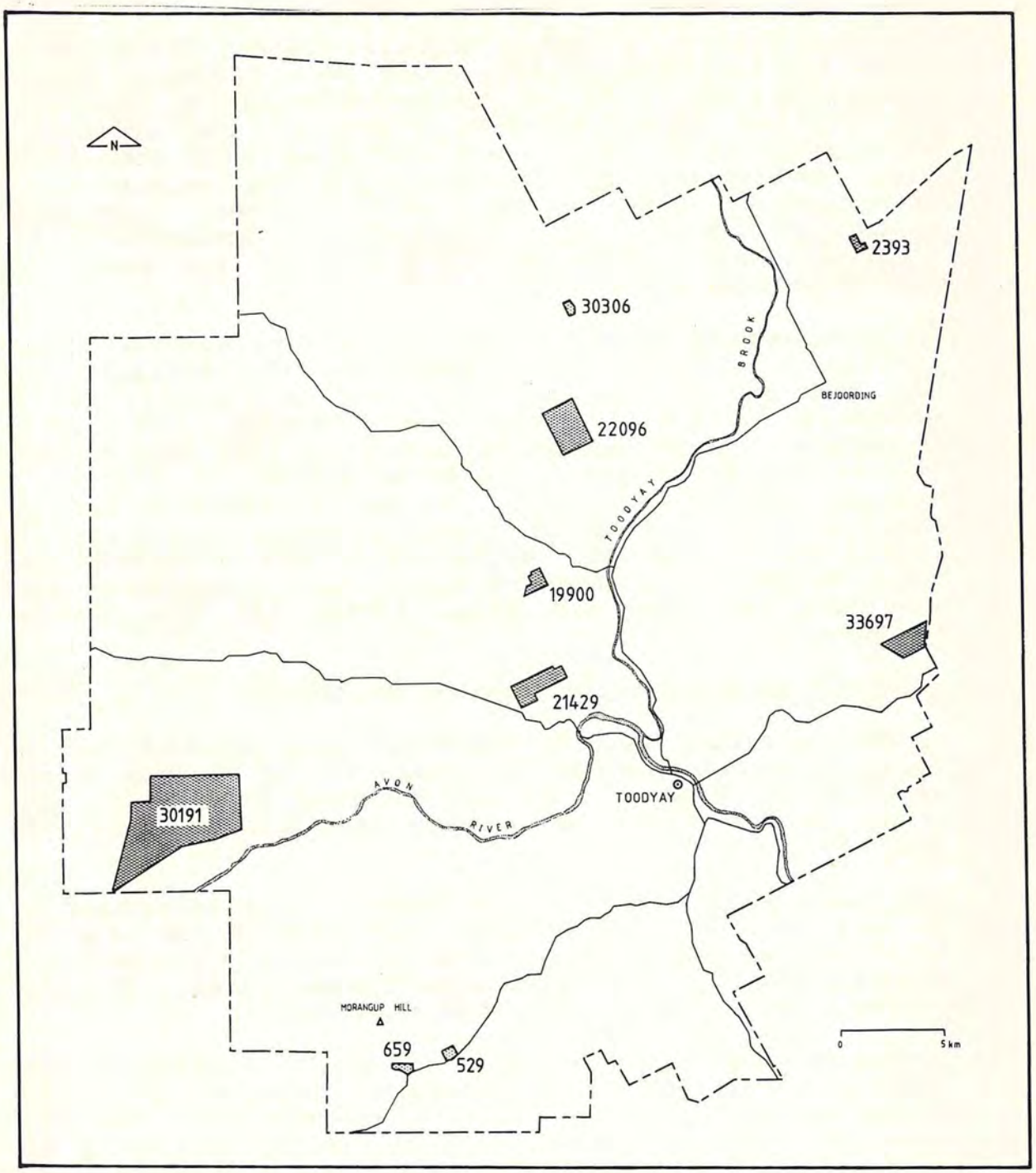


Figure 4. Shire of Toodyay showing location of nature reserves vested in WAWA, towns, major roads and waterways.

east of Lower Chittering. It is bounded to the north and east by freehold farmlands under cereal crops, pasture and some citrus orchards, to the south by the Avon Valley National Park (Reserve No. A30192) and to the west by Crown land covering mineral tenements.

Moondyne lies on a gently sloping plateau 275 - 300 m above sea level immediately north of the deeply incised Avon River valley, and is representative of the uplands of the Darling Range in this region. The soils are principally lateritic gravels and loams with some sandy loams particularly in the east, and the vegetation is predominantly open forest with Jarrah (Eucalyptus marginata), Marri (E. calophylla), Powderbark (E. accedens), and Wandoo (E. wandoo) being the main tree species represented.

As a management plan for Moondyne Nature Reserve (Crook and Evans, 1981) was approved by the Minister for Fisheries and Wildlife in 1981, this reserve will not be discussed in detail in this Plan. However, it will be considered in the concluding section of this Plan as part of the system of nature reserves within the Shire. A species list of the flora recorded on Moondyne and the results of a preliminary trapping program are given in Appendices VII and VIII respectively. This information has only recently been obtained and as such complements both the work by Crook and Evans (1981) and this present document.

Goonaring Nature Reserve (Reserve No. 659).

Goonaring Nature Reserve (with an area of 52.6 ha) is located approximately 19 km south-west of Toodyay at the junction of Toodyay Road and Morangup Road which pass along the southern and western boundaries respectively (Fig. 5).

The reserve is irregular in shape and is surrounded by cleared, privately owned land. The land to the east and north of the reserve was cleared as recently as January - February 1982 for subdivision into hobby farms. The land to the south and west is cleared farmland.

Goonaring lies on the hilly lateritic country of the Darling escarpment. The reserve contains a spring, Goonaring Spring, near its southern boundary, and from here the land rises steadily to the north. The soils are predominantly laterite derived loams, with a high proportion of laterite rock and gravel.

In the vicinity of Goonaring Spring the vegetation is mainly Paperbark/Swan River Blackbutt (Melaleuca preissiana/Eucalyptus patens) forest while the northern area of the reserve contains Jarrah (E. marginata) woodland and forest, and Marri (E. calophylla) woodland.

Beelaring Nature Reserve (Reserve No. 529)

Beelaring Nature Reserve is approximately 17 km south-west of Toodyay, on the Toodyay-Perth Road. The reserve is approximately two kilometres east-north-east of Goonaring Nature Reserve, and like Goonaring, lies in the hilly lateritic country of the Darling escarpment. The reserve has an area of 39.9 ha and is almost square. All the surrounding land, which is privately owned, has been cleared; to the north and south the reserve boundaries are fenced and the land is under pasture, while the land to the north and west is part of the same block as that adjacent to Goonaring which was cleared in January-February 1982.

Beelaring Spring, from which the reserve takes its name, is in the southern part of the reserve, and is surrounded by a variable forest dominated by Flooded Gum (Eucalyptus rudis), Marri, Swan River Blackbutt and Swamp Paperbark. Moving north this association changes to a Jarrah and Marri woodland with a dense tall shrub understorey; an association which occurs over most of the reserve. The soils are predominantly red-brown loams with some laterite gravel.

Beelaring and Goonaring are discussed together in PART 2 as they have a shared history and conservation values and are separated by less than two kilometres.

Rugged Hills Nature Reserve (Reserve No. 21429)

Rugged Hills is one of the three nature reserves in the Hills Region (as described in Section 2, Geomorphology) of the Shire. This is a region characterised by mesaform hills fringed with breakaways and dissected by gently sloping valleys. The other two nature reserves in the Hills Region, Poison Gully and Flat Rock Gully, are 6 and 14 km respectively north of Rugged Hills.

Rugged Hills is eight kilometres north-west of Toodyay, and is surrounded by privately owned land. It is roughly "L-shaped" and has an area of 252.0 ha. About 50 percent of the land surrounding the reserve has been cleared, and only the southern half of the reserve has been adequately fenced. Most of the adjacent land is under pasture and used for grazing sheep and cattle.

The reserve is centred on a broad plateau orientated north-south and fringed with steep-sided gullies and breakaways. The soils, which are characteristic of the Darling plateau, range from sandy loams with quantities of laterite gravel on the tops of breakaways, to sandy clay loams at the bottom of gently sloping valleys. This catena of soils supports a corresponding toposequence of vegetation, from Marri woodland on the plateau surface to York Gum and Jam at the bottom of the gently sloping valleys.

Rugged Hills is characterised by a number of woodland formations. A Marri dominated association occupies most of the higher ground, and is replaced at lower elevations by Powderbark (Eucalyptus accedens) and Wandoo (E. wandoo). Isolated patches of York Gum (E. loxophleba) and Jam (Acacia acuminata) and Brown Mallet (E. astringens) are also present.

Poison Gully Nature Reserve (Reserve No. 19900)

Poison Gully is situated approximately eight kilometres north-west of the Toodyay townsite and lies midway between Rugged Hills and Flat Rock Gully Nature Reserves in the Hills Region of the Shire. The reserve is irregular in shape and has an area of 87.2 ha. It is surrounded by privately owned land, most of which has been cleared or partially cleared for cropping or grazing or both.

The reserve is typified by rolling lateritic hills dissected by fertile valleys. The soils are mainly brown loams and sandy loams with varying quantities of laterite gravel. A small section on the north-western boundary has red loamy soils. The reserve supports a combination of woodland communities, the dominant species being Wandoo, Powderbark, Marri and Brown Mallet. A population of York Gum and Jam retains a foothold in the red soil along the north-western boundary.

Flat Rock Gully Nature Reserve (Reserve No. 22096)

Flat Rock Gully Nature Reserve (12 km north of Toodyay) is the northernmost of the three Hills Region nature reserves. It is rectangular in shape and has an area of 386.1 ha.

Apart from a short section near the southern corner where it borders State Forest, the reserve is surrounded by privately owned land. The farmland adjacent to the northern, southern and western boundaries is completely cleared and used for cropping and pasture. The land adjacent to the eastern boundary retains its original vegetation due to the rugged nature of the terrain.

The reserve is dominated by an extensive lateritised plateau and associated breakaways and gullies. The succession to lowland formations in the north-eastern corner completes the distinct landscape unit contained within the boundaries of the reserve. Laterite gravel mixed with sandy loams are the predominant soils.

Flat Rock Gully is characterised by woodland and forest formations. The central plateau carries a Marri dominated open woodland over a dense understorey, while Powderbark woodland/forest is dominant around the breakaways and steep gullies. Much of the north-western part of the reserve supports woodlands of Wandoo and Powderbark. This diverse pattern of vegetation further emphasises the landscape unit which Flat Rock Gully represents.

Bewmalling Nature Reserve (Reserve No. 30306)

Bewmalling Nature Reserve is situated in the north of the Shire approximately 11 km south-east of Bolgart and 4 km north of Flat Rock Gully. The reserve is roughly rectangular in shape and encompasses an area of 39.2 ha. It is surrounded by cleared, fenced farmland which is used for grazing and cropping. Old Plains Road passes along the eastern boundary of the reserve.

The reserve lies in undulating country and is cut by the Mount Anvil Gully which passes through it from west to east. Loams and sandy loams are the predominant soils, heavier clays being present in areas supporting Wandoo. Several granite outcrops are located near the south-western boundary of the reserve.

In general the reserve is dominated by a York Gum/Jam association which is typical of the broad gently sloping river valleys and undulating hills of the eastern part of the Toodyay Shire.

Wattening Nature Reserve (Reserve No. 2393)

Wattening Nature Reserve is in the north-eastern corner of the Shire, six kilometres south-east of Bolgart and eight kilometres north-east of Bejoording. The reserve is "L-shaped" with an area of 40.5 ha. Wroth/Wattening Spring Road passes along the southern half of the south-western boundary of the reserve.

The surrounding privately owned land has been extensively cleared for grazing and cropping, with the exception of a small gravel reserve near the southern corner of the reserve. The only significant area of uncleared land bordering the reserve lies to the south-east and protects the source of one of two permanent streams which pass through the reserve. Their flow is supplemented by water from Wattening Spring which is located on the eastern boundary of the reserve.

The reserve is flat, with soils varying from light coloured sands to sandy loams. Black peaty soils occur in the wet swampy areas. Most of Wattening Nature Reserve carries a York Gum/Jam association.

Wongamine Nature Reserve (Reserve No. 33697)

Wongamine Nature Reserve is situated on the eastern border of Toodyay Shire, about 12 km east-north-east of Toodyay. The reserve is tetragonal in shape and covers an area of 212.9 ha. Like Wattening Nature Reserve it lies in undulating country which has been extensively cleared for farming. The south-western boundary abuts a gravel reserve, with the remaining sides bordering on privately owned land. An uncleared area adjoins the reserve to the north. Roads pass along the south western and south-eastern boundaries; these are Forrest Road and Bejoording Road respectively.

The reserve contains one of the isolated eastern remnants of the laterite plateau, and is dissected by steep sided gullies and breakaways. A small area of sandplain occurs within the reserve, adjacent to the northern boundary.

The soils vary from laterite based loams and sandy clays, which support the Wandoo and Powderbark dominated woodlands, to reddish loams which support the Salmon Gum and York Gum associations. Pockets of white and yellow sands support Banksia scrub and heath.

PART 2 : BEELARING NATURE RESERVE (NO. 529) AND GOONARING NATURE RESERVE (NO. 659)

A. THE RESERVES

1. PHYSICAL CHARACTERISTICS AND RELATIONSHIPS

Beelaring and Goonaring Nature Reserves, which are only 2 km apart, are located in the southern corner of the Toodyay Shire, approximately 18 km south-west of Toodyay townsite (Fig. 4). The Toodyay-Perth Road passes along the southern boundary of both reserves, and Morangup Road follows the south-western boundary of Goonaring Nature Reserve.

Beelaring Nature Reserve is almost square with an area of 39.9 ha and a perimeter of approximately 2.5 km, while Goonaring Nature Reserve is irregularly shaped with an area of 52.6 ha and perimeter of about 3 km (Fig. 5). Both Goonaring and Beelaring lie in the hilly laterite country on the edge of the Darling plateau.

Beelaring Spring and Goonaring Spring, from which each reserve takes its name, are located in the south-eastern and southern parts of their respective reserves. On both reserves the springs occupy low-lying grounds from which the land rises towards Morangup Hill in the north.

The private land separating, and to the north of, the reserves has been recently cleared and is unfenced. The remainder of the land surrounding the reserves is privately owned, cleared and fenced and is used for pasture and cropping.

2. HISTORY

The histories of Beelaring and Goonaring are closely linked; they were both gazetted in the late nineteenth century, on 7 March 1882 and 13 March 1884 respectively, for the purpose of 'Watering and Stopping Place for Teams'. Both reserves, plus Wongamine, were set aside to provide watering and resting facilities for the large number of bullock and horse teams used to haul supplies to the Yilgarn goldfields.

The purpose of Goonaring was amended on 16 September 1966 to 'Resting Place for Travellers and Stock'. On 23 October 1970 the purpose of both reserves was amended to 'Conservation of Flora and Fauna' with vesting in WAWA. This change of purpose and vesting was based on the following recommendation

> ..."they (the reserves) contain some fine stands of Jarrah and Marri complete with the usual Darling Scarp flora. These areas would therefore make an excellent refuge for bird life. These two reserves are very small and could not hope to retain much of the local fauna. However they should be preserved,

since they are on the main road and will prov. small areas where people can see wildflowers and birdlife." (Deputy Director of Fisheries and Wildlife in litt. to the Under Secretary for Lands, 1970).

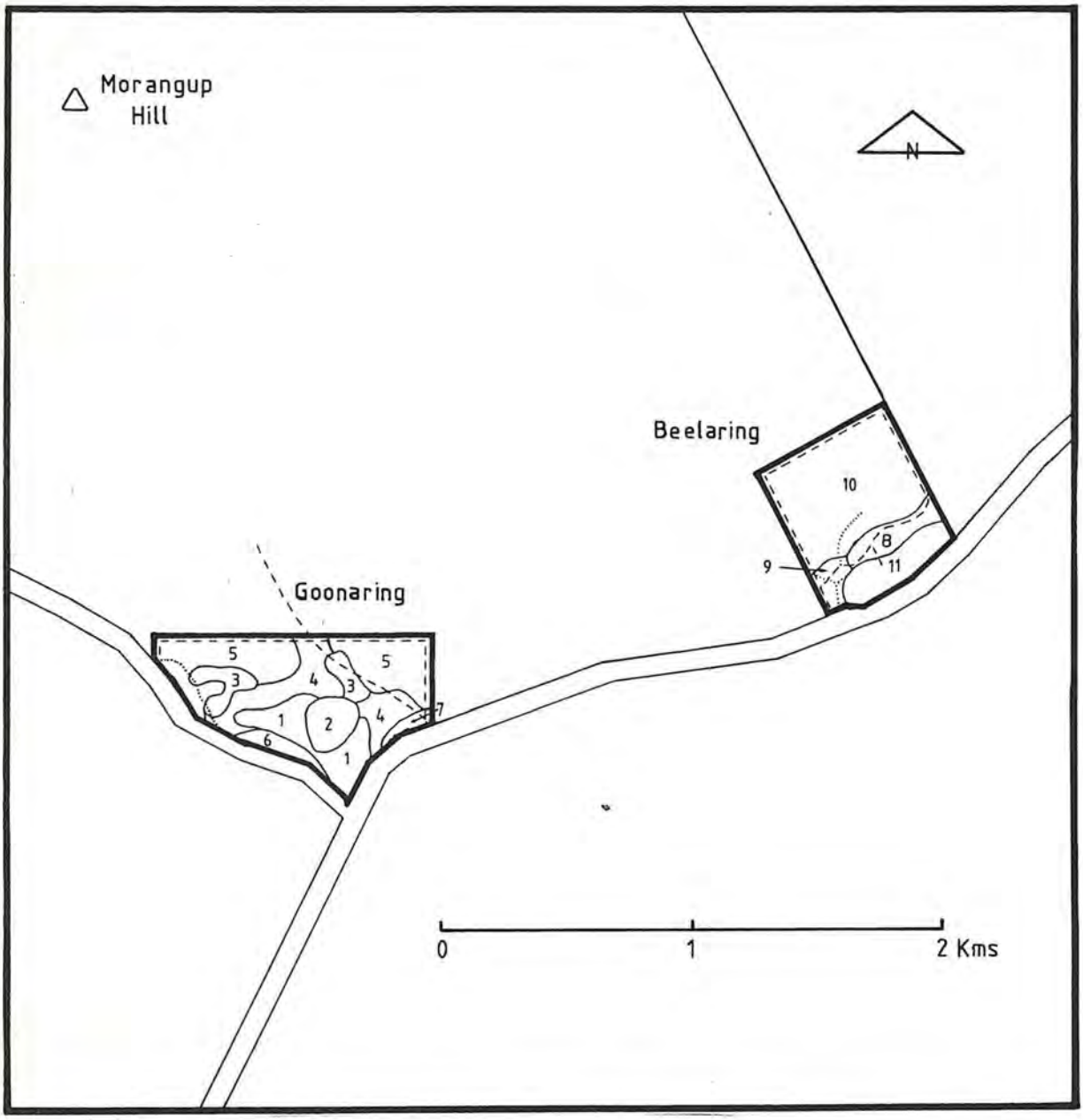


Figure 5. Beelaring and Goonaring Nature Reserves showing their relationship with surrounding lands, firebreaks and tracks (dashed and dotted lines) and vegetation formations (identified by numbers, and described in the associated text).

Since the early 1970s there has been continuing controversy about the use of the land separating, and to the north of, the reserves. Prior to this time the area, including the two reserves, was used by Wundowie Charcoal and Iron Industry, who lightly logged it.

> At this time..."The area provided an excellent place to see easily a full representative sample of Jarrah, Marri and heathland bird species present in the Western Division of the Avon Valley. The partial removal of some of the forest canopy by Wundowie Industry seems to have actually improved the overall habitat for diversity of species ....as many as 80 species of birds (have been recorded) in the area." (J. Masters in litt. to J. Goodsell, Department of Fisheries and Wildlife, 1975).

In 1975 the land to the north of, and separating, the reserves was sold to Agnew Clough Pty Ltd. At the same time concern was expressed...

> "...regarding the highly likely destruction of flora in these reserves should future land use of the watershed linking Morangup Hill and the reserves, require removal of the existing forests and heathlands on its slope. General clearing in the area might lead to a situation of complete salting of the swamp portions of these two reserves. Unfortunately there is ample evidence of this, at slightly lower levels along the same two watersheds shared by these reserves, after any major removal of vegetation." (J. Masters in litt. to J. Goodsell, Department of Fisheries and Wildlife, 1975)

In a Department of Fisheries and Wildlife submission to the System 6 Committee in 1977, the importance of Beelaring and Goonaring Springs was emphasised, and it was recommended that their catchments be reserved in their natural state, i.e:

> "Each reserve contains a spring which discharges fresh water into a stream for most of the year. The springs are largely responsible for a diverse flora and fauna in both reserves. Reserve C529 (Beelaring) contains stands of Dryandra carduacea, a fire sensitive species which should be conserved in several reserves to ensure its survival. Species of Lambstail (Lachnostachys spp.) which are rare in the Darling District are also believed to occur. The streams from both springs contain a crustacean of the Koonac group (Cherax sp.) whose species as yet cannot be positively confirmed. (The area) south of the ridge, forms the catchment of the two springs. It is believed that clearing of this area would adversely affect the quality of water from the springs thereby reducing the biological and aesthetic importance of the reserves." (Director in litt. to Hon. Minister of Fisheries and Wildlife, 1977.)

By late 1977 there was considerable concern both in the Toodyay district and within the Department of Fisheries and Wildlife that the uncleared area to the north of the reserves would be cleared, subdivided and sold as hobby farms. In September 1977 Agnew Clough Ltd sought approval

for a proposed subdivision of the area. Approval was given only after an assurance was received that 700 ha of environmentally fragile land would be made public open space and left in its virgin state.

Four thousand hectares of this land was sold to Jimwa Pastoral Company in February 1981 and clearing commenced immediately. Despite numerous objections by Cabinet Ministers, the Toodyay Shire Council and interested parties through the media, all the land between the reserves and Morangup Hill has been cleared. Again, despite further objections, the cleared vegetation was windrowed and burnt. It now remains to be seen what impact this clearing will have on salinity levels in Goonaring and Beelaring Springs, and on adjacent farmland. The clearing has certainly significantly reduced the habitat available for all local fauna, as well as significantly reducing the local viable gene pool for much of the flora within the two reserves.

3. SOILS AND VEGETATION

The soils on both Goonaring and Beelaring are predominantly laterite-derived loams, with the proportion of gravel increasing on the higher slopes. The only marked variation occurs in the low lying areas associated with the springs, where the surface soils are more peaty in texture.

The dominant formation on both reserves is Jarrah/Marri woodland, and both reserves have areas of Dryandra thicket. The composition of the forest around Beelaring and Goonaring Springs differs significantly. A Paperbark - Swan River Blackbutt forest occurs around Goonaring Spring, while a mixed forest of Swan River Blackbutt, Marri and Flooded Gum flanks Beelaring Spring (Fig. 6).

The vegetation on the reserves can be divided into 11 formations, 7 of which are found on Goonaring, and the remaining 4 on Beelaring. Although several formations on the two reserves have similar dominant species, they have been differentiated as separate formations on the basis of widely differing understoreys.

The distribution of vegetation on the reserves is shown in Figure 5, and described as follows:

Goonaring

1. Paperbark/Swan River Blackbutt (Melaleuca preissiana - Eucalyptus patens) FOREST, 15-20 m in height, with Flooded Gum (Eucalyptus rudis) a less common component of the upper storey. This association occurs over Blackboy (Xanthorrhoea preissii) SCRUB 2-4 m, over sparsely distributed Native Broom (Viminaria juncea) to 2 m, Acacia saligna to 2 m, Acacia divergens to 1 m and low sedges.

Figure 6. The mixed FOREST of Swan River Blackbutt, Marri and Flooded Gum which flanks Beelaring Spring.

2. Petrophile seminuda LOW HEATH C over Dryandra aff. nivea DENSE LOW HEATH D.

3. Pingle (Dryandra carduacea) THICKET/SCRUB to approximately 3 m, over scattered Blackboys and Leptospermum erubescens to approximately 2 m. The understorey is a mixed LOW HEATH C of Hakea gilbertii, H. incrassata, Prickly Poison (Gastrolobium spinosum), Scrub Sheoak (Casuarina humilis), Wilson's Grevillea (Grevillea wilsoni), Dryandra tortifolia, Calytrix brachyphylla and Calothamnus sp. Isolated examples of Marri (Eucalyptus calophylla) are emergent to approximately 18 m.

4. Marri WOODLAND/OPEN WOODLAND, 15-18 m in height, over Blackboys, 1-3 m in height, over a sparse understorey including Hakea incrassata, Pingle, Prickly Poison, Zamia Palm (Macrozamia riedlii) and Leptospermum erubescens.

5. Jarrah (Eucalyptus marginata) LOW FOREST A/L WOODLAND A, 10-15 m in height, with Marri forming a minor component of the upper storey in some places. This occurs over a variable open understorey, characteristic species include Bull Banksia (Banksia grandis), Pingle, Blackboys, Snakebush (Hemiandra pungens), Adenanthos drummondii and Calothamnus sp.

6. Widely scattered examples of Flooded Gum and Drummond's Gum (Eucalyptus drummondii), 10-14 m in height, over a recently burnt and largely degenerate shrub understorey.

7. Very sparse Drummond's Gum, 10-14 m in height, over a sparse understorey of varying density (Fig. 7). Species present include Blackboys, Pingle, Wavy-leaved Hakea (Hakea undulata) and Hakea marginata over Hakea incrassata, Daviesia sp. and low sedges.

Beelaring

8. Jarrah/Marri WOODLAND/LOW WOODLAND A, 12-17 m in height, over Pingle dominated THICKET to 3 m. Parrot Bush (Dryandra sessilis), Bull Banksia, Blackboys, Adenanthos drummondii and Leptospermum erubescens are also present in the THICKET understorey. Sparse low growing species include Dryandra nivea, Wilson's Grevillea, Honey Bush (Hakea lissocarpha) and Daviesia sp.

9. Pingle THICKET, 2-3 m in height, over sparsely distributed low shrubs including Wilson's Grevillea, Prickly Poison and Hakea incrassata. Occasional Marri and Jarrah are emergent to approximately 15 m.

10. Marri WOODLAND/OPEN WOODLAND 15-20 m in height, over Pingle dominated THICKET to 3 m. Other understorey species include Parrot Bush, Blackboys and Zamia Palms.

11. Mixed Swan River Blackbutt, Marri and Flooded Gum FOREST, 15-18 m in height, with Paperbarks to 14 m as a lesser component of the upper storey. The understorey is variable and includes Native Broom, Acacia divergens, Blackboys, Bracken (Pteridium esculentum) and dense sedges.

    In the south-eastern corner of the reserve the swamp vegetation changes to a Melaleuca lateritia dominated THICKET/SCRUB to 2.5 m over dense TALL SEDGES with occasional degenerate Flooded Gum emergent to 15 m.

The System Six report includes the following species as part of the understorey flora on Beelaring Nature Reserve:- Trymalium ledifolium, Acacia saligna, Leucopogon oxycedrus and Camphor Myrtle (Baekea camphorosmae). The area is also reputed to contain a rare Lambstail (Lachnostachys sp.).

Figure 7. A lone example of Drummond's Gum on Goonaring Nature Reserve - this species usually prefers a moister climate.

4. FAUNA

Of the 31 bird species recorded on Beelaring and Goonaring (App. III), 10 species including the White-cheeked Honeyeater, Yellow-plumed Honeyeater, Barn Owl, Spotted Pardalote and Yellow Robin are considered uncommon and one, the Western Rosella, is scarce.

Western Grey Kangaroos (Macropus fuliginosus) are present on both reserves. The only species trapped on both reserves was the House Mouse (Mus musculus), all other species were trapped on only one of the reserves. The Honey Possum (Tarsipes rostratus), plus four reptile

species - a skink (Morethia obscura), the Wood G. (Diplodactylus granariensis), a legless lizard (De. fraseri) and the Yellow-faced Whip-snake (Demansi. reticulata reticulata) - have been trapped on Goonaring Nature Reserve. In addition foxes and rabbits have been seen on the reserve. The only animal trapped on Beelaring was a burrowing skink (Hemiergis initialis initialis). The Western Green and Golden Tree Frog (Litoria moorei) has been sighted on Beelaring.

5. PAST MANAGEMENT, USE AND FIRE HISTORY

Both reserves were originally gazetted almost 100 years ago and, as natural freshwater springs, they were subjected to considerable pressures when the area was used as a watering and stopping place for bullock teams. Both reserves continued to be used for their declared, gazetted purpose, "Watering and Stopping Place", until well into the second half of this century.

Over this period both reserves have been subjected to a variety of pressures.

It appears from early aerial photography and ground surveys of the vegetation, that the south-western corner of Beelaring was the main area used for watering and resting purposes. A network of tracks still lead into this area (Fig. 5), and an even aged stand of Dryandra carduacea indicates that this area was once cleared, and the Dryandra have since regenerated. A deep board-lined well still remains, and is in remarkably good condition (Fig. 8). The south-west corner of Beelaring is still occasionally used by picnickers and overnight campers.

Goonaring still shows signs of timber cutting, and of mineral exploration activities resulting in numerous tracks throughout the reserve. A well used gravel road also cuts through the north-east corner of the reserve (Fig. 5), linking the Toodyay-Perth Road and Morangup Hill. This is not a gazetted road.

Past management has involved the construction of three metre wide firebreaks along the north-western and south-western boundaries of Beelaring and northern and eastern boundaries of Goonaring (Fig. 5). A track following the north-eastern boundary of Beelaring provides a suitable firebreak on this side, while the Perth-Toodyay Road acts as a firebreak on the south-eastern boundary. Goonaring Nature Reserve is bounded on its remaining sides by Morangup Road and the Perth-Toodyay Road.

No specific fire history is available for either of the reserves however it is evident that Goonaring sustained a severe fire in 1980/81. Beelaring does not appear to have been burnt for four or five years.

Figure 8. This deep board-lined well on Beelaring Nature Reserve was used around the turn of the century by stock and travellers moving between Perth and the Yilgarn goldfields.

6. NATURE CONSERVATION VALUES

Goonaring and Beelaring Nature Reserves share many nature conservation values, and in addition possess their own values. Many of these values have been outlined in Section 2, History, as they have played an integral part in the history of the two reserves. Additional values are discussed below.

Both reserves:

> "contain some fine stands of Jarrah and Marri complete with the usual Darling Scarp flora. These areas (would) therefore make an excellent refuge for birdlife" (Deputy Director, of Fisheries and Wildlife in litt. to the Under Secretary for Lands, 1970).

The following extract from recommendations for System 6 highlights another of the biological conservation values of the two reserves:

> "Small spring-fed streams are fairly common along the Darling Scarp. Some of them appear to have been

> isolated for a considerable time and their prese.. aquatic faunas are apparently endemic. The two streams derived from Beelaring and Goonaring Springs are apparently important as they contain an undescribed form of gilgie (Family Parastacidae). ...The Springs discharge fresh water into streams for most of the year and are largely responsible for the diverse flora and fauna of the reserves" (Department of Fisheries and Wildlife, 1977).

As such the catchment area of the two springs is very important, and the recent clearing of this area is likely to lead to a decline in water quality accompanied by increased salinity. This will affect not only the vegetation around the springs on the reserves, it will also lead to increased salinity in the streams to which the springs contribute water.

Part of the nature conservation values of the reserves results from their close proximity to the Toodyay-Perth Road. They are easily accessible, and as such provide suitable small areas where people can see wildflowers and birdlife.

Since the recent clearing of the land between and north of the reserves, both reserves have become important refuges as they provide food, refuge and nesting sites for fauna ranging from migratory bird species to kangaroos. Each reserve contains a species of reptile not previously recorded in the Shire - the Yellow-faced Whip-snake (Demansia reticulata reticulata) and a skink (Hemiergis initialis initialis) were recorded on Goonaring and Beelaring respectively.

In addition each reserve possesses unique conservation values.

First, those of Beelaring Nature Reserve:

Beelaring contains a dense understorey of Pingle, a fire sensitive species which should be conserved in several reserves to ensure its survival. Also, the reserve is believed to contain rare species of Lambstail (Lachnostachys sp.).

The reserve also possesses conservation values of cultural/historical significance in the form of the old board-lined well in the south-western corner (Fig. 8). This well was deepened and lined prior to 1889 when the Toodyay Road Board spent £120 on developing watering points on Crown Reserves (App. II). The well is still in good condition, and prior to the recent land clearing operations, contained fresh water for most of the year. It is still used for its supply of fresh water.

The area around the Spring provides habitat for numerous amphibians, the most common species being the Western Green and Golden Tree Frog. This area also supports mixed

forest (Fig. 6), which is completely different to the Swan River Blackbutt/Paperbark forest found around Goonaring Spring.

Though small, the area supports a range of habitats, which make it especially important in terms of the number of avian species supported. Numerous bird species have been recorded on the reserve and of these four are known to breed on the reserve itself. The flowering woodland and Dryandra dominated heathlands provide an important seasonal nectar source for nomadic honeyeaters.

Second, the unique conservation values of Goonaring:

The spring on Goonaring provides a habitat not only for frogs and gilgies, but also for the Native Minnow (Galaxias occidentalis) which is not found on Beelaring.

Numerous flowering plants can be observed within the limited area of the reserve, and as such it is used extensively by the Western Australian Wildflower Society. In addition the reserve contains the northernmost known occurrence of the Triggerplant (Stylidium crassifolium).

Therefore in the light of recent clearing operations and the many nature conservation values of the two Spring reserves they are both worthy of 'Key Site-Ecosystem Management' status and Class "A" status under the Land Act.

B. PLAN FOR MANAGEMENT

1. MANAGEMENT OBJECTIVES

The management of both Goonaring and Beelaring will be primarily directed towards maintaining their nature conservation values and maintaining their integrity as conservation units.

Active management is expected to be required in the following fields during the course of operation of this Plan:

Protection from Fire

To protect the assets of adjacent landholders and to conserve the natural values of the reserves. To minimise the occurrence of wildfires on the reserve and to suppress such wildfires as may occur.

Protection from Pests : Animal and Weed Control

To protect the reserves and surrounding farmland from damage as a result of infestation with animals and plants which are declared from time to time under the provisions of the Agriculture and Related Resources Protection Act.

Rehabilitation and Maintenance of the Natural Environment

To restore areas degraded by vehicles, to close and revegetate the tracks cutting through the reserves and to ensure that rubbish is removed or buried.

Public Use

To continue to encourage passive public uses such as bird watching, wildflower appreciation and photography.

2. FIRE PROTECTION

Rationale

Both Beelaring and Goonaring Nature Reserves are islands of bushland in the midst of a cleared farming environment. As such they are not vulnerable to fires spreading onto the reserve from nearby forested areas. However, they are vulnerable to fires escaping from clearing or agricultural burns, particularly from the recently cleared land to the north of, and separating, the reserves.

The small size of the reserves reduces the probability of a fire originating from natural causes within the boundaries of the individual reserves. However there is the danger of fire originating from cigarette butts or matches thrown from cars passing along the roads which follow the reserve boundaries.

Therefore the danger of wild fires is best minimised by maintaining firebreaks around the perimeter of the reserves, and by excluding vehicles.

Construction and maintenance of firebreaks

The existing three metre wide perimeter firebreaks (Fig. 5) will be kept free of overgrowth. These will provide access in the case of fire, halt or slow down the movement of fire across the reserve boundaries and protect adjoining landholders' fences in the case of fire.

No firebreaks are necessary along the Perth-Toodyay Road as the road forms a natural barrier to the movement of fire. On Beelaring a track approximately 150 m into the reserve, running parallel to the Perth-Toodyay Road, provides an additional barrier.

Fuel reduction measures

Fuel reduction burning is not considered necessary as there is a very low probability of fire starting on either of the reserves and escaping into adjoining properties. Also since the reserves have sustained recent fires there has been little fuel accumulation.

Fire Suppression

Fire fighting units from the Department of Fisheries and Wildlife at Wanneroo will attend, whenever possible (subject to the limitations of personnel and equipment) fires occurring on, or considered to be threatening, either of the reserves.

Adequacy of Control Measures

In this respect special attention shall be paid to the feelings of reserve neighbours and to establishing and maintaining effective contact with neighbours. As for other reserves in the Shire, this Plan includes the formal provision for reserve neighbours to draw the attention of the Director of Fisheries and Wildlife to what they consider to be inadequacies in fire protection arrangements for the reserves. On receipt of such comments the Director will organise a joint inspection and take such other action as may be needed to remedy the situation.

Notifiable Authority

The Department of Fisheries and Wildlife shall be regarded as a Notifiable Authority in terms of the Bush Fires Act and Regulations in respect of Beelaring and Goonaring Nature Reserves.

3. PROTECTION FROM PESTS : ANIMAL AND WEED CONTROL

Control of pest animals and plants may be necessary from time to time to protect fauna and flora and the environment of the reserves generally and as part of the organised

control of vertebrate pests or weeds in the vicinity of the reserves.

Such arrangements as may be necessary in respect of control of declared animals and plants shall be made by consultation and co-operation between the Agriculture Protection Board and the Department of Fisheries and Wildlife.

Adequacy of control measures

As with the provisions for fire protection, reserve neighbours are invited to draw the attention of the Director of Fisheries and Wildlife to what they feel are inadequacies in the control of pest plants and animals on the reserves. On receipt of such comments the Director may organise a joint inspection of the reserve concerned or take such other action as may be needed to remedy the situation.

4. REHABILITATION AND MAINTENANCE OF THE NATURAL ENVIRONMENT

Since the clearing of the land separating and to the north of the reserves, they have come under increasing pressure from vehicles, rubbish dumping and the removal of flora.

Fencing and Access

Both reserves will be fenced to exclude vehicles and to discourage rubbish dumping and the removal of flora. Gates will be provided for pedestrian access and to provide access for reserve management vehicles.

Closure of Tracks

Tracks other than those indicated by a dashed line (Fig. 5) will be closed to all vehicles, except for reserve management purposes, and ripped to encourage re-establishment of vegetation. The option will be retained within this plan for the re-routing of the road (ungazetted, but made) which presently passes through the north-eastern corner of Goonaring if mis-use of, or damage to, the reserve occurs. Changes will only be made following consultation with the Toodyay Shire Council.

5. PUBLIC USE

Passive use of the reserves for bird watching and wildflower enjoyment will continue to be encouraged. However it must be remembered that all public use of the reserves must remain of secondary importance to the primary purpose of the reserves, that of nature conservation.

Access Classification

The close proximity of Beelaring and Goonaring to a major road, their location amidst cleared farmland and their

small size makes them highly susceptible to damage. For these reasons, both will be declared LIMITED ACCESS AREAS and vehicles will be excluded. Access for pedestrians will be provided so that groups which have used the reserve in the past for the quiet enjoyment of nature may continue to do so.

Signs

Signs identifying each reserve and conforming to the Department of Fisheries and Wildlife's standard specifications will be erected on the two reserves, adjacent to the Perth-Toodyay Road.

6. MANAGEMENT - GENERAL

During the currency of this Plan the Department of Fisheries and Wildlife may, with the approval of the Chairman of WAWA undertake or authorise such other work or action as may be seen to be necessary or desirable to properly promote the stated objectives of management of the reserves.

PART 3 : RUGGED HILLS NATURE RESERVE (RESERVE NO. 21429)

A. THE RESERVE

1. PHYSICAL CHARACTERISTICS AND RELATIONSHIPS

Rugged Hills Nature Reserve is one of the three nature reserves in the central Hills Region of the Toodyay Shire. It is located to the north of Julimar Road, six kilometres north-west of Toodyay townsite, and about five kilometres south of Poison Gully Nature Reserve (Fig. 4). The Reserve is roughly 'L-shaped', and is 252.0 ha in area with a perimeter of some 8 km (Fig. 9).

The land surrounding the reserve is privately owned. It is mostly uncleared with the exception of that to the south-west which has recently been subdivided. The topography is hilly, with the lowest points being in the southern and north-eastern corners from which the land rises to a central, broad and flat-topped ridge spanning the reserve from east to west. At the eastern extremity of the ridge is a hill rising to some 300 m.

2. HISTORY

The three Hills Region nature reserves, Rugged Hills, Poison Gully and Flat Rock Gully, were initially released around the turn of the century for pastoral pursuits. Two decades later they were resumed, presumably because of the stands of Brown Mallet each area contained. At this time, the bark of this tree was highly valued for its tannins, which were used to tan skins.

Over the first three decades of the twentieth century Rugged Hills formed part of a pastoral lease, and it was not until September 1935 that the area was resumed by the Crown for the purpose of 'Timber'. In the following decades grazing leases were granted over the reserve from time to time, the last one expiring during 1980.

In 1975 the area was examined by Casperson, on behalf of the Toodyay Shire Council, and he recommended that the area be given nature reserve status, the recommendation being based on the following considerations:

> "This reserve provides an excellent example of the transition in flora which occurs between the Darling Plateau and the Avon Valley. In its lower elevations Wandoo (E. wandoo) predominates while on the Plateau surface Marri (E. calophylla) and Jarrah (E. marginata) are the principal trees. Powderbark (E. accedens) and Salmon Gum (E. salmonophloia) are found on the slope. At the breakaway there was evidence of small mammal activity in the form of droppings and runways. A stone cairn was found near the breakaway at the western end of the reserve" (Casperson 1977).

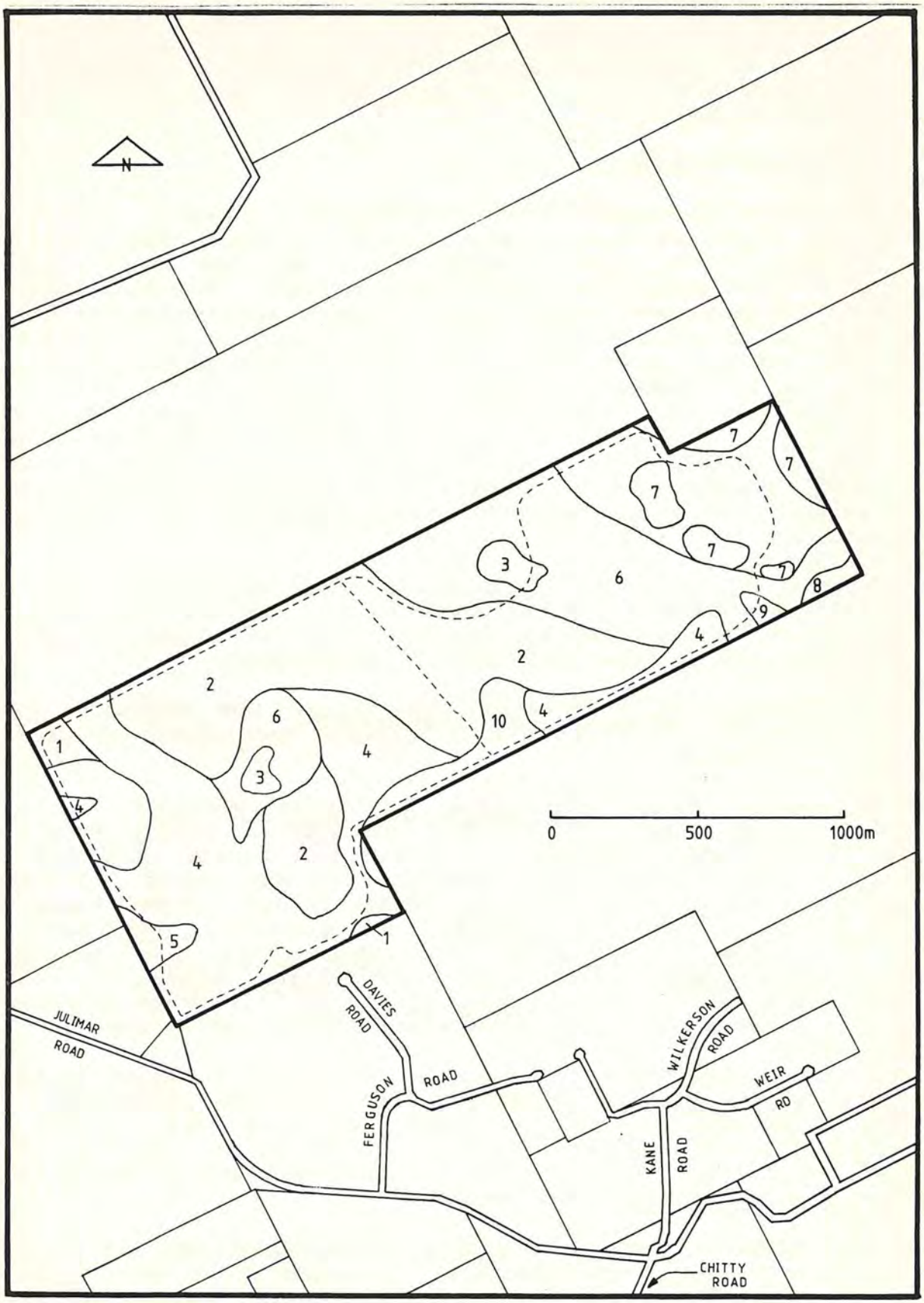


Figure 9. Rugged Hills Nature Reserve showing its relationship with surrounding lands, firebreaks (dashed lines) and vegetation formations (identified by numbers, and described in the associated text).

The Department of Fisheries and Wildlife acted on Casperson's recommendation and when the grazing lease current at that time expired the purpose of the reserve was changed to Conservation of Flora and Fauna and it was vested in WAWA.

3. SOILS AND VEGETATION

Rugged Hills Nature Reserve contains a variety of soil types characteristic of the Darling Plateau. The central plateau, which supports Marri woodlands, has sandy loams mixed with quantities of laterite gravel. The breakaways and steep slopes, which often support Powderbark forest, have soils containing a very high proportion of lateritic rock and gravel. Lower down, on the more gentle slopes, the soils change to sandy clay loams with a smaller percentage of gravel. These areas support Wandoo woodlands, while York Gum and Jam woodlands are found in a similar position in the landscape, but on reddish brown loamy soils. Where granite outcrops and surface rock occurs, heath is dominant with Blackboys and Sheoaks emergent.

Consistent with the diversity of landforms and soils, the reserve supports a variety of mainly woodland vegetation types. These can be divided into ten associations, distributed as shown in Figure 9, as follows:

1. Sheoak (Allocasuarina huegeliana) LOW WOODLAND A, 10-14 m in height, with a sparse understorey of OPEN LOW GRASS.

2. Mature Marri (Eucalyptus calophylla) WOODLAND, 15 to 20 m, over THICKET/DENSE THICKET of mainly Pingle (Dryandra carduacea) growing to a height of 2-3 m. Other understorey species include Scrub Sheoak (Allocasuarina humilis), Silky-leaved Blood Flower (Calothamnus sanguineus), Zamia Palm (Macrozamia riedlei), Banksia sp. aff. sphaerocarpa, Leptospermum erubescens, Parrot Bush (Dryandra sessilis) and Blackboys (Xanthorrhoea preissii). Patches of the association lack the Marri woodland upper storey.

3. Leptospermum erubescens and White Myrtle (Hypocalymna augustifolium) HEATH A over Graceful Honeymyrtle (Melaleuca radula) HEATH B over LOW SEDGES. Scattered Blackboys are emergent to heights of 1.5-2 m. Around areas of granite sheet Pincushions (Borya nitida) are common.

4. Wandoo (Eucalyptus wandoo) FOREST/WOODLAND, 15-20 m in height, over patches of regenerating Wandoo LOW WOODLAND A, 10-14 m in height. The understorey is generally sparse; common species are Blackboys, Zamia Palms and sedges (Loxocarya sp.).

5. This is a variable intermediate zone of Wandoo OPEN LOW WOODLAND A (10-15 m) with scattered Jam (Acacia

acuminata) and Sheoak. The mixed dense understorey is composed of Blackboys, Leptospermum erubescens and Zamia Palms over Dryandra tortifolia, sedges (Loxocarya sp.) and grasses.

6. Mature Powderbark (Eucalyptus accedens) FOREST/WOODLAND, 15-20 m in height, in some areas forming a LOW WOODLAND A of younger trees. The understorey is generally open, with patches of Parrot Bush to 3 m on breakaways, and Bullock Poison (Gastrolobium trilobium) to 1.5 m in the gullies.

7. York Gum/Jam (Eucalyptus loxophleba) LOW WOODLAND A, with York Gum of 12-14 m and Jam 5-10 m over VERY OPEN LOW GRASS.

8. Brown Mallet (Eucalyptus astringens) LOW WOODLAND A, with an open understorey of patches of Bullock Poison and Leucopogon sp.

9. Powderbark Marri WOODLAND to 20 m over THICKET to 3 m of Pingle, Parrot Bush and Prickly Poison.

10. Jarrah (E. marginata) LOW FOREST A, 12-16 m in height, over THICKET/DENSE THICKET of Pingle (2-3 m).

4. FAUNA

Birds recorded during surveys preparatory to publication of this plan are listed in Appendix III. To date 20 species have been recorded on the reserve.

According to the Toodyay Naturalists' Club, which has compiled bird lists for various habitats within the Shire, 105 species occur in York Gum/Jam, Wandoo woodland and Jarrah/Marri-vegetation types which are well represented on Rugged Hills. Many of these are migrant species or species found only in the eastern or western parts of the Shire. However, it is expected that at least six bird-of-prey species, plus the Port Lincoln Parrot, Tree Martin, Rufous Whistler, White-browed Babbler, Banded Blue Wren, Western Warbler and several very common birds such as the Western Spinebill and Magpie Lark, would be found on the reserve in addition to those species already recorded.

Mammals sighted on the reserve include the Western Grey Kangaroo (Macropus fuliginosus), Western Brush Wallaby (Macropus irma) and rabbits. A brief trapping program indicated that House Mouse (Mus musculus) and the Western Pigmy-possum (Cercartetus concinna) were present. Two reptiles, the Wood Gecko (Diplodactylus granariensis) and Western Bearded Dragon (Pogona minor), have also been trapped on the reserve.

As with other nature reserves in the Shire, full surveys of the fauna of Rugged Hills Nature Reserve have not been carried out, and detailed conclusions cannot be drawn as

to the faunistic values of the reserve. However the varied habitats of the reserve might be expected to support a diversity of fauna.

5. PAST MANAGEMENT, USE AND FIRE HISTORY

Although this reserve was originally set aside for timber, it was never commercially exploited. Some trees were felled close to the edges of the reserve, and their timber used for fencing purposes. The area has, however, been periodically grazed, a fence being constructed around it to contain stock. This has since fallen into disrepair. Only the southern boundary, where recent subdivisions border the reserve, is adequately fenced.

The last of the grazing leases was terminated in 1980, but stock still roam freely on the reserve. Control of wandering stock is a matter of high management priority on this new addition to the nature reserves in the Shire.

A system of internal and peripheral firebreaks was constructed in 1981, and this was upgraded in 1982 (Fig. 9). No fire history has been recorded, but the structure and composition of the vegetation suggest that it has not been burnt for many years.

6. NATURE CONSERVATION VALUES

This is the third largest nature reserve in the Shire after Moondyne and Flat Rock Gully, and being close to Toodyay townsite is readily accessible by road. As such it is important both as a sanctuary for wildlife and as a potential area to support environmental education activities.

Rugged Hills contains vegetation and habitats similar to those represented on Flat Rock Gully and Poison Gully, the other two Hills Region reserves. Several valuable features of the region are particularly well represented on Rugged Hills, including spectacular scenery of broken hilly country with extensive views from vantage points over the gullies. Rugged Hills is the only Hills Region reserve to contain stands of Jarrah forest, a vegetation formation nearing the north-easternmost limit of its occurrence in the Toodyay Shire. Rugged Hills also has extensive and quite superb tracts of Powderbark woodland. Brown Mallet occurs on Rugged Hills both in pure stands and in association with Powderbark.

The reserve protects the sources of three seasonal streams.

Birds are numerous on the reserve, 20 species having been recorded in brief surveys and many more are likely to occur. The reserve is large enough to support breeding populations of a number of species, as well as providing shelter and refuge for nomadic and migratory species. The area supports a considerable population of Western Grey

Kangaroos. Western Brush Wallabies are less common, favouring the areas of denser cover.

Rugged Hills Nature Reserve is regarded as a 'Key Site-Ecosystem Management' representing Hills Region environments and, by virtue of its greater accessibility than the two others of the Region, is the only one likely to receive significant levels of use.

B. PLAN FOR MANAGEMENT

1. MANAGEMENT OBJECTIVES

As with other nature reserves in the Shire management will be primarily directed towards maintaining and enhancing its nature conservation values. Active management is expected to be required in the following fields during the course of operation of this Plan:

Protection from Fire

To protect the assets of adjacent landholders and the nature conservation values of the reserve. To minimise the occurrence of wildfires on the reserve and to supress such wildfires as may occur.

Protection from Pests : Animal and Weed Control

To protect the reserve and surrounding farmland from damage as a result of infestation with animals and plants which are declared from time to time under the provisions of the Agriculture and Related Resources Protection Act.

Public Use

To use Rugged Hills Nature Reserve as a site potentially suitable for environmental interpretation, this being a result of its diversity of habitats and close proximity to Toodyay townsite.

2. FIRE PROTECTION

Rationale

The presence of tracts of uncleared bushland on the north-west and south-east boundaries makes the reserve potentially vulnerable to fire from these directions. This hazard is reduced by their limited extent, partially cleared nature and regular grazing by sheep. Fuel accumulations are negligible and are maintained at a low level. Grazing may have been an important factor in prevention of fire on the reserve during the recent past.

The urban-rural subdivision of land on the southern boundaries heightens the need for adequate fire protection in this area.

Fire protection of the reserve is based on six metre wide peripheral firebreaks and one internal break, also of six metre width. These were constructed in 1981, and upgraded in 1982 to hinder the movement of fire across the reserve boundaries and enable rapid access by fire units to any part of the reserve.

Firebreak Maintenance

All existing firebreaks on the reserve will be maintained to ensure they remain free of vegetation and continue to provide rapid access in the case of fire.

Access

In addition to maintenance of existing firebreaks two access points with gates will be established and maintained, one at the western end of the south-western boundary and the second at the north-eastern corner.

Controlled Burning

A low fuel buffer between the perimeter firebreak and the reserve boundary will be maintained adjacent to subdivided land in the southern part of the reserve. Burning other than this has not been prescribed but provision is retained in this Plan for rotational burning of parts of the reserve should this prove essential as a fuel reduction measure.

Fire Suppression

Fire units from the Department of Fisheries and Wildlife at Wanneroo will attend whenever possible (subject to the limitations of personnel and equipment) fires occuring on, or considered to be threatening the reserve. In conjunction with the Local Authority and Bush Fires Board the Department will encourage residents of the adjoining urban-rural land in the development of a locally-based Volunteer Bush Fire Brigade.

Adequacy of Control Measures

In this respect special attention shall be paid to the feelings of reserve neighbours and to establishing and maintaining effective contact with neighbours. As for other reserves in the Shire, this Plan includes the formal provision for reserve neighbours to draw the attention of the Director of Fisheries and Wildlife to what they consider to be inadequacies in fire protection arrangements for the reserve. On receipt of such comments the Director will organise a joint inspection of the problem and take such other action as may be needed to remedy the situation.

Notifiable Authority

The Department of Fisheries and Wildlife shall be regarded as a Notifiable Authority in terms of the Bush Fires Act and Regulations in respect of Rugged Hills Nature Reserve.

3. PROTECTION FROM PESTS : ANIMAL AND WEED CONTROL

Control of pest animals and plants may be necessary from time to time to protect fauna and flora and the environment

of the reserve generally and as part of the organised control of vertebrate pests or weeds in the vicinity of the reserve.

Such arrangements as may be necessary in respect of organised control of declared animals and plants shall be made by consultation and co-operation between the Agriculture Protection Board and the Department of Fisheries and Wildlife.

Sheep to be Controlled

Rugged Hills is unusual among upland woodland nature reserves for its long and continuing history of periodic grazing. The exclusion of stock from this reserve, as part of the active implementation of this management plan, will provide an ideal opportunity to monitor regeneration following the cessation of grazing. This monitoring program will give quantitative information on changes in vegetation structure and composition following stock exclusion.

Adequacy of Control Measures

As with the provisions for fire protection, reserve neighbours are invited to draw the attention of the Director of Fisheries and Wildlife to what they see as inadequacies in the control of pest plants and animals on the reserve. On receipt of such comments the Director may organise a joint inspection of the Reserve or take such other action as may be needed to remedy the situation.

4. PUBLIC USE

This reserve is suitable for interpretive use by virtue of its varied topography, diversity of habitats and close proximity to Toodyay townsite. It offers a variety of opportunities for environmental interpretation through bushwalking, bird watching, enjoyment of wildflowers and the peaceful contemplation of the natural environment. There is, however, no established pattern of use and the primary consideration of management remains the maintenance and enhancement of the nature conservation values of the area.

Access Classification

In view of these factors, the size of the reserve and its total inaccessibility to vehicles prior to construction of the present firebreaks, it is considered that use of vehicles on the reserve is unnecessary and inappropriate except in the course of management and fire control. Provision is therefore included in this Plan for classification of the reserve as a LIMITED ACCESS AREA.

Signs

Signs conforming to the Department of Fisheries and Wildlife's standard specifications will be erected both to

identify the reserve by name and to denote the nature of limitations to access.

5. MANAGEMENT - GENERAL

During the currency of this Plan the Department of Fisheries and Wildlife may, with the approval of the Chairman of WAWA, undertake or authorise such other work or action as may be seen to be necessary or desirable to properly promote the stated objective of management of the reserve.

PART 4 : POISON GULLY NATURE RESERVE (RESERVE NO. 19900)

A. THE RESERVE

1. PHYSICAL CHARACTERISTICS AND RELATIONSHIPS

Poison Gully Nature Reserve is in the Hills Region of Toodyay Shire, some eight kilometres north-west of the Toodyay townsite and equidistant between Flat Rock Gully and Rugged Hills Nature Reserves (Fig. 4).

The reserve is irregular in shape with an area of 87 ha and a perimeter of 4.8 km (Fig. 10). It is surrounded by private land, most of which has been cleared or parkland cleared for farming. In the parkland areas many of the larger trees remain but the lower strata have been replaced with pasture. An area of relatively undisturbed woodland adjoins the north-eastern boundary of the reserve, where steep breakaway country extends beyond its borders.

Poison Gully lies in undulating country, which was once forested with Marri, Wandoo and Powderbark but which is now mainly cleared. The topography of Poison Gully itself is varied. From an altitude of approximately 300 m in the south-west corner, the land rises towards the east and north, levelling out to form a flat-topped, two-pronged ridge which occupies much of the central portion of the reserve. The ridge falls away sharply along its north-eastern side, where a large steep-sided gully is the main feature. Similar gullies and breakaways occur along the irregular north-western boundary.

2. HISTORY

Poison Gully Nature Reserve was first gazetted as a Timber Reserve on 21 September 1929, to protect a population of Brown Mallet, (Eucalyptus astringens), growing on the eastern side of the reserve. Prior to this the land had been released, around the turn of the century, for pastoral pursuits.

The reserve was subsequently cut over by Industrial Extracts Ltd., to exploit the stands of Brown Mallet for their tannin-rich bark, but this was limited by competition from synthetics and Black Wattle, an eastern Australian species grown in South Africa for the same purpose.

In April 1964, the reserve was cancelled and the Cook Pastoral Company applied for its release to amalgamate with their farm. In May of the same year the Surveyor General recommended that the area be set aside for the 'Conservation of Flora'. This was based on the comparatively small area of the district occupied by reserves, and the belief that there would be sufficient regeneration of the vegetation on the reserve to warrant retention of the land for flora conservation. On July 3 1964 the area's purpose was changed to 'Conservation of Flora'.

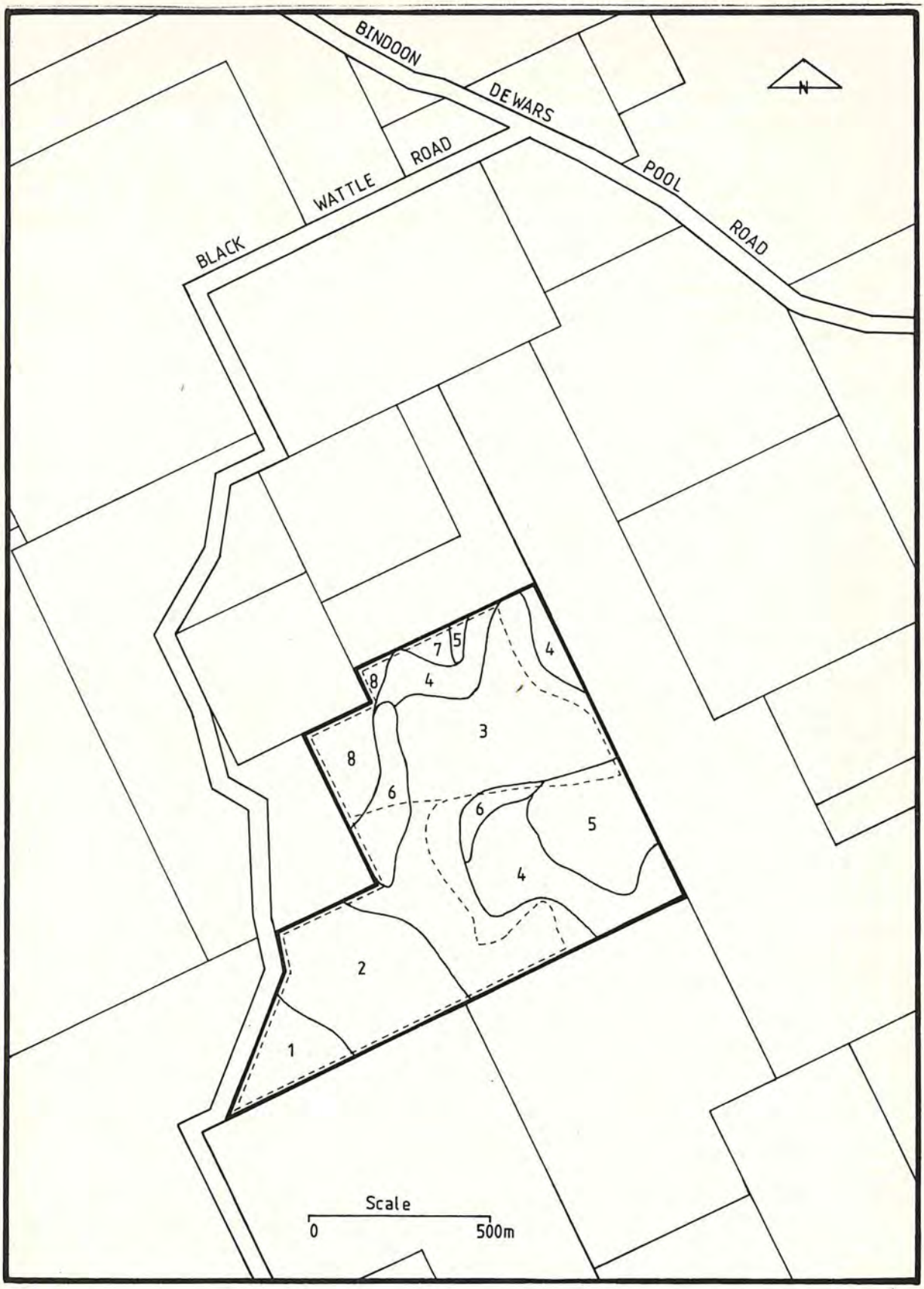


Figure 10. Poison Gully Nature Reserve showing its relationship with surrounding lands, firebreaks (dashed lines) and vegetation formations (identifird by numbers, and described in the associated text).

Casperson (1975),who carried out a biological survey of the Shire, recommended that the purpose be extended to include conservation of fauna and that the reserve be vested in WAWA. The following description accompanied the recommendation:

> "The principal plant cover of this reserve is Marri and Wandoo. Although land surrounding the reserve has been largely cleared the reserve itself contains a good cross-section of native flora".

On 21 January 1977 the purpose was again changed to 'Conservation of Flora and Fauna' and the reserve was vested in WAWA.

3. SOILS AND VEGETATION

Like Flat Rock Gully and Rugged Hills, Poison Gully Nature Reserve is on the eastern edge of the dissected Darling Plateau, in which rolling lateritic hills are cut by fertile valleys. The soils on the reserve are mainly brown loams and sandy loams with varying quantities of laterite gravel. In the eastern and northern sectors the steep gullies and breakaways have more laterite rock than elsewhere. There is a small area of red, loamy soils on the north-western side of the reserve.

The reserve supports a variety of predominantly woodland formations the dominant species being Wandoo, Powderbark, Marri and Brown Mallet. A stand of York Gum and Jam retains a foothold in the red soil on the north-eastern side of the reserve. The Wandoo and Wandoo/Marri woodlands tend to occupy the lower parts of the landscape while the Powderbark/Brown Mallet association occurs only along the steep laterite gully slopes. Pure stands of Powderbark are restricted to the tops of the breakaways. The high ground in the centre of the reserve supports a mixed Marri/Powderbark woodland. Eight formations have been identified which are distributed as shown in Figure 10 and are described as follows:

1. Wandoo (Eucalyptus wandoo) LOW WOODLAND A, 12-14 m in height, with scattered mature examples emergent to 18 m. The understorey is an OPEN DWARF SCRUB C dominated by Acacia aff. pulchella and Zamia Palm (Macrozamia reidlei), with a ground cover of OPEN LOW GRASS and sedges (Loxocarya sp.).

2. Marri/Wandoo (Eucalyptus calophylla) WOODLAND, 15-18 m, over Blackboy (Xanthorrhoea preissii) SCRUB 1-2 m in height. The ground cover is of VERY OPEN LOW GRASS and sedges (Loxocarya sp.).

3. Marri/Powderbark (E. accedens) with occasional Wandoo WOODLAND, 15-18 m, over patches of regenerating Marri and Powderbark forming a LOW WOODLAND A, 10-14 m in height. The woodland has a mixed THICKET/LOW SCRUB A understorey in which Parrot Bush (Dryandra sessilis),

Pingle (Dryandra carduacea), Blackboys, Prickly Poison (Gastrolobium spinosum) and Leptospermum sp. are prominent.

4. Powderbark Brown Mallet LOW FOREST to 12 m, with scattered Brown Mallet emergent to 15 m. The understorey is open with patches of Bullock Poison.

5. Wandoo WOODLAND, 16-18 m, over regenerating Wandoo LOW WOODLAND A/LOW FOREST A from 10-12 m. The understorey is generally sparse.

6. Powderbark LOW FOREST 10-15 m, with taller mature examples at the heads of the gullies. The understorey is sparse with patches of Bullock Poison, to about 1 m.

7. York Gum (E. loxophleba) LOW WOODLAND A, 10-14 m in height, over Jam (Acacia acuminata) SCRUB 4-6 m over OPEN GRASS.

8. Jam LOW WOODLAND A, 6-8 m, with scattered examples of Wandoo emergent to approximately 14 m, over LOW GRASS.

4. FAUNA

Twenty-nine bird species were recorded during pre-planning surveys (App. III). Most of these are common in the York Gum/Jam, Wandoo and Marri woodlands of Toodyay Shire; less common species recorded were the Black-capped Sittela, Rufous Tree-creeper and Painted Quail.

Mammals sighted or trapped on the reserve include the Western Grey Kangaroo (Macropus fuliginosus) and the Western Pigmy-possum (Cercartetus concinna). One species of reptile has been recorded on the reserve to date, the Common Scaly-foot (Pygopus lepidopodus).

As with other reserves in the Shire, full surveys of the fauna of Poison Gully have not been carried out and no final conclusions can be drawn on its faunistic values.

5. PAST MANAGEMENT, USE AND FIRE HISTORY

Apart from its early use as a source of tanning bark and wandoo for local farm use the reserve received little management until 1977 when the Department of Fisheries and Wildlife installed six metre wide internal and perimeter firebreaks (Fig. 10). There is no road access to the reserve and it is seldom visited by the public. There are no records of its fire history except that Mr H. Cook, whose family have owned the adjacent farm for many years, believes the reserve may not have been burned since a severe fire swept through the area in the mid-1950s.

6. NATURE CONSERVATION VALUES

Although the reserve is relatively small it supports some fine stands of mature Wandoo (Fig. 11) and Powderbark in addition to a broad cross section of other woodland types and their associated flora. As the reserve has not been burnt for many years the vegetation is in excellent condition.

Figure 11. On the breakaways throughout Poison Gully Nature Reserve stands of Wandoo occur.

Much of the vegetation is similar to Rugged Hills and Flat Rock Gully, but it is an important adjunct to these two reserves which has the added advantage of being little disturbed and virtually unused. It is isolated from road access in a neighbourhood in which such areas are greatly appreciated. Despite its small size, therefore, Poison Gully Nature Reserve is regarded as a 'Wildlife Refuge' worthy of key site status in case of damage or loss of one or both of the other Hills Region nature reserves.

The reserve owes much of its undisturbed nature to a combination of distance and inaccessibility from main road access and the protective attitudes of its neighbours.

B. PLAN FOR MANAGEMENT

1. MANAGEMENT OBJECTIVES

The management of this reserve will be directed towards maintenance of the conservation values of the area. Active management is expected to be required in the following fields during the course of operation of this plan:

Protection from Fire

To protect the assets of adjacent landholders and the nature conservation values of the reserve. To minimise the occurrence of wildfires on the reserve and to supress such wildfires as may occur.

Protection from Pests : Animal and Weed Control

To protect the reserve and surrounding farmland from damage as a result of infestation with animals and plants which are declared from time to time under the provisions of the Agriculture and Related Resources Protection Act.

Public Use and Research

To not encourage public use of the reserve, with the primary management objective remaining one of the conservation of the natural environment. To encourage non-destructive research, subject to the approval of the Department of Fisheries and Wildlife.

2. FIRE PROTECTION

Rationale

Poison Gully Nature Reserve is set in the midst of cleared and partially cleared farmland and is surrounded by a comprehensive firebreak system. As such it poses very little fire risk to the surrounding area. The small size of the reserve reduces the probability of fire starting from natural causes on the reserve, and this probability is further reduced by its inaccessibility.
These factors account for the long, fire-free history of the reserve which has not been accompanied by a substantial build-up of litter or shrub-layer fuel. This plan therefore provides for the minimisation of fire occurrence, and advocates the exclusion of fire from the reserve. Adoption of this course is encouraged by reserve neighbour interest in the area.

Firebreaks to be maintained

The firebreak system on the reserve will continue to be maintained at its present standard.

Access

The reserve is accessible at the south-west corner where a gate will be erected in the boundary fenceline.

Fire Suppression

Fire fighting units from the Department of Fisheries and Wildlife at Wanneroo will attend whenever possible (subject to the limitations of personnel and equipment) fires occurring on, or considered to be threatening, the reserve.

Adequacy of Control Measures

As this reserve is land-locked amidst farming land it is important that good relationships be maintained with the reserve neighbours if fire occurrence on the reserve is to be minimised. This plan enables reserve neighbours to comment on what they consider to be inadequacies in fire protection arrangements for the reserve. On receipt of such comments the Director of Fisheries and Wildlife will organise a joint inspection of the problem and take such other action as may be needed to remedy the situation.

Notifiable Authority

The Department of Fisheries and Wildlife shall be regarded as a Notifiable Authority in terms of the Bush Fires Act and Regulations in respect of Poison Gully Nature Reserve.

3. PROTECTION FROM PESTS : ANIMAL AND WEED CONTROL

Control of declared pest animals and plants may be necessary from time to time to protect fauna and flora and the environment of the reserve generally and as part of organised control of vertebrate pests or weeds in the vicinity of the reserve.

Such arrangements as may be necessary in respect of organised pest control shall be made by consultation and co-operation between the Agriculture Protection Board and the Department of Fisheries and Wildlife.

Adequacy of Control Measures

As with the provisions for fire protection, reserve neighbours are invited to draw the attention of the Director of Fisheries and Wildlife to what they see as inadequacies in the control of pest plants and animals on the reserve. On receipt of such comments the Director may organise a joint inspection or take such other action as may be necessary to remedy the situation.

4. PUBLIC USE

This reserve is not as well suited for public use as other reserves within the Shire due to its inaccessibility. The

reserve is surrounded by privately owned farmland, and the reserve can only be reached by passing across this privately owned land. No public road provides access to the reserve. Therefore under the existing conditions, public use of the reserve will not be encouraged.

Access Classification

The reserve will not be classified as a LIMITED ACCESS AREA by virtue of its inaccessibility.

Signs

A sign identifying the status of the area as a nature reserve will be erected at the access point in the south-west corner. The sign will conform to the standard specifications for Department of Fisheries and Wildlife nature reserve signs.

5. RESEARCH

Poison Gully Nature Reserve has a long history of freedom from fire and grazing. It has been lightly exploited for timber but otherwise presents the appearance of being the least disturbed of the three Hills Region nature reserves. Provision will therefore be retained in this Plan for the area to be used as a research site after consultation with the proprietors of the Cook Pastoral Co. regarding access to the area.

6. MANAGEMENT - GENERAL

During the currency of this Plan the Department of Fisheries and Wildlife may, with the approval of the Chairman of WAWA, undertake or authorise such other work or action as may be seen to be necessary or desirable to properly promote the stated objectives of management of the reserve.

PART 5 : FLAT ROCK GULLY NATURE RESERVE (RESERVE NO. 22096)

A. THE RESERVE

1. PHYSICAL CHARACTERISTICS AND RELATIONSHIPS

Flat Rock Gully is the northernmost of the three Hills Region nature reserves and is situated approximately 12 km north of Toodyay townsite, and about 6 km north-east of Poison Gully Nature Reserve (Fig. 4). The reserve is rectangular in shape, with its longer axis running in a north-south direction. It covers an area of approximately 386 ha, and has a perimeter of about 8 km (Fig. 12). It lies in undulating country on the Darling Plateau.

The reserve is surrounded by private land, except where a tongue of State Forest adjoins the south-western boundary. The private land adjoining the south-western and north-western boundaries is cleared. That to the north-east of the reserve is mostly cleared, however there is a belt of woodland remaining against the reserve boundary.

The reserve occupies the greater part of a lateritised plateau and includes areas of edging breakaways and gullies and, in the north-eastern corner, a succession to lowland formations. In the south-east and south-west corners, and along the north-eastern side, water erosion has cut through the plateau forming steep-sided gullies and breakaways. The reserve therefore forms a distinct landscape unit.

Like Poison Gully Nature Reserve, Flat Rock Gully is landlocked, and accessible only through private property.

2. HISTORY

Flat Rock Gully was released for pastoral pursuits around the turn of the century. On 1 December 1939 the area was resumed and was set aside for 'Government Requirements'. It was logged over the ensuing period. In 1975 Casperson in his report 'Tooday - A Survey of Major Habitats Within the Shire', recommended that the area be set aside as a flora and fauna reserve. Casperson's recommendation was based on the following submission:

> "Apart from the large Class A reserves in the south-west of the Shire (Nos. 30191, 30192 and 30193) this reserve is the largest block of reserved land within the Shire. The open forest (Eucalyptus wandoo) community represented on the reserve has been judged to be poorly reserved (Specht, 1974). This reserve represents the only unalienated land of this type available for reservation within the Shire. Setting aside of this area for conservation purposes would ensure the presence of a reserve large enough to retain its character and provide an enduring refuge for species native to the area."

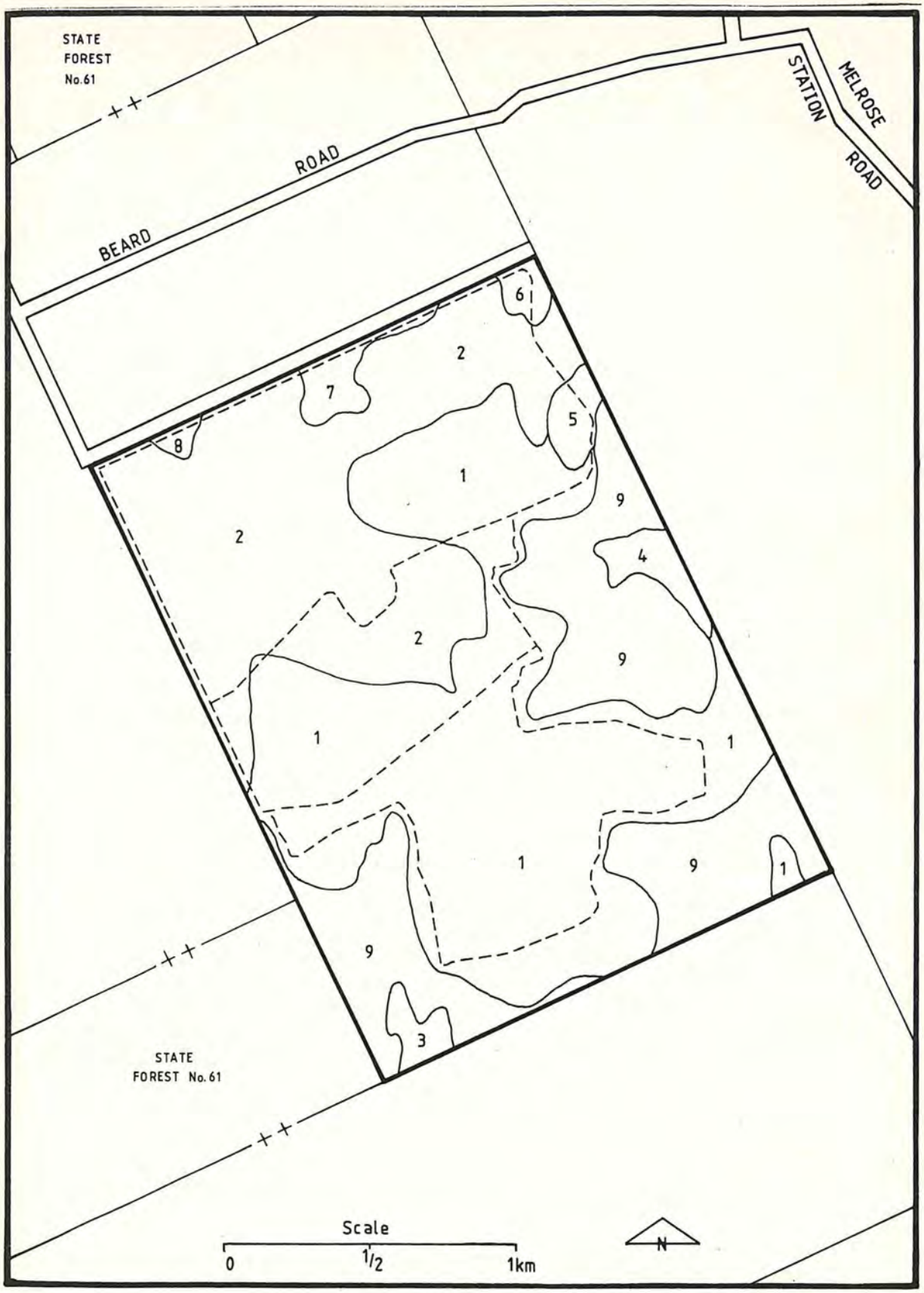


Figure 12. Flat Rock Gully Nature Reserve showing its relationship with surrounding lands, firebreaks (dashed lines) and vegetation formations (identified by numbers, and described in the associated text).

The following year, 1976, the Lands and Surveys Department received an application for the cancellation of the reserve and the subsequent release of the land for selection by adjoining holders. The area was examined by a Departmental Wildlife Officer, who recognised the reserve as being a valuable conservation area. His report, plus Casperson's recommendations, resulted in the purpose of the reserve being changed on 13 July 1976, to the 'Conservation of Flora and Fauna', and the reserve being vested in WAWA.

3. SOILS AND VEGETATION

Over most of the reserve the soils are sandy loams mixed with varying quantities of laterite gravel. On the breakaways and steep-sided gullies these become predominantly lateritic in nature. A small area in the north-eastern corner is characterised by rich, red-brown loams. A few isolated pockets of exposed granite occur.

The vegetation is dominated by woodland and forest formations. The central plateau surface supports woodlands of very open Marri and Wandoo over a dense understorey. Around the breakaways and steep gullies Powderbark becomes dominant. Much of the north-western part of the reserve supports a mixed Wandoo and Powderbark association.

The reserve has a long history of freedom from fire (greater than 25 years) and fine mature stands of Pingle (a fire sensitive species), in some places mixed with Prickly Poison, are a feature of the open woodlands.

A total of nine vegetation formations have been recognised within the reserve boundaries (Fig. 12). These are:

1. Marri (E. calophylla) OPEN WOODLAND, 14-18 m in height, with some Powderbark (E. accedens) and Wandoo (E. wandoo) also present. The associated understorey of THICKET/DENSE THICKET is dominated by three major species: Pingle (Dryandra carduacea), Prickly Poison (Gastrolobium spinosum) and Acacia celastrifolia. Other common understorey species include Blackboy (Xanthorrhoea preissii), Zamia Palm (Macrozamia riedlei), Adenanthos drummondii, Silky-leaved Blood Flower (Calothamnus sanguineus), Petrophile serruriae, Parrot Bush (Dryandra sessilis) and Hakea trifurcata. Occasional examples of Drummond's Gum (Eucalyptus drummondii) to 5 m also occur.

2. Wandoo/Powderbark WOODLAND/FOREST, 15-18 m in height, over a generally sparse understorey of Zamia Palms, Blackboys, Acacia pulchella aff., White Myrtle (Hypocalymna angustifolium) and Trymalium lidifolium. There are occasional Marri.

3. Graceful Honeymyrtle (Melaleuca radula) HEATH A over OPEN LOW GRASS on rocky slopes.

4. Graceful Honeymyrtle HEATH A on rocky slopes with Blackboys emergent to 4 m.

5. Jam (Acacia acuminata) LOW WOODLAND B, 4-5 m in height, over Graceful Honeymyrtle SCRUB, 2-3 m, over OPEN LOW GRASS on rocky slopes with red soil.

6. York Gum (E. loxophleba) LOW WOODLAND A, 12-15 m in height, over Jam SCRUB, 3-5 m, over LOW GRASS.

7. Jam LOW FOREST B, 4-5 m in height, with scattered Sheoak (Allocasuarina huegeliana) also present. This association carries an understorey of Graceful Honeymyrtle OPEN SCRUB, 2-3 m in height, over VERY OPEN LOW GRASS.

8. Wandoo LOW WOODLAND A, 12-14 m in height, over Graceful Honeymyrtle dominated HEATH B. Other understorey species include Dryandra tortifolia, Hakea incrassata and White Myrtle.

9. Powderbark FOREST/WOODLAND, 14-18 m, with stands of Brown Mallet (E. astringens) (Fig. 13), 10-15 m, over a variable sparse understorey. Stands of Prickly Poison (Gastrolobium spinosum), Parrot Bush and Pingle (Dryandra carduacea) occur occasionally.

Figure 13. One of the stands of Brown Mallet, a species once highly valued for the tanning properties of its bark, on Flat Rock Gully Nature Reserve.

4. FAUNA

Thirty-five bird species recorded on the reserve during pre-planning surveys are listed in Appendix III.
The greater number of species recorded on Flat Rock Gully compared to Rugged Hills and Poison Gully is a function of its greater size and its completness as a distinct landscape unit. In addition to the common and several uncommon bird species which utilise the three Hills Region reserves, a further three less common species, the Western Yellow Robin, Boobook Owl and Tawny Frogmouth, have been sighted on Flat Rock Gully. Two migratory species, the White-winged Triller and Rainbow Bird, have also been sighted on the reserve.

Mammals known to occur on the reserve include the Western Grey Kangaroo (Macropus fuliginosus), the Western Brush Wallaby (M. irma), the Western Pigmy-possum (Cercartetus concinna) and the Common Dunnart (Sminthopsis murina). The Western Pigmy-possums were caught in dense Dryandra carduacea stands at a time when the species were flowering. Reptiles sighted or trapped include the Western Bearded Dragon (Pogona minor), Burton's Snake-lizard (Lialis burtonis) and a skink (Morethia obscura).

5. PAST MANAGEMENT, USE AND FIRE HISTORY

Flat Rock Gully Nature Reserve was heavily logged for Wandoo in its early days as a reserve for 'Government Requirements'. Much of the openness of the plateau surface appears to have been induced by logging. Old stumps and felled trees can still be seen and logging tracks are still visible even though considerable regeneration has since taken place.

Most of the land around Flat Rock Gully was developed subsequently to the Second World War (App. II). The reserve itself escaped development firstly because of its status and secondly because of the prolific growth of Gastrolobium poison plants. This has assured that the reserve is well fenced and stock are excluded.

In 1976, when the reserve was vested in WAWA, perimeter and internal firebreaks were installed (Fig. 8). Where farmland borders the reserve the neighbouring farmers have constructed fenceline firebreaks.

There are no records of fire history for this reserve. However the presence of charred stumps, charred fallen timber and stands of even aged trees suggest it to have been subject to a severe fire 20-30 years ago. The mature Pingle stands suggest the reserve has not been burnt since.

6. NATURE CONSERVATION VALUES

Apart from Moondyne Nature Reserve in the south-west this is the largest nature reserve in the Shire. It is large

enough to retain its biological and scenic resources, and to provide a permanent refuge for species native to the area. Although logging operations have taken place in the past, the reserve still supports magnificent open forests and woodlands of mature Wandoo, Powderbark and Marri, associations once common over much of western and central Toodyay.

The distinct landscape unit of Flat Rock Gully Nature Reserve contains the diversity of topography and vegetation associations which typify the Hills Region. It supports a succession of vegetation from upland to valley floor woodland types and, with other reserves in the Shire, it represents part of the sequence from Jarrah dominated forests in the west, through Wandoo, to Salmon Gum woodlands in the east. Flat Rock Gully contains Marri, in one of its easternmost occurrences in the nature reserve system, as a woodland dominant. The reserve also supports populations of Brown Mallet (Fig.13), near the north-western limits of its known distribution, and Drummond's Gum which is known from two populations further east.

Preliminary surveys suggest that the diverse vegetation supports a rich fauna. Most notable of the mammals is the large population of Western Pigmy-possums.

The woodlands provide excellent sites for birds that utilise tree hollows for nesting. Wedge-tailed Eagles nest in one of the steep ravines and this serves to emphasise the value of the reserve as a relatively large area of natural bushland in the region.

Thus, although the reserve has a long history of disturbance from logging, and the woodlands of the plateau surface have been substantially modified as a result, it is regarded as a 'Key Site - Ecosystem Management' in the nature reserve system by virtue of its size, the inclusion within its boundaries of a distinct landscape unit, and the diversity of habitats it supports.

B. PLAN FOR MANAGEMENT

1. MANAGEMENT OBJECTIVES

The management of this reserve will be wholly directed towards maintaining the conservation values of the area, and as with other reserves in the Shire will remain conservative.

Provisions for management will include the following:

Protection from Fire

To protect the assets of adjacent landholders and to conserve the natural values of the reserve. To minimise the occurrence of wildfires on the reserve and to suppress such wildfires as may occur.

Protection from Pests : Animal and Weed Control

To protect the reserve and surrounding farmland from damage as a result of infestation with animals and plants which are declared from time to time under the provisions of the Agriculture and Related Resources Protection Act.

Public Use and Research

To maintain a conservative approach to public use of the reserve. Research and field survey work being done by interested groups, including the Toodyay Naturalists' Club, will continue to be encouraged.

2. FIRE PROTECTION

Rationale

Flat Rock Gully is unusual among the predominantly woodland nature reserves in the region by virtue of its history of heavy logging and subsequent prolonged freedom from fire. The latter has, until now, been largely fortuitous but should be continued as a factor in the active management of the area. The reserve has considerable potential as a site for the study of woodland successions following logging and this Plan shall provide for the continued exclusion of fire during the period so as this potential can be assessed.

This plan therefore provides firstly for fire protection measures which minimise the risk of fire spreading into the reserve from adjacent bushland (and farmland), and secondly for the maintenance of an effective system of natural and artificial firebreaks and barriers to fire spread.

Firebreaks to be maintained

All existing firebreaks on the reserve (Fig. 12) will be maintained to ensure they remain free of overgrowth and

for access in case of fire.

Access

Gates will be erected at the north-west and south-east corners to allow access onto the reserve for management and firefighting purposes.

Fire Suppression

Fire fighting units from the Department of Fisheries and Wildlife at Wanneroo will attend whenever possible (subject to the limitations of personnel and equipment) fires occurring on, or considered to be threatening, the reserve.

Protective Burning

This reserve has not been burnt for at least 20 years, and as such contains mature stands of Pingle and associated woodlands. This is one of the only regions in the Shire where significant stands of mature Pingle are found, and these in turn support Pygmy-possums in the highest known density within the Shire. With its peripheral and internal break system, and surrounding cleared farmland, the reserve provides an ideal opportunity to maintain the woodland and Pingle associations free of fire for long periods.

Controlled burning will not be prescribed as part of the fire protection measures in this plan. However provision shall be maintained for controlled burning of parts of the reserve from time to time for the purpose of research or fuel reduction.

Adequacy of Control Measures

In this respect special attention shall be paid to the feelings of reserve neighbours and to establishing and maintaining effective contact with neighbours. As with other reserves in the Shire, this Plan includes the formal provision for reserve neighbours to draw the attention of the Director of Fisheries and Wildlife to what they consider to be inadequacies in fire protection arrangements for the reserve. On receipt of such comments the Director will organise a joint inspection and take such other action as may be needed to remedy the situation.

Notifiable Authority

The Department of Fisheries and Wildlife shall be regarded as a Notifiable Authority in terms of the Bush Fires Act and Regulations in respect of the Flat Rock Gully Nature Reserve.

3. PROTECTION FROM PESTS : ANIMAL AND WEED CONTROL

Control of pest animals and plants may be necessary from time to time to protect fauna and flora and the environment

of the reserve generally and as part of organised control of vertebrate pests or weeds in the vicinity of the reserve.

Such arrangements as may be necessary in respect of organised control of declared animals and plants shall be made by consultation and cooperation between the Agriculture Protection Board and the Department of Fisheries and Wildlife.

As with the provisions for fire protection, reserve neighbours are invited to draw the attention of the Director of Fisheries and Wildlife to what they see as inadequacies in the control of pest plants and animals on the reserve. On receipt of such comments the Director may organise a joint inspection of the reserve or take such other action as may be needed to remedy the situation.

4. PUBLIC USE AND RESEARCH

Similarly to Poison Gully Nature Reserve, this reserve is not well suited for public use. It is almost completely surrounded by private land, with the exception of the rugged tongue of State Forest, and no public roads provide access to the reserve. Public use of the reserve will therefore not be provided for in this Plan.

Use of the reserve for research purposes however will continue to be encouraged. Departmental surveys of birds, and mammal and reptile trapping programs have been implemented and further research on the population of Western Pigmy-possums is planned.

Access Classification

At present there is no need to declare the reserve a LIMITED ACCESS AREA as it is landlocked by privately owned farmland, and no general public access to the reserve is available.

Signs

Signs identifying the reserve by name and complying to the Department of Fisheries and Wildlife's standard specifications for nature reserve signs will be erected at the north-west and south-east corners of the reserve adjacent to the proposed access gates.

5. MANAGEMENT - GENERAL

During the currency of this Plan the Department of Fisheries and Wildlife may, with the approval of the Chairman of WAWA, undertake or authorise such other work or action as may be seen to be necessary or desirable to properly promote the stated objectives of management of the reserve.

PART 6 : BEWMALLING NATURE RESERVE (RESERVE NO. 30306)

A. THE RESERVE

1. PHYSICAL CHARACTERISTICS AND RELATIONSHIPS

Bewmalling Nature Reserve, which is in the north of the Shire, about 11 km south-west of Bolgart and 4 km north of Flat Rock Gully Nature Reserve (Fig. 4), is roughly rectangular in shape and 39.2 ha in area (Fig. 14). It lies in gently undulating country and is surrounded by farmland. Old Plains Road passes along the north-eastern boundary of the reserve.

The dominant physical feature in the reserve is Mount Anvil Gully which cuts through it from west to east. The gully carries a stream which flows in winter and spring. The land rises on each side of the watercourse to a maximum of 270 m at the northern and southern boundaries of the reserve. The point of lowest elevation (245 m) is midway along the north-eastern boundary where the stream leaves the reserve. This altitude range of 25 m within the reserve reflects the gently undulating topography of the area as a whole.

2. HISTORY

The present day reserve was originally part of a block of land released in the 1860s and used for grazing until 31 August 1893, when it was resumed and declared a reserve for its initial 'Public Utility' purpose. It is adjacent to the northern stock route and was of value as a resting place for travellers and stock en-route between the Avon Valley area and Victoria Plains.

Over the intervening years Bewmalling was subject to a variety of "public utility" uses. It provided grazing and water for travelling stock and some of the timber it contained was used for fencing on neighbouring farms. During its days of pastoral use, two granite stone buildings were erected near the Mount Anvil Gully Stream. The ruins of these buildings are still clearly visible today (Fig. 15).

The purpose of the reserve was changed to 'Conservation of Flora' on 17 April 1970. In his report on the major habitats within the Toodyay Shire, Casperson recommended that:

> "...such lands which are presently set aside for conservation of flora and fauna be vested to safeguard their existence."

The result was a further change in purpose to 'Conservation of Flora and Fauna' and the vesting of Bewmalling Nature Reserve in WAWA on 4 February 1977.

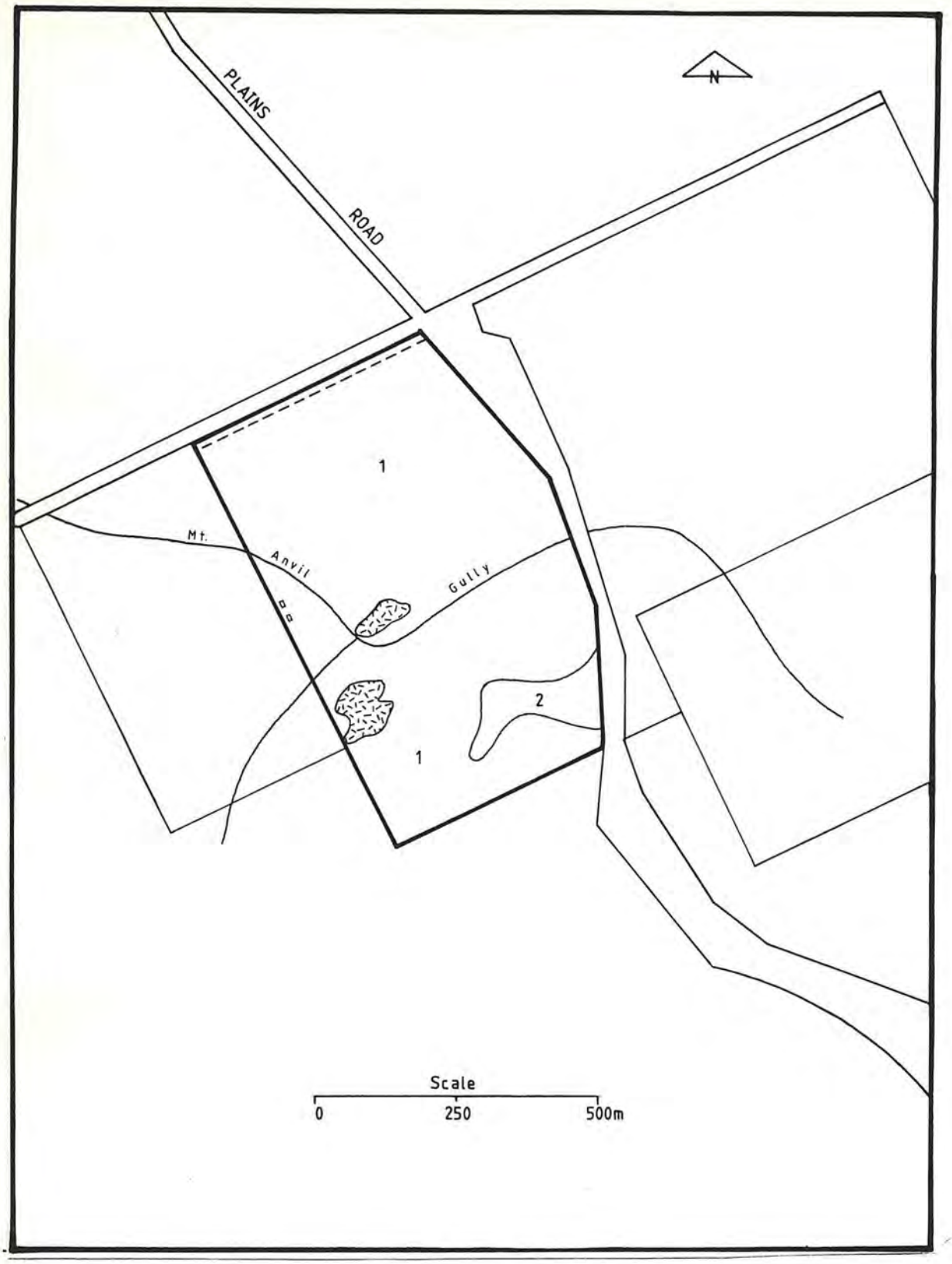


Figure 14. Bewmalling Nature Reserve showing its relationship with surrounding lands, tracks (dashed lines) and vegetation formations (identified by numbers, and described in the associated text).

Figure 15. The century old ruins on Bewmalling Nature Reserve form an integral part of the reserve's nature conservation values.

3. SOILS AND VEGETATION

Red loams and lighter sandy loams are the predominant soils on the reserve, though clays are present in areas supporting Wandoo (Eucalyptus wandoo). Several granite outcrops occur near the south-western border of the reserve.

The reserve is dominated by York Gum/Jam (Eucalyptus loxophleba/Acacia acuminata) woodland (Fig. 16), the composition of which varies from place to place, York Gum being dominant in some areas and Jam more prolific in others. The other major plant formation is a Wandoo/York Gum woodland but this is more limited in extent. Sheoaks (Allocasuarina huegeliana) are widespread but nowhere dominant. The two main vegetation types are distributed as shown in Figure 14, and may be described as follows:

1. York Gum (Eucalyptus loxophleba) LOW WOODLAND A/OPEN LOW WOODLAND A, 8-15 m, with more mature York Gum emergent to 18 m. This association occurs over Jam (Acacia acuminata) to approximately 7 m, and a ground cover of OPEN LOW SEDGES and OPEN LOW GRASS. York Gum is generally dominant, with Jam becoming dominant in places.

Figure 16. York Gum Low Woodland A, with Jam locally dominant, on Bewmalling Nature Reserve - this is one of the few areas where this formerly extensive formation remains.

2. York Gum/Wandoo (Eucalyptus wandoo) WOODLAND, 15-18 m in height, over OPEN LOW GRASSES. Sundews (Drosera spp.), Triggerplants (Stylidium spp.), Conostylis prolifera and the Spider Orchid (Caladenia patersonii) are common in the ground cover.

The third feature area delineated in Figure 14 is outcrops of granite. These are limited in extent and are described as follows:

3. Granite outcrops : lichen-covered granite surfaces with dense mosses growing in shallow soil in the hollows. Sun orchids (Thelymitra spp.) are common around these rocks.

4. FAUNA

Sixteen bird species recorded during surveys preliminary to the preparation of this plan are listed in Appendix III.

The Toodyay Naturalists' Club have recorded 87 bird species in York Gum/Jam communities and it is expected that following more comprehensive surveys of Bewmalling more bird species will be recorded.

Mammals sighted on the reserve include the Western Grey Kangaroo (Macropus fuliginosus), fox and rabbit. Two reptiles have been trapped on the reserve, the Black-headed Whip-snake (Denisonia gouldii) and a gecko (Diplodactylus pulcher).

As with other reserves in the Shire, for which comprehensive data on fauna occurrence is unavailable at the time of preparation of this Plan, no conclusions are drawn as to its faunistic values.

5. PAST MANAGEMENT, USE AND FIRE HISTORY

The reserve has no firebreaks, although a peripheral track follows the north-eastern boundary. The perimeter fencing is in reasonable condition, and where farmland adjoins the reserve the landholders have ploughed three metre wide firebreaks along their boundaries. No fire history records are available but the reserve appears not to have been burnt for a number of years. This deduction is based on the fire sensitivity of Jam. This species when burnt does not resprout or regenerate, however following a fire new plants grow from seed. As the Jam on Bewmalling are 3 m or more in height and are therefore probably 10 to 12 years old, it appears that the reserve has not suffered a severe fire for at least this period.

6. NATURE CONSERVATION VALUES

Bewmalling, and Wattening to the east, are the only nature reserves in the Shire to contain more than a few hectares of York Gum/Jam woodland. These woodlands, which are generally characteristic of red-brown loamy soils suitable for agriculture, were the first to be exploited when the land was opened up for selection. The limited extent of York Gum/Jam woodland (Fig.16) represented in the nature reserve system makes individual reserves such as Bewmalling especially important as conservation areas.

The history of use of the reserve adds to its interest. The York Gum/Jam woodland is a remnant of a once prized agricultural landscape, and the ruins on the south-western boundary are a valuable focus of interest and a reminder of the recent past. It is estimated that of the two buildings one was constructed in the early 1860s and the other in the early 1870s. Both were built from loose rocks gathered from around the granite outcrops nearby. Today the ruins and the large exposed granite outcrops provide ideal habitat for small mammals and reptiles (Fig. 15).

Because of its isolation in the midst of cleared farmland Bewmalling is also valuable as a refuge for birds, particularly migratory and transitory species. Although small in size, the reserve provides a refuge for tree-dwelling and other small mammals.

Size and disturbance detract from the value of Bewmalling as a representative area of York Gum/Jam woodland, but because of the rarity of these woodlands in the nature reserve system it has been assigned 'Key Site - Ecosystem Management' status.

B. PLAN FOR MANAGEMENT

1. MANAGEMENT OBJECTIVES

The major objective of management for Bewmalling is the conservation of a representative sample of York Gum/Jam woodland.

This objective is complicated by the long history of grazing, particularly by sheep, and the occurrence over most of the area of a dense ground-cover of exotic grasses and other weeds. York Gum woodlands naturally have a rich ground-cover of native soft grasses and herbs. This was the origin of their value to the early pastoralists. The relatively fertile soils of these woodlands, however, provides the ideal situation for a variety of introduced weeds and crop and pasture plants, the spread of which has been encouraged by grazing. On the other hand, during the period Bewmalling was grazed, sheep helped keep weed species in check. To some degree they replaced marsupial herbivores, whose numbers and movement have been restricted by large-scale clearing, exotic predators and enclosure of farmlands.

Its objective is also complicated, as is the case with most nature reserves, by irretrievable alteration to the natural pattern of fire. This is particularly a problem in the York Gum/Jam woodlands where the exclusion of stock leads to the accumulation of dry grasses.

Thus, although the objective of management is to conserve the woodland formation, in practice we are dealing with a disclimax community and a near total lack of knowledge of the dynamics of the system concerned. In the face of such constraints management needs to be conservative and linked with an actively promoted programme of research in woodland dynamics.

In Bewmalling we have a small slice of the history of early agriculture in the Avon Valley. Bewmalling is a living tribute to the development of land-use and one of the best examples of the earliest pastoral system in the Avon Valley. Its perceived value as such can be expected to increase dramatically during the years of currency of this Plan.

Provisions for management will include the following:

Protection From Fire

To protect the assets of adjacent landholders and the conservation values of the reserve. To minimise the occurrence of wildfires on the reserve and to suppress such wild fires as may occur.

Protection from Pests : Animal and Weed Control

To protect the reserve and surrounding farmlands from damage as a result of infestation with animals and plants

under the provisions of the Agriculture and Related Resources Protection Act.

Public Use and Research

To continue to encourage non-destructive research in woodland ecology and the use of the reserve for passive recreational pursuits such as birdwatching and wildflower study. All uses will remain subsidiary to maintaining the nature conservation values of the area.

2. FIRE PROTECTION

Rationale

Bewmalling's position as a small nature reserve in the midst of developed farmland helps to minimise the risk to it from fire. Uncontrolled fire is uncommon on farmland in this area and the small size of the reserve minimises the probability of fires starting within its area. Its small size also negates the need for strategic measures such as extensive firebreaks and heightens difficulties both of control of possible wildfires and maintenance of any mosaic pattern of different successional stages of the vegetation by periodic controlled burning. These considerations and the lack of knowledge of the response to fire of the woodlands concerned are considered to outweigh any heightening of fire risk associated with accumulation of grasses and to dictate a conservative approach to fire management for the period of this Plan.

Construction of Firebreaks

Provision is retained within this Plan for the construction of a minimal system of perimeter firebreaks. These should be no greater than three metres in width and as close to reserve boundaries as possible. The major objectives of these breaks would be to provide access, to hinder the movement of fire across the reserve boundaries, and to protect the fencelines bordering the reserve.

Prescribed Burning

Fire prescriptions may be applied to the reserve during the course of this Plan either as a means of reducing grass-layer fuel or to promote succession of vegetation, in the one instance as an option of last resort in fire protection and in the second for possible research purposes.

Fire Suppression

Fire fighting units from the Department of Fisheries and Wildlife at Wanneroo will attend fires whenever possible (subject to the limitations of personnel and equipment) fires involving, or considered to be threatening, Bewmalling Nature Reserve. Being such a small area it is unlikely that assistance of Fisheries and Wildlife would

be of great effect in suppressing any fires actually on the reserve at the time of a report. The provision for fire suppression assistance is aimed at achieving early notification of any wildfire which may threaten the reserve and to promote appreciation in the local community of the importance with which the reserve is regarded by WAWA and the Department of Fisheries and Wildlife.

Adequacy of Control Measures

In this respect special attention shall be paid to the feelings of reserve neighbours and to establishing and maintaining effective contact with neighbours. This Plan includes provision for reserve neighbours to draw the attention of the Director of Fisheries and Wildlife to what they consider to be inadequacies in fire protection arrangements for the reserve. On receipt of such comments the Director will organise a joint inspection and any necessary action will follow.

Notifiable Authority

The Department of Fisheries and Wildlife shall be regarded as a Notifiable Authority in terms of the Bush Fires Act and Regulations in respect of Bewmalling Nature Reserve.

3. PROTECTION FROM PESTS : ANIMAL AND WEED CONTROL

Control of pest animals and plants may be necessary from time to time to protect fauna and flora and the general reserve environment, and as part of organised control of vertebrate pests or weeds in the vicinity of the reserve. Such arrangements as may be necessary for the organised control of declared plant and animal pests shall be made by consultation and cooperation between the Agriculture Protection Board and the Department of Fisheries and Wildlife.

As with the provisions for fire protection, reserve neighbours are invited to comment on what they feel are inadequacies in the control of pests within the reserve. On receipt of comments the Director shall take the appropriate action.

4. PUBLIC USE

Bewmalling receives little public use, but use may increase as the values of the nature reserve become more widely appreciated. At present there is no access to vehicles and it is desirable that this should continue.

In the presence of low levels of use at the time of preparation of a management plan, guidance of use patterns which may develop subsequently is simplified.

Access Classification

Use on the reserve of vehicles of any kind will be minimised by its declaration as a LIMITED ACCESS AREA.

Exclusion of vehicles is in keeping with the scale of the reserve and its historic significance. Classification is expected to minimise the possibility of damage to the reserve and the artefacts it supports.

Signs

Signs identifying Bewmalling Nature Reserve will be erected at each end of its frontage to Old Plains Road. These and such other signs as may be required to guide use patterns will comply with the Departmental Signs Standard.

5. RESEARCH

Research, whether by amateur or professional individuals, or groups, which furthers the objectives of management, will be encouraged under this Plan. Research involving observation alone, in which no associated activity contravenes the Wildlife Conservation Regulations or provisions of this Plan, will require no special permission from the Department of Fisheries and Wildlife. Experimental or other research involving manipulation of wildlife or the natural environment requires authorisation from the Department of Fisheries and Wildlife.

6. MANAGEMENT - GENERAL

During the currency of this Plan the Department of Fisheries and Wildlife may, with the approval of the Chairman of WAWA, undertake or authorise such other work or action as may be seen to be necessary or desirable to properly promote the stated objectives of management of the reserve.

PART 7 : WATTENING NATURE RESERVE (RESERVE NO. 2393)

A. THE RESERVE

1. PHYSICAL CHARACTERISTICS AND RELATIONSHIPS

Wattening Nature Reserve is situated in the north-eastern corner of the Shire 6.5 km south-east of Bolgart and 8.3 km north-east of Bejoording (Fig. 4). Wroth Road/Wattening Spring Road passes along the southern half of the reserve's south-western boundary, and a private road follows the south-eastern boundary.

The reserve is "L-shaped" with an area of 40.5 ha and a perimeter of approximately 3.1 km (Fig. 17). The reserve lies in gently undulating country which has been extensively cleared for farming. Apart from a small gravel reserve near the southern corner, the surrounding land is privately owned.

The area is remarkable in that it retains a supply of fresh water throughout the year. Two permanent streams pass through the reserve, one from the north-east and the other from the south-east. These eventually join up to the west of the reserve and form one of the tributaries of Toodyay Brook. Their flow is supplemented with water from Wattening Spring which is located on the eastern boundary of the reserve. A perennial swampy soak, just to the east of the reserve, provides water during the winter months.

The only uncleared land bordering the reserve is to the south-east and protects the headwaters of one of the streams. This area was partially cleared about 20 years ago and has since regenerated to support a dense Acorn Banksia (Banksia prionotes) woodland.

The reserve is relatively flat, with less than a 10 m variation in altitude throughout. A slight depression occupies the centre of the reserve, with higher ground towards the northern and southern ends.

2. HISTORY

Wattening Nature Reserve was initially set aside for the purpose of 'Public Utility' on 28 September 1893. This was one of five nature reserves in the Toodyay Shire originally set aside to provide watering and resting facilities for bullock and horse teams. Of the five, three were originally designated as 'Watering and Stopping Places', and two, including Wattening, for 'Public Utility'. They all served the same purposes but those on the northern stock route were gazetted with a more generalised purpose than the ones on the heavily used approach to the eastern goldfields.

The purpose of Wattening remained unchanged until Casperson (1975), in his report on the major habitats within the Shire, recommended that the area be set aside

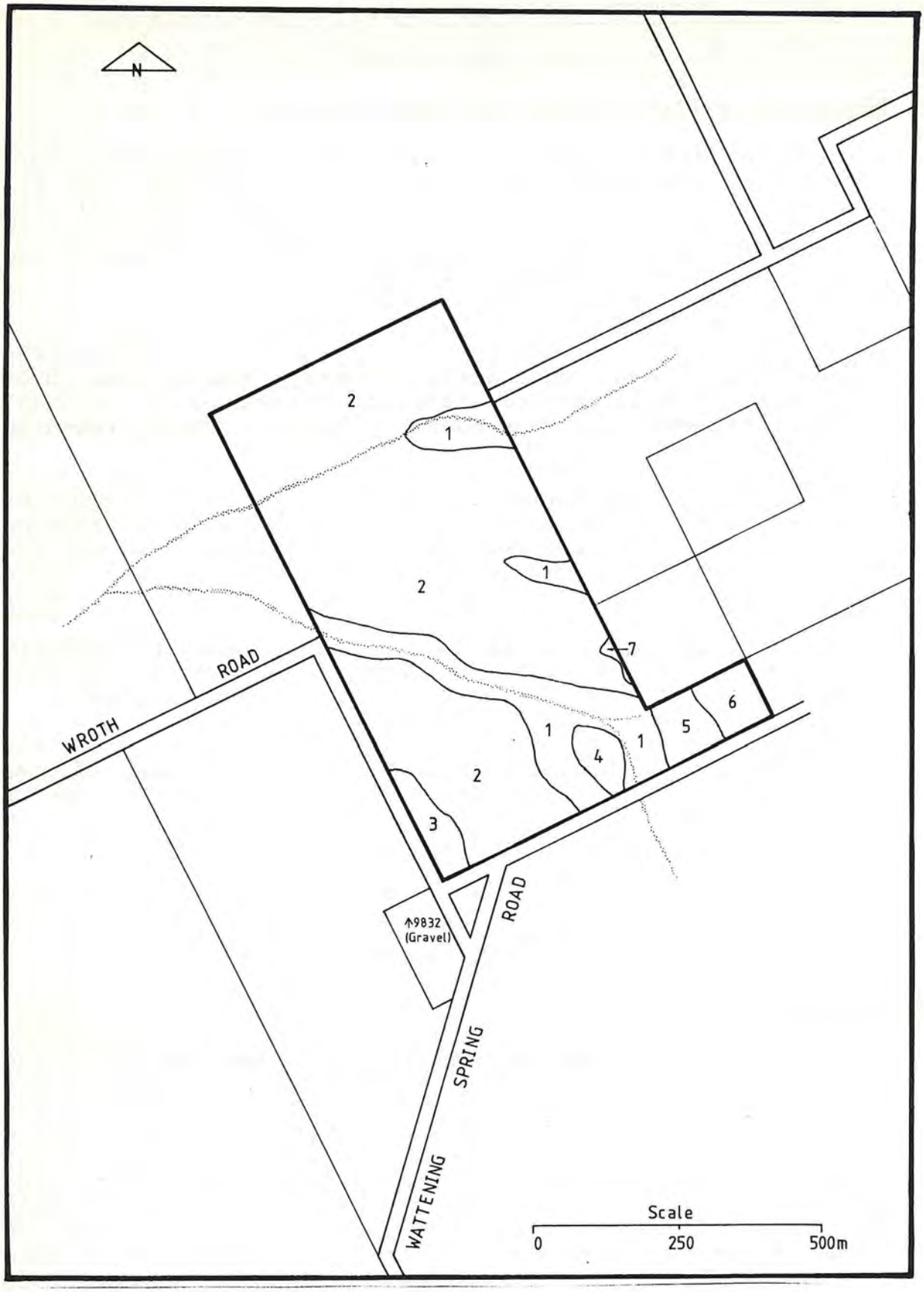


Figure 17. Wattening Nature Reserve showing its relationship with surrounding lands, creeks (stippled lines) and vegetation formations (identified by numbers, and described in the associated text)

for the Conservation of Flora and Fauna and be vested in WAWA. His report was based on the following recommendation:

> "This reserve is unique amongst the reserves within the Shire. Located in the north-eastern part of the Shire it is the only piece of land available for reservation in this area. The surrounding sandplains have been cleared and the only remaining native flora is in road verges and this particular reserve. Long term viability of flora in the road verges is doubtful therefore the setting aside of this reserve for conservation purposes would ensure that this small pocket would persist. Principal trees in the reserve are Casuarina spp., Flooded Gum (Eucalyptus rudis) and York Gum (E. loxophleba). The reserve is at the headwaters of Wattening Brook. On the banks of the stream are thick stands of bullrushes (Typha) and the stream, although very narrow and shallow supports a large crayfish population as evident by their numerous excavations and remains. Remains submitted to Mr Brenton Knotts (Senior Demonstrator, Dept. of Zoology, U. of W.A.) were not recognized as being characteristic of the common varieties of crayfish. As the survival of these crayfish is dependent upon the small stream it is a matter of priority that they be identified and their status assessed. The isolated nature of this population and its dependence upon the stream which originates from this reserve make its reservation crucial to their survival."

Casperson's recommendations resulted in the purpose of the reserve being changed to Conservation of Flora and Fauna and it being vested in WAWA.

3. SOILS AND VEGETATION

Soils vary from light coloured sands to sandy loams. The lack of differentiation in soils on this reserve reflects the uniformity of the topography. Black, peat-like soils occur in the lower-lying wet and swampy areas.

Most of the reserve, with its sandy to sandy loam soils, supports York Gum (Eucalyptus loxophleba) and Jam (Acacia acuminata) associations. Swamp Sheoak (Casuarina obesa) LOW FOREST dominates the edges of waterways and lower lying areas. A further five vegetation associations, all of limited extent, occur within the reserve boundaries (Fig. 17). The following detailed descriptions apply:

1. Swamp Sheoak (Casuarina obesa) LOW FOREST A, 10-16 m in height, over dry LOW GRASS. Where swampy conditions persist along the watercourses dense stands of Bullrush (Typha angustifolium) and TALL SEDGES often form a dense understorey.

2. York Gum (Eucalyptus loxophleba) LOW WOODLAND A/OPEN LOW WOODLAND A, 8-15 m, over Jam (Acacia acuminata),

5-12 m, over dry LOW GRASS. In places Hakea obliqua forms an intermediate shrub understorey to approximately 3 m. Swamp Sheoak becomes a component of this association along poorly defined seasonal drainage lines.

3. Tamma (Allocasuarina campestris) THICKET/DENSE THICKET, 2-3 m, over OPEN LOW SEDGES and OPEN LOW GRASS. Scattered Jam are emergent to 8 m throughout.

4. OPEN LOW GRASS and scattered clumps of LOW SEDGES with some dead Swamp Sheoak emergent to approximately 10 m. This area, which is swampy in winter, appears to have been heavily grazed.

5. Flooded Gum (Eucalyptus rudis) LOW FOREST A, 10-15 m in height, with a few trees adjacent to the swamp emergent to 18 m. This association occurs over an open understorey, with a few areas of DENSE LOW SEDGES.

   Between this association and the Casuarina LOW FOREST there is a belt of mature Swamp Paperbarks (Melaleuca raphiophylla), 10 - 12 m in height (Fig. 18).

6. OPEN LOW GRASS on sandy soil, with a few York Gums and Acorn Banksia trees. This association is an extension of the dense stand of Acorn Banksia which was described earlier. The OPEN LOW GRASS association has been heavily grazed.

7. SEASONAL OPEN LOW GRASS which is used for grazing. This is the dominant association in the adjacent privately owned land. Area 7 is a limited extension into the reserve of this vegetation.

4. FAUNA

Systematic surveys of the fauna of Wattening have not been carried out. A bird species list (App. III) has been compiled from opportunistic observations made by a number of people. Thirteen species of bird have been recorded in this way and the reserve undoubtedly provides refuge and a source of fresh water for many more species from time to time.

Sight records of mammals have been made for all reserves, while a limited trapping programme has been implemented on all the reserves within the Shire. Species trapped on Wattening Nature Reserve include three reptiles; a skink (Menetia greyii), a legless lizard (Delma fraseri) and Burton's Snake-Lizard (Lialis burtonis) and two amphibians, the Western Green and Golden Tree Frog (Litoria moorei) and a froglet (Ranidella pseudinsignifera). The Euro (Macropus robustus) plus exotic species such as rabbits and foxes have been sighted. Small unidentified fish and an unidentified species of crayfish occur in the two

freshwater streams and frogs are numerous in the damp areas.

Figure 18. A belt of mature Paperbarks occurs in the south-eastern corner of Wattening Nature Reserve

5. PAST MANAGEMENT, USE AND FIRE HISTORY

The Wattening 'Public Utility' reserve appears, on present evidence, to have been heavily used during both its early and latter days. In the early days a stone lined well was built at the source of Wattening Springs and would certainly have been well known as a reliable source of water for bullock and horse teams following the northern stock route. A building site in a clearing among the Flooded Gums appears to have originated during this period. There is widespread evidence of old and more recent timber cutting, particularly of Jam trees for

fencing, and there are a number of disused vehicle tracks which are still clearly visible. There is also a small gravel pit located near the southern corner of the reserve. The reserve has been used for grazing until quite recently and neighbours are still adjusting to the change of status.

The reserve is still being used for its valuable permanent water supply, as water is being drawn off the reserve for stock. A pump is located on the south-eastern boundary where one of the two permanent streams enters the reserve.

No accurate fire history records exist for the reserve, but examination of the vegetation indicates that it has not been burnt for some years. This conclusion is supported by Wattening's position in the midst of farmland which has been cleared for many years. Isolated as it is in long established agricultural/pastoral land there has not recently been the problem of fires escaping from clearing operations, or of high intensity fires extending through extensive tracts of bushland. Farmer's firebreaks along the north-western and north-eastern boundaries are the only fire protection measures in existence at present.

6. NATURE CONSERVATION VALUES

Wattening is the only nature reserve in the north-eastern quadrat of the Toodyay Shire. And, as it has an ample supply of permanent fresh water and good woodland cover, it has the potential to provide a valuable refuge for nomadic birds and for a variety of permanent resident bird species, small mammals and reptiles. The known vertebrate fauna of 13 birds, at least 3 reptiles and 2 amphibians, would be considerably extended by further more intensive survey. These values are unaffected by the high level of disturbance of the vegetation, the product of more than 100 years of European use, and a considerably longer period of use by Aboriginals. Most of the past use would have been centred around the area's water resources.

The York Gum woodland on the reserve is unusual in that it has become established on a sandy soil, rather than on the typical loamy York Gum substrate. The York Gum association is probably successfully utilising this habitat due to the presence of a permanent water supply, which must compensate to some extent for the poor water holding capacity and low nutrient status of the sandy soil.

Despite the disturbed nature of the vegetation on the reserve, Wattening is considered of sufficient value to be afforded 'Wildlife Refuge' status in the Western Australian system of nature reserves.

In addition to the purely faunistic and floristic values of Wattening, its place in the history of the region is appreciated. Within the context of this Plan the nature conservation values of this reserve are a product of

interactions between human and natural processes. Therefore a combination of past human influences and the existing natural features form the basis of any management decisions, and the human artefacts that remain are part of the evolved reserve environment.

B. PLAN FOR MANAGEMENT

1. MANAGEMENT OBJECTIVES

The primary objective of management for Wattening Nature Reserve is the conservation of a representative sample of a once extensive, and now very limited, vegetation complex and its associated fauna. Included with this objective is the conservation of the aquatic habitats represented and the historic values of the reserve as a whole. The reserve has a very high conservation value due to the extensive stand of York Gum woodland, an association which has been poorly reserved, both within Toodyay Shire and throughout the State as a whole. This includes the pure stands of Swamp Sheoak LOW FOREST, an association found on no other nature reserve within the Shire.

Active management is expected to be required in the following fields during the course of operation of this plan:

Protection from fire.

To protect the assets of adjacent landholders and at the same time protect the natural values of the reserve. To minimise the risk of occurrence of wildfires on the reserve and to suppress such wild fires as may occur.

Protection from Pests : Animal and weed control.

To protect the reserve and surrounding farmlands from damage as a result of infestation with such plants and animals as may be declared from time to time under the provisions of the Agriculture and Related Resources Protection Act.

Public Use and Research

To continue to encourage passive use of the reserve for bird-watching and wildflower study with both uses remaining subsidiary to maintaining the nature conservation values of the area. To use the area's long history of disturbance as a valuable background for the study of the effective conservation of small areas of lowland woodlands.

2. FIRE PROTECTION

Rationale

The position of a small nature reserve such as Wattening in the midst of a long-established farming landscape minimises the probability of fires escaping onto the reserve. Being a small reserve the likelihood of a fire starting from natural causes within its boundaries and spreading to damage adjoining farmland is also low. Finally the extensive system of waterways is a natural, maintenance-free barrier to bushfires.

Firebreak Construction

For these reasons there is no immediate need to undertake firebreak construction or any such other active measures for fire protection which would further disrupt the qualities of the natural environment.

Provision is, however, retained in this Plan for the construction of three metre wide breaks along all reserve boundaries with the exception of the south-eastern boundary and southern half of the south-western boundary where adjacent roads form suitable firebreaks.

Fire Suppression

Fire fighting units from the Department's base at Wanneroo will, where possible (subject to the limitations of personnel and equipment) attend fires occurring on, or considered to be threatening, the reserve.

Protective burning

At present effective fuel levels on the nature reserve are very low and are kept low by grazing. There is no immediate need to implement a programme of fuel reduction by controlled burning. Such a need may arise in the future. Once sheep are excluded from the reserve the growth of understorey grasses may well create a fire hazard in the dry summer months. Prescribed burning is one means of reducing the likelihood of fire damage to the woodlands. Provision is retained in this Plan for the prescribed burning of vegetation on the reserve should this prove necessary in the mitigation of fire hazard. A viable alternative to burning may be selective grazing by domestic stock of the winter and spring growth of grasses.

Adequacy of Control Measures

Special attention will be paid to the views of reserve neighbours in the matter of maintaining measures for fire protection and formal provision shall be included in this plan for adjacent landholders to draw the attention of the Director of Fisheries and Wildlife to what they consider to be inadequacies in fire protection arrangements for the reserve. On receipt of such comments the Director will organise a joint inspection of the problem and take such other action as may be needed to remedy the situation.

Notifiable Authority

The Department of Fisheries and Wildlife shall be regarded as a Notifiable Authority in terms of the Bush Fires Act and Regulations in respect of Wattening Nature Reserve.

3. PROTECTION FROM PESTS: ANIMAL AND WEED CONTROL

Control of pest animals and plants may be necessary from time to time to protect fauna and flora and the environment

of the reserve generally and as part of the organised control of vertebrate pests or weeds in the vicinity of the reserve.

Such arrangements as may be necessary in respect of organised control of declared animals and plants shall be made by consultation and co-operation between the Agriculture Protection Board and the Department of Fisheries and Wildlife.

Grazing on the Reserve

At the time of drafting this Plan fencing around the reserve was inadequate and livestock were grazing on the reserve. Although the presence of stock on the reserve is limiting fuel accumulation particularly from the growth of weeds, it may also be causing continuing damage to vegetation through selective grazing, particularly to the herbaceous and soft-foliaged plants associated with wetland areas. This possibility needs to be viewed however, in the context of the long use of the area by sheep and cattle, dating with certainty from before its gazettal as a 'Public Utility' reserve and possibly from the earliest days of settlement. Sudden exclusion of sheep would be likely to be equally damaging. The problems caused by the upsurge of growth of exotic grasses and other weeds in York Gum areas following exclusion of livestock is well demonstrated in Bewmalling Nature Reserve.

Therefore once the reserve is fenced the provision will be retained within this Plan to continue grazing sheep on the reserve, and at the same time establish a series of exclusion plots to determine the likely effects of the cessation of grazing on the flora.

Adequacy of control measures

Similarly to fire protection, landholders adjacent to the reserve are invited to comment on what they feel are the inadequacies in the above policies regarding pest control. On receiving such comments the Director will take suitable action to remedy the situation.

4. PUBLIC USE

Use of Wattening for the quiet enjoyment of nature will not be discouraged. The reserve, with its combination of York Gum LOW WOODLAND and Swamp Sheoak LOW FOREST, contains associations not found elsewhere in the Shire. As such Wattening complements the diversity of habitats provided by the system of nature reserves within the Shire, a system which exists for both conservation and the appreciation of the natural environment. The reserve also has some points of historical interest, these being the stone-lined well and the old building site, both located on the eastern boundary of the reserve.

Access Classification

The values and fragility of this nature reserve and its small size dictate the need to declare it a LIMITED ACCESS AREA in terms of public use. As such, vehicles will be excluded from the reserve.

Signs

A sign identifying the area as Wattening Nature Reserve shall be erected on the south-western boundary of the reserve adjacent to Wroth/Wattening Spring Road. The sign will conform to the Sign Standard specifications of the Department of Fisheries and Wildlife.

5. RESEARCH

As part of an active research program, and in view of the area's long history of use for grazing, and the need to limit fuel accumulation, grazing on the reserve may be re-introduced. The main aims of this research would be to monitor the continuing impact of grazing on the reserve flora,and to monitor the change in floral composition of the understorey following the exclusion of stock from selected areas.

6. MANAGEMENT - GENERAL

During the currency of this Plan the Department of Fisheries and Wildlife may, with the approval of the Chairman of WAWA, undertake or authorise such other work or action as may be seen to be necessary or desirable to properly promote the stated objective of management of the reserve.

PART 8 : WONGAMINE NATURE RESERVE (RESERVE NO. 33697)

A. THE RESERVE

1. PHYSICAL CHARACTERISTICS AND RELATIONSHIPS

Wongamine Nature Reserve is on the eastern border of Toodyay Shire and approximately 12 km east-north-east of Toodyay town (Fig. 4). It is tetragonal in shape, with an area of 212.9 ha and a perimeter of some 6.5 km (Fig. 19).

The western boundary of Wongamine is formed by Forrest Road, on the other side of which is another Crown reserve (No. 33802), set aside as a source of gravel for roadmaking. A second road (Beejording Road) marks the eastern boundaries both of Wongamine and of the Shire. The remaining borders, including that of the eastern side of Beejording Road, are shared with farmland.

Most of Wongamine is part of an isolated laterite plateau, the eroded remains of the Darling Plateau peneplain, and has an elevation ranging from 260 m in the east to more than 330 m in the west. As a result the reserve contains a number of steep-sided gullies and breakaways together with some more undulating terrain, especially towards the lower elevations, in the east.

2. HISTORY

Wongamine Nature Reserve was originally set aside on 18 October 1901 for the purpose of 'Water and Stopping Place'. Like Goonaring and Beelaring Springs (PART 2) Wongamine is on the old goldfields route between Perth and Coolgardie. Its original declaration as a Crown reserve followed on from those of the two Springs reserves, and it was the last of the present day system of nature reserves within the Shire to be set aside as a 'Watering and Stopping Place'. Wongamine was probably extensively used for this purpose by travellers moving to and from the eastern goldfields. The year of its gazettal, 1901, was the peak of the goldrush and such areas were in high demand.

Modes and patterns of travel changed dramatically in the following years and the purpose of the reserve was amended to 'Timber' by Government Gazette notice of 8 August 1944. The change was in recognition of the value of stands of Wandoo (Eucalyptus wandoo) and Brown Mallet (E. astringens) on the reserve. Wandoo is a useful farm timber, as is Brown Mallet which has straight-grained, durable and tough wood. However the prime value of Brown Mallet was its bark, which contains 45-70 percent tannin, which was of great value in tanning hides. In the earlier days of Western Australia's settlement the harvesting of Brown Mallet bark for local use and for export to European tanneries was a thriving industry but one which declined with increasing labour and shipping costs, and with competition from synthetic tanning agents.

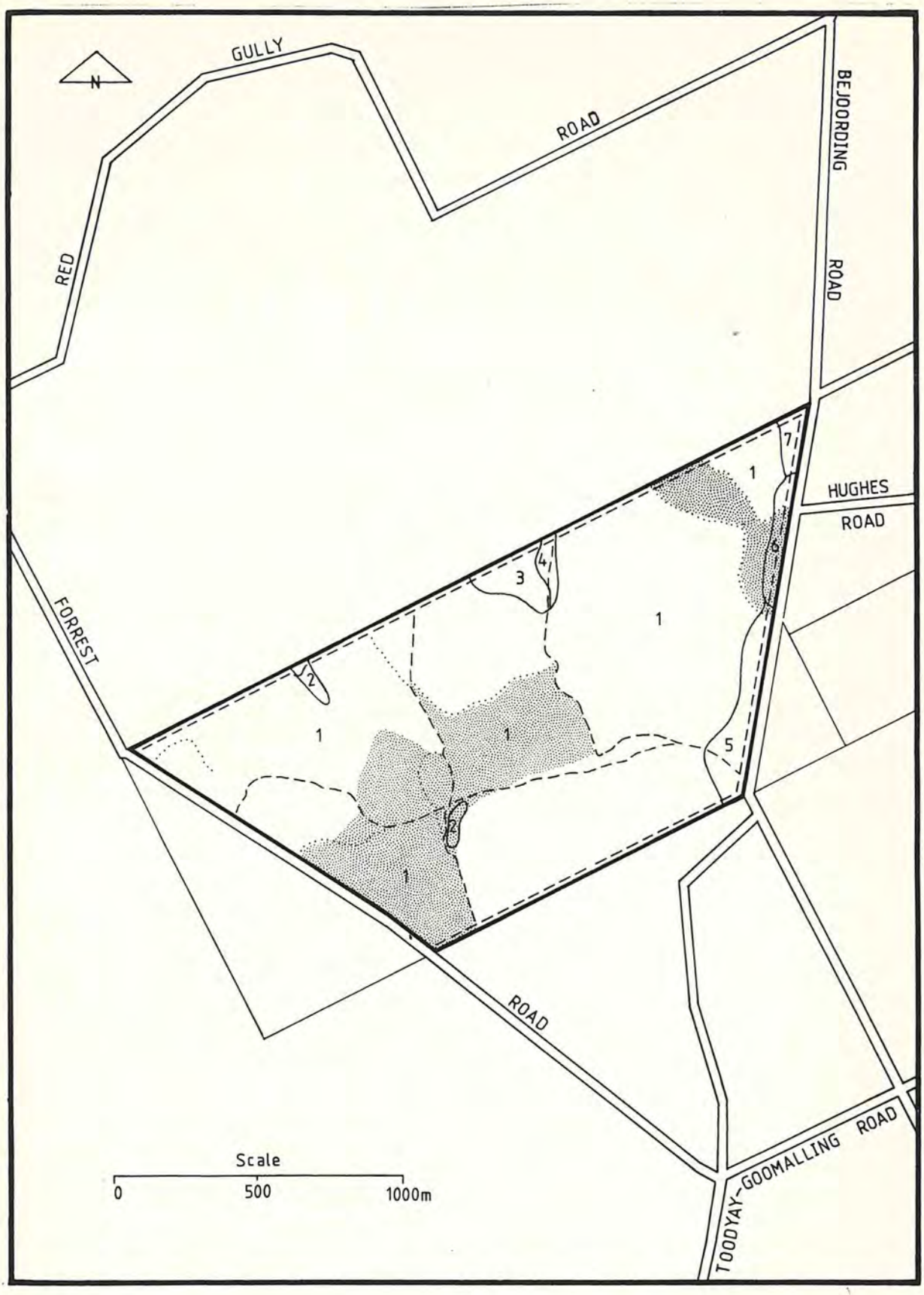


Figure 19. Wongamine Nature Reserve showing its relationship with surrounding lands, firebreaks and tracks (dashed lines) and vegetation formations (identified by numbers, and described in the associated text).

In 1974 the Toodyay Naturalists' Club recommended that the purpose of the Wongamine Reserve be again amended. In doing so the Club pointed out the substantial conservation values of Wongamine:

"(1) It is the most eastward undeveloped area of laterite country in the Shire.

(2) No similar country exists in the adjacent Goomalling Shire, and it is the last example of this class of country existing within the surrounding York Gum/Jam belt between Bolgart and York in this particular rainfall zone.

(3) It is totally surrounded by developed farmland and is large and diverse enough to serve as a fairly complete ecological unit capable of retaining its present flora and fauna."

After consultation between the Department of Lands and Surveys, the Forests Department and the Department of Fisheries and Wildlife, the portion of land west of Forrest Road (Fig. 19), was excised to become the present day, neighbouring gravel reserve. On 31 October 1975 the remaining and greater part became Wongamine Nature Reserve and was vested in WAWA.

Like a number of other nature reserves in the Shire of Toodyay, Wongamine achieved its status as a nature reserve by living out its usefulness for other purposes. Both the goldrush and the tanning industries are a part of history, but the values of Wongamine as a conservation area remain as an unexpected legacy of both.

3. SOILS AND VEGETATION

The soils vary from laterite based loams and sandy clays on the plateau surface to reddish loams on the valley slopes and broad valley bottoms. Pockets of whitish and yellow sands occur primarily near the central part of the northern boundary. With the exception of the sands, which form a fairly distinct lens of aeolian origin, soil types grade into one another, so forming a catena of soils from the plateau surface to the gully floors.

As the pattern of vegetation closely follows that of the soils, vegetation formations also tend to overlap, components of one merging with those of the next. Generally however, the laterite based loams and sandy clays support Wandoo woodlands, the predominant vegetation on the reserve, and reddish loams carry Salmon and York Gum formations. The pockets of whitish and yellow sands support Banksia woodland and heaths.

Seven vegetation associations have been recognised. These are distributed as shown in Figure 19 and are described as follows:

1. Variable WOODLAND/OPEN WOODLAND dominated by Wandoo (Eucalyptus wandoo), 15-20 m in height, with Powderbark (Eucalyptus accedens) forming an important component on ridges and breakaways. The understorey is extremely variable and ranges from LOW SCRUB A to DENSE HEATH A and THICKET. Common understorey species include Leptospermum erubescens, Parrot Bush (Dryandra sessilis), Pingle (D. carduacea), Couch Honeypot (D. nivea), Blackboys (Xanthorrhoea preissii), Prickly Poison (Gastrolobium spinosum), Hakea trifurcata, H. incrassata, Silky-leaved Blood Flower (Calothamnus sanguineus), Tamma (Allocasuarina campestris), Graceful Honeymyrtle (Melaleuca radula) and Rough Honeymyrtle (Melaluca scabra). In some parts of this association young Wandoo forms OPEN LOW WOODLAND A.

2. LOW WOODLAND A of Brown Mallet (Eucalyptus astringens), 10-14 m in height, over a LOW SCRUB B of Bullock Poison (Gastrolobium trilobium). This formation is restricted to breakaway slopes and occurs in two associations of limited extent.

   Although most of Wongamine carries woodlands, sandplain heathlands extend into the reserve from the northern boundary, following the extent of a lens of aeolian sands more characteristic of the Bolgart River catchment to the north-east than of the peneplain surface which most of Wongamine represents.

   Of the two heathland types the first (3) occurs on yellow sands and the second (4) on white sands.

3. HEATH B/LOW SCRUB B of One-sided Bottlebush (Calothamnus quadrifidus) over clumps of LOW SEDGES on yellow sand. Scattered examples of Drummond's Gum (Eucalyptus drummondii) are emergent around the periphery. Where the sandplain extends into uncleared private land Mottlecah (Eucalyptus macrocarpa) is common, growing to approximately 4 m in height.

4. Scattered Christmas Tree (Nuytsia floribunda) and Slender Banksia (Banksia attenuata), 4-5 m, are emergent over Leptospermum erubescens THICKET/SCRUB, 2-4 m in height, on white sand. The understorey is a HEATH A/B rich in species, including Smokebush (Conospermum stoechadis), One-sided Bottlebrush, Scrub Sheoak (Allocasuarina humilis), Hakea ruscifolia, Adenanthos cygnorum, Blueboy (Stirlingia latifolia) and Verticordia sp.

5. OPEN WOODLAND of Salmon Gum (E. salmonophloia), 20-26 m in height, over patches of regenerating Salmon Gum OPEN LOW WOODLAND A, 8-15 m in height. Wandoo and York Gum (E. loxophleba) are present as minor components and the understorey is sparse.

6. LOW WOODLAND A/OPEN LOW WOODLAND A of York Gum/Wandoo to 15 m over Jam (Acacia acuminata), 4-6 m in height, over LOW SCRUB B and LOW GRASS.

7. OPEN LOW WOODLAND A of Wandoo, over a LOW WOODLAND B of Sheoak (Allocasuarina huegeliana). Beneath this woodland there is a sparse understorey of Parrot Bush and Prickly Poison.

The Toodyay Naturalists' Club has recorded 103 plant species on the reserve, of which 20 were orchids (App. VII).

4. FAUNA

Knowledge of the fauna of Wongamine also comes principally from the Toodyay Naturalists' Club, its members having recorded 62 bird species on the reserve (App. III). Wongamine is a zone of transition for fauna as well as flora, containing bird species representative of both the eastern and western parts of the Shire. Birds such as the White-backed Swallow, Yellow-throated Miner and White-fronted Honeyeater are usually only found in the east, while the White-tailed Black Cockatoo, Western Yellow Robin and White-naped Honeyeater are representative of habitats in the west. All of these occur on the reserve. In addition Wongamine provides habitat for five migrant birds, the Pallid Cuckoo, Bronze Cuckoo, White-winged Triller, Rufous Songlark and Brown Songlark.

Sight records of mammals and reptiles, and the results of a limited trapping programme, carried out as part of the surveys leading to preparation of this plan, have established a baseline of information on the occurrence of fauna on the reserve. The Euro (Macropus robustus) and the Western Grey Kangaroo (M. fuliginosus), plus exotic species such as rabbits and foxes, are frequently seen on Wongamine, and the House Mouse (Mus musculus) has been trapped on the reserve. Six species of reptile were also caught during the trapping programme: Common Scaly-foot (Pygopus lepidopodus), three skinks (Morethia obscura, Menetia greyii and Egernia multiscutata bos) a legless lizard (Delma grayii) and the Wood Gecko (Diplodactylus granariensis).

Also of interest on Wongamine is the presence of a species of trapdoor spider, found in the Wheatbelt, of the tribe Aganippine. Its classification is currently under revision and it is likely that Wongamine will be established as the type locality for this species (B. York Main, pers. comm., 1982).

5. PAST MANAGEMENT, USE AND FIRE HISTORY

In the past Wongamine has been used for a variety of purposes. Although some tree felling occurred during its time as a timber reserve,the impact of this past use appears to have been minimal. In the 1960s and 1970s

there was a spate of rubbish dumping but this was largely alleviated by the joint action of the Shire Council and the Toodyay Naturalists' Club. Trail-bike riding emerged as a problem in the mid 1970s but declined following declaration of the nature reserve.

Small parts of the reserve have also been utilised as sources of gravel, and excavations near the eastern corner and along the Forrest Road frontage are still visible. There are numerous gravel tracks in the area. These originated as a result of past use and have been maintained by the ease of vehicular access onto the reserve from roads on the eastern and western boundaries.

A registered apiary site is located in the north-western corner of the reserve and it is used by a local resident to support a small number of hives.

In 1980 two fires occurred on the reserve. Both escaped from adjoining farmland, the first from a clearing burn, the second from a stubble fire. Their extent is indicated by the areas in Figure 19. Prevailing weather conditions necessitated the use of bulldozers as well as conventional fire fighting techniques in their control, which added to the network of tracks on the reserve. Subsequent to the 1980 fire the Department upgraded the existing system of firebreaks and widened the northern boundary break to 12 m where the reserve borders on uncleared land.

6. NATURE CONSERVATION VALUES

Wongamine Nature Reserve is the only conservation area in the eastern part of Toodyay Shire. It illustrates the transition from the Wandoo dominated woodlands, which characterise the Hills Region of the central part of the Shire, to Salmon Gum and York Gum dominated communities, which are more typical of woodlands of the wheatbelt areas of the State. Botanically the area is very rich and the diversity of the flora of Wongamine is increased by the sandplain heathlands near the northern boundary.

The isolation of the reserve among farmland makes it important as a fauna refuge. It is suitable as a habitat for kangaroos, small mammals and a large number of bird species that might otherwise be absent from this part of the Shire.

The diversity of its flora and the representation of a number of wheatbelt vegetation formations combine with its value as a habitat for fauna and its size and compact shape to give a firm basis to recognition of Wongamine as a 'Key Site - Ecosystem Management' in the nature reserve system.

B. PLAN FOR MANAGEMENT

1. MANAGEMENT OBJECTIVES

Management will be primarily directed towards rehabilitation and maintenance of the conservation values of the reserve, including the continued control of exploitive and damaging use. Facilitation of uses and research appropriate to a nature reserve are objectives of second priority.

Active management is expected to be required in the following fields during the course of operation of this plan:

Protection from Fire

To protect the assets of adjacent landholders and the natural values of the reserve. To minimise the occurrence of wild fires on the reserve and to suppress such wild fires as may occur.

Protection from Pests : Animal and Weed Control

To protect the reserve and the surrounding land from plant and animal pests; this need is covered under the provisions of the Agriculture and Related Resources Protection Act.

Public Use and Research

To continue to encourage the use of Wongamine for passive activities such as wildflower photography and birdwatching, and for non-destructive research projects; with all public use remaining of secondary importance to the maintenance of the nature conservation values of the area. The reserve has a long history of public use which has recently been brought under effective control by an informal management program, largely initiated by the Toodyay Naturalists' Club, and carried out by the Department of Fisheries and Wildlife.

Rehabilitation and Maintenance of the Natural Environment

To restore areas degraded by gravel extraction, to close and revegetate many tracks and to ensure that rubbish overlooked during earlier collections is removed or buried.

2. FIRE PROTECTION

Fire protection measures will include the maintenance of the peripheral and internal firebreaks, the regular monitoring of fuel levels and a provision for close consultation between the Department, neighbouring landholders and the Local Authority concerning fire control.

Rationale

Wongamine Nature Reserve is an isolated pocket of bushland in a largely cleared area of farmland. One major potential source of fire, from escape of clearing burns on adjoining property, has therefore been minimised in the Wongamine area. Given continuation of a high level of neighbour understanding of the need for care in control of fire, in the course of normal farm management operations, the risk of fire escaping onto the reserve is minimised. In addition, by virtue of the excellent accessibility by road, fire suppression is greatly facilitated. This combination of factors provides an excellent opportunity to exercise a programme of conservative fire protection management pending accumulation of better knowledge of woodland fire regimes than is presently available. The programme will be based on the following provisions:

Firebreaks to be Maintained

All existing peripheral breaks will be regularly maintained to ensure they remain free of vegetation and for access in case of fire. Internal breaks shown in Figure 11 will be maintained, primarily as access routes and fire lines. The northern peripheral break will be maintained at a width of 12 m, the remaining boundary breaks at 6 m and the internal access breaks at widths of 3 m.

Fire Suppression

Fire fighting units from the Department of Fisheries and Wildlife at Wanneroo will attend whenever possible (subject to the limitations of personnel and equipment) fires occurring on, or considered to be threatening, the reserve.

Protective burning

The combination of the recent fires (in 1980) and naturally sparse cover of Wandoo woodlands, the dominant vegetation, combine to present low fuel levels at the time of writing this Plan. During the course of its currency, however, fuel levels will be periodically monitored and close liaison maintained with the Local Authority and Bush Fire Control Officers to ensure they remain within accepted, safe limits. Provision is retained in this Plan for prescribed burning for fuel control purposes.

Adequacy of Control Measures

In this respect special attention will be paid to the feelings of reserve neighbours and to establishing and maintaining effective contact with neighbours. This plan includes the formal provision for reserve neighbours to draw the attention of the Director of Fisheries and Wildlife to considered inadequacies in fire protection arrangements for the reserve. On receiving such comments

a joint inspection will be arranged by the Department and any necessary further action taken.

Notifiable Authority

The Department of Fisheries and Wildlife shall be regarded as a Notifiable Authority in terms of the Bushfires Act and Regulations in respect of Wongamine Nature Reserve.

3. PROTECTION FROM PESTS : ANIMAL AND WEED CONTROL

Control of pest animals and plants may be necessary from time to time to protect fauna and flora, and the general reserve environment, and as part of the organised control of vertebrate pests and weeds in the surrounding farmland. Where organised pest control is necessary arrangements will be made by consultation and co-operation between the Agriculture Protection Board and the Department of Fisheries and Wildlife.

Adequacy of control measures

Similarly to fire protection, landholders adjacent to the reserve are invited to comment on what they feel are the inadequacies in the above policies regarding pest control. On receiving such comments the Director will take suitable action to remedy the situation.

4. REHABILITATION AND MAINTENANCE OF THE NATURAL ENVIRONMENT.

Gravel pits to be rehabilitated

The surface of gravel pits near the eastern corner of the reserve and along the Forrest Road boundary will be ripped to encourage re-establishment of vegetation. Tracks associated with these pits will be allowed to fall into disuse. Local community groups will be encouraged to initiate programmes aimed at re-establishment of naturally occurring species of local origin in these areas.

Closure of tracks

Tracks on the reserve not required for fire access purposes will not be maintained as vehicle routes, such steps as may be necessary being taken to close them off, so permitting gradual regeneration of the vegetation.

Rubbish

Most of the rubbish dumped on the reserve during the earlier period of its history has been progressively buried or removed during the last several years. That remaining will also be removed and further management will be directed toward minimising mis-use of this kind.

Fencing and Access

In further support of the rehabilitation programme this Plan will provide for fences to be erected along the

Forrest and Beejording Road boundaries of the reserve to delineate the LIMITED ACCESS AREA.

5. PUBLIC USE

Wongamine has a long history of use for a variety of purposes consistent with its status as a nature reserve which also is based on its accessibility and pleasant woodland environment. It is near one end of the spectrum of nature reserves in the Shire in terms of the general suitability for use, while the variety of its vegetation, flora and fauna ensure its interest, and the system of internal firebreaks and tracks provide ready access to visitors. Conservation of natural values is the primary objective of management but provision will be made in this Plan for appropriate use of the area by the public.

Facilities to be provided

Facilities for car parking and for access to the reserve by pedestrian visitors (gates and stiles), plus interpretive facilities, will be provided. As is the general practice on nature reserves in this State there will be no provision for other facilities of a primarily recreational nature.

Access Classification

Most of the recent mis-use of Wongamine has been a continuation or extension of long established practices abetted by the accessibility of the reserve by road. Primarily as a means of support to rehabilitation programmes, past and projected, by Departmental and volunteer groups, provision shall be made in this Plan for the classification of Wongamine as a LIMITED ACCESS AREA.

Signs

Signs identifying the reserve by name and complying to the Signs Standard of the Department of Fisheries and Wildlife will be erected at strategic points on the reserve. Other signs denoting limitations to access and such other advice as may be deemed to be necessary in the course of management operations will also be placed on the reserve.

6. RESEARCH

Further to the general measures in facilitation of public use of the reserve, specific provision is made in this Plan for the encouragement of research relevant to the management of woodland nature reserves. As the implementation of experimental or other research programs involving manipulation of wildlife or of the natural environment requires authorisation under the Wildlife Conservation Act and Regulations it will be subject to Departmental agreement on objectives and methods used.

7. MANAGEMENT - GENERAL

During the currency of this Plan the Department of Fisheries and Wildlife may, with the approval of the Chairman of WAWA, undertake or authorise such other work or action as may be seen to be necessary or desirable to properly promote the stated objective of management of the reserve.

PART 9 : GENERAL CONSIDERATIONS

A. THE TOODYAY NATURE RESERVES

Table 3 summarises the biophysical attributes and management prescriptions for the nature reserves of Toodyay Shire. Together these reserves contain representative samples of the majority of habitats in the region, from the Jarrah/Marri dominated western plateau (Moondyne), through the York Gum/Jam fluvial lowlands (Bewmalling) to the Salmon Gum woodlands of the eastern parts of the Shire (Wongamine). Of particular interest in the Shire is the inclusion within the nature reserve system, of habitats influenced by man (Wattening) or, with man-made features of historical importance (Bewmalling), which adds further to the diversity of the Toodyay nature reserve system.

Although 5 of the 9 nature reserves in the Shire of Toodyay are less than 100 ha, their value as representative samples of habitat, and as suitable habitat for birds, reptiles, small mammals and invertebrates, is inestimable. The individual reserves, as islands in the midst of a cleared agricultural landscape, provide nesting sites, shelter and food for a variety of resident bird species, particularly those that utilise the interface between woodland and crop or pasture. Refuge is also provided, by the reserves, for a number of species of frog, snake and lizard, and for numerous invertebrates. Several small marsupials such as the Common Dunnart (S. murina) and Western Pygmy-possum (C. concinna) are also known to use these small reserves.

All the reserves, regardless of their size, also provide refuge for kangaroos, and for migratory and transitory bird species.

B. MANAGEMENT STRATEGY

In general the management of nature reserves in Western Australia is conservative and aims to maintain and enhance the conservation values of the areas involved. Therefore management aims to minimise interference with natural processes.

In the Toodyay system of reserves a similar conservative strategy will be implemented, which will include a recognition of the differing, but equally important, conservation values of minimally disturbed habitats (Moondyne) and man-modified habitats (Wattening and Beelaring). An integral part of this strategy is the maintenance and enhancement of the conservation values inherent to the diverse habitats included in the Toodyay system.

Fire Protection

The active implementation over the last five years of fire protection measures on the Toodyay nature reserves, has resulted in the establishment of a comprehensive system of firebreaks.

Research

Successful management of a natural area directed towards the enhancement of its conservation values must be based on a detailed knowledge of the individiual habitats concerned. Research provides much of this knowledge.

Several observational research projects have been carried out on nature reserves within the Shire; the Toodyay Naturalists' Club being a primary force in this field. Experimental research, which involves manipulation of flora and fauna, may also be pursued, but only if permission is granted by the Department of Fisheries and Wildlife. Both of these forms of research will provide a firmer basis apon which management decisions can be made. An important, integral part of research is monitoring, and a program of monitoring will be implemented as part of this plan.

Public Use

Moondyne, Goonaring, Rugged Hills and Wongamine Nature Reserves by virtue of their accessibility and the range of habitats represented between them, are most suited for interpretive purposes. This group, as part of the Toodyay system of nature reserves, will be the subject of an interpretive program which will highlight the biological, physical, historical and cultural values of the reserves. This program complements the value of the remaining five reserves for low key interpretive uses such as photography and bird observation.

In all cases public use will remain of secondary importance to the primary purpose of the area, that of nature conservation.

TABLE 3. SUMMARY OF THE NATURE RESERVES OF THE SHIRE OF TOODYAY

Reserve No.	Reserve Name	Area (ha)	Geomorphic Zone	Dominant tree species	Nature reserve status	Access Classification
A30191	Moondyne	1991.1	Darling Scarp	Jarrah, Marri, Powderbark, Wandoo	Key Site Ecosystem Management	LIMITED ACCESS
529	Beelaring	39.9	Darling Scarp	Jarrah, Marri, Swan River Blackbutt, Flooded Gum Paperbark	Key Site-Ecosystem Management	LIMITED ACCESS
659	Goonaring	52.6				
21429	Rugged Hills	252.0	Hills Region	Wandoo, Marri, Powderbark, Brown Mallet	Key Site-Ecosystem Management	LIMITED ACCESS
19900	Poison Gully	87.2	Hills Region	Wandoo, Marri, Powderbark, Brown Mallet	Wildlife Refuge	LIMITED ACCESS
22096	Flat Rock Gully	386.1	Hills Region	Wandoo, Marri, Powderbark, Brown Mallet	Key Site-Ecosystem Management	LIMITED ACCESS
30306	Bewmalling	39.2	Avon Valley/ Plain	York Gum/Jam	Key Site-Ecosystem Management	LIMITED ACCESS
2393	Wattening	40.5	Avon Valley/ Plain	York Gum/Jam	Wildlife Refuge	LIMITED ACCESS
33697	Wongamine	212.9	Eastern remanant of lateritic plateau	Wandoo, Salmon Gum, York Gum, Powderbark	Key Site-Ecosystem Management	LIMITED ACCESS

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APPENDIX I: STRUCTURAL VEGETATION CATEGORIES

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	DENSE 70-100%	MID-DENSE 30-70%	SPARSE 10-30%	VERY SPARSE 2-10%
Trees>30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland
Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
Trees<5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
Mallee Tree Form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee Shrub Form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Malle	Very Open Shrub Mallee
Shrubs>2m	Dense Thicket	Thicket	Scrub	Open Scrub
Shrubs 1.5-2.0m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
Shrubs 1.0-1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
Shrubs 0.5-1.0m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
Shrubs <0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
Mat Plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
Hummock Grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
Bunch Grass>0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
Bunch Grass<0.5m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
Sedges>0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
Sedges<0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, Liverwort	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

APPENDIX II. THE HISTORY OF LAND USE IN THE SHIRE OF TOODYAY

Present land use in the Shire of Toodyay is a function of socioeconomic conditions, past land use and the long history of agricultural settlement in the area. The history of Toodyay township and of the nine nature reserves in the Shire forms an integral part of the history of agricultural development within the Shire. Therefore, to understand present day land use patterns and practices, it is necessary to explore agricultural development in the Toodyay area from the first years of settlement.

1836-1860 : Pastoralists and smallholders

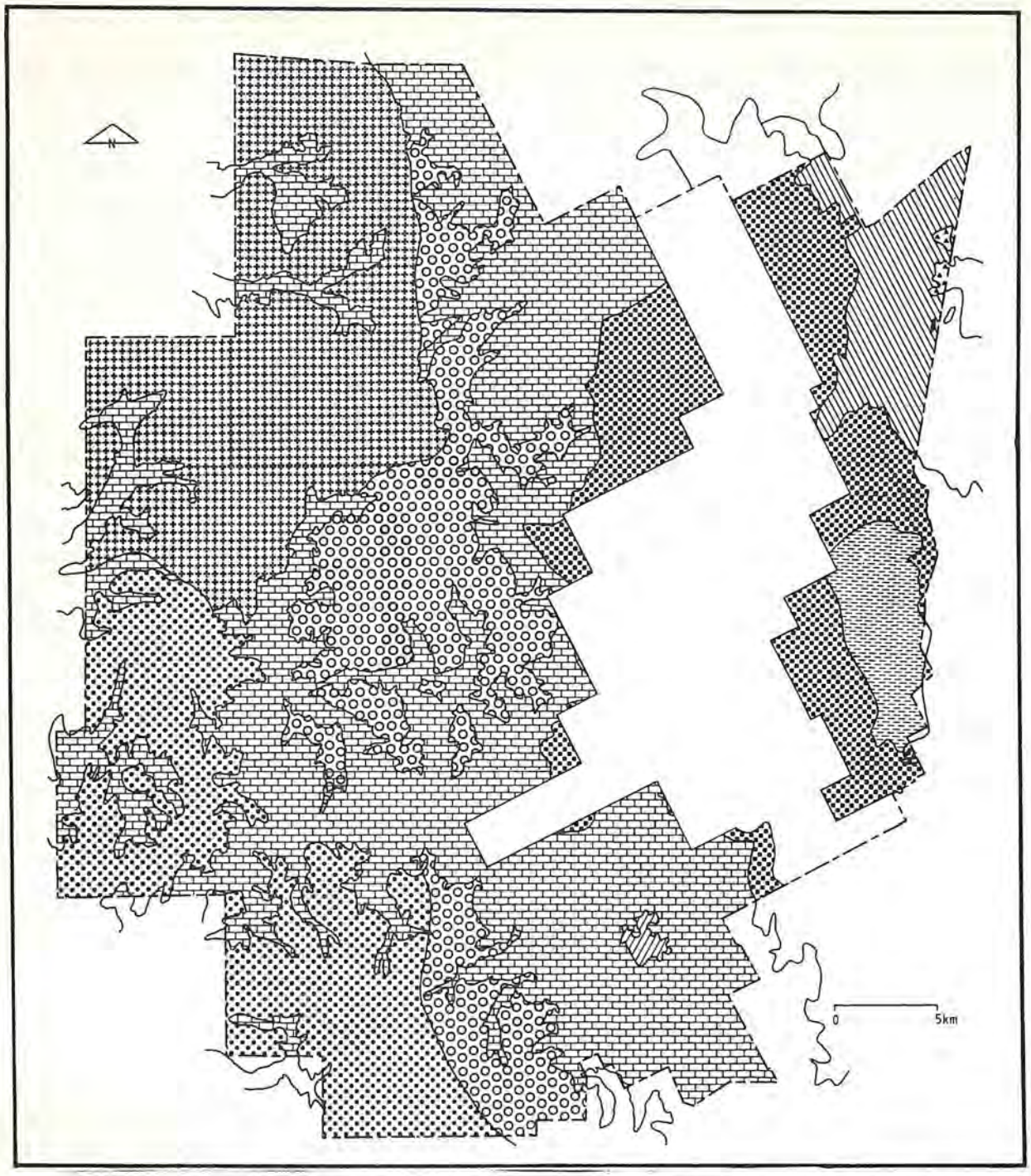
The rich Toodyay valley was discovered in 1831 and the first land grants were taken up in 1836. Figure 3 indicates the original pattern of vegetation. By the end of 1836 one third of the Toodyay valley had been selected.

These first grants followed the course of the Toodyay Brook and its immediate catchment area. The extent of the first land releases is shown in Figure 20. This initial selection was almost wholly of areas of York Gum woodland, a vegetation association noted by the early settlers for its lush native grasses and availability of water. These qualities made it prime pastoral land, suitable for grazing large flocks of sheep. Selection of these grants was accompanied by the declaration of the townsites of Toodyay and Bejoording.

Very little land was released for development over the period 1841-1860 (Fig. 21), due to poor roads and the resultant slow travel combined with labour shortages and the 1840s depression in the colony. The land releases during this time were scattered through the Marri/Wandoo vegetation, with some in the York Gum woodland. A settlement originating from a cluster of small land holdings was established around Wattening Springs.

During the 1850s wealthy squatters consolidated their large holdings, while new land development was characterised by the establishment of small farms of 10 to 20 acres. These centred on good stock watering points, either springs or pools on the creeks which flow to the Toodyay Brook and Avon River. The farms were clustered in small communities, usually along existing roads (Erickson, 1974, p. 144). Some were on small areas leased from large landowners, but more than 70 locations of less than 20 acres were bought from the Crown. The demand for such allotments was high among labourers and Ticket of Leave men, and only a dozen or so were secured by pastoralists as stock watering places.

The introduction of grazing leases in 1847 directly contributed to the pattern of extensive pastoral holdings interspersed with occasional clusters of small holdings. The terms of these pastoral leases were such that the land could not to be cultivated, and generally the landholder purchased 10 to 60 acres around the homestead for crops and dairy cattle. This contributed further to the development of a pattern of small enclosed fields centred on homesteads, and surrounded by tracts



Wandoo, York Gum and Salmon Gum woodland

York Gum woodland

Jarrah, Marri and Wandoo woodland

Jarrah and Wandoo woodland

Marri and Wandoo woodland

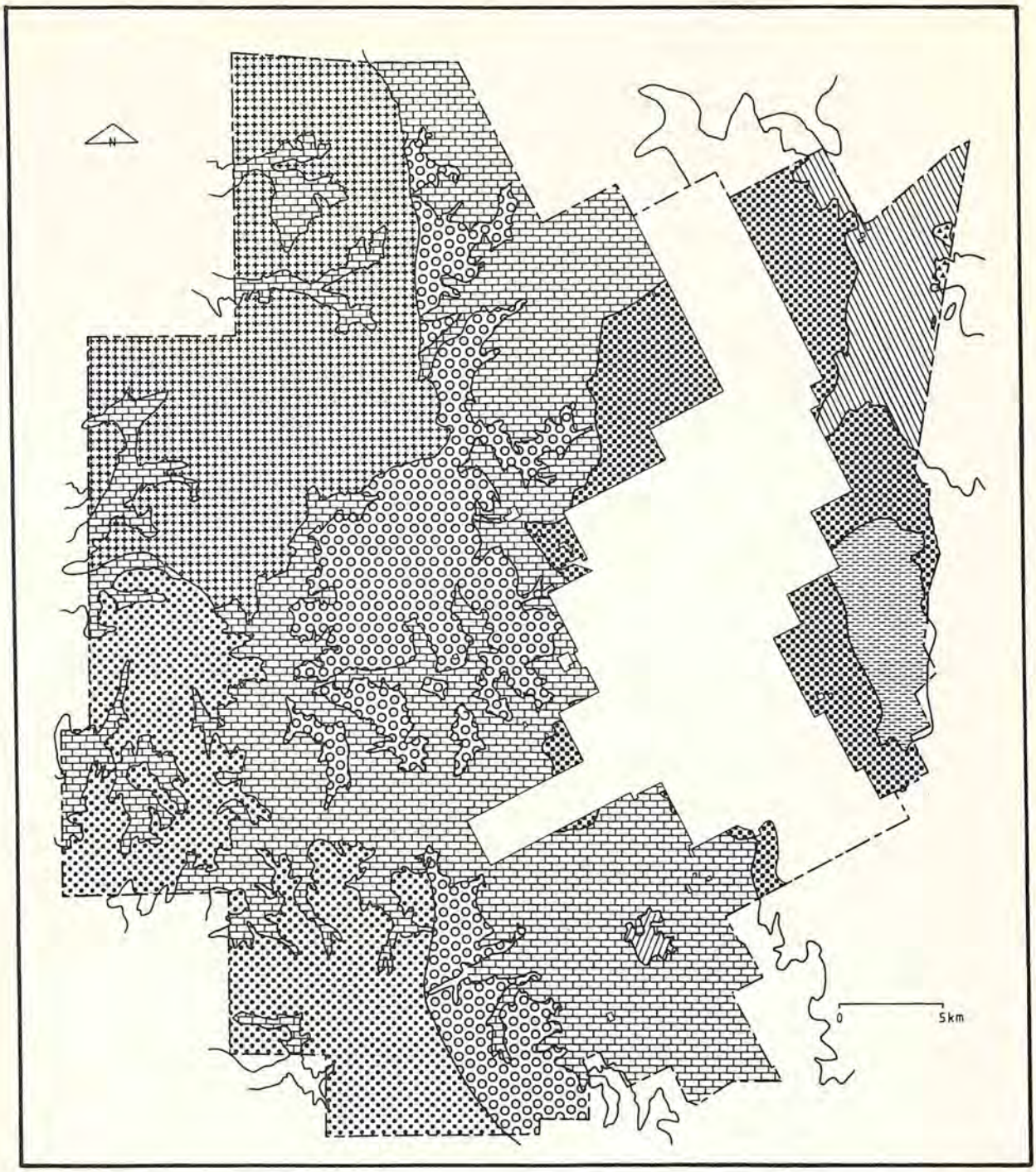
Jarrah, Wandoo and Powderbark woodland

Jarrah/Marri forest

Scrub/Heath sandplain

Wandoo woodland

Figure 20. Land releases in the Shire of Toodyay: 1831-1840.



Wandoo, York Gum and Salmon Gum woodland

York Gum woodland

Jarrah, Marri and Wandoo woodland

Jarrah and Wandoo woodland

Marri and Wandoo woodland

Jarrah, Wandoo and Powderbark woodland

Jarrah/Marri forest

Scrub/Heath sandplain

Wandoo woodland

Figure 21. Land releases in the Shire of Toodyay: 1841-1860.

of open uncleared bushland, used for grazing; a pattern which was to be a continuing feature of land use in the Shire for much of the nineteenth century.

As the 1850s progressed, the future of parts of the region for cropping became apparent. Encouraged by the needs of the convict establishments, progressive farmers planted fields of 50 and more acres of wheat. (Erickson, 1974, p. 160). However, there was still very little land that had been cleared for this kind of intensive agriculture.

The pastoral industry continued as the major force in new land development. In 1854 the Toodyay, Northam and Victoria Plains Agricultural Society was formed to encourage northern exploration to discover more pastoral land. This need for new pastoral land was a direct function of heavy grazing of native bushland.

Because of labour shortages and economic depression, alternative sources of income were sought. Sandalwood was cut and exported to China and the near east over the years 1845 to 1847, and this helped the settlers survive a very lean period.

Even in these early decades bushfires presented a major problem and in 1858 the Agricultural Society commented that it was "at a loss to point out a remedy for bushfires".[1]

1861 - 1880 : The beginnings of agriculture

The pattern of land development during the period 1861-1880 was slightly different to that of preceding decades (Fig. 22). Areas of land released increased in size to approximately 40 acre lots and they were situated in the Marri/Wandoo woodland. The settlers selected sites that were near water and had good soils for agriculture. Choice of sites was based on the detailed knowledge of the area gained by the early settlers.

Although pastoral activities continued to predominate there was some further move towards agriculture, which was an expression of a change in the composition of the population. The population of Toodyay district was increasing rapidly as Pensioner Guards and Ticket of Leave convicts came into the area. They were granted or purchased areas of land on which their primary activity was intensive agriculture: growing vegetables, hay, grains and fruit. Wheat, in particular, became important as the need for flour to provide bread for the growing population increased. Cultivation was usually confined to the fertile flats beside the river and brooks.

Land regulations introduced by Fraser in 1872 and 1875 cancelled several big pastoral leases in the vicinity of settled areas. The resumed land was surveyed into agricultural blocks and thrown open for selection as Special Occupation

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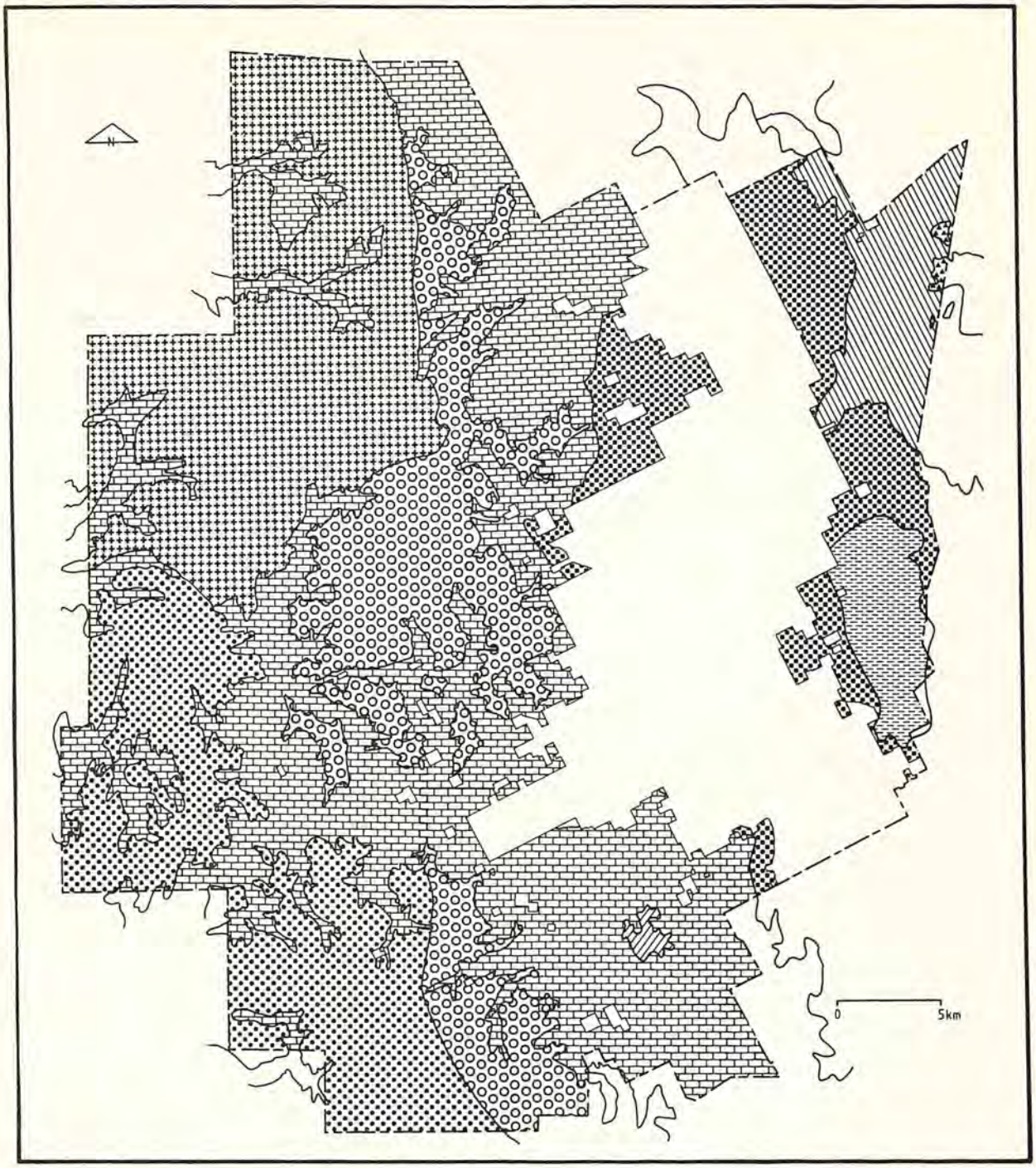
[1]Toodyay, Northam and Victoria Plains Agric. Soc. Minutes, 1 Nov. 1859, WAA 627A.



Wandoo, York Gum and Salmon Gum woodland

York Gum woodland

Jarrah, Marri and Wandoo woodland

Jarrah and Wandoo woodland

Marri and Wandoo woodland

Jarrah, Wandoo and Powderbark woodland

Jarrah/Marri forest

Scrub/Heath sandplain

Wandoo woodland

Figure 22. Land releases in the Shire of Toodyay: 1861-1880.

Leases.[2] Extensive areas of the large tracts granted in 1836 were cleared for grain crops and stock feed and the displaced flocks of sheep were moved to pastoral leases to the north and north-east of the Shire. Flocks of sheep were also run on large leases encompassing Marri/Wandoo woodland and Jarrah/Wandoo/Powderbark woodland. Shepherds were employed to care for the flocks and it was not until the late 1870s that fencing wire and iron posts came into general use.

The Toodyay district was rapidly becoming an established agricultural area. The townsite of Newcastle was officially gazetted in 1861, following continued flooding of old Toodyay. It is ironic that the lack of adequate water was to remain a handicap to Newcastle's further growth for many years (Erickson, 1974, p. 323). Finally, in 1877, Newcastle was granted municipal status.

1881 - 1900 : Consolidation of agriculture and the emergence of Crown reserves

Over the decades 1881-1900 extensive areas of land were released (Fig. 23) and land clearing activity increased. A large proportion of the land released in the Toodyay Shire over this period resulted from negotiations between the Midland Railway Company and the Government .[3] Much of the 136 000 acres within the Shire released to the Company had been previously held under pastoral lease by the early settlers. The Company offered to lease back the areas but at significantly higher rates than the Government, an action which delayed the active development of these areas for more than 20 years.

In 1892 the Lands Department increased the size of blocks released to 1 000 acres and this, combined with the Homestead Act[4] and, the Midland Railway Co. grants, resulted in the opening up of substantial new areas.

With the discovery of gold Toodyay became a staging point for the movement of goods and people east to the goldfields. This encouraged the Toodyay settlers to diversify their land use -

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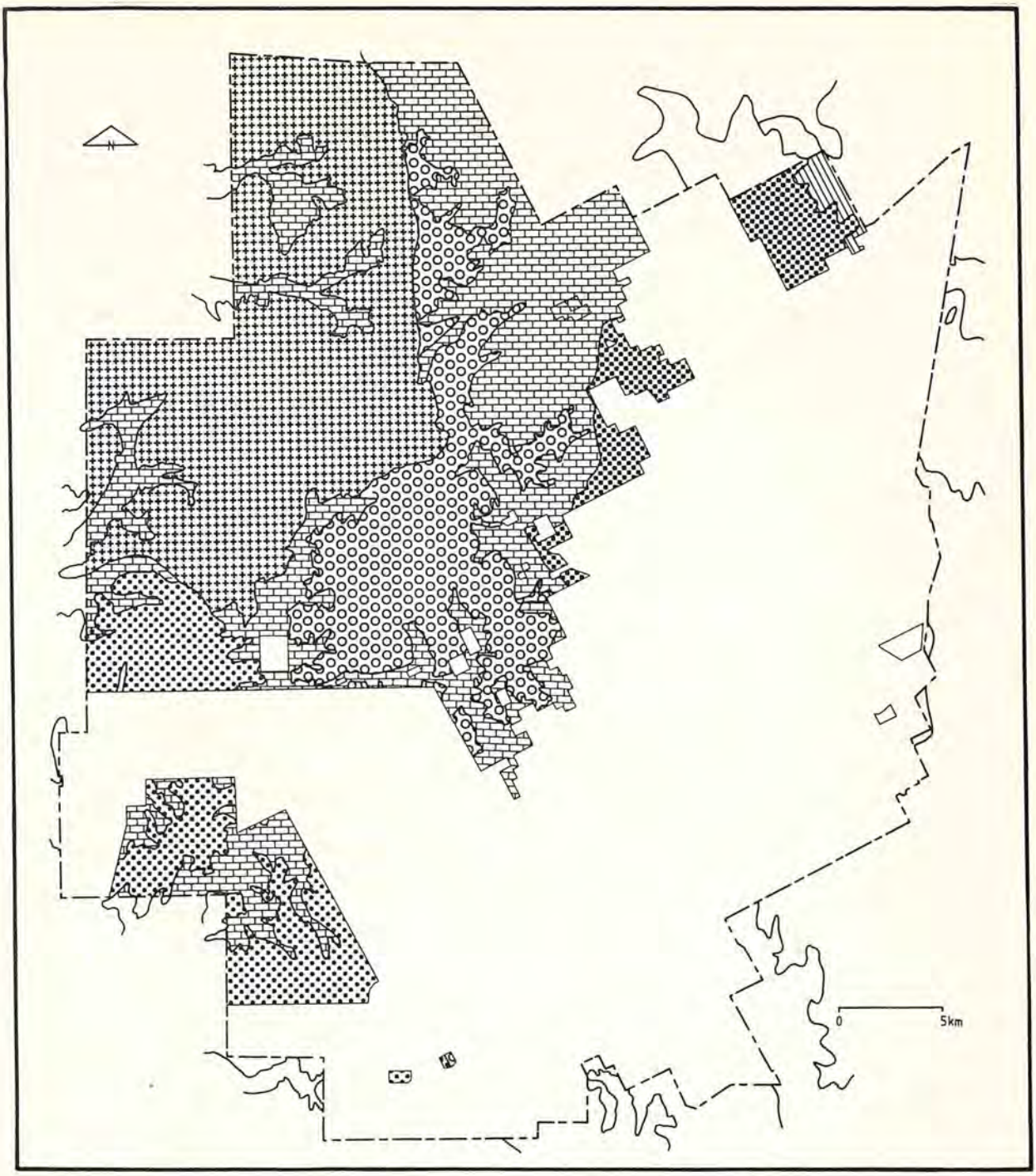
[2] An applicant for a Special Occupation Lease could buy 100 to 500 acres by paying a deposit of 1s.6d per acre and making similar annual payments during the next 10 years. He was obliged to fence the whole block and plant a crop on at least a quarter of the land before he could receive his titles. He could claim commonage on adjacent Crown land where he was permitted to run 4 head of stock for every 100 acres he was purchasing. This stock had to be for milk or meat production and not for wool (Erickson, 1974, p. 252).

[3] In 1883 negotiations resulted in an agreement granting 12 000 acres of land to the Company for every completed mile of the proposed railway line between York and Champion Bay.

[4] The Homestead Act, passed by Forrest's government in 1893, provided that a man under certain conditions of occupation and improvement, would be given up to 160 acres of farmland, and could buy adjacent leasehold on conditional purchase.



Jarrah, Wandoo and Powderbark woodland

Jarrah/Marri forest

Marri and Wandoo woodland

Jarrah, Marri and Wandoo woodland

York Gum woodland

Wandoo woodland

Scrub/Heath on sandplain

Figure 23. Land releases in the Shire of Toodyay: 1881-1900.

sheep were produced for meat as well as wool, pigs were kept for ham bacon and pork production, and cattle were produced in greater numbers than previously.

In response to increasing demand, particularly at the goldfields, the small viticultural industry which had been present in Toodyay since the earliest days of settlement, expanded rapidly both in the area under vines and the amount of dried fruit and wine produced.

In addition to its role as a major producer of wheat, oats, hay and wine, Toodyay, during the final years of the nineteenth century became a major producer of butter, bacon, ham, pickled and salted pork, poultry and eggs.

By 1900 Toodyay had become an established agricultural area. The subdivision of 'Coondle', a property of 8 800 acres, in 1898, and the Norman Estates, in 1900, was the result of an increasing demand for smaller blocks for intensive agriculture. ('Coondle' was divided into 71 blocks, ranging from 15 to 410 acres in size, and Norman Estates was subdivided into 43 lots ranging in size from 100 to 290 acres).

Not only was land use changing in the Toodyay area, but the indigenous products were also being exploited in a different manner. No longer were kangaroos and possums being hunted for meat and furs for domestic use; rather overseas demands for furs in the 1880s saw the settlers begin to supplement their income by exporting possum and kangaroo skin. Large numbers of the farming workforce hunted possum and kangaroo full time, while others became carters to the Yilgarn goldfields. The resultant loss of labour from the farming communities delayed the clearing of land in Toodyay, with a consequent delay until the first decades of the twentieth century in the changeover from pastoral activities to intensive agriculture.

It was also during the decades 1881-1900 that Crown reserves were being set aside for various purposes, predominantly as "Watering and Stopping Places for Teams". These small Crown reserves were, in the main, located on roads leading east. They were established to provide watering and resting facilities for the large number of bullock and horse teams used to haul supplies to the Yilgarn goldfields. Three reserves of the present day nature reserve system, Goonaring, Beelaring and Wongamine, were originally set aside as "Water and Stopping Places". A further two, Bewmalling and Wattening were set aside for the purposes of "Public Utility" and were used for much the same purposes as the "Water and Stopping Place" reserves. However as the latter two reserves were situated on the northern stock route, rather than the more heavily used approach to the eastern goldfields, they were gazetted for the more generalised purpose of public utility. Prior to 1889 the Toodyay Road Board spent £120 on developing these watering points.[5]

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[5]Beelaring was one of the sites chosen for development and the plank lined well is still in good condition, with an ample supply of water through the year (Fig. 8).

1901 - 1940 : Expansion slows down

Erickson (1974) in her history of the Toodyay district, made the following comments about Toodyay's transition from the 19th to 20th century

> '...farming in the old districts of Toodyay and York had reached a limit of development, since the only notable increase in stock was in pigs, while wheat cropping had scarcely improved' (p. 304).
>
> ...'Newcastle entered the 20th century on the crest of a wave of prosperity, but within a few years it became obvious that the rival town of Northam commanded more advantages and Newcastle gradually lapsed into a backwater existence' (p. 350).

Newcastle's name was finally changed back to Toodyay in 1911, as confusion had resulted from an identically named town in N.S.W. and the settlers of the Toodyay district wanted a more localised original name.

Land release over the first two decades of the 20th century involved smaller areas than had been granted previously (Fig. 24). In general, land released over this period was in more difficult terrain, and clearing was much harder. The land was dominated by either Jarrah/Wandoo/Powderbark woodland, or Jarrah/Marri/Wandoo woodland.

The sale of some of the hitherto unused Midland Railway Co. land near Bolgart led to the establishment of a new community around Wattening Springs. This release was responsible for the development of the last remaining large tract of York Gum country.

Established farms continued to be consolidated in their extensive mixed farming regime: one of sheep for wool and fat lamb production, and the cropping of wheat, barley, hay, fruit and vines. The Toodyay district remained the major producer of pickled and salted pork and was still an important producer of bacon, ham, poultry and butter.

In 1901 Crown reserve No. 1296 (now Wongamine Nature Reserve) was gazetted; it was the last of those reserves, which later became part of the present day system of nature reserves in the Shire of Toodyay, to be set aside for the purposes of "Water and Stopping Place". It was used by teams travelling to and from the Yilgarn goldfields.[6]

The last of the major land releases were made during the decades 1921-1940 (Fig. 25). These were mainly areas of Marri/Wandoo woodland. During this period State Forests, covering large tracts of land in the western half of the Shire

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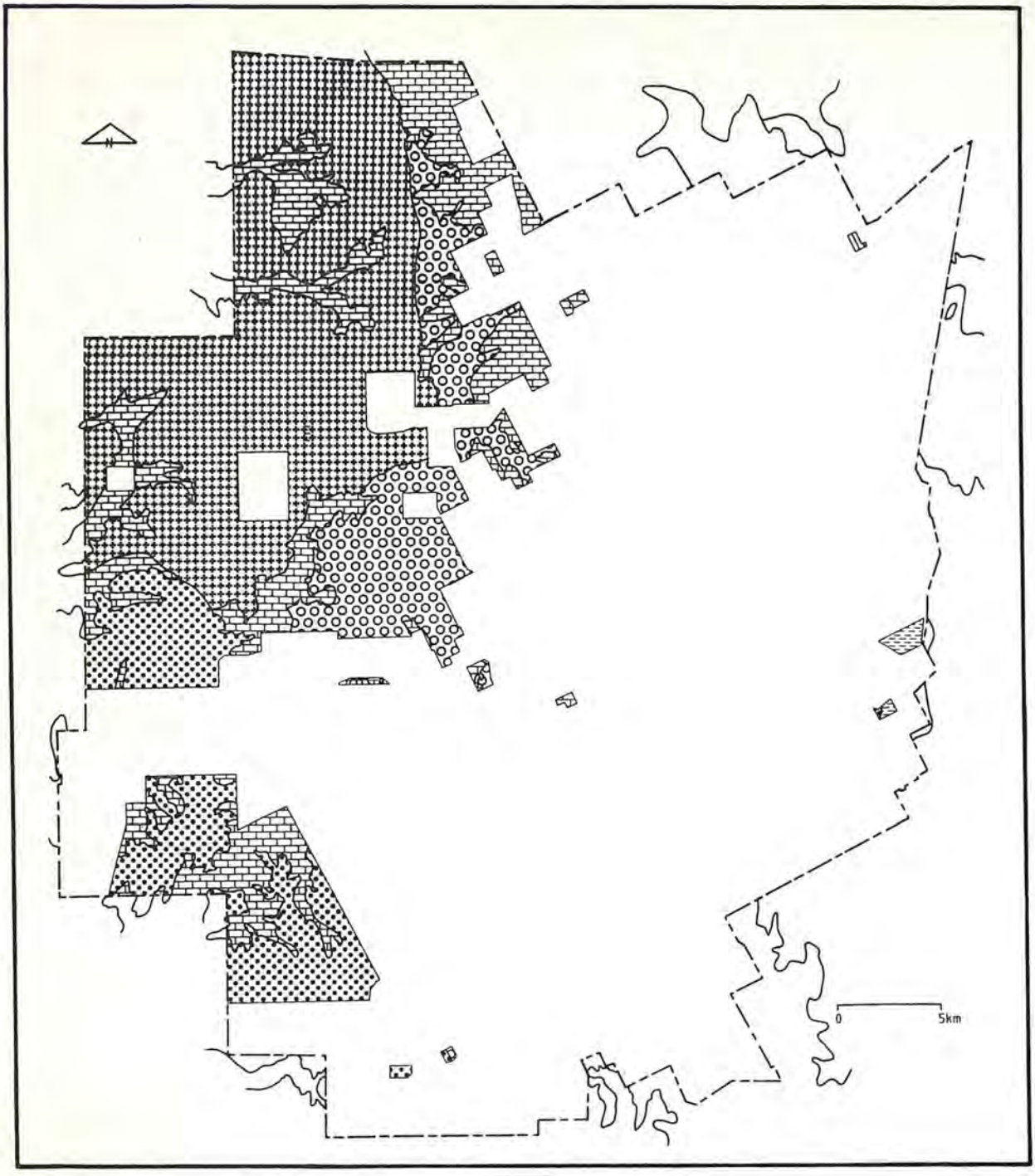
[6]It is interesting to note that this reserve was gazetted in the year in which the goldrush peaked; its proposal was obviously in response to the increased watering needs of the large numbers of travellers moving to and from the goldfields.



Jarrah, Wandoo and Powderbark woodland

Jarrah/Marri forest

Marri and Wandoo woodland

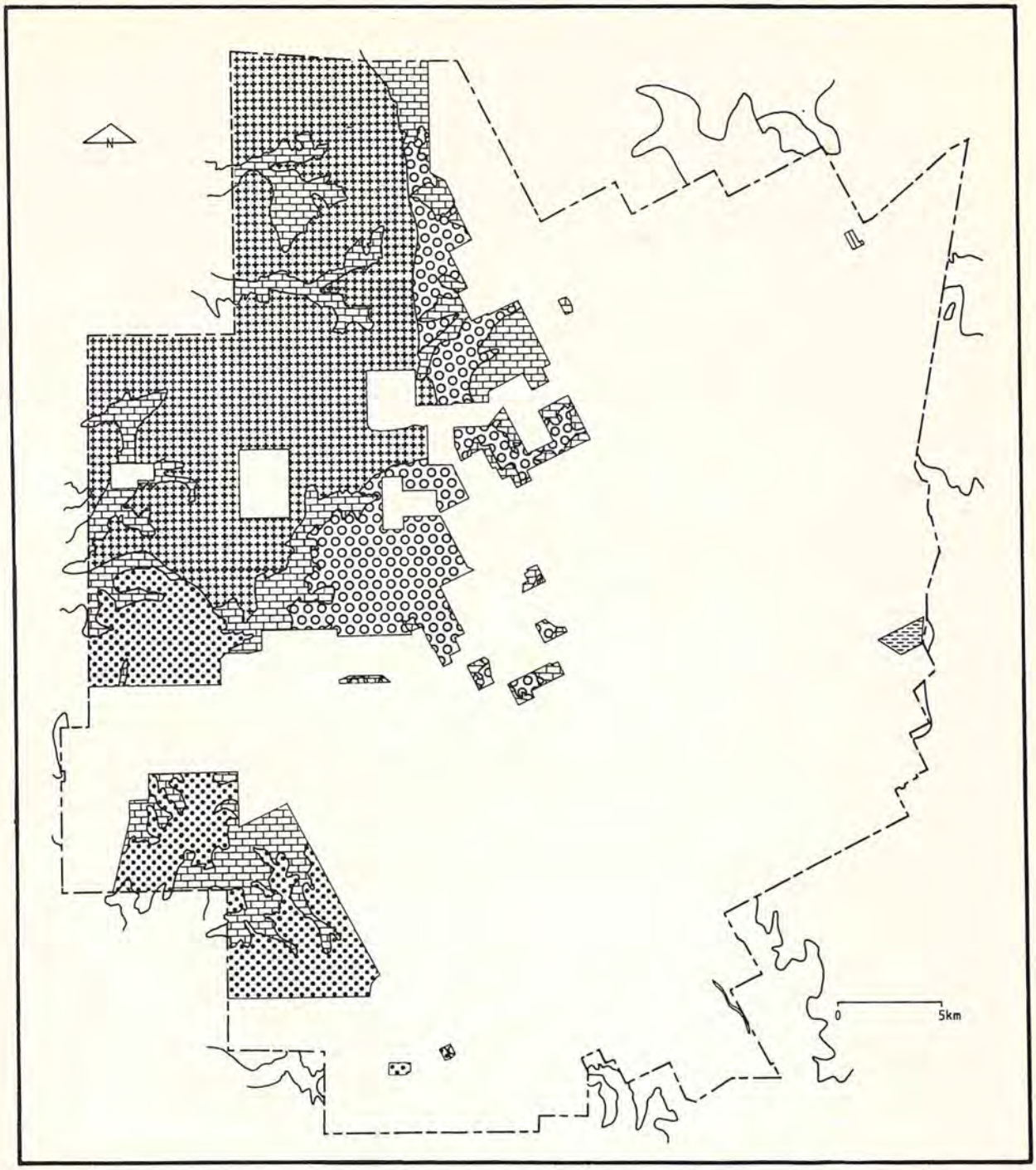
Jarrah, Marri and Wandoo woodland

York Gum woodland

Wandoo woodland

Scrub/Heath on sandplain

Figure 24. Land releases in the Shire of Toodyay: 1901-1920.



Jarrah, Wandoo and Powderbark woodland

Jarrah/Marri forest

Marri and Wandoo woodland

Wandoo woodland

Scrub/Heath on sandplain

Jarrah, Marri and Wandoo woodland

Figure 25. Land releases in the Shire of Toodyay:1921-1940 (To the present day only very minor changes have occurred in the areas of land alienated from the Crown).

of Toodyay, were gazetted and exist relatively unchanged to today. At the same time two more of the present day system of nature reserves, Poison Gully and Rugged Hills nature reserves, were gazetted by the Crown as "Timber" reserves. Another of the present day system (Flat Rock Gully Nature Reserve) was gazetted at this time under the more generalised purpose of "Government Requirements". However this reserve was used primarily for logging and thus served a similar purpose to the reserves gazetted at this time solely for the purpose of "Timber".

Prior to gazettal as Crown reserves all three reserves had been released around the turn of the century for pastoral pursuits. Two decades later they were resumed and presumably the major influencing factor was the stands of Brown Mallet each area contained. At this time, the bark of this tree was highly valued for its tannins, which were used to tan skins.

The rural industries of Australia were greatly affected by the First World War and Western Australia's major rural exports of wheat, flour, wool, apples, butter and fat lambs faced severe shipping problems. However throughout this time the Avon Valley remained the most stable mixed farming area in the state. Production in the Toodyay area was concentrated on wheat, oats, barley, hay, vineyards, fruit, fat lambs, wool, dairying, beef cattle and pigs.

During this period 'the town slowly faded' (Erickson, 1974, p. 358) due primarily to competition from the adjacent town of Northam.

1940 - Present : Extensive clearing and the consolidation of existing landuse patterns

Although the pattern of privately owned land has remained relatively unchanged over the last 40 years, extensive tracts of this land have been cleared during the years 1940 - 1980. (Figs. 26 - 29 indicate the changes in the extent of cleared, partially cleared and uncleared land. These figures are based on information obtained from aerial photographs taken in 1941 (Fig. 26), 1963 (Fig. 27), 1972 (Fig. 28) and 1980 (Fig. 29)).

The clearing of large tracts of land following the Second World War was due primarily to the introduction of bulldozers for tree felling and the extensive use of chemical fertilisers to enrich the relatively infertile soils. This enabled large areas of land to be rapidly and economically cleared. In Western Australia the 20 years 1949-69 (the "boom years") saw cleared land on farms double, sheep numbers treble, and wheat acreage and production increase nearly four fold. Fertilisers, mainly superphosphate, were used not only on cereal crops, but also in equal or greater amounts on sown pastures. Trace elements - copper, zinc and molybdenum - were also added in large annual tonnages (Burvill, 1979, p. 62).

A comparison of Figures 26 and 27 indicates the extensive clearing that occurred in the Toodyay Shire during this period. This extensive clearing also marked a shift in emphasis in land

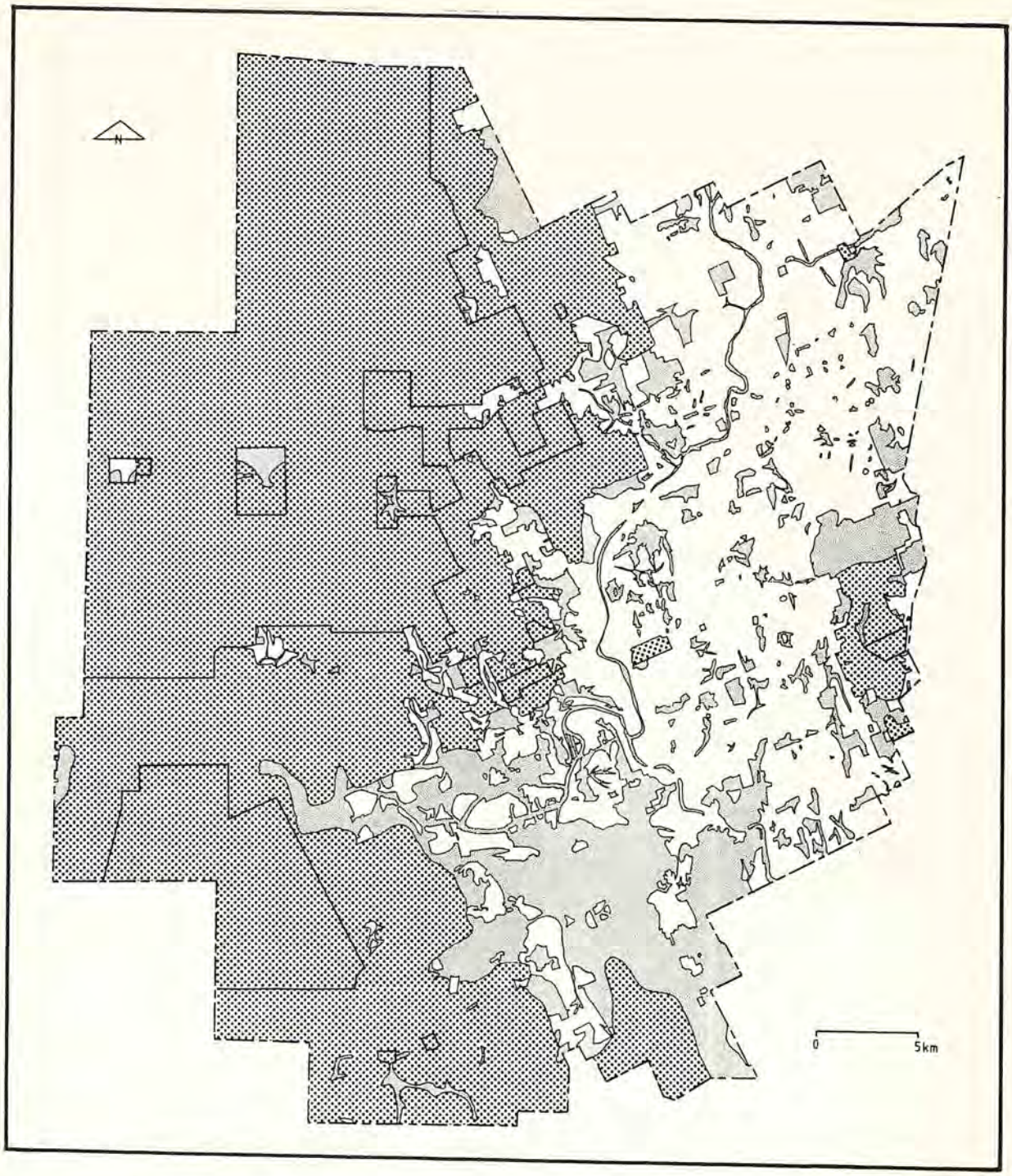
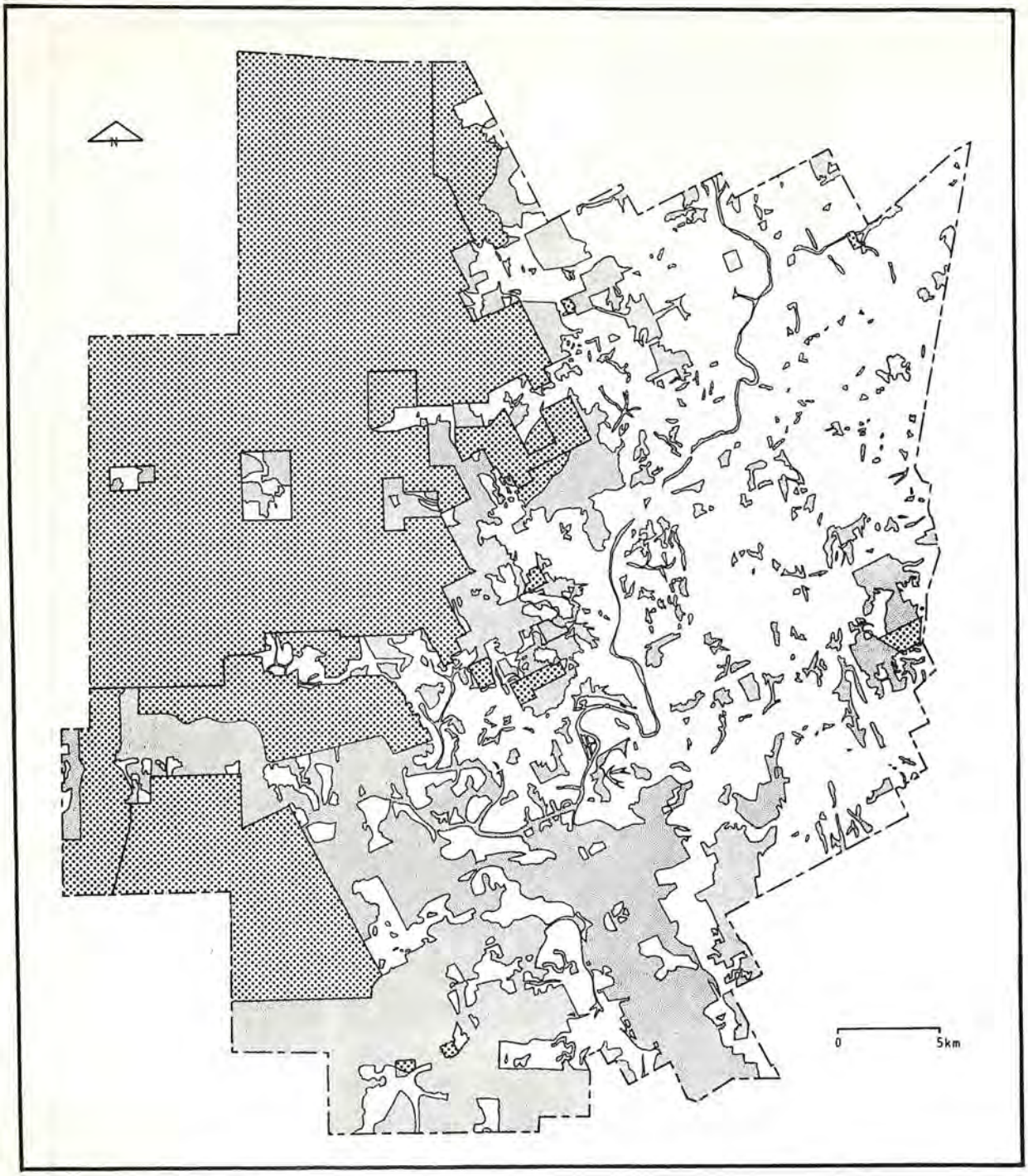


Figure 26. Pattern of land clearing in the Shire of Toodyay: 1941.

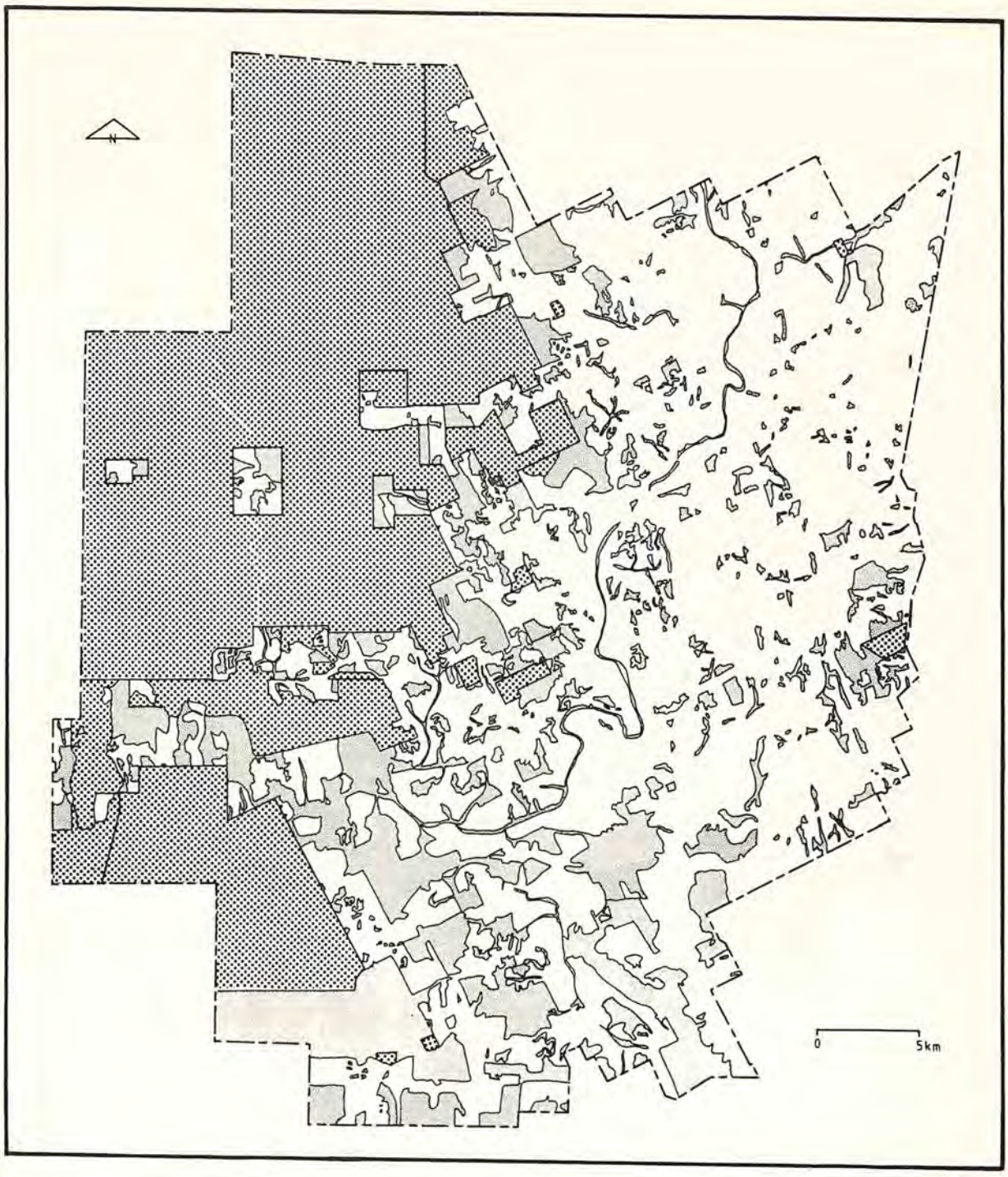


Uncleared

Partially cleared and/or pastoral usage

Cleared

Figure 27. Pattern of land clearing in the Shire of Toodyay: 1963.

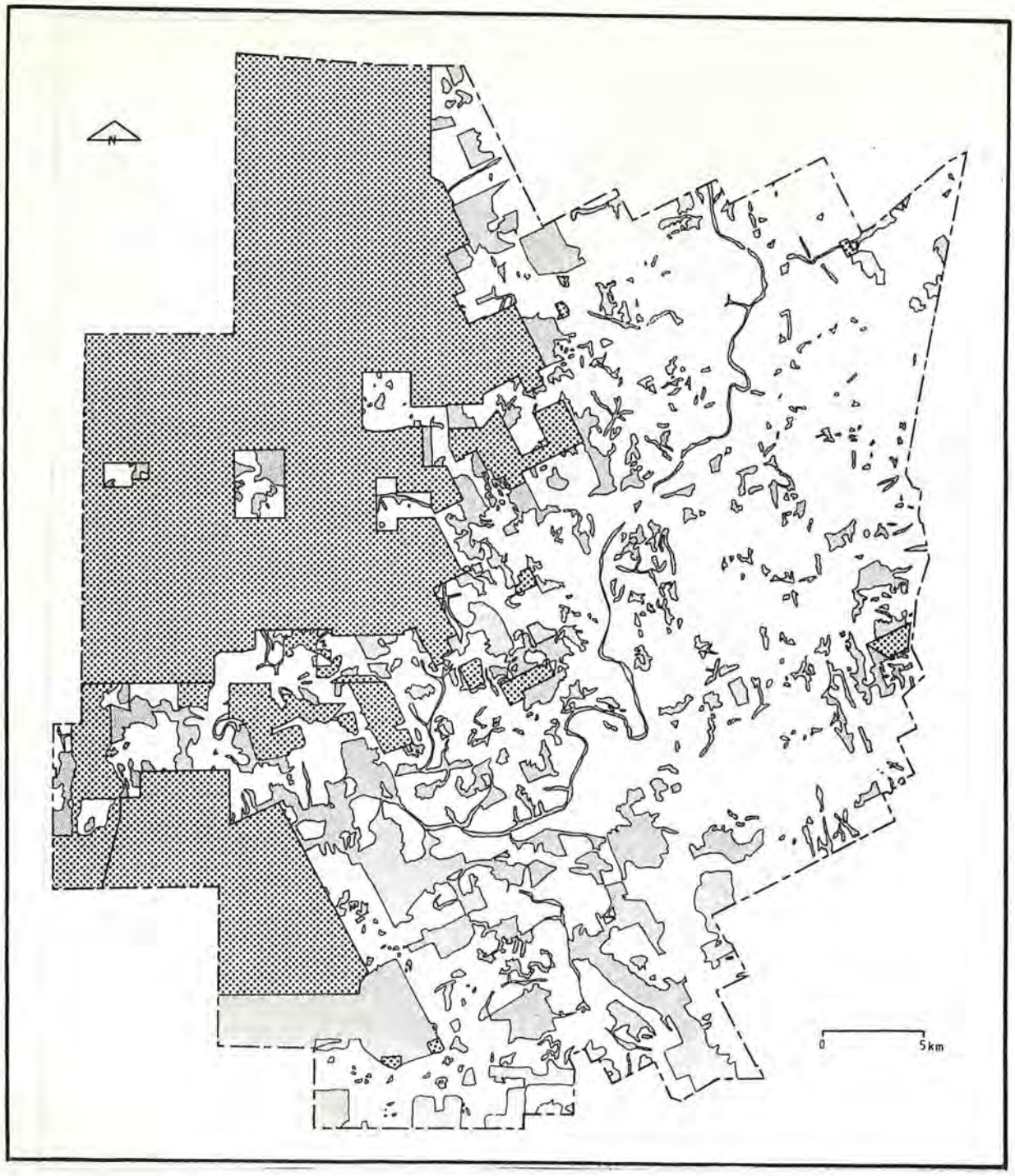


Uncleared

Partially cleared and/or pastoral usage

Cleared

Figure 28. Pattern of land clearing in the Shire of Toodyay: 1972.



Uncleared

Partially cleared and/or pastoral usage

Cleared

Figure 29. Pattern of land clearing in the Shire of Toodyay: 1980.

use. Beef cattle numbers increased, as did sheep numbers and the area under barley and oats. The area under wheat, however, remained constant at 10 000 to 12 000 acres.

Over the last 20 years the number of rural holdings in Toodyay Shire has remained fairly constant, as have the areas under crop and established pasture. (Figs. 27, 28 and 29 indicate the progression of clearing in the Shire over the years 1963 to 1980). Similarly sheep, pig and cattle numbers have remained constant, although beef cattle numbers experienced a brief boom over the period 1973 - 1975.

Toodyay has survived the recent economic recession due to its stability as an established mixed farming region, and its ability to adjust production to suit existing market conditions.

One such adjustment which is influencing present landuse in Toodyay is that of rural homesite use and hobby farms. This trend originated, and is likely to continue, due to pressure from people in Perth seeking a "rural" way of life, combined with the recent rural recession which has necessitated farmers exploring other avenues to derive a suitable income (Taylor and Burrell (n.d.) p. 21). Rural homesite development can have a dramatic impact on landuse patterns as it leads to a decrease in the area of farmland, an increase in the number of rural holdings and a dramatic decrease in rural property size.

However, the Toodyay agricultural district has always experienced cyclic changes in property size, superimposed on a basically stable regime of extensive mixed farming. When the Toodyay valley was first settled large acreages were granted to the early pastoralists. Even in these early days, small holdings were intensively farmed by Ticket of Leave men and labourers. The large pastoral leases were subdivided, only to be amalgamated in many cases in order to become economically viable. Another cycle is now being completed, with the advent of subdivision of larger holdings into smaller rural homesite lots.

The last decade (1970-1980) has seen the gazettal of the last Crown reserves (Moondyne and Rugged Hills Nature Reserves) to become part of the present system. Moondyne reserve was originally part of a single block of Commonwealth land which was set aside as a military training area. Recognition of the area's value as a potential reserve for the conservation of flora and fauna led to it being gazetted in 1970. The ecological values of Rugged Hills were recognised in 1975 by Casperson who carried out a biological survey of the Shire. However, it was not until 1980 that the reserve's purpose was changed from 'Timber' to the 'Conservation of Flora and Fauna'. Over the decade 1970 - 1980 the nine nature reserves in the Shire of Toodyay have all been vested in WAWA for the 'Conservation of Flora and Fauna'.

All the nature reserves in the Shire are now "islands" of uncleared vegetation in a largely developed, mainly agricultural landscape (Fig. 29). By the beginning of the twentieth century the two spring reserves, Beelaring and Goonaring, were islands

of Crown land in the midst of alienated land, and by 1920 five of the present day nature reserves were in a similar position. By 1940 seven of the nine reserves within the Shire were completely surrounded by alienated land, and one of the remaining two, Flat Rock Gully Nature Reserve, was almost completely isolated. The only exception was, and is, Moondyne Nature Reserve, which abuts upon the Avon Valley National Park in the south and a mineral tenement area in the west.

The present day system of nature reserves contains representative samples of all the vegetation types utilised during the different phases of agricultural development in the Shire. Bewmalling and Wattening Nature Reserves both of which were initially set aside in 1893 for the purpose of 'Public Utility', contain tracts of York Gum woodland. This was prime pastoral country to the first settlers. At the other end of the spectrum one of the most recent acquisitions to the reserves system, Moondyne Nature Reserve, contains Jarrah forest and associated plant communities; country which has only been cleared and used for agriculture in the last two decades.

Not only does the present nature reserve system fulfil an important role as a record of the original vegetation which formed the basis of the Shire's existing land use pattern, it is also an integral part of present day land use.

APPENDIX III : BIRD SPECIES SIGHTED ON NATURE RESERVES IN THE SHIRE OF TOODYAY

	529 & 659	21429	19900	22096	30306	2393	33697
NON PASSERINES							
EMUS - (DROMAIIDAE)							
Emu Dromaius novaehollandiae				x			
HERONS - (ARDEIDAE)							
White-faced Heron Ardea novaehollandiae					x	x	
DUCKS - (ANATIDAE)							
Australian Shelduck (Mountain Duck) Tadorna tadornoides							x
Pacific Black Duck (Black Duck) Anas superciliosa	x						
LARGE RAPTORS - (ACCIPITRIDAE)							
Brown Goshawk Accipiter fasciatus	x						x
Wedge-tailed Eagle Aquila audax				x			x
FALCONS - (FALCONIDAE)							
Australian Hobby (Little Falcon) Falco longipennis							x
Brown Falcon Falco berigora		x					x
QUAILS - (PHASIANIDAE)							
Stubble Quail Coturnix novaezelandiae	x						
BUTTON-QUAILS (TURNICIDAE)							
Painted Button-quail (Painted Quail) Turnix varia			x				x

APPENDIX III. cont'd...

	529 & 659	21429	19900	22096	30306	2393	33697
PIGEONS - (COLUMBIDAE)							
Common Bronzewing *Phaps chalcoptera*		x	x	x			x
Crested Pigeon *Ocyphaps lophotes*			x				x
COCKATOOS - (CACATUIDAE)							
White-tailed Black-Cockatoo *Calyptorhynchus baudinii*	x						x
Galah *Cacatua roseicapilla*		x		x			x
Little Corella *Cacatua sanguinea*							x
LORIKEETS - (LORIIDAE)							
Purple-crowned Lorikeet *Glossopsitta porphyrocephala*	x						x
PARROTS - (PLATYCERCIDAE)							
Red-capped Parrot *Purpureicephalus spurius*	x						
Western Rosella *Platycercus icterotis*	x						
Port Lincoln Ringneck (Port Lincoln Parrot) *Barnardius zonarius*	x	x	x	x	x	x	x
Elegant Parrot *Neophema elegans*							x
CUCKOOS - (CUCULIDAE)							
Pallid Cuckoo *Cuculus pallidus*							x
Fan-tailed Cuckoo *Cuculus pyrrhophanus*					x		x
Horsefield's Bronze-Cuckoo (Rufous-tailed Bronze-Cuckoo) *Chrysococcyx basalis*				x			x

APPENDIX III. cont'd...

	529 & 659	21429	19900	22096	30306	2393	33697
Shining Bronze-Cuckoo *Chrysococcyx lucidus*							x
OWLS - (STRIGIDAE)							
Southern Boobook (Boobook Owl) *Ninox novaeseelandiae*		x		x			
BARN OWLS - (TYTONIDAE)							
Barn Owl *Tyto alba*	x						
FROGMOUTHS - (PODARGIDAE)							
Tawny Frogmouth *Podargus strigoides*				x			
KINGFISHERS - (ALCEDINIDAE)							
Laughing Kookaburra (Kookaburra) *Dacelo novaeguineae*	x	x			x		x
BEE-EATERS - (MEROPIDAE)							
Rainbow Bee-eater (Australian Bee-eater) *Merops ornatus*	x			x			x
PASSERINES							
SWALLOWS - (HIRUNDINIDAE)							
White-backed Swallow *Cheramoeca leucosternum*							x
Tree Martin *Cecropis nigricans*							x
PIPITS - (MOTACILLIDAE)							
Richard's Pipit *Anthus novaeseelandiae*							x
CUCKOO-SHRIKES (CAMPEPHAGIDAE)							
Black-faced Cuckoo-Shrike *Coracina novaehollandiae*		x	x	x	x		x

APPENDIX III. cont'd...

	529 & 659	21429	19900	22096	30306	2393	33697
White-winged Triller *Lalage sueurii*	x			x			x
ROBINS/WHISTLERS/MONARCHS/FANTAILS (MUSCICAPIDAE)							
Southern Scrub-robin *Drymodes brunneopygia*							x
Scarlet Robin *Petroica multicolor*		x	x	x	x		
Red-capped Robin *Petroica goodenovii*	x	x		x			x
Western Yellow Robin *Eopsaltria griseogularis*	x			x			x
Jacky Winter (Brown Flycatcher) *Microeca leucophaea*						x	
Golden Whistler *Pachycephala pectoralis*	x						
Rufous Whistler *Pachycephala rufiventris*	x			x	x		x
Grey Shrike-thrush *Colluricincla harmonica*	x	x		x	x		x
Grey Fantail *Rhipidura fuliginosa*	x	x	x	x	x	x	x
Willie Wagtail *Rhipidura leucophrys*				x	x	x	x
BABBLERS - (TIMALIIDAE)							
White-browed Babbler *Pomatostomus superciliosus*							x
OLD WORLD WARBLERS - (SYLVIIDAE)							
Rufous Songlark *Cinclorhamphus mathewsi*							x
Brown Songlark *Cinclorhamphus cruralis*							x

APPENDIX III. cont'd...

	529 & 659	21429	19900	22096	30306	2393	33697
WRENS - (MALURIDAE)							
Splendid Fairy-Wren (Splendid Wren) *Malurus splendens*	x			x			x
AUSTRALIAN WARBLERS - (ACANTHIZIDAE)							
Calamanthus (Field Wren) *Sericornis fuliginosus*							x
Weebill *Smicrornis brevirostris*				x		x	x
Western Gerygone (Western Warbler) *Gerygone fusca*	x	x	x	x	x	x	x
Inland Thornbill (Broad-tailed Thornbill) *Acanthiza apicalis*	x				x		x
Western Thornbill *Acanthiza inornata*	x			x			x
Yellow-rumped Thornbill *Acanthiza chrysorrhoa*	x	x	x	x	x	x	x
SITTELLA - (NEOSITTIDAE)							
Varied Sittella *Daphoenositta chrysoptera*	x	x	x				x
TREECREEPER - (CLIMACTERIDAE)							
Rufous Treecreeper *Climacteris rufa*		x	x	x			
HONEYEATERS - (MELIPHAGIDAE)							
Red Wattlebird *Anthochaera carunculata*	x	x	x	x		x	x
Little Wattlebird *Anthochaera chrysoptera*	x			x			
Yellow-throated Miner *Manorina flavigula*							x
Singing Honeyeater *Lichenostomus virescens*		x	x	x	x		x

APPENDIX III. cont'd...

	529 & 659	21429	19900	22096	30306	2393	33697
Yellow-plumed Honyeater *Lichenostomus ornatus*	x			x			x
Brown-headed Honeyeater *Melithreptus brevirostris*	x						x
White-naped Honeyeater *Melithreptus lunatus*	x			x			x
Brown Honeyeater *Lichmera indistincta*	x	x	x	x		x	x
New Holland Honeyeater *Phylidonyris novaehollandiae*	x						x
White-cheeked Honeyeater *Phylidonyris nigra*	x						x
White-fronted Honeyeater *Phylidonyris albifrons*							x
Tawny-crowned Honeyeater *Phylidonyris melanops*	x						x
Western Spinebill *Acanthorhynchus superciliosus*	x			x			x
CHATS - (EPHTHIANURIDAE)							
White-fronted Chat *Ephthianura albifrons*							x
MISTLETOEBIRD - (DICAEIDAE)							
Mistletoebird *Dicaeum hirundinaceum*			x				x
PARDALOTES - (PARDALOTIDAE)							
Spotted Pardalote *Pardalotus punctatus*	x			x			
Striated Pardalote *Pardalotus striatus*	x	x					x
WHITE-EYES - (ZOSTEROPIDAE)							
Silvereye *Zosterops lateralis*	x						x

APPENDIX III. cont'd...

	529 & 659	21429	19900	22096	30306	2393	33697
FINCHS - (PLOCEIDAE)							
Zebra Finch *Poephila guttata*							x
MAGPIE-LARKS - (GRALLINIDAE)							
Australian Magpie-lark *Grallina cyanoleuca*	x						
WOODSWALLOWS - (ARTAMIDAE)							
Black-faced Woodswallow *Artemus cinereus*						x	x
Dusky Woodswallow *Artemus minor*	x			x			
BUTCHERBIRDS/MAGPIES - (CRACTICIDAE)							
Grey Butcherbird *Cracticus torquatus*		x			x		
Australian Magpie *Gymnorhina tibicen*	x		x	x			x
CROWS/RAVENS - (CORVIDAE)							
Australian Raven *Corvus coronoides*	x	x	x	x	x	x	x

APPENDIX IV. BIRD LIST FOR SIX HABITAT TYPES WITHIN THE SHIRE OF TOODYAY, COMPILED BY THE TOODYAY NATURALISTS' CLUB†

	1	2	3	4	5	6	Breeding
NON PASSERINES							
EMUS - (DROMAIIDAE)							
Emu *Dromaius novaehollandiae*		Y	Y			Y	*
GREBES - (PODICIPEDIDAE)							
Hoary-headed Grebe *Poliocephalus poliocephalus*				Y		Y	
Australasian Grebe (Little Grebe) *Tachybaptus novaehollandiae*				X		X	*
PELICANS - (PELECANIDAE)							
Australian Pelican *Pelecanus conspicillatus*				Z			
DARTERS - (ANHINGIDAE)							
Darter *Anhinga melanogaster*				Z			
CORMORANTS - (PHALACROCORACIDAE)							
Great Cormorant (Black Cormorant) *Phalacrocorax carbo*				Z			
Little Black Cormorant *Phalacrocorax sulcirostris*				X			*
Little Pied Cormorant *Phalacrocorax melanoleucos*				X			*
HERONS - (ARDEIDAE)							
Pacific Heron (White-necked Heron) *Ardea pacifica*				Y		Y	
White-faced Heron *Ardea novaehollandiae*	X	X	X	X		X	*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
Great Egret (Great White Egret) *Egretta alba*				Y			
Rufous Night Heron (Nankeen Night Heron) *Nycticorax caledonicus*				Y			*
Black Bittern *Dupetor flavicollis*				Z			
Australasian Bittern *Botaurus poiciloptilus*				Z			
IBISES AND SPOONBILLS - (PLATALEIDAE)							
Straw-necked Ibis *Threskiornis spinicollis*				Y		Y	
Royal Spoonbill *Platalea regia*				Z			
Yellow-billed Spoonbill *Platalea flavipes*				Z			
DUCKS - (ANATIDAE)							
Black Swan *Cygnus atratus*				Y			*
Australian Shelduck (Mountain Duck) *Tadorna tadornoides*				X		X	*
Pacific Black Duck (Black Duck) *Anas superciliosa*	X	X		X		X	*
Grey Teal *Anas gibberifrons*				X		X	*
Chestnut Teal *Anas castanea*				Z			
Australasian Shoveler (Blue-winged Shoveler) *Anas rhynchotis*				Z		Z	
Pink-eared Duck *Malacorhynchus membranaceus*				Z		Z	
Hardhead (White-eyed Duck) *Aythya australis*				Y		Y	*
Maned Duck (Wood Duck) *Chenonetta jubata*				X		X	*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
Blue-billed Duck *Oxyura australis*				Y		Y	*
Musk Duck *Biziura lobata*				Y		Y	*
LARGE RAPTORS - (ACCIPITRIDAE)							
Black-shouldered Kite *Elanus notatus*	X	X				X	*
Square-tailed Kite *Lophoictinia isura*	Z	Z	Z		Z	Z	*
Whistling Kite *Haliastur sphenurus*	X	X	X	X		X	*
Brown Goshawk *Accipiter fasciatus*	X	X	X	X	X	X	*
Collared Sparrowhawk *Accipiter cirrhocephalus*	Z	Z	Z	Z			*
Wedge-tailed Eagle *Aquila audax*	X	X	X		X	X	*
Little Eagle *Hieraaetus morphnoides*	X	X	X			X	*
Spotted Harrier *Circus assimilis*	Y	Y			Y	Y	
Marsh Harrier *Circus aeruginosus*				Z		Z	
Black Falcon *Falco subniger*		R	A	R	E		
Peregrine Falcon *Falco peregrinus*	Z	Z	Z	Z		Z	
Australian Hobby (Little Falcon) *Falco longipennis*	Y	Y	Y			Y	
Grey Falcon *Falco hypoleucos*		R	A	R	E		
Brown Falcon *Falco berigora*	X	X			X	X	

	1	2	3	4	5	6	Breeding
Australian Kestrel Falco cenchroides	X	X			X	X	*
MOUND BUILDERS - (MEGAPODIIDAE)							
Malleefowl Leipoa ocellata		R	A	R	E		
QUAILS - (PHASIANIDAE)							
Stubble Quail Coturnix novaezelandiae						X	*
BUTTON-QUAILS - (TURNICIDAE)							
Painted Button-quail (Painted Quail) Turnix varia		Y	Y			Y	*
Little Button-quail (Little Quail) Turnix velox	Y					Y	*
RAILS - (RALLIDAE)							
Buff-banded Rail (Banded Landrail) Rallus philippensis						Z	*
Baillon's Crake (Marsh Crake) Porzana pusilla						Y	*
Black-tailed Native-hen Gallinula ventralis				Y		Y	*
Dusky Moorhen Gallinula tenebrosa				Y			*
Purple Swamphen Porphyrio porphyrio				Z		Z	
Eurasian Coot Fulica atra				X		X	*
BUSTARDS - (OTIDIDAE)							
Australian Bustard Ardeotis australis					Z	Z	
THICK-KNEES - (BURHINIDAE)							
Brush Thick-knee Burhinus magnirostris	Z	Z	Z			Z	*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
PLOVERS - (CHARADRIIDAE)							
Banded Lapwing (Banded Plover) *Vanellus tricolor*	X					X	*
Red-kneed Dotterel *Erythrogonys cinctus*				Z		Z	
Red-capped Plover *Charadrius ruficapillus*				Z		Z	
Black-fronted Plover *Charadrius melanops*				X		X	*
Inland Dotterel *Peltohyas australis*						Z	
AVOCETS AND STILTS - (RECURVIROSTRIDAE)							
Black-winged Stilt *Himantopus himantopus*				Y		Y	*
Red-necked Avocet *Recurvirostra novaehollandiae*				Z		Z	
SANDPIPERS - (SCOLOPACIDAE)							
Wood Sandpiper *Tringa glareola*				Z			
Common Sandpiper *Tringa hypoleucos*				Y			
Greenshank *Tringa nebularia*				Z		Z	
GULLS AND TERNS - (LARIDAE)							
Silver Gull *Larus novaehollandiae*				Z		Z	
Whiskered Tern *Chlidonias hybrida*				Z		Z	
Gull-billed Tern *Gelochelidon nilotica*				Z		Z	

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
PIGEONS - (COLUMBIDAE)							
Laughing Turtle-Dove *Streptopelia senegalensis*	X			X		X	*
Diamond Dove *Geopelia cuneata*	Z						
Common Bronzewing *Phaps chalcoptera*	Y	Y	Y			Y	*
Crested Pigeon *Ocyphaps lophotes*	Y	Y	Y			Y	*
COCKATOOS - (CACATUIDAE)							
Red-tailed Black Cockatoo *Calyptorhynchus magnificus*		Z	Z				
White-tailed Black Cockatoo *Calyptorhynchus baudinii*		X	X		X		
Galah *Cacatua roseicapilla*	X	X				X	*
Long-billed Corella *Cacatua tenuirostris*	Y	Y					*
Pink Cockatoo (Major Mitchell) *Cacatua leadbeateri*	Z	Z					
LORIKEETS - (LORIIDAE)							
Purple-crowned Lorikeet *Glossopsitta porphyrocephala*	X	X	X				*
PARROTS - (POLYTELITIDAE)							
Regent Parrot *Polytelis anthopeplus*	Z	Z	Z				
Cockatiel *Nymphicus hollandicus*	Z	Z				Z	
PARROTS - (PLATYCERCIDAE)							
Budgerigar *Melopsittacus undulatus*	Z	Z	Z				

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
Red-capped Parrot Purpureicephalus spurius		X	X				*
Western Rosella Platycercus icterotis		Z	Z				
Port Lincoln Ringneck (Port Lincoln Parrot) Barnardius zonarius	X	X	X	X		X	*
Mulga Parrot (Many coloured Parrot) Psephotus varius	Z						
Elegant Parrot Neophema elegans	Y	Y	Y				*
CUCKOOS - (CUCULIDAE)							
Pallid Cuckoo Cuculus pallidus	X	X	X	X	X	X	*
Fan-tailed Cuckoo Cuculus pyrrhophanus	Y	Y	Y	Y			
Horsefield's Bronze Cuckoo (Rufous-tailed Bronze Cuckoo) Chrysococcyx basalis	X	X	X	X	X		*
Shining Bronze Cuckoo Chrysococcyx lucidus	X	X	X	X	X		*
OWLS - (STRIGIDAE)							
Southern Boobook (Boobook Owl) Ninox novaeseelandiae	Y	Y	Y	Y			*
BARN OWLS - (TYTONIDAE)							
Barn Owl Tyto alba	Y	Y	Y	Y			*
Masked Owl Tyto novaehollandiae	Z	Z	Z				
FROGMOUTHS - (PODARGIDAE)							
Tawny Frogmouth Podargus strigoides	Y	Y	Y	Y			*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
OWLET - NIGHTJARS - (AEGOTHELIDAE)							
Australian Owlet - nightjar *Aegotheles cristatus*	Y	Y	Y	Y			
SWIFTS - (APODIDAE)							
Fork-tailed Swift *Apus pacificus*	Z						
KINGFISHERS - (ALCEDINIDAE)							
Laughing Kookaburra (Kookaburra) *Dacelo novaeguineae*	X	X	X	X			*
Sacred Kingfisher *Halcyon sancta*	X	X	X	X			*
BEE-EATERS (MEROPIDAE)							
Rainbow Bee-eater *Merops ornatus*	X	X	X	X		X	*
PASSERINES							
SWALLOWS - (HIRUNDINIDAE)							
White-backed Swallow *Cheramoeca leucosternum*	Y	Y				Y	*
Welcome Swallow *Hirundo neoxena*	X	X	X	X		X	*
Tree Martin *Cecropis nigricans*	X	X	X	X		X	*
Fairy Martin *Cecropis ariel*	Y	Y				Y	*
PIPITS - (MOTACILLIDAE)							
Richard's Pipit *Anthus novaeseelandiae*						X	*
CUCKOO - SHRIKES - (CAMPEPHAGIDAE)							
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	X	X	X	X	X	X	*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
Ground Cuckoo-shrike *Coracina maxima*	R	A	R	E			
White-winged Triller *Lalage sueurii*	X	X	X	X	X	X	*
ROBINS/WHISTLERS/MONARCHS/FANTAILS - (MUSCICAPIDAE)							
Southern Scrub-robin *Drymodes brunneopygia*	Z						
Scarlet Robin *Petroica multicolor*	X	X	X	X			*
Red-capped Robin *Petroica goodenovii*	X	X	X	X			*
Hooded Robin *Melanodryas cucullata*	Z	Z	Z				*
Western Yellow Robin *Eopsaltria griseogularis*		Y	Y				*
Golden Whistler *Pachycephala pectoralis*		Y	Y				*
Rufous Whistler *Pachycephala rufiventris*	X	X	X	X	X		*
Grey Shrike-thrush *Colluricincla harmonica*	Y	Y	Y	Y	Y		*
Grey Fantail *Rhipidura fuliginosa*	NO RECORD						
Willie Wagtail *Rhipidura leucophrys*	NO RECORD						
BABBLERS - (TIMALIIDAE)							
White-browed Babbler *Pomatostomus superciliosus*	X	X	X				*
OLD WORLD WARBLERS - (SYLVIIDAE)							
Clamorous Reed-Warbler (Reed Warbler) *Acrocephalus stentoreus*						Y	*
Little Grassbird *Megalurus gramineus*						Z	

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
Rufous Songlark Cinclorhamphus mathewsi	Y	Y				Y	*
Brown Songlark Cinclorhamphus cruralis						Y	*
WRENS - (MALURIDAE)							
Splendid Fairy-wren (Splendid Wren) Malurus splendens	X	X	X	X	X	X	*
White-winged Fairy-wren (White-winged Wren) Malurus leucopterus					Z		
AUSTRALIAN WARBLERS - (ACANTHIZIDAE)							
Weebill Smicrornis brevirostris	X	X	X	X			*
Western Gerygone Gerygone fusca	X	X	X	X	X		*
Inland Thornbill Acanthiza apicalis	Y	Y	Y	Y			*
Chestnut-rumped Thornbill Acanthiza uropygialis	Z	Z					
Western Thornbill Acanthiza inornata		X	X	X			*
Yellow-rumped Thornbill Acanthiza chrysorrhoa	X	X	X	X	X		*
SITTELLAS - (NEOSITTIDAE)							
Varied Sittella Daphoenositta chrysoptera	Y	Y	Y	Y			*
TREECREEPERS - (CLIMACTERIDAE)							
Rufous Treecreeper Climacteris rufa	Y	Y	Y				*
HONEYEATERS - (MELIPHAGIDAE)							
Red Wattlebird Anthochaera carunculata	X	X	X	X	X		*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
Little Wattlebird *Anthochaera chrysoptera*		X	X		X		*
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*	Z	Z	Z				
Yellow-throated Miner *Manorina flavigula*	Y	Y			Y		*
Singing Honeyeater *Lichenostomus virescens*	X	X	X	X	X		*
Yellow-plumed Honeyeater *Lichenostomus ornatus*	Y	Y	Y	Y			*
Brown-headed Honeyeater *Melithreptus brevirostris*	X	X	X	X			*
White-naped Honeyeater *Melithreptus lunatus*		X	X				*
Brown Honeyeater *Lichmera indistincta*	X	X	X	X	X		*
New Holland Honeyeater *Phylidonyris novaehollandiae*		X	X				*
White-cheeked Honeyeater *Phylidonyris niger*		Y	Y				*
White-fronted Honeyeater *Phylidonyris albifrons*		Z					
Tawny-crowned Honeyeater *Phylidonyris melanops*		Y	Y		Y		*
Western Spinebill *Acanthorhynchus superciliosus*		X	X		X		*
CHATS - (EPHTHIANURIDAE)							
Crimson Chat *Ephthianura tricolor*						Z	*
White-fronted Chat *Ephthianura albifrons*	Y	Y	Y	Y	Y	Y	*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
MISTLETOEBIRD - (DICAEIDAE)							
Mistletoebird *Dicaeum hirundinaceum*	Y	Y	Y	Y	Y		
PARDALOTES - (PARDALOTIDAE)							
Spotted Pardalote *Pardalotus punctatus*	Y	Y	Y	Y			
Striated Pardalote *Pardalotus striatus*	X	X	X	X			*
WHITE EYES - (ZOSTEROPIDAE)							
Silvereye *Zosterops lateralis*	X	X	X	X	X	X	*
WEAVERS/FINCHES - (PLOCEIDAE)							
Zebra Finch *Poephila guttata*	Y	Y				Y	*
MAGPIE - LARKS - (GRALLINIDAE)							
Australian Magpie-lark *Grallina cyanoleuca*	X	X	X	X		X	*
WOODSWALLOWS - (ARTAMIDAE)							
Masked Woodswallow *Artamus personatus*	Z					Z	
Black-faced Woodswallow *Artamus cinereus*	X	X			X	X	*
Dusky Woodswallow *Artamus cyanopterus*		X	X				*
BUTCHERBIRDS AND MAGPIES - (CRACTICIDAE)							
Grey Butcherbird *Cracticus torquatus*	Y	Y	Y				*
Pied Butcherbird *Cracticus nigrogularis*	Y	Y				Y	*
Australian Magpie *Gymnorhina tibicen*	X	X	X	X	X	X	*

APPENDIX IV. cont'd...

	1	2	3	4	5	6	Breeding
Grey Currawong *Strepera versicolor*	Y	Y	Y				*
CROWS - (CORVIDAE)							
Australian Raven *Corvus coronoides*	X	X	X	X	X	X	*
Little Crow *Corvus bennetti*	X	X	X	X	X	X	

HABITAT TYPES

1. York Gum/Jam
2. Wandoo Woodland
3. Jarrah/Marri
4. Avon River
5. Sandplain Heath
6. Open Farmland

Status

X - common

Y - uncommon

Z - scarce

* - breeding

† Scientific and common names are according to the *1975 Checklist of the Birds of Australia*, Part 1, by H.T. Condon and its amendments (*Emu* 76 : 216-217; *Emu* 78 : 80-87) and the *Interim List of Australian Songbirds* by R. Shodde.

APPENDIX V. FAUNA LIST (EXCLUDING BIRDS) FOR THE SHIRE OF TOODYAY, COMPILED BY THE TOODYAY NATURALISTS' CLUB

MONOTREMES

Tachyglossus aculeatus	Echidna

MARSUPIALS

Antechinus flavipes	Yellow-footed Antechinus, Mardo
Cercartetus concinnus	Western Pygmy-possum
Dasyurus geoffroii	Western Quoll, Native Cat
Isoodon obesulus	Southern Brown Bandicoot
Macropus eugenii	Tammar Wallaby
Macropus fuliginosus	Western Grey Kangaroo
Macropus irma	Western Brush Wallaby
Macropus robustus	Euro
Phascogale tapoatafa	Brush-tailed Phascogale, Wambenger
Pseudocheirus occidentalis	Western Ringtail Possum
Sminthopsis crassicaudata	Fat-tailed Dunnart
Sminthopsis granulipes	White-tailed Dunnart
Sminthopsis murina	Common Dunnart
Tarsipes rostratus	Honey Possum, Noolbenger
Trichosurus vulpecula	Common Brushtail Possum

BATS

Chalinolobus gouldii	Gould's Wattled Bat
Chalinolobus morio	Chocolate Wattled Bat
Eptesicus pumilis	Little Cave Eptesicus
Pteropus scapulatus	Little Red Flying-fox
Tadarida australis	White-striped Mastiff-bat
Taphozous flaviventris	Yellow-bellied Sheathtail Bat
Mormopterus planiceps	Little Mastiff-bat

RODENTS

Hydromys chrystogaster	Water-rat
Mus musculus	House Mouse (Introduced)
Rattus rattus	Black Rat (Introduced)

OTHER INTRODUCED SPECIES

Felis catus	Feral Cat
Oryctolagus cuniculus	European Rabbit
Vulpes vulpes	Red Fox

SNAKES

Aspidites ramsayi	Ramsay's Python, Woma
Denisonia gouldii	Little Whip Snake
Notechis scutatus	Tiger Snake
Pseudechis australis	Mulga Snake
Pseudonaja affinis	Dugite
Pseudonaja modesta	Five-ringed Snake
Pseudonaja nuchalis	Gwardar
Python spilotus	Carpet Snake

APPENDIX V. cont'd...

Rhamphatyphlops australis	Blind Snake
Rhamphotyphlops bituberculata	Blind Snake
Vermicella bertholdi	Bandy Bandy
Vermicella bimaculata	Black-naped Snake
Vermicella semifasciata	Half-ringed Snake

LIZARDS

Crenadactylus ocellatus	Clawless Gecko
Cryptoblepharus plagiocephalus	
Ctenotus fallens	
Ctenophorus ornatus	Granite Dragon
Ctenophorus reticulatus	Netted Dragon
Delma fraseri	
Delma grayii	
Diplodactylus granariensis	
Diplodactylus ocellatus	
Diplodactylus polyophthalmus	
Diplodactylus pulcher	
Diplodactylus spinigerus	
Eremiascincus richardsonii	
Gehyra variegata	
Grenadactylus ocellatus	
Lerista distinguenda	
Lialis burtonis	Burton's Snake-lizard
Menetia greyii	
Moloch horridus	Mountain Devil
Morethia obscura	
Oedura reticulata	
Phyllodactylus marmoratus	
Pogona minor	Western Bearded Dragon
Pygopus lepidopodus	Common Scaly-foot
Tiliqua occipitalis	Western Blue-tongue
Tiliqua rugosa	Bobtail
Varanus gouldii	Bungarra
Varanus tristis	Racehorse Goanna

FROGS

Heleioporus albopunctatus	Spotted Burrowing Frog
Limnodynastes dorsalis	Western Banjo Frog, Pobblebonk
Litoria adelaidensis	Slender Tree Frog
Litoria moorei	Western Green and Golden Tree Frog
Neobatrachus pelobatoides	Humming Frog
Pseudophryne guentheri	Guenther's Toadlet
Ranidella pseudinsignifera	

TORTOISES

Chelodina oblonga	Oblong Tortoise

FISH

Aldrichetta forsteri(B)	Yellow-eye Mullet: occasional
Mugil cephalus(B)	Mangrove Mullet: occasional
Atherinosoma presbyteroides(B)	Hardyhead: occasional

APPENDIX V. cont'd...

Bostockia porosa(A)	Nightfish: common
Carassius auratus(A)	Goldfish or Golden Carp: rare, introduced
Galaxias occidentalis(A)	Western Minnow: common
Gambusia affinis(A)	Mosquito Fish: common, introduced
Pseudogobius olarum(B)	Swan River Goby: common
Tandanus bostocki(A)	Freshwater Cobbler: rare

(A) Primary freshwater species
(B) Secondary freshwater species (i.e. primarily marine or estuarine but frequently encountered in fresh water).

CRUSTACEA

Cherax quinquencarinatus	Gilgie

MOLLUSCS

Anticorbula amara	Small river clam: common
Coxiella glabra	Salt lake snail: Mortlock River
Physa sp.	Freshwater snail: found in dams, introduced
Physatra sp.	Freshwater snail: rare
Plotiopsis australis	Spiral snail: river
Potamopyrgus sp.	Tiny snail: found in dam, rare
Westralunio carteri	River clam: rare

BUTTERFLIES

Danaus chrysippus petilia	Lesser Wanderer
Danaus plexippus	Wanderer
Delias aganippe	Wood White
Erina acasta	Blotched Blue
Erina hyacinthina simplexa	Western Dusky Blue
Eurema smilax	Small Grass Yellow
Geitoneura klugi klugi	Klug's Xenica
Geitoneura minyas minyas	Western Xenica
Ogyris amaryllis	Amaryllis Azure
Ogyris idmo	Large Brown Azure
Papilio demoleus sthenelus	Chequered Swallowtail
Pieris rapae	Cabbage White
Precis villida calybe	Meadow Argus
Vanessa itea	Australian Admiral
Vanessa kershawi	Painted Lady
Zizeeria otis labradus	Common Grass-blue

APPENDIX VI. FLORA SPECIES LIST FOR WONGAMINE NATURE RESERVE
FAMILIES ARRANGED AFTER GREEN (1981)
(Source : Toodyay Naturalists' Club (1979))

ADIANTACEAE
- Adiantum aethiopicum

LILIACEAE
- Xanthorrhoea preissii
- X. reflexa

HAEMODORACEAE
- Anigozanthos humilis
- Conostylis breviscapa

IRIDACEAE
- Patersonia occidentalis

ORCHIDACEAE
- Caladenia deformis
- C. filamentosa
- C. flava
- C. gemmata
- C. menziesii
- C. patersonii
- C. reptans
- C. saccharata
- C. sericea
- Diuris longifolia
- Elythranthera brunonis
- E. emarginata
- Eriochilus dilatatus
- Leporella fimbriata
- Lyperanthus nigricans
- Pterostylis nana
- P. recurva
- P. vittata
- Thelymitra crinita

CASUARINACEAE
- Allocasuarina campestris
- A. huegeliana

PROTEACEAE
- Adenanthos sericeus
- Banksia attenuata
- B. grandis
- B. prionotes
- Conospermum amoenum
- C. stoechadis
- Dryandra armata
- D. carduacea
- D. kippistiana
- D. nivea
- D. sclerophylla
- D. sessilis

APPENDIX VI. cont'd...

D. vestita
Grevillea excelsior
G. pilulifera
G. synapheae
G. thelmanniana
G. spp.
Hakea incrassata
H. ruscifolia
H. undulata
Isopogon dubius
Petrophile divaricata
Stirlingia latifolia

DROSERACEAE
Drosera erythrorhiza
D. macrantha
D. microphylla

PITTOSPORACEAE
Billardiera candida
B. erubescens

LEGUMINOSAE SUBFAM. MIMOSOIDEAE
Acacia acuminata
A. pulchella
A. urophylla

LEGUMINOSAE SUBFAM. PAPILIONOIDEAE
Daviesia incrassata
Dillwynia spp.
Gastrolobium spinosum
Hovea pungens
H. chorizemifolia
Isotropis cuneifolia
Kennedia prostrata
Mirbelia spp.

RUTACEAE
Eriostemon spicatus

POLYGALACEAE
Comesperma volubile

STACKHOUSIACEAE
Stackhousia brunonis
S. huegelii

STERCULIACEAE
Thomasia spp.

DILLENIACEAE
Hibbertia hypericoides
H. spp.

THYMELAEACEAE
Pimelia sp.

APPENDIX VI. cont'd...

MYRTACEAE
- Calothamnus quadrifidus
- C. sanguineus
- Calytrix fraseri
- C. glutinosa
- Eucalyptus accedens
- E. astringens
- E. drummondii
- E. foecunda
- E. macrocarpa
- E. salmonophloia
- E. wandoo
- Kunzea recurva
- Leptospermum erubescens
- Melaleuca radula
- M. scabra
- M. undulata
- Verticordia spp.

HALORAGACEAE
- Glischrocaryon aureum

EPACRIDACEAE
- Astroloma spp.
- Styphelia tenuiflora

LAMIACEAE
- Hemiandra pungens

GOODENIACEAE
- Dampiera lindleyi
- D. linearis
- D. teres
- Lechenaultia biloba
- Scaevola spp.

APPENDIX VII. FLORA SPECIES LIST FOR MOONDYNE NATURE RESERVE. FAMILIES ARRANGED AFTER GREEN (1981) (Source : B. and K. Dell (1981))

ISOETACEAE
- Isoetes drummondii

ADIANTACEAE
- Cheilanthes tenuifolia

ZAMIACEAE
- Macrozamia riedlei

JUNCAGINACEAE
- Triglochin procera

POACEAE
- Neurachne alopecuroidea
- Poa drummondiana

CYPERACEAE
- Lepidosperma angustatum
- L. longitudinale
- Schoenus aff. clandestinus

RESTIONACEAE
- Leptocarpus coangustatus
- Loxocarya cinerea

CENTROLEPIDACEAE
- Aphelia cyperoides
- A. drummondii
- A. gricilis
- Centrolepis aristata

PHILYDRACEAE
- Philydrella pygmaea

JUNCACEAE
- Luzula meridionalis

LILIACEAE
- Agrostocrinum scabrum
- Arthropodium capillipes
- Borya nitida
- Burchardia multiflora
- B. umbellata
- Caesia parviflora
- Calectasia cyanea
- Chamaescilla corymbosa
- Dianella revoluta
- Kingia australis
- Laxmannia grandiflora
- Lomandra purpurea
- L. sp.
- Sowerbaea laxiflora
- Stypandra grandiflora

APPENDIX VII. cont'd...

Thysanotus patersonii
T. thrysoideus
Trichoryne elatior
Xanthorrhoea gracilis
X. preissii

HAEMODORACEAE
Anigozanthos bicolor
A. humilis
A. manglesii
Conostylis androstemma
C. aurea
C. candicans
C. caricina
C. serrulata
C. setigera
C. setosa
Haemodorum laxum
H. simplex
Tribonanthes uniflora

HYPOXIDACEAE
Hypoxis occidentalis

IRIDACEAE
Orthrosanthus multiflorus
Patersonia babianoides
P. juncea
P. sericea

ORCHIDACEAE
Caladenia deformis
C. filamentosa
C. flava
C. gemmata
C. marginata
C. menziesii
C. patersonii
C. sericea
C. sp.
Calochilus robertsonii
Diuris laxiflora
D. longifolia
Drakaea elastica
Elythranthera brunonis
E. emarginata
Leptoceras fimbriata
Microtis unifolia
Pterostylis vittata
Spiculaea ciliata
Thelymitra antennifera
T. crinita
T. pauciflora
Paracaleana nigrita

APPENDIX VII. cont'd...

CASUARINACEAE
- Allocasuarina huegeliana
- A. humilis

PROTEACEAE
- Adenanthos barbigerus
- Banksia grandis
- B. sphaerocarpa
- Conospermum densiflorum
- Dryandra bipinnatifida
- D. carduacea
- D. fraseri
- D. nivea
- D. praemorsa
- D. sessilis
- Gevillea bipinnatifida
- G. pilulifera
- G. synapheae
- Hakea cristata
- H. erinacea
- H. incrassata
- H. lissocarpha
- H. prostrata
- H. ruscifolia
- H. stenocarpa
- H. trifurcata
- H. undulata
- Isopogon asper
- I. dubius
- Persoonia elliptica
- P. trinervis
- Petrophile serruriae
- P. striata
- Stirlingia latifolia
- Synaphea petiolaris

SANTALACEAE
- Leptomeria pauciflora
- Santalum acuminatum

LORANTHACEAE
- Nuytsia floribunda

POLYGONACEAE
- Meuhlenbeckia adpressa

AMARANTACEAE
- Ptilotus drummondii
- P. manglesii

DROSERACEAE
- Drosera gigantea
- D. leucoblasta (deep apricot form)
- D. leucoblasta (pale pink form)
- D. macrantha

APPENDIX VII. cont'd...

D. menziesii
D. pallida
D. platystigma
D. stolonifera

CRASSULACEAE
Crassula natans

PITTOSPORACEAE
Sollya fusiformis

LEGUMINOSAE SUBFAM. MIMOSOIDEAE
Acacia acuminata
A. barbinervis
A. drummondii subsp. elegans
A. laxocarpa var. sedifolia (very fine form)
A. laxocarpa var. sedifolia
A. microbotrya
A. nervosa
A. pulchella var. glaberrima
A. restiacea
A. saligna
Acacia urophylla
A. willdenowiana

LEGUMINOSAE SUBFAM. CAESALPINIOIDEAE
Labichea punctata

LEGUMINOSAE SUBFAM. PAPILIONOIDEAE
Bossiaea eriocarpa
B. ornata
Daviesia decurrens
D. hakeoides
D. horrida
D. polyphylla
D. preissii
D. rhombifolia
Dillwynia cinarescens
Gastrolobium calycinum
G. pulchellum
G. villosum
Gompholobium capitatum
G. knightianum
G. marginatum
G. shuttleworthii
G. tomentosum
Hovea chorizemifolia
H. trisperma
Isotropis cuneifolia
Jacksonia alata
J. floribunda
J. sternbergiana
Kennedia coccinea
K. prostrata
Sphaerolobium vimineum
Templetonia drummondii
Viminaria juncea

APPENDIX VII. cont'd...

LINACEAE
- Linum marginale

RUTACEAE
- Boronia ovata
- B. ramosa
- B. scabra
- Eriostemon spicatus

TREMANDRACEAE
- Tetratheca hirsuta
- T. nuda
- Tremandra diffusa

POLYGALACEAE
- Comesperma calymega
- C. aff. virgatum
- C. volubile

EUPHORBIACEAE
- Monotaxis grandiflora
- Phyllanthus calycinus
- Ricinocarpos glaucus

STACKHOUSIACEAE
- Stackhousia brunonis
- S. pubescens

RHAMNACEAE
- Cryptandra arbutiflora
- Spyridium tridentatum
- Trymalium angustifolium
- T. ledifolium
- T. spathulatum

STERCULIACEAE
- Thomasia foliosa
- T. glutinosa

DILLENIACEAE
- Hibbertia acerosa
- H. huegelii
- H. pachyrrhiza
- H. hypericoides
- H. lasiopus
- H. montana
- H. polystachya
- H. rhadinopoda
- H. aff. rhadinopoda
- H. sp.

THYMELAEACEAE
- Pimelia imbricata
- P. preissii
- P. suaveolens

APPENDIX VII. cont'd...

MYRTACEAE
- Baeckea camphorosmae
- Calothamnus sanguineus
- Calytrix angulata
- C. variabilis (white and pink forms)
- C. aff. variabilis
- Eucalyptus accedens
- E. calophylla
- E. camaldulensis
- E. marginata
- E. wandoo
- Kunzea recurva
- Leptospermum erubescens
- Lhotzkya brevifolia
- Melaleuca radula
- M. scabra
- Verticordia acerosa
- V. huegelii

HALORAGACEAE
- Glyschrocaryon aureum
- Gonocarpus cordiger

APIACEAE
- Daucus glochidiatus
- Eryngium pinnatifidum
- Trachymene pilosa
- Xanthosia ciliata

EPACRIDACEAE
- Astroloma ciliatum
- A. compactum
- A. macrocalyx
- A. pallidum
- Leucopogon nutans
- L. polymorphus
- Styphelia tenuiflora

SOLANACEAE
- Nicotiana rotundifolia

SCROPHULARIACEAE
- Parentucellia latifolia
- P. viscosa (white form)
- P. viscosa (yellow form)

LENTIBULARIACEAE
- Polypompholyx multifida
- P. tenella

LOBELIACEAE
- Isotoma hypocrateriformis
- Lobelia winfridae

GOODENIACEAE
- Dampiera alata
- D. cuneata

APPENDIX VII. cont'd...

D. lavandulacea
D. linearis
Goodenia filiformis var. pulchella
Lechenaultia biloba
Scaevola glandulifera
S. longifolia
S. platyphylla

STYLIDIACEAE
Levenhookia pusilla
L. stipitata
Stylidium amoenum
S. brunonianum
S. calcaratum
S. caricifolium ssp. caricifolium
S. carnosum
S. ciliatum
S. despectum
S. diuroides
S. hispidum
S. junceum ssp. junceum
S. perpusillum
S. petiolare
S. pubigerum
S. pulchellum
S. pycnostachyum
S. schoenoides
S. sp.

ASTERACEAE
Brachycome iberidifolia
Craspedia uniflora
Helichrysum bracteatum
H. leucopsidium
H. lindleyi
Helipterum cotula
H. manglesii
Lagenifera huegelii
Millotia myosotidifolia
Podolepis canescens
P. gracilis
P. lessonii
Senecio hispidulus
S. lautus
S. sp.
Trichocline spathulata
Ursinia anthemoides
Waitzia aurea
W. citrina (white form)
W. paniculata
W. suaveolens

APPENDIX VIII. RESULTS OF A PRELIMINARY TRAPPING PROGRAM ON MOONDYNE NATURE RESERVE

MAMMALS - MARSUPIALS

Cercartetus concinna	Western Pigmy-possum
Tarsipes rostratus	Honey Possum

REPTILES

Snakes

Denisonia gouldii	Little Whip Snake
Pseudechis australis	Mulga Snake

Lizards

Cryptoblepharus plagiocephalus	skink
Ctenotus lesueurii	skink
Ctenotus schomburgkii	skink
Diplodactylus granariensis	Wood Gecko
Diplodactylus polyophthalmus	gecko
Lerista distinguenda	skink
Lialis burtonis	Burton's Snake-lizard
Menetia greyii	skink
Morethia obscura	skink
Phyllurus milii	Thick-tailed Gecko
Pogona minor	Western Bearded Dragon
Tiliqua rugosa	Bobtail
Varanus gouldii	Bungarra
Varanus tristis	Racehorse Goanna

AMPHIBIANS

Heleioporus albopunctatus	Spotted Burrowing Frog
Heleioporus eyrei	Moaning Frog
Pseudophryne guentheri	Guenther's Toadlet