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Native Vegetation Handbook for the Shire of Wickepin

Shaun B. Grein

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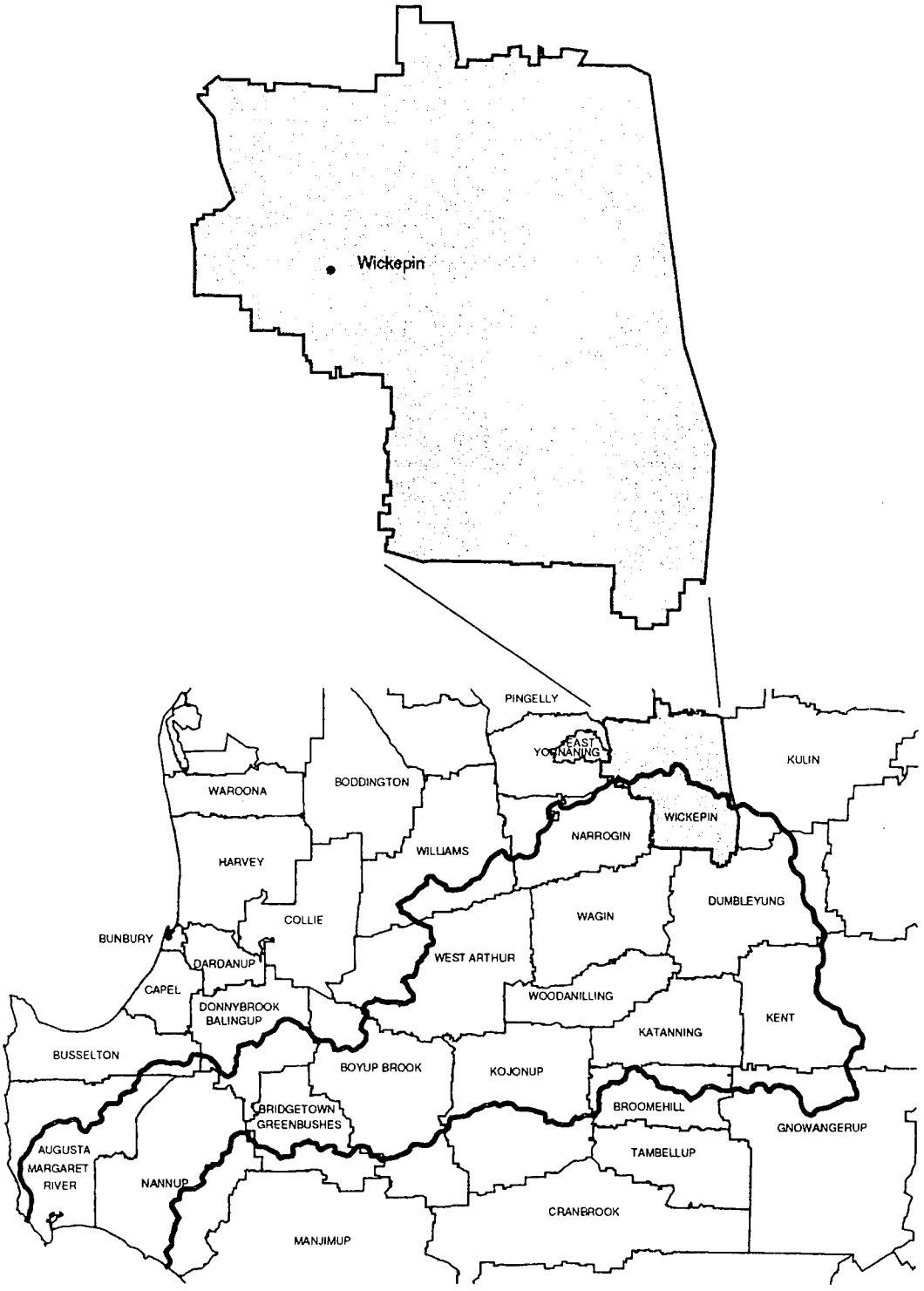

DEPARTMENT OF AGRICULTURE
WESTERN AUSTRALIA

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Greening Western Australia

Australian Nature Conservation Agency

Copies of Native Vegetation Handbook for the Shire of Wickepin are available by contacting:
The Spatial Resources Information Group
Western Australian Department of Agriculture, South Perth
Phone: (09) 368 3732

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Cover: The Shire of Wickepin in relation to the Blackwood River Catchment (indicated by bold line).

NATIVE VEGETATION HANDBOOK

FOR THE SHIRE OF WICKEPIN

Shaun B. Grein

Spatial Resources Information Group

Land Management Branch

Division of Regional Operations

Western Australian Department of Agriculture

Produced by the Western Australian Department of Agriculture, the Environmental Protection Authority and Greening Western Australia with the assistance from the Commonwealth Government through the Australian National Conservation Agency's Save the Bush Program.

May, 1994

Contents

List of Figures

The Vegetation Handbook for the Shire of Wickepin is one of a series covering the Agricultural region of Western Australia. Other handbooks in the series that have been completed are:

The Shire of Dumbleyung
The Shire of Corrigin
The Shire of Wagin
The Shire of Katanning
The Shire of Narrogin
The Shire of Mingenew

The Shire of Wickepin

Introduction

Purpose of this Booklet

This project has arisen from the need to provide data to people in rural communities, land conservation districts (LCDs) and local government authorities who manage the remnant native vegetation within rural areas, whether on a regional, catchment or local basis.

This booklet is one of a series covering the agricultural region of Western Australia. The management of native vegetation and agricultural land is closely related. It is vital that both native vegetation and agricultural land issues are considered within the context of their ecological area of influence. Both have a wide range of effects on each other and as a consequence should be managed together. For example native vegetation has an effect on the hydrology of agricultural land, and nutrients can be transferred from farmland to remnants of native vegetation.

This booklet provides land managers with information relating to the natural resources of the Shire of Wickepin including the existing vegetation, drainage systems and soils. Some of the problems relating to the management of natural vegetation resources in the Shire of Wickepin and possible solutions to these problems are also discussed. By providing this information it is hoped this booklet will contribute to the long term viability of the agricultural landscape and the conservation of native vegetation within the Shire.

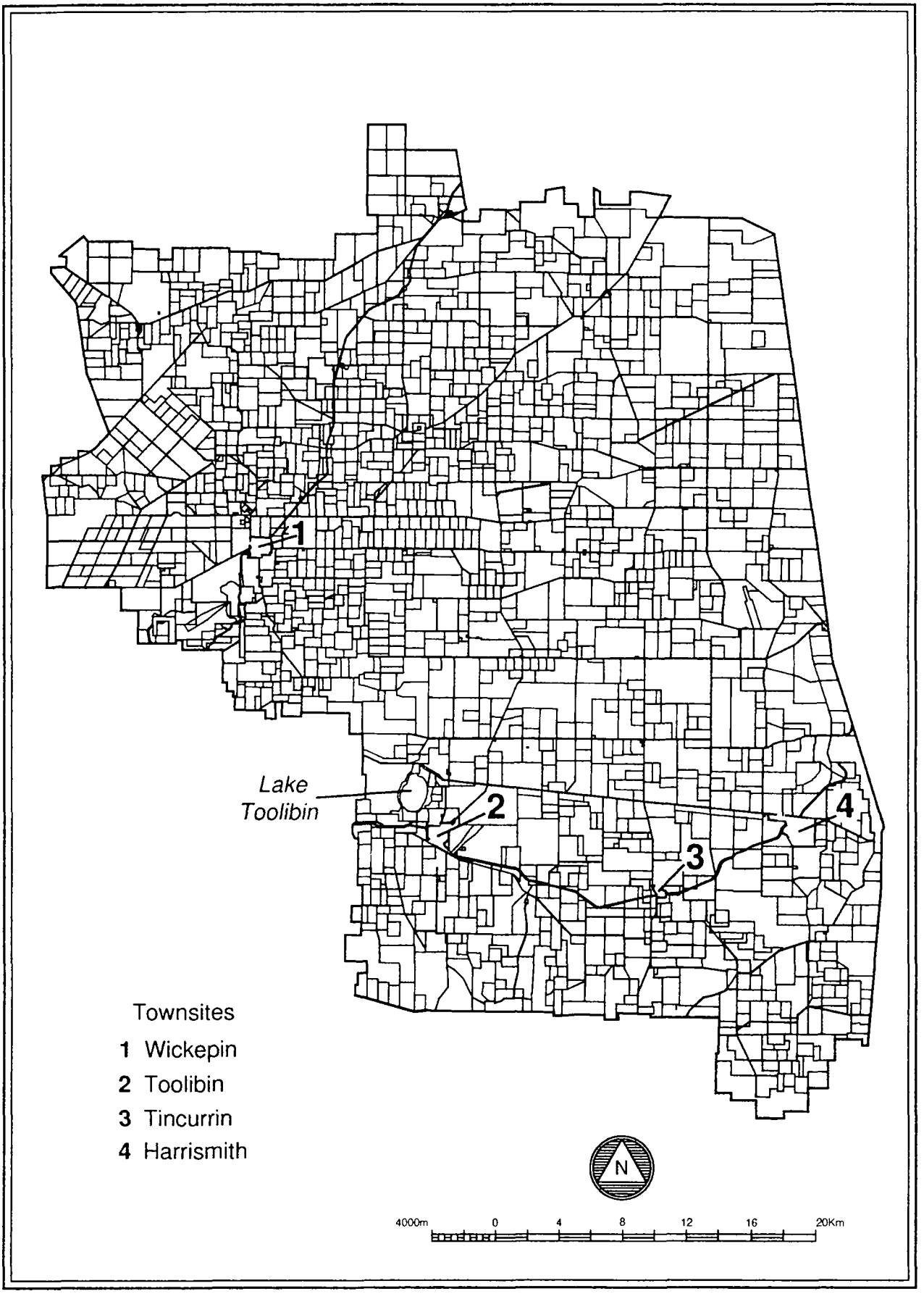

Figure 1 Cadastral Boundaries and townsites in the Shire of Wickepin.

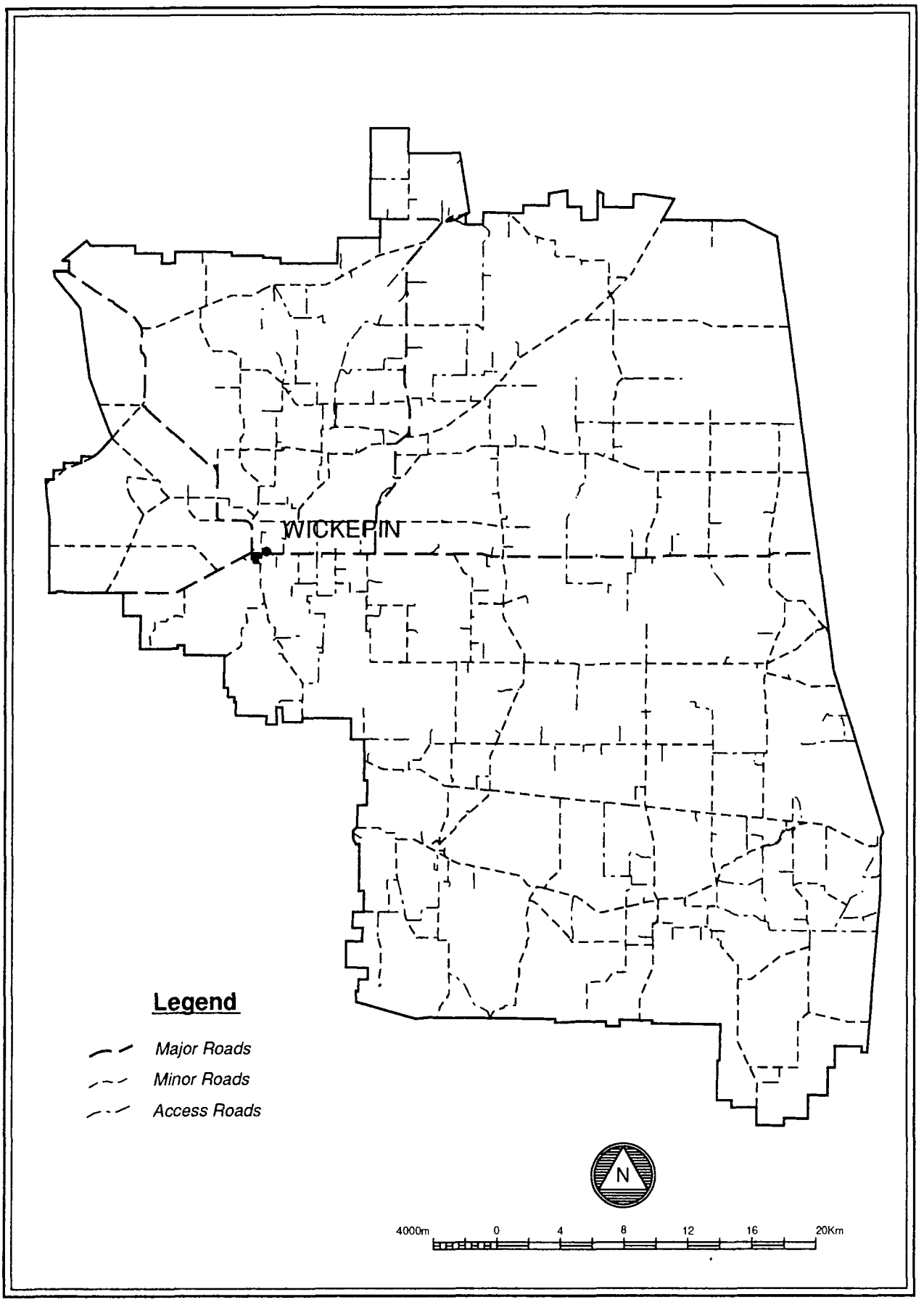

Figure 2 All major, minor and access roads in the Shire of Wickepin.

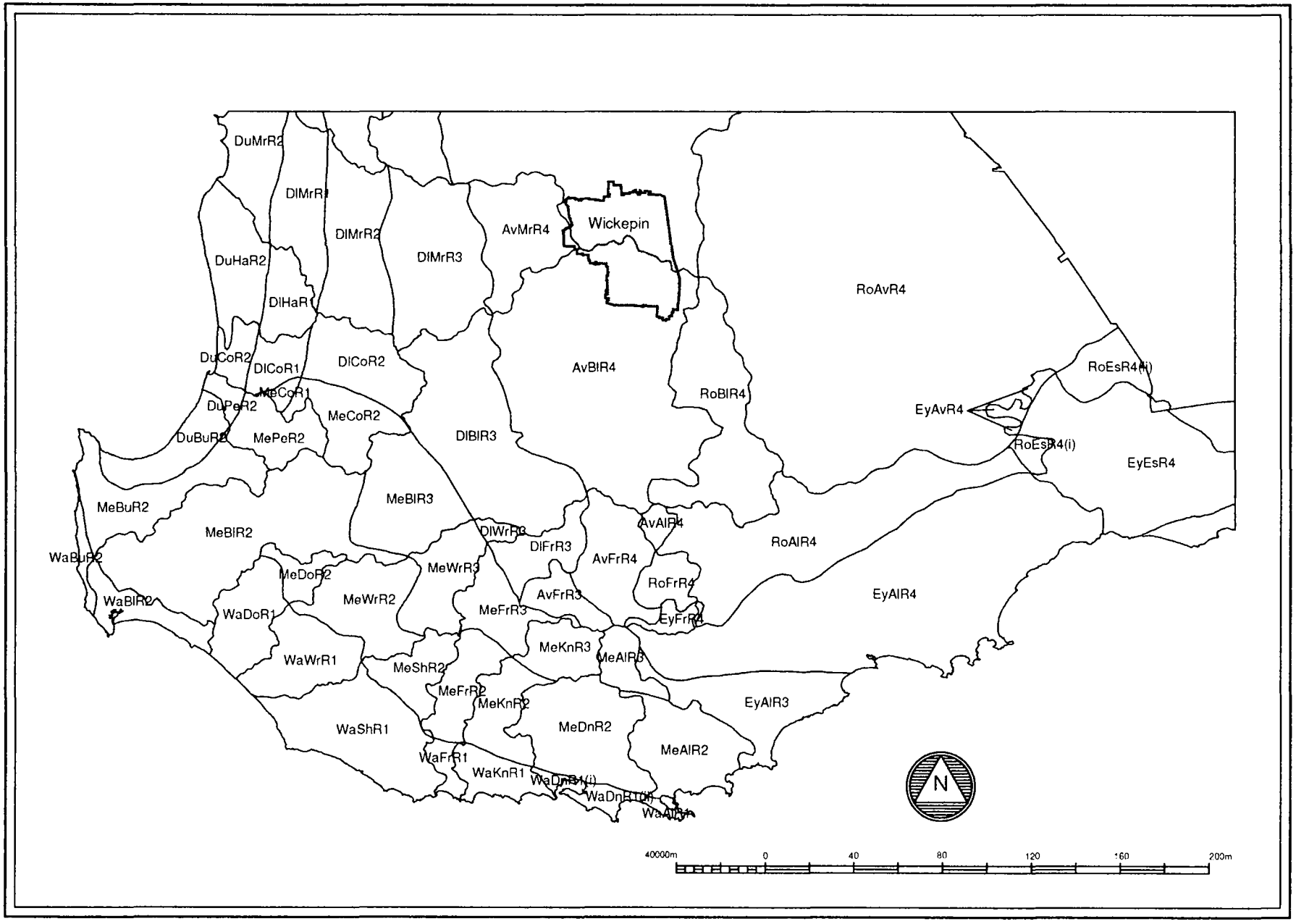

Figure 3 The Shire of Wickepin in relation to the Natural Resource Zones of the South-West Land Division of Western Australia (Allison, *et.al* 1993).

The Shire of Wickepin

The Shire of Wickepin covers an area of 202347 hectares. Much of the southern region of the Shire is located in the Blackwood River Catchment (see cover map) and is drained by the upper reaches of the Blackwood River. The northern region of the Shire is drained by the Avon River. Townsites in the Shire include Wickepin, Yealering, Toolibin and Harrismith (Figure 1).

The Shire's climate is regarded as Mediterranean, with dry, warm summers and cool winters. It receives on average, 505 mm rainfall per annum. The average maximum temperature ranges from 31^{0}C in January to 14^{0}C in July, while the corresponding average minimum temperatures ranges from 15^{0}C in January to 6^{0}C in August. The population of the Shire was 912 in 1988 (Pink, 1991). Agricultural land use in the Shire is predominantly wheat and sheep:- in 1991/92 a total of 39860 hectares of the Shire was sown with wheat, 99894 hectares with sown pasture and grasses, 11451 hectares of native pastures, 394 hectares with hay and 5447 hectares left fallow (ABS, 1992). The cadastral boundaries in the Shire are shown in Figure 1 and all 911 kilometres of road network in the Shire is shown in Figure 2

The South-west of Western Australia has been divided into districts (called Natural Resource Zones) on the basis of their natural resources ie vegetation type, drainage/catchment system and rainfall (Allison *et al.*, 1993). The Shire of Wickepin contains parts of two Natural Resource Zones (No.62 and No.60) (Figure 3) making it a mosaic of two vegetation types and two catchments within an area receiving less than 500 mm rainfall per annum.

The Wickepin Land Conservation District (LCD) formed in 1985 and is based on the Shire's boundaries. It is among the best organised and most successful Land Conservation District Committees (LCDCs) in the State.

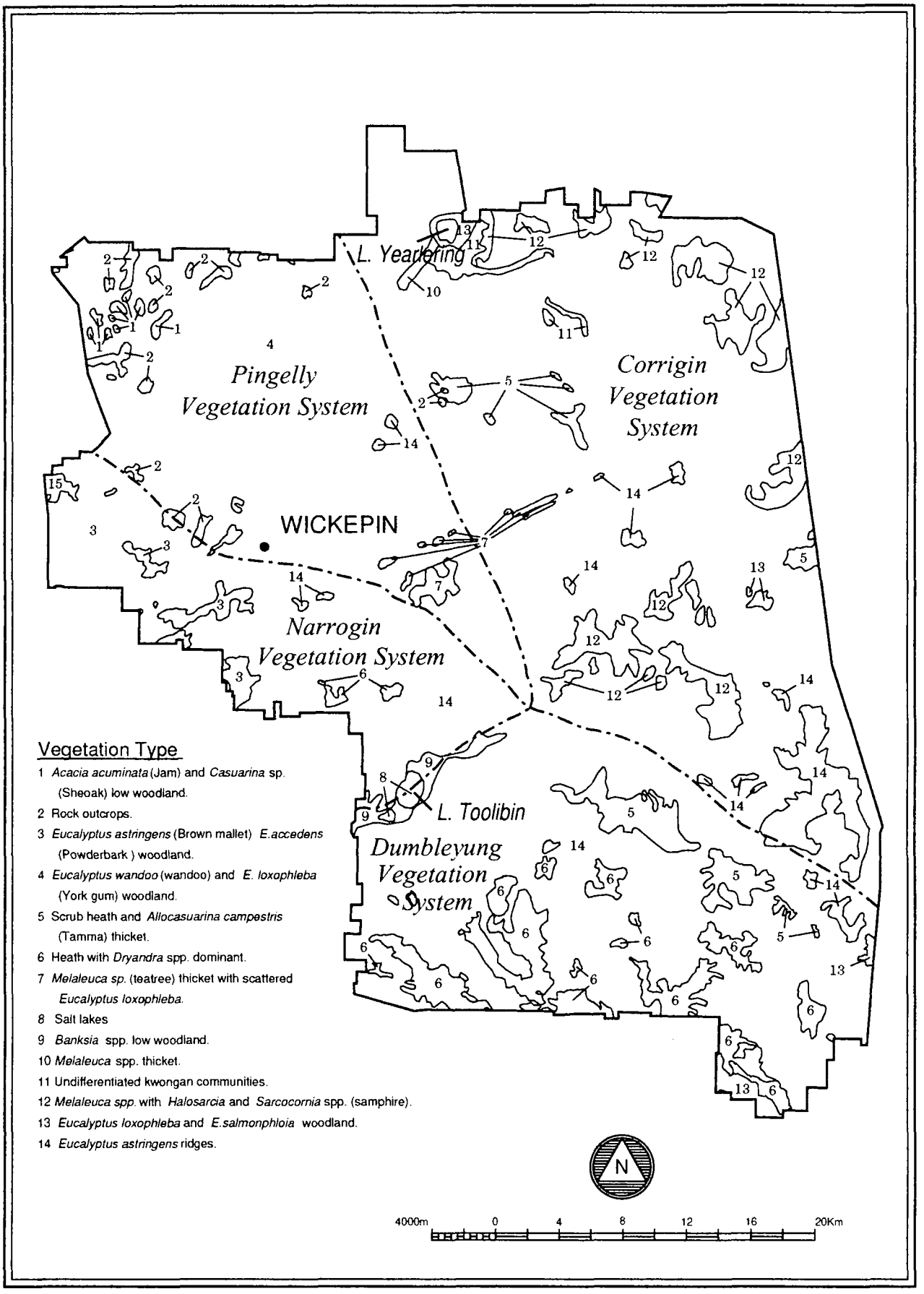

Figure 4 Vegetation systems (italics, dashed line) and major vegetation types (continuous line) in the Shire of Wickepin (According to Beard, 1976, 1980b).

Vegetation of the Shire of Wickepin - Past And Present

Native vegetation has been degraded in a variety of ways as a consequence of the extensive clearing and agricultural practices. In the South-west of Western Australia, clearing for agricultural purposes has resulted in the removal of 85-95% of native vegetation. More than 80% of plant species now extinct were formerly found on land cleared for agriculture.

Physical factors such as soil and climate combine to produce natural ecological regions, within which the plant life essentially similar. Western Australia is divided into three Botanical Provinces (ie. natural ecological regions) - the South-Western, the Eremaean, and the Northern (Beard, 1980a). The Botanical Provinces are in turn divided into Botanical Districts and then into Vegetation Systems. The Shire of Wickepin lies within the Avon Botanical District of the South-West Botanical Province and contains portions of four Vegetation Systems - Corrigin, Narrogin, Pingelly and Dumbleyung (Figure 4). Each of these Vegetation Systems consists of a series of plant communities occurring in a mosaic pattern which are closely linked to topographic and soil features.

Brief Description of the Vegetation Systems

This section is based on the plant distribution studies of J.S. Beard and further detail can be obtained from the following references - i) Beard, J.S., (1976). *The Vegetation of the Corrigin Area: Vegetation Map and Explanatory Memoir (1:250,000 series).* Vegmap Publications, Perth. ii) Beard, J.S., (1980b). *The Vegetation of the Dumbleyung Area: Vegetation Map and Explanatory Memoir (1:250,000 series).* Vegmap Publications, Perth.

The type of vegetation is closely related to the soil type on which it grows. In fact many of the soil types of the Shire are recognised by their associated type of vegetation.

The eastern boundary of the **Corrigin Vegetation System** corresponds with the beginning of mallee country (Figure 4). This System is characterised by a hilly and deeply dissected landscape with the northern area of the System well drained by the upper reaches of the Avon River. The higher ground is capped by large patches of sand and laterite with the laterite usually appearing at the surface of the edges of sandplains. It rarely occurs as breakaways. There are some salt lakes in the vicinity of Lake Yealering with saltbushes on adjoining flats. However valley floors are not necessarily salt. Within the Corrigin System there are four principle types of

vegetation: kwongan (scrub vegetation) on sandplains, patches of mallee, woodland on slopes and flats and in the valley floors teatree thickets or teatree and samphire.

Mallee species recorded in this System are principally black marlock (*Eucalyptus redunca*), lerp mallee (*Eucalyptus incrassata*) tall sand mallee (*Eucalyptus eremophila*) and capped mallee (*Eucalyptus pileata*) with a closed understorey usually present. Woodland or low woodland of brown mallet (*Eucalyptus astringens*) is found on elevated breakaways, while its associate powderbark (*Eucalyptus accedens*) is found in the western part of the System. Brown mallet is replaced by blue mallet (*Eucalyptus gardneri*) in some localities. Wandoo (*Eucalyptus wandoo*) tends to occur mainly on the upper slopes below the sandplain, while York gum (*Eucalyptus loxophleba*) occurs mainly on middle slopes.

Salmon gum (*Eucalyptus salmonophloia*) and red morrel (*Eucalyptus longicornis*) are found on flats with heavy soil, while flooded gum (*Eucalyptus rudis*) occurs along major creeks along with lesser bottlebrush (*Callistemon phoeniceus*). Along salty creeks swamp sheoak (*Casuarina obesa*) and *Melaleuca hamulosa* with samphire are common.

The South-west corner of the Shire contains vegetation typical of the **Narrogin System** (Figure 4). The System extends south of Karping and Wickepin, and southwards into the Dumbleyung Vegetation System. The country is less dissected than the Pingelly System so substantial areas of laterite-capped plateau remain. As rainfall in this area is higher than in the Pingelly System, the plateaux are covered by woodland of brown mallet and powderbark, except for local patches of heath. Woodlands of York gum and wandoo cover the dissected country below the breakaways. In the west, wandoo is on the upper and York gum on the lower slopes. Flooded gum often lines major drainage channels. There are some teatree and samphire around Toolibin Lake and the other small salt lakes below it. In the south-east of the System there are a few prominent granite outcrops.

The **Pingelly System** lies to the north of the Narrogin System and extends southwards as far as Wickepin (Figure 4). The eastern boundary extends from the eastern end of Yenyening Lake to Wickepin and the southern boundary from Karping to Wickepin. The landscape is undulating, hilly, deeply dissected with remnants of lateritic crust capping higher ground to form prominent mesas. Numerous granite exposures also occur, forming conspicuous domes and tors. While ten main vegetation types which occur in the Pingelly System, only a few of these can be

found in the Shire of Wickepin. Much of this System in the Shire consists of a mosaic of jam (*Acacia acuminata*) and rock sheoak (*Allocasuarina huegeliana*) low woodland with numerous rock outcrops, York gum and wandoo woodland.

A small portion of the **Dumbleyung System** occurs in the Shire, south-east of Lake Taarblin and Toolibin (Figure 4). For practical purposes, the vegetation of this small section of the Dumbleyung System is the same as that of the Narrogin System.

Current Extent of Native Vegetation

The total area of native vegetation in the Shire of Wickepin has been significantly reduced through rapid broadscale clearing for agricultural purposes. However, much of the native vegetation that remains in public reserves and on private land is similar in composition to that which existed previously, although the extent of cover has been significantly reduced.

Approximately 8% of the Shire of Wickepin remains covered by original native vegetation, five percent (10335 ha) of which is found on private land. The remaining three percent (5320 ha) exists as public reserves.

In the Shire of Wickepin there are 579 bush remnants, of which 93% or 541 remnants are regarded as being "remnant vegetation", 4% or 23 remnants regarded as being "scattered trees" and 2.5% or 15 remnants as being of "modified vegetation". More than 75% of all bush remnants in the Shire are less than 20 ha in area (Beeston *et al.*, 1993)(Figure 5).

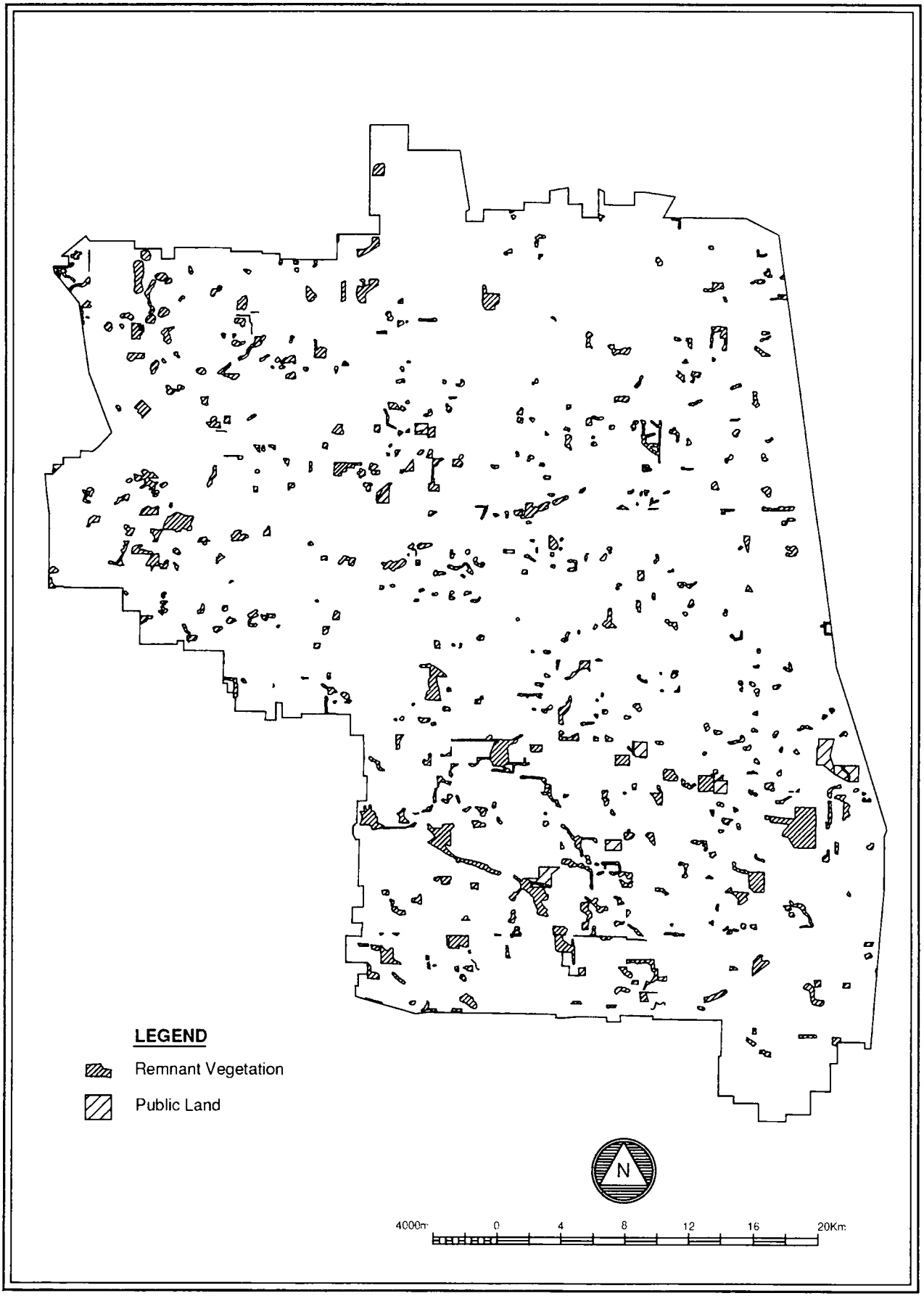

Figure 5 The Shire of Wickepin showing native vegetation cover. Over eight per cent of the Shire remains vegetated, with most on private land.

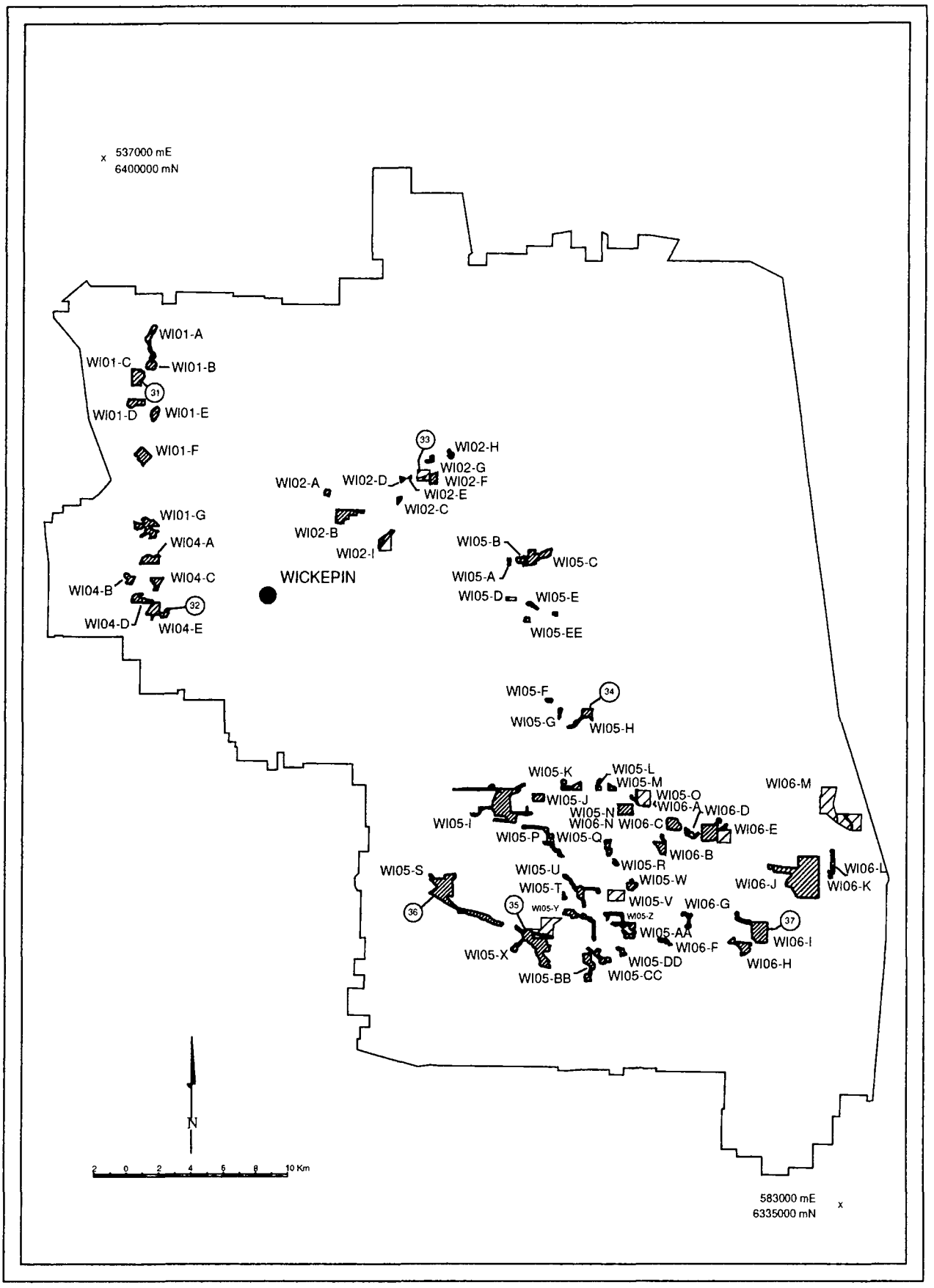

Figure 5a. The Shire of Wickepin showing remnant vegetation areas surveyed in detail and where information was acquired by general observation.

Vegetation classed as "remnant vegetation" has one or more of the following characteristics (Beeston *et al.*, 1993) :

* Most closely reflects the natural state of vegetation for a given area.
* Has an intact understorey (if forest or woodland).
* Has minimal disturbance by agents of human activity.

Vegetation classed as "modified vegetation" has one or more of the following characteristics:

* Degraded understorey (i.e. reduction in the number of native species, includes weeds).
* Obvious human disturbance- clearing, mining, grazing, weeds.
* Affected by salt.
* Narrow corridors of vegetation (usually along roads and railway lines or windbreaks), which are more likely to be affected by edge effects.

Vegetation classed as "scattered vegetation" have:

* No understorey.
* Parkland cleared i.e. are scattered single trees
* No significant signs or chance of regeneration.

In 1991 Frans Mollemans undertook a botanical survey of the Shire of Wickepin (Mollemans, unpub.)(N.B. Copies of the findings of this survey are available by contacting the Spatial Resource Information Group, WADA, 368 3732). A total of 61 bush remnants were surveyed including seven in detail (Figure 5a).

Those in the north-western corner of the Shire contained a mosaic of rock sheoak and eucalypt woodland on either pale yellow brown sand or gravel soil. Rock sheoak tends to be the most dominant species in remnant in this area. Remnants to the west of the Wickepin townsite are dominated by sheoak-eucalyptus-jam-acacia sp. woodland on sand and loam soil, with flat granite outcropping. Remnants in the north of the Shire are a mosaic of areas of salmon gum woodland, sheoak and eucalypt woodland and scrub, tamma (*Allocasuarina campestris*) scrub. Remnants in the vicinity of Lake Toolibin are dominated by eucalypts and sheoak over heath, with *Banksia* scrub over *Eremaea-Leptospermum* heath, jam, York gum and sheoak over heath. Wandoo, York gum, jam and sheoak over roadside teatree (*Leptospermum erubescens)* heath occurs less frequently.

Wetlands

Wetlands are defined by the Wetlands Advisory Committee as ".... areas of seasonally, intermittently or permanently waterlogged soils or inundated land whether natural or otherwise, fresh or saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and tributaries".

The rise of saline groundwater as a result of the clearing of native vegetation has been well documented throughout the agricultural region. The wetlands of the wheatbelt have suffered enormous changes as a result of these salinisation processes.

Most of the wetlands in the Blackwood River Catchment were fresh or near fresh until the 1940's. Prior to increases in salinity the wetlands were covered by sheoak, paperbark and teatree. When shooting ducks during the late 1930's and early 1940's, locals recalled that it was possible to become lost in the heavy undergrowth on Lake Toolibin and that Lake Yealering was so fresh in the early 1930's that sheep used to drink directly from it (Sanders, 1991). Animal life in the wetlands of the Blackwood was varied and diverse and quite different to that which occurs today.

Environmental changes in the wetlands of the Blackwood Catchment began with the rise of the saline water table that followed the "opening up" of the wheatbelt in the early 1900's. The salinity changes in the Blackwood River catchment began to take effect in 1940, which was earlier than many other wheatbelt catchments as the region was settled and cleared earlier. These changes were quickly followed by the death of vegetation fringing lakes and wetlands in the catchment. The extensive reedbeds and *Marsillea* sp. (nardoo) that were found in Lake Toolibin began to disappear as a result of these changes and were no longer present in any Blackwood River catchment wetland after the early 1970's (Sanders, 1991).

Many of the vertebrate animals (including water-rats, water birds, reptiles, frogs) that were once common to wetlands and the surrounding areas have now disappeared. This could be because of increased wetland salinity or the decline of their prey or related to predation by introduced animals, habitat destruction or other factors.

The Shire of Wickepin has several wetland areas within its boundaries. Some of the main ones include Lake Dulbining and Lake Toolibin. Both of these lakes are drained by the upper reaches of the Arthur River.

Lake Dulbining, approximately 13 kilometres south-east of Wickepin is a moderate-sized, brackish, seasonally inundated lake with few areas of open water. Extensive stands of swamp sheoak are present as a woodland over most of the lake and occasionally occur as thickets. Paperbarks occur intermittently amongst the thickets and throughout the woodland when the lake is dry. Samphires such as *Halosarcia pergranulata, Halosarcia lepidosperma* and *Crassula sp.* grow on the lake bed. Swamp sheoak also grows above the water mark at the edge of the lake and on higher ground is replaced by eucalypt woodland (Halse *et al.*, 1993).

Lake Toolibin is one of the few "fresh" water lakes that remain in the agricultural area. It lies at the headwaters of the Arthur River, to the east of Narrogin and just south of Lake Dulbining. The lake and the surrounding environment support 24 species of breeding waterbirds, more than any other wetland in the south west of Western Australia. In total, 41 species of waterbirds have been recorded there, the highest species richness of any inland lake in the south west. It is a large (296.5 ha with a vegetated area of 253.2 ha) slightly brackish, semi-permanently inundated lake. Figure 6 shows the vegetation associations that presently occur in and around Lake Toolibin. It contains very dense thickets of swamp sheoak, *Melaleuca strobophylla* and occasional flooded gums below the water mark. A few swamp sheoak reach 12 m in height. Many trees have died on the western side of the lake as a result of increasing salinity. There are also a few dead trees (mostly flooded gum) in the open lagoon on the eastern side of the lake. When the lake is dry, samphire species *Halosarcia lepidosperma, Halosarcia pergranulata* and *Halosarcia indica* occur on the lake bed as open shrubland. There are patches of *Atriplex exilifolia, Carpobrotus sp., Goodenia visida* and *Wilsonia humilis* among the samphire (Halse *et al.*, 1993).

Surveys of waterbird populations show that Lake Toolibin is the most important inland wetland in the region. More waterbird species were recorded breeding in Lake Toolibin than in any of the other 251 wetlands examined in surveys conducted by the Royal Australasian Ornithologists Union (R.A.O.U.) surveys conducted between 1981 and 1985 (Northern Arthur River Wetlands Committee, 1987).

The main reason for the high number of waterbirds in Lake Toolibin appears to be due to extensive, dense thickets of swamp yate and *Melaleuca* sp. occurring through much of the inundated area. Live vegetation in the lake is of paramount importance in providing suitable nesting sites for most species breeding there (Northern Arthur River Wetlands Committee, 1987).

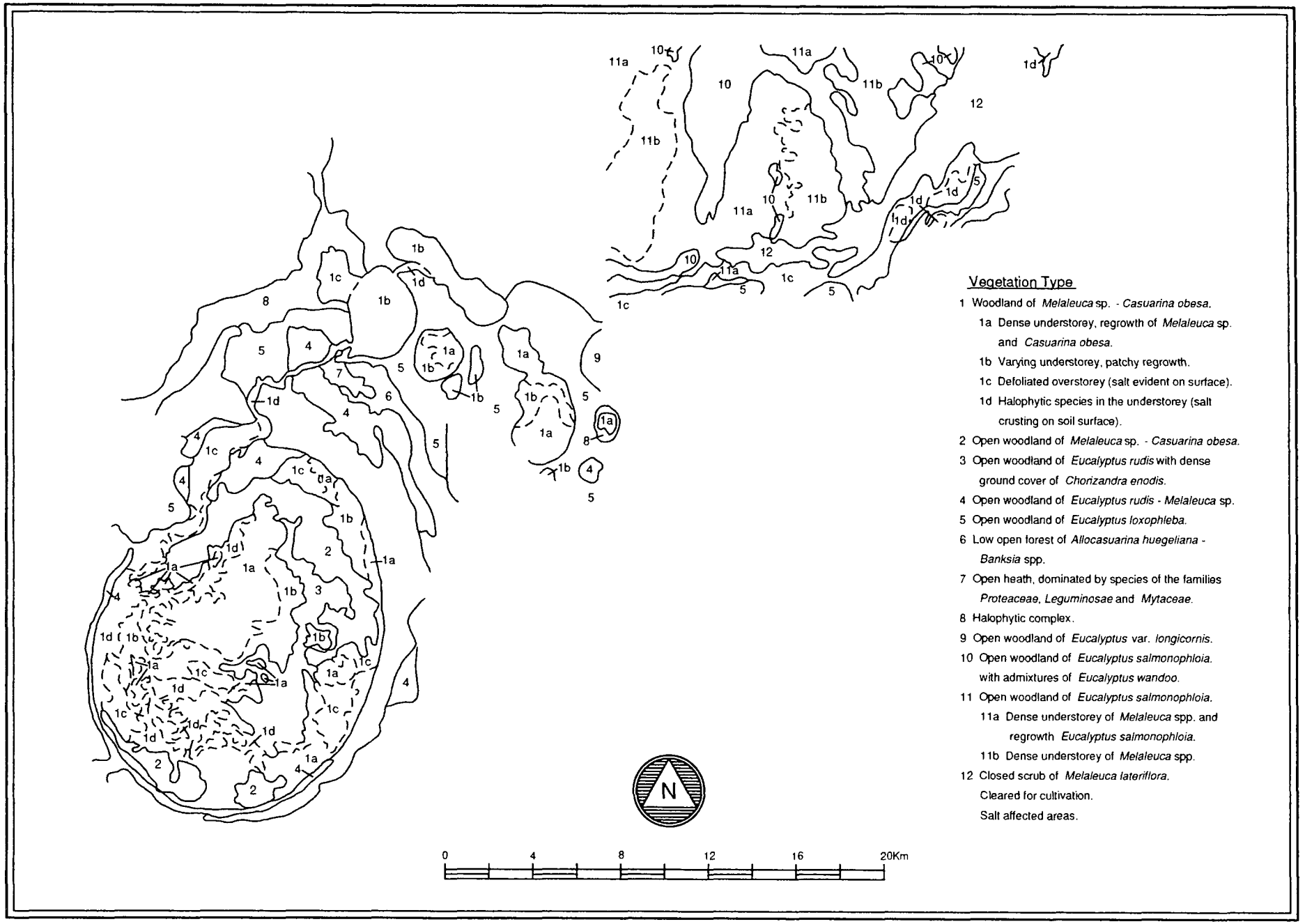

Figure 6 Vegetation map of Lake Toolibin and associated Reserves (taken from Arthur River Wetlands Committee, 1987).

An enormous recovery plan for Lake Toolibin is currently underway and is being coordinated by a number of government agencies and private consultants. The principal goals of this recovery plan are to protect and rehabilitate Lake Toolibin and its environment as a freshwater ecosystem. The protection and rehabilitation of the lake ecosystem also requires detailed consideration of requirements for protecting and rehabilitating the total catchment. Considerable sums of money have already been spent on groundwater pumping (to discharge rising water table) and surface water control to prevent waterlogging and surface water runoff. The revegetation of the catchment of Lake Toolibin is considered to be essential for the long-term recovery of the lake and extensive revegetation and regeneration programs will be implemented over the next ten years.

The amount of salinized land in agricultural areas is still increasing (Schofield *et al.*, 1988), which means that wetlands will continue to become saline and that there will be resultant changes in wetland vegetation. Although it may be too late to rehabilitate most of the degraded wetlands in the Shire of Wickepin, a greater understanding of how and why they have changed may assist in the management of the few undisturbed wetlands remaining in the Wheatbelt

Fauna

The clearing of large amounts of natural bushland for agriculture, the introduction of feral animals, alterations to fire regimes and other disturbances have caused the local extinction of 17 of the 43 species (40%) of mammals recorded from the Wheatbelt since European settlement. Only 12 of the 43 species are now considered to be moderately common to abundant (Kitchener *et al.*, 1980). Most of the original species of birds still occur in the wheatbelt, although several species have been lost from particular nature reserves (Kitchener *et al.*, 1982). Birds such as whistlers and fairy wrens have not coped well with the changes associated with clearing and are generally declining in numbers. They may well become locally extinct. Species such as Carnaby's Cockatoo (*Calyptorhynchus funereus latirostris*) and Major Mitchells Cockatoo (*Cacatua leadbeateri*) have undergone a significant reduction through loss of habitat (Saunders *et al.*, 1985).

In the south west of the state, 83% of the land birds are dependant on native vegetation for all or some of their annual requirements (Smith, 1987). Continued loss of these bird species can therefore be expected due to degradation of remnant vegetation and continued clearing. However some species such as galahs (*Cacatua roseicapilla*), ravens (*Corvus coronoides*), crested pigeons (*Ocyphaps lophotes*),

magpies (*Gymnorhina dorsalis*) and wood-ducks (*Chenonetta jubata*) have benefited from increased agricultural development and are increasing in numbers.

In the Shire of Wickepin animals commonly seen include the western grey kangaroo (*Macropus fuliginosus*) the western brush wallaby (*Macropus sperma*) and the echidna (*Tachyglossus aculeatus*) and reptiles including the bobtail (*Tiliqua ragosa*), the blue tongue lizard (*Tiliqua occipitalis*), the dugite (*Pseudonaja affinif*), the mulga snake (*Notechis australis*) and a variety of geckos. Animals which are considered to be the under threat of extinction and are being monitored include the tammar wallaby (*Macropus eugenii*), the brush wallaby (*Macropus irma*), the Red-tailed Black-Cockatoo (*Calyptorhynchus magnificus naso*) and Carnaby's Cockatoo (*Calyptorhynchus funereus latirostris*). Most of these species are under threat because of introduced predators, loss of habitat and of their preferred food. No specific faunal surveys have been undertaken in the Shire, although general reconnaissance surveys have been regularly been carried out by wildlife officers from the Department of Conservation and Land Management's Narrogin District Office.

Rare and Endangered Flora

Three of the 238 species Western Australian plants declared endangered are found in the Shire of Wickepin (Hopper *et al.*, 1990).

The three Rare and Endangered species of flora found in the Shire of Wickepin are:

1. ***Calectasia arnoldii*** **ms** - Very erect growing plant to 30 cm with numerous stilt roots. Some projection from upper branches. Found between Corrigin and Dumbleyung.

2. ***Conostylis seorsifolia*** subsp. ***trichophylla.***(Hairy Mat Conostylis) - A prostrate mat-forming herb with solitary flowers and flat silvery leaves to 8 cm long. Grows in winter-wet loam beneath wandoo woodland near Tincurrin. Flowering period - October to November.

3. ***Leschenaultia pulvinaris*** (Cushion Leschenaultia) - A prostrate shrub forming low cushions to 7 cm tall by 30 cm in diameter which are covered in masses of attractive blue flowers in early summer. Occurs on sandplain often near low-lying seepage areas between York and Lake Grace. Flowering period - October to December.

There are compelling reasons for focussing conservation efforts on endangered species. From an asthetic perspective, it is clear that there lies an opportunity to appreciate and study the biological diversity and attractiveness of many of these

endangered flora. Equally compelling is the fact the extinction of a species constitutes an irreplaceable lost opportunity for plant utilisation by humans. Some of the worlds rare species proven to be of outstanding economic value. Also as so little is known of the biochemistry of many of these species, there lies the possibility of discovering cures to major human diseases. For example it has recently been publicised that smokebush (*Conostephinum* spp.) may possibly provide a potential cure for AIDS.

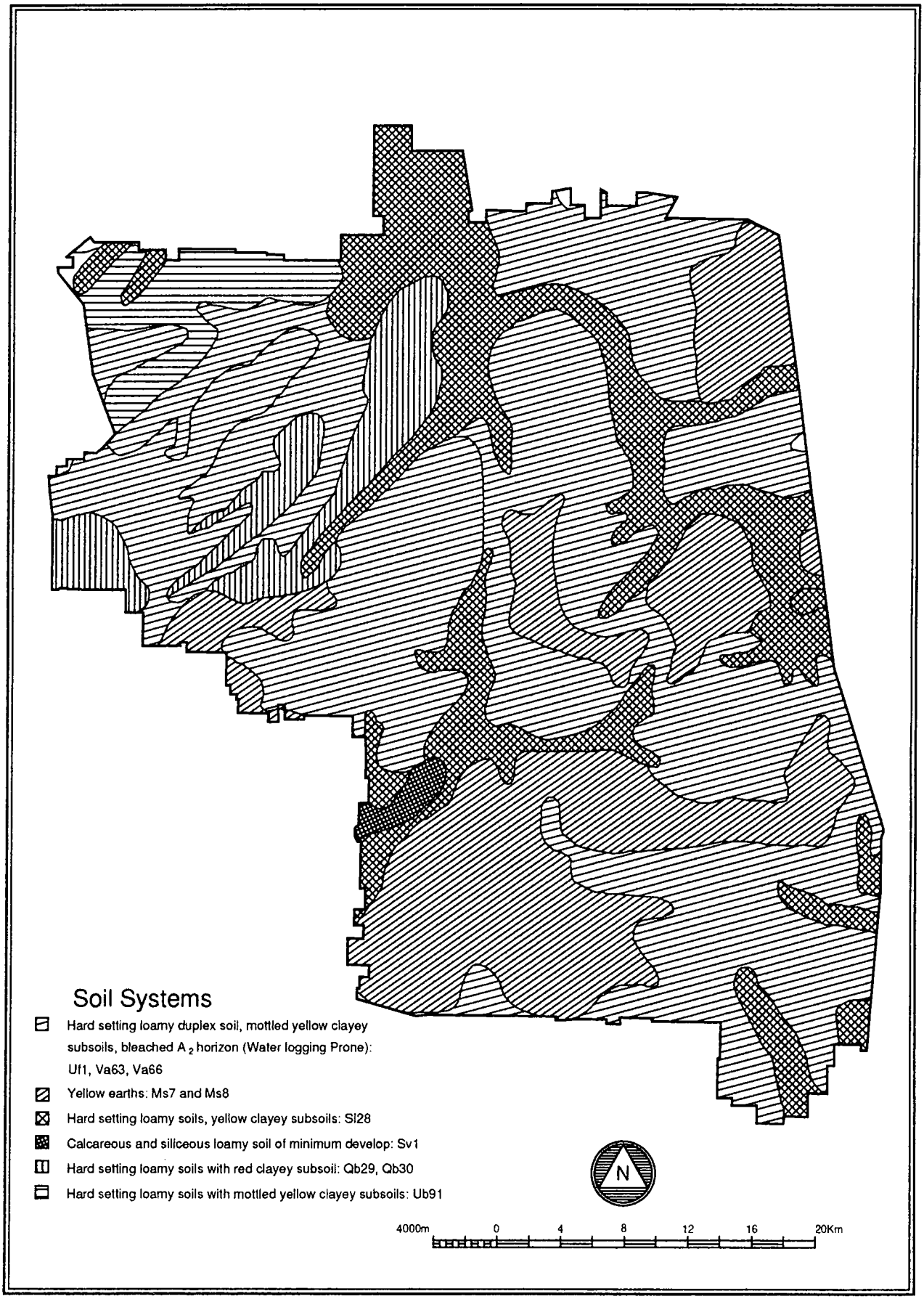

Figure 7 The six main soil systems of the Shire of Wickepin, each of which is a mosaic of different soil types.

Land Resources

Geology

The Shire of Wickepin is almost entirely underlain by granitic rocks, covered by alluvium in the major valleys. Rock outcrops are mainly confined to the catchment of Northwest Creek and indicate that the catchment is underlain by ancient granites of the Yilgarn Block. Generally the basement rocks are mantled by a lateritised, deeply weathered profile. Large dolerite dykes outcrop frequently on the catchment divides indicating that they may exert a predominant geological control on the current drainage pattern. It is assumed by hydrologists that the topographic divide is also a groundwater divide and that regional groundwater flow from outside the catchment does not occur. Numerous soaks occur in the eastern part of the Shire at the contact between sandy slopes and the clay flats indicate the existence of perched groundwaters beneath the sandplain soils.

Soils

The distribution of the six soil landscape systems for the Shire of Wickepin is shown on Figure 7 (Northcote *et al.*, 1967). Within some of these are sub-systems known as soil types. The ten types within the six soil landscape systems differ mainly in their position within the topographic profile and form a mosaic of soil landscapes.

To the east of the Shire, the sandplain soils of the ancient plateau are extensively preserved. To the west, greater stripping of the landscape has produced shallow duplex soils formed on the lateritic profile, and resulted in the surface drainage system being better defined than that to the east. A key to understanding the five soil units which occur in the Shire follows:

1) *Hard-setting loamy duplex soils, mottled yellow clayey subsoils, bleached A_2 horizon (waterlogging prone)*

i) **Uf 1** - undulating with ridges, spurs and lateritic mesas and buttes. Chief soils on broad undulating ridges and spurs are hard, and also sandy, neutral, and also acidic, yellow mottled soils all containing ironstone gravels.

ii) **Va 63** - valley plains and terraces. Chief soils are hard alkaline yellow mottled soils.

iii) **Va 66** - gently undulating to rolling terrain with some ridges and uneven slopes. Chief soils are hard alkaline yellow mottled soils and hard alkaline red soils.

2) *Yellow earths*

i) **Ms 7** - Gently sloping to gently undulating plateau areas with long and very gentle slopes and , in places, abrupt erosional scarps. Chief soils are on gently convex slopes of the plateau, sandy yellow earths containing ironstone gravels.

ii) **Ms 8** - Gently sloping to gently undulating plateau area or uplands with long and very gentle slopes and, in places, abrupt erosional scarps. Chief soils are on depositional slopes, sandy yellow earths containing ironstone gravels, and yellow earthy sands often with ironstone gravels.

3) *Hard-setting loamy duplex soils, red clayey subsoils*

i) **Qb 29** - Rolling to hilly with some steep slopes, gneiss outcrops common. Chief soils are hard neutral red soils.

ii) **Qb 30** - Rolling to hilly with some steep slopes; rock outcrops common with some lateritic mesas and buttes on drainage divides. Chief soils are hard neutral red soils and acidic red soils.

4) *Hard-setting loamy soils, yellow clayey subsoils*

i) **SI 28** - Broad flat valley with clay pans and salt-lake remnants in some localities. Chief soils are hard alkaline yellow underlain by acid lateritic clays.

5) *Calcareous and siliceous loamy soils of minimal development*

i) **SI 1** - Saline valleys and salt lakes.

6) *Hard-setting loamy soils with mottled yellow clayey subsoils*

i) **Ub 91** - Undulating to hilly with some steep slopes; tors common; some lateritic mesas and buttes on drainage divides. Chief soils are hard neutral and acidic yellow mottled soils sometimes containing ironstone gravels.

Topography

The eastern region of the Shire of Wickepin can be described as being a terraced or flat to broad alluvial plain, typical of many central wheatbelt shires. The west of the Shire is relatively hilly, particularly in the Yarling Brook and the western part of the North Toolibin Lake Catchment. The most significant features in the Shire are Walters and Uleling Hills and Lake Toolibin. Six major river catchments drain the Shire. The northern half of the Shire drains into the Avon River via Yealering Lake and involve three catchments - Yarling Brook, Boyning Gully and Wogolin Creek.

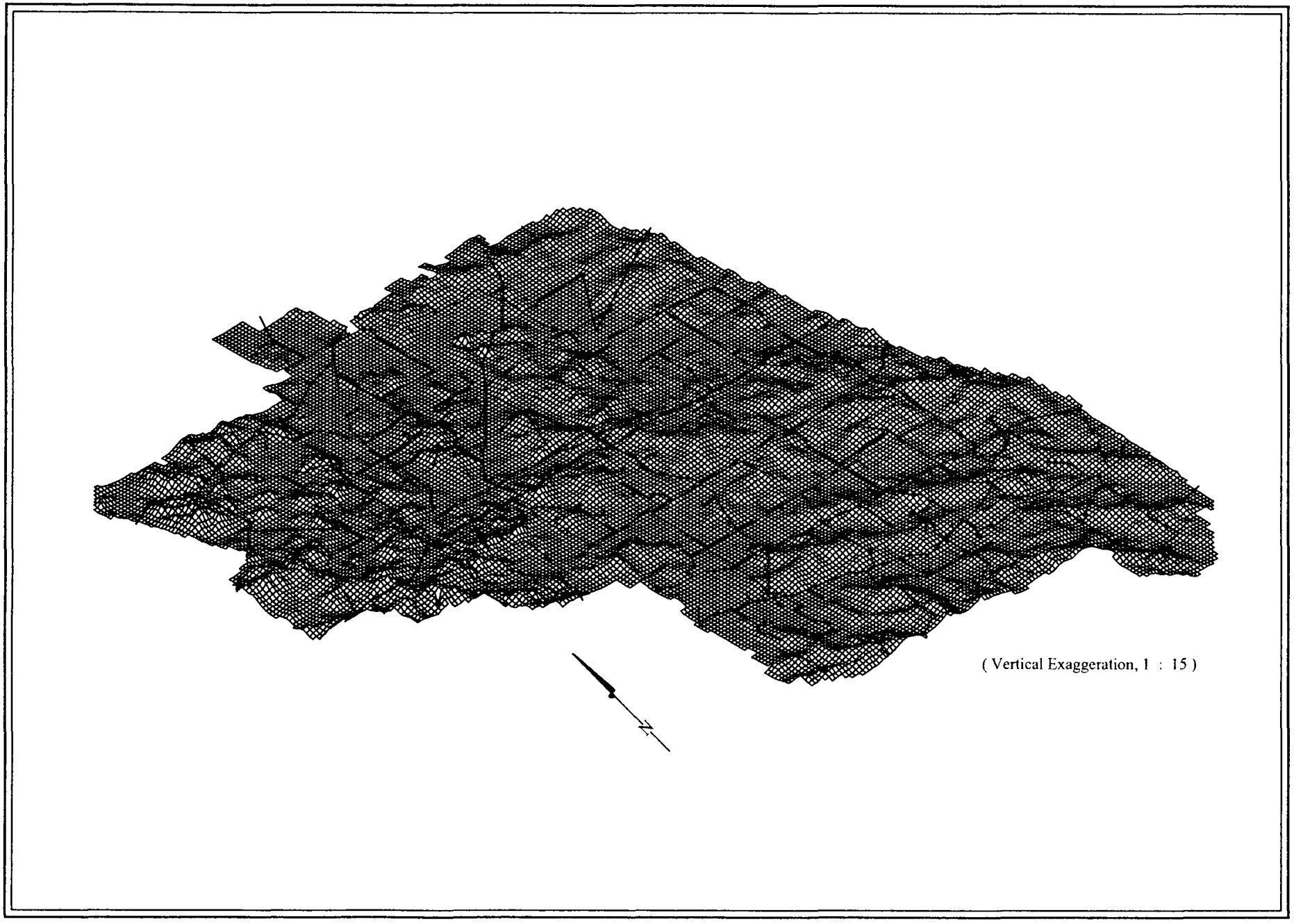

Figure 8 Topographical view of the Shire of Wickepin.

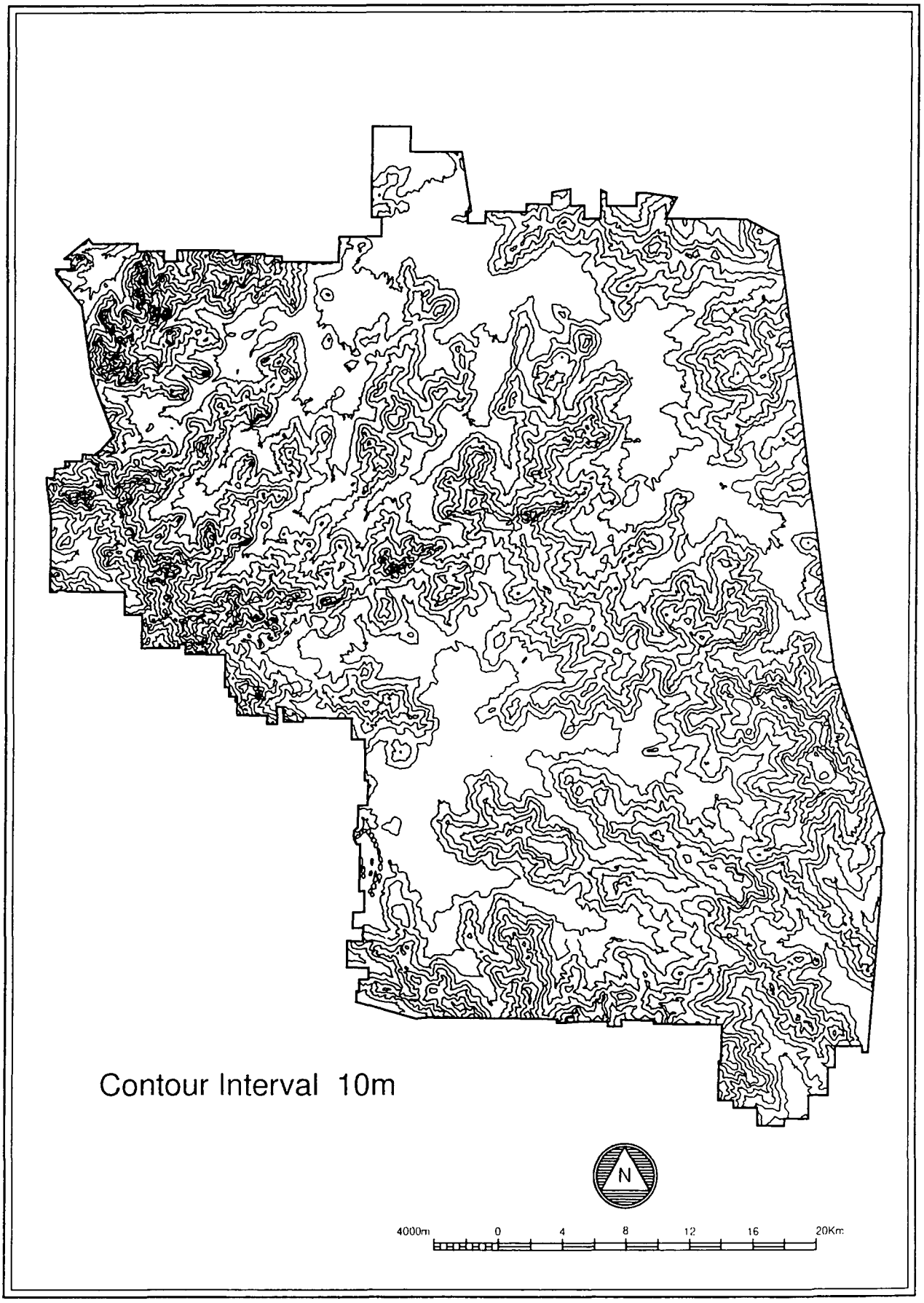

Figure 9 Contour lines in the Shire of Wickepin at intervals of 10 metres.

The southern half of the Shire is drained by the Blackwood River via Taarblin Lake and Arthur River. The three catchments involved are North Toolibin Lake, Toolibin Lake and Wasbedine Gully. The extreme south-east corner of the Shire near Harrismith also drains into the Blackwood River via Dongolocking Creek. Figure 8 gives a topographic view of the Shire, showing vertical exaggeration, while Figure 9 is a map of the Shire, showing contours at 10 metre intervals.

Land Management and Land Degradation Issues of the Shire

Since settlement in the south west of Western Australia and the subsequent clearing and replacement of native vegetation with crops and pastures, problems have arisen for both agricultural production and native vegetation conservation. Some of the most obvious problems are associated with changes in hydrology e.g rising water table with associated salinity and waterlogging. Water erosion and wind erosion are a problem on unprotected soils.

There are several forms of land degradation that occur within the Shire of Wickepin: salinity, waterlogging, wind and water erosion, soil acidification and subsoil compaction. An integrated approach to tackling these problems uses farm planning to: reorientate paddock boundaries; revegetate and fence drainage lines; protect and connect existing vegetation and establish windbreaks and replant on both recharge and degraded areas. In addition altering management practices to minimum and zero tillage will benefit both agricultural production and wildlife conservation.

Most farmers now recognise that replanting the trees and shrubs that existed prior to clearing is one of the most effective means of reversing the current trend towards land degradation. One of the main problems has been a lack of information about how to go about revegetation and what, when and where to plant. The "Revegetation Guide to the Central Wheatbelt" (Lefroy *et al.*, 1991) is an excellent resource book which attempts to address these problems by providing lists of local species grouped according to the specific soil types of a particular area.

Clearing

The Shire of Wickepin has been more extensively cleared than many other older shires such as Corrigin and Narrogin. As a consequence, there remains a smaller area of original native vegetative cover on farms and public reserves than in these older farming districts. However overclearing varies significantly between catchments within the Shire. Eighty percent of the farms in the Dongolocking Creek Catchment

are overcleared, whereas only 30% of farms in the North Toolibin Lake catchment are considered to be overcleared (Wickepin Land Conservation District, 1990).

Current clearing guidelines recommend that for an area receiving 500 mm/annum rainfall or less (e.g. Shire of Wickepin), 20% of the catchment should remain under perennial vegetation to prevent land degradation (Clark, 1992). Currently the Shire has 8% remnant native vegetation cover.

There are several actions being undertaken by the State Government and Local Government authorities to address the clearing of native vegetation. Clearing of vegetation on private land is currently under the control of the Soil and Land Conservation Act which requires all landowners to give notice to the Commissioner of Soil Conservation of their intent to clear land. The guidelines for assessing notices of intent to clear land are directed at preventing further land degradation problems (Select Committee into Land Conservation, 1992). In addition many local government authorities have implemented planning schemes which may give them scope to effectively control the clearing of land.

Continued clearing of vegetation is obviously not compatible with the desire for native vegetation to persist. Much of the south west was cleared during major agricultural developments following World War II, and little thought was given to nature conservation requirements.

A great deal of the native vegetation that remains was set aside by the government as crown reserves for townsites, water catchments and sites of gravel extraction etc. Many of these small patches of native vegetation were designated by the government as conservation reserves in the 1960s and 1970s. However their conservation value varies because most of the patches of vegetation that are now nature or conservation reserves are fragmented and represent only a very small percentage of the region's vegetative cover.

Rising Water Tables and Salinity

The principle cause for increased soil surface salinisation in much of the Wheatbelt has been the removal of native vegetation. Native vegetation uses more water than pasture species as native plants posses extensive root systems and transpire all year, whereas crops and pastures transpire for only 6 months of the year. The replacement of native vegetation with crops and pastures has resulted in changes to the water balance of the soil, bringing rising water tables and soluble salts to the surface.

There are two main effects of vegetation clearance in salt-prone areas: firstly, deep-rooted plants no longer draw groundwater for transpiration so water accumulates instead of being discharged in the atmosphere; and secondly, there is a decrease in the infiltration of rainwater because there is no vegetation to intercept it and as a consequence of this lack of water use the water table rises and dissolves the accumulated salts. Quite often the effects of salinity are not seen for 15-20 years following native vegetation removal.

Trees affected by salt display a reduction in growth and stunting compared to those that survive. Further salination among intolerant species results in the death of the lower leaves and branches proceeding from the base upwards followed by wilting, death of growing tip and eventual tree death.

The Shire of Wickepin had 6,972 ha (3.95% of arable land) affected by severe salinity in 1989 (George, 1990). However the affect of salinity on the landscape varies from catchment to catchment. In the Wogolin Catchment there is 3400 ha of agricultural land which at risk of becoming salty. At present approximately 20 % of this land is affected by salinity (Wickepin Land Conservation District, 1990).

Biological solutions to salinity problems can emulate more expensive engineering methods because perennial vegetation can be used to pump out more water from aquifers that have become saline or are in danger of doing so than can annual crps and pastures. Obviously salt tolerant species are required for salt affected sites, not only to control the salt levels but also as a measure to prevent and manage erosion. Recharge and discharge areas should be replanted with trees or shrubs to reduce the amount of water entering or leaving the system. Some of the more commonly planted salt tolerant species include saltbush (*Atriplex* spp.), wandoo and various samphire species. Planting swamp sheoak, orange wattle (*Acacia saligna*) and a number of *Melaleuca* species will aid in reversing the problems associated with waterlogged and salt affected areas. Planting trees such as salt river gum (*Eucalyptus sargentii*), flat-topped yate, river gum (*Eucalyptus camaldulensis*), moort (*Eucalyptus platypus*) and coastal moort (*Eucalyptus platypus* var *heterophylla*) will lower the watertable in most salt affected areas. Around salt lakes where soils are often waterlogged as well as saline, the soil will need to be mounded before planting. It may be more viable for farmers to plant salt tolerant shrubs in salt affected areas. Although these species may be less palatable to sheep than many herbaceous pasture species, they are grazed heavily when the herbaceous species are absent (Runciman and Malcolm, 1991).

It has been suggested (Lefroy *et al.*, 1991) that for the soils indigenous to the Shire of Wickepin, York gum, jam, rock sheoak and *Acacia microbotrya* could be planted. On the soils following drainage lines and around the fringes of salt lake, it is suggested that planting salt river gum (*Eucalyptus sargentii*) and swamp sheoak will help to reverse both salinity and waterlogging problems.

Wind Erosion

Wind erosion is the action of the wind removing and redepositing soil. It can result in the loss of vegetation through sand blasting and smothering, and it reduces plant growth because of the loss of soil structure and fertility. The predominantly sandy-surfaced soils of Western Australia are naturally prone to wind erosion when vegetation is insufficient to protect the soil surface. The most susceptible areas are those which are prone to sustained droughts extended over several growing seasons. The extent and severity of wind erosion depends on seasonal conditions.

The Shire of Wickepin, being largely comprised of leached and weathered soils is considered to be highly susceptible to wind erosion (State of the Environment Report, 1992). Surprisingly wind erosion problems were reported by only 20% of farmers in the Shire (Wickepin Land Conservation District, 1990). Wind erosion will occur on both sandy and lateritic soils if vegetation is removed. Overgrazing is the main cause of vegetation removal.

No till methods of cropping, direct seeding of crops into stubble and the establishment of windbreaks for shelter will help in ameliorating the effect of wind erosion. Ideally windbreaks should be several rows wide and should include a mix of trees and shrubs. By 1990, 118 km of windbreaks had been planted by farmers who reported experiencing wind erosion problems on their properties (Wickepin Land Conservation District, 1990). Shelterbelts can also serve as corridors for wildlife and may link up areas of existing vegetation.

Water Erosion

Water erosion is the loss of topsoil due to runoff from the soil surface. Water erosion occurs in three forms of increasing severity: sheet, rill and gully erosion.

Western Australian soils are particularly susceptible to water erosion because they are inherently infertile and have a sandy, loose texture. Their susceptibly is further increased by cultivation, overgrazing and stock trampling. An estimated 0.7 million

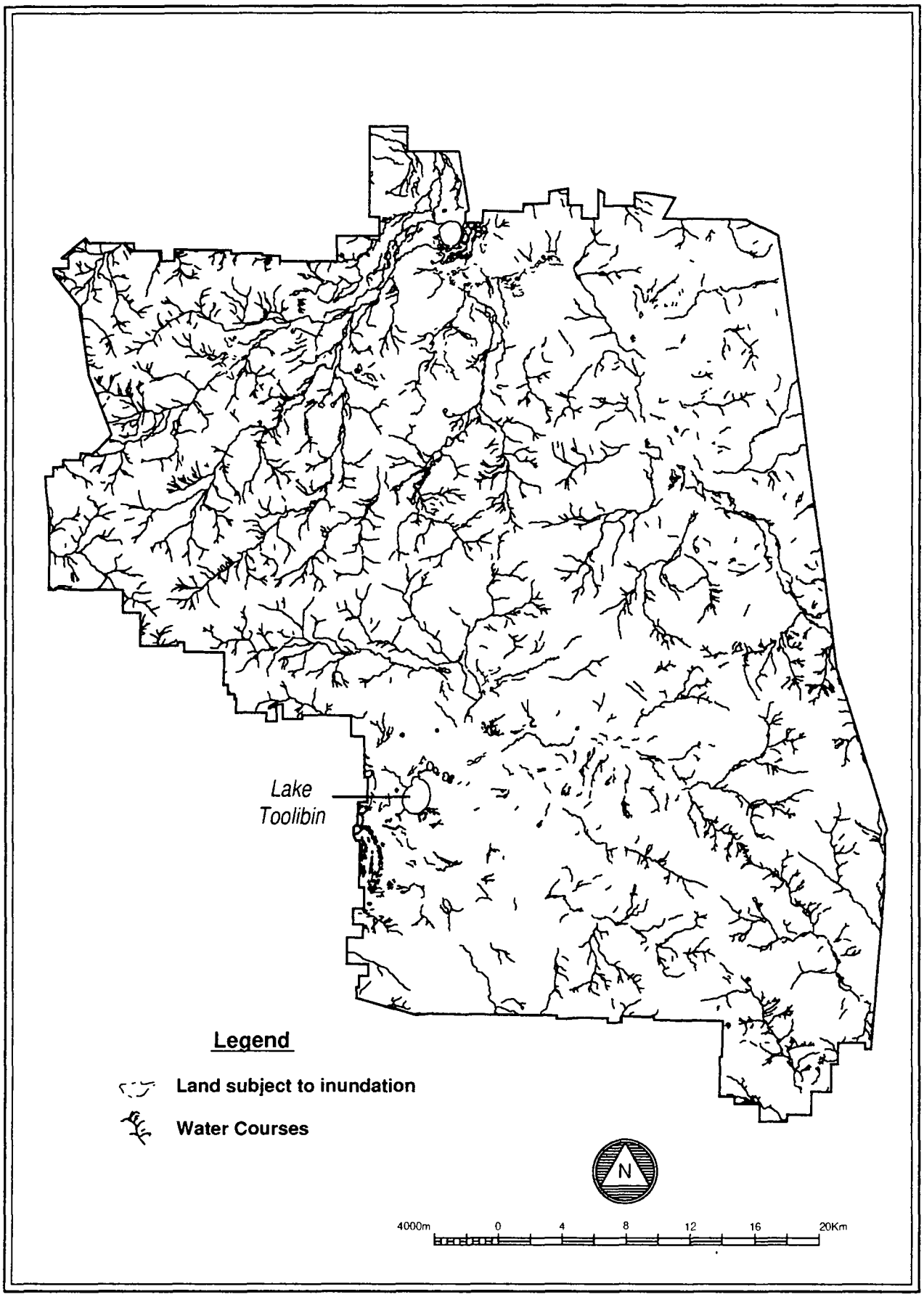

Figure 10 Major Drainage systems of the Shire of Wickepin showing areas subject to inundation and major water courses.

hectares of the 6 million hectares of land cropped annually in the wheatbelt is affected by water erosion.

In the Shire of Wickepin water erosion can be expected to occur on all soil types particularly on slopes steeper than 1%. Clayey soils tend to be more prone to water erosion. (State of the Environment Report, 1992). Almost half of all farmers in the Shire recognise that they still experience water erosion damage to their properties (Wickepin Land Conservation District, 1990). Figure 10 shows some of the areas of the Shire which may be susceptible to water erosion.

Acidity

The acidification of topsoils and subsoils can inhibit the growth of plant roots of both native and pasture species. Although some soils are predisposed to acidic conditions, agricultural practices are a major cause for the acceleration of the acidification process. This happens through using ammonium based fertilisers and growing clover pastures. Acidic soils tend to be more susceptible to degradation by wind and water erosion (State of the Environment Report, 1992) as soil particles do not bind together effectively under conditions of low pH.

In the Shire of Wickepin, most of the soils are regarded as being of moderate to high risk of developing subsurface soil acidification at depths of greater than one metre (State of the Environment Report, 1992). Solutions to ameliorating soil acidity include the rotation of legume-based pastures with non-legume based pastures, reduction in the use of chemical fertilisers and increased liming and gypsum applications.

Soil Compaction

Soil compaction by stock and heavy farm machinery is a major degradation problem experienced by many Wheatbelt Shires including Wickepin. Stock and heavy machinery compact the soil and prevent infiltration of both water and air. This inevitably results in reduced plant growth and an increase in wind and water erosion. The problem can be rectified by using lighter farm machinery and restricting machinery traffic on the land through using minimum or zero tillage to establish crops. Fencing remnant vegetation will prevent stock causing soil compaction within the bush.

Waterlogging

Waterlogging is the temporary or permanent saturation of the soil by rainfall or runoff and is usually a result of poor drainage. The problem is often exacerbated by excessive or inappropriate clearing of deep-rooted native vegetation and soil compaction by livestock and heavy machinery. The principal cause of waterlogging is a combination of excess rainfall, poor external drainage (runoff), poor internal drainage (water movement in the soil profile) and the inability of the soil to store much water.

Waterlogging is most prevalent in the 400-500mm rainfall area of the Wheatbelt and the problem is usually seasonal, although areas with soils of low permeability in valleys downslope of areas which shed water will be prone to waterlogging in years of high rainfall.

Waterlogging affects 9,959 hectares of agricultural land in the Shire of Wickepin on a regular basis. The annual cost of waterlogging through reduced crop production in the Shire is in the order of $1.3 million. The Wogolin Creek Catchment is the worst affected in the Shire; 20% is regularly waterlogged (Wickepin Land Conservation District, 1990).

Managing Existing Vegetation

Protecting existing vegetation is often easier than replanting. However, the survival of existing vegetation is affected by a number of factors including: grazing by stock of unfenced bush (passive clearing); changes in hydrology; increased exposure to the elements; increased fertiliser regimes; pests, herbicide drift and weed invasion. Native plants are often choked or covered by fast growing introduced plants that become weeds when they escape from pastures. Weeds compete with native plants for water and nutrients, increase the risk of fire and often do not provide the food and shelter that wildlife need.

Specific recommendations on how to manage existing bush are provided in "Managing your Bushland: A Guide for Western Australian Landowners" (Hussey and Wallace, 1993).

The long term solution to the problems of land degradation and the loss of local plant and animal species lies in taking a catchment approach to the management of natural resources within the Shire of Wickepin.

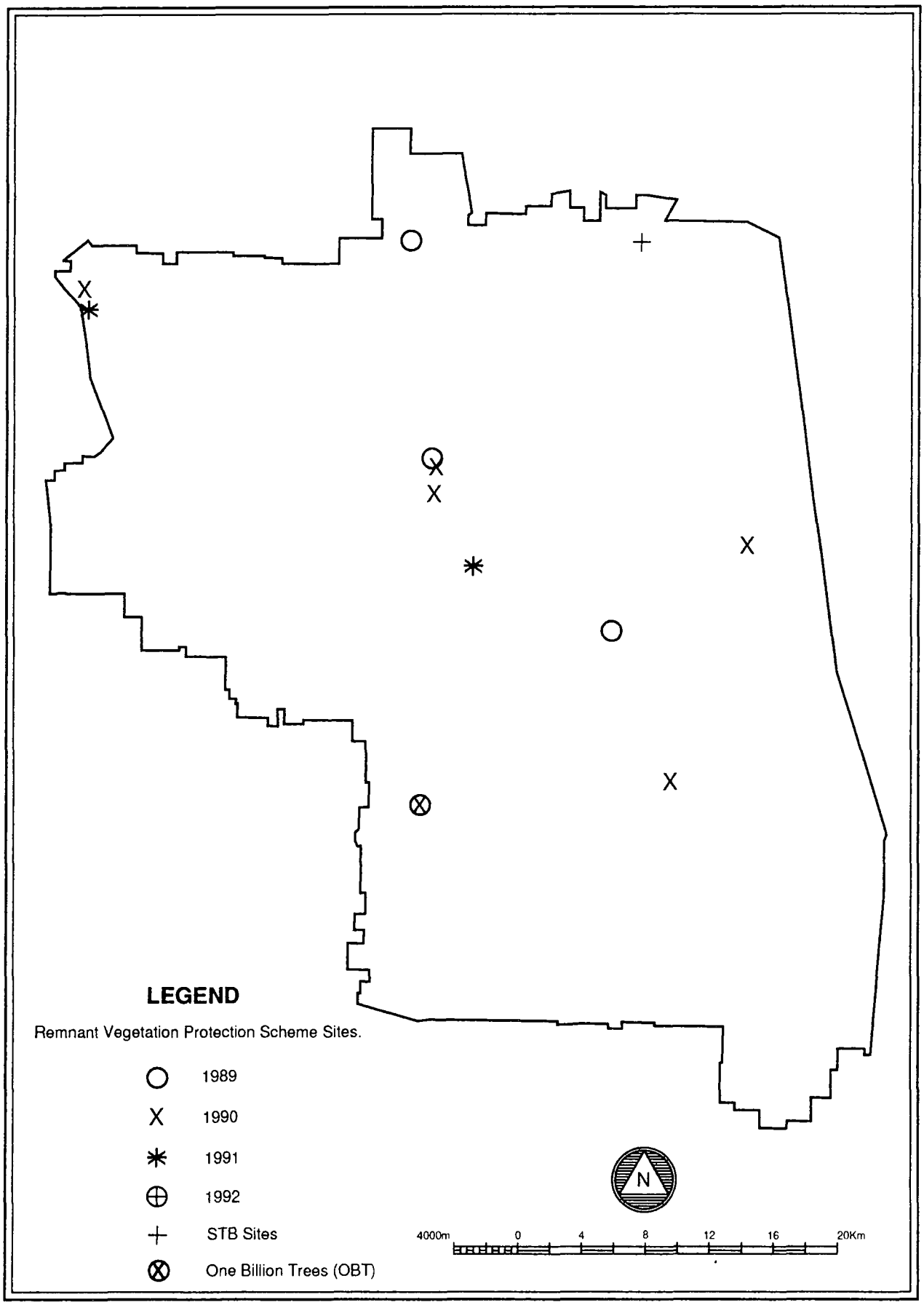

Figure 11 Save The Bush, One Billion Trees and Remnant Vegetation Protection Scheme sites in the Wickepin Shire.

Bringing It All Together

Integrated Management for Land and Nature Conservation in the Shire

The Wheatbelt of Western Australia today has severe nature conservation and agricultural problems resulting from the excessive clearing of native vegetation. The problems associated with land degradation and the maintenance of native vegetation are problems which cannot be halted by onsite management alone. An integrated catchment/land conservation district/farm-based approach is needed to effectively manage the land and native vegetation resources and ensure long term agricultural production, optimal water use and the maintenance of the diversity of flora and fauna. Retention of remnant vegetation, rehabilitation of degraded areas and strategic revegetation are essential components of this approach. Ownership of the problems and solutions at a local scale is the key to success.

As so much of the conservation resource lies under the control of private landowners and the local government authorities, the responsibility for the co-ordination of the conservation and management of natural resources must ultimately stem from these locally based groups. The Shire of Wickepin has a number of different organisations working towards land and nature conservation in the Shire.

The Wickepin Land Conservation District has been a prime mover in this field. Within it are two catchment groups; the Lake Toolibin Catchment Group and the Wogolin Catchment Group which is divided into two subcatchments, the Quinnining and Dundinin subcatchments. The Fence Road Catchment Group covers areas in Wickepin and two other Shires. It is independent of the Wickepin LCD. Two other catchment groups have recently been formed but at the stage have not commenced activities.

Projects in the Shire

A combination of measures and solutions aimed at protecting remnant vegetation, strategically revegetating areas degraded or void of native vegetation, and combating land degradation problems in the Shire of Wickepin have proven to be an effective method of achieving positive results.

The Remnant Vegetation Protection Scheme (RVPS) was developed by the State Government in 1988 to enhance soil and nature conservation by protecting native vegetation on farm land. It has been an effective scheme in the Shire of Wickepin. Since 1988/89, the Shire has received 16 RVPS grants to assist in the fencing of 485.5 hectares of native vegetation on farm land (Figure 11). Many of the fenced remnants

which were previously in poor to average condition are now showing obvious signs of regeneration. However about half of all remnants on private land in the Shire are either unfenced or inadequately fenced or in many cases fences are present but are falling into disrepair (Mollemans, 1993).

There are several examples of projects with the aim of strategically revegetating sparsely vegetated areas currently underway in the Shire of Wickepin. In late 1980's, the Northern Arthur River Wetlands Committee commissioned a report entitled "The Status and Future of Lake Toolibin as a Wildlife Reserve" (Northern Arthur Wetlands Committee, 1987) as a way assessing the status of Lake Toolibin as one of the few remaining inland, freshwater lakes with a healthy emergent (lake-bed) vegetation, threatened by salinisation (Figure 6). Among the recommendations of this study was that Lake Toolibin and the surrounding catchment be extensively revegetated. These recommendation have been largely taken up in the form of the Lake Toolibin Recovery Plan, an enormous project involving the expenditure of up to 4 million dollars over the next 10 years. The primary objective of this plan is to ensure the long-term maintenance of Lake Toolibin and its surrounding nature reserves as a healthy and resilient ecosystem, suitable for continued waterbird usage at current high levels. The Recovery Plan involves an integrated strategy of short-term and ongoing measures at a local and catchment scale. Some of the principal elements of the Recovery Plan include:

1. Watertable drawdown by staged groundwater pumping to ensure the drawdown of the saline water table beneath the lake and reserves.

2. Surface water drainage of the Toolibin Flats to reduce saline inflows to the lake and reduce waterlogging.

3. Lake outlet control to improve flushing efficiency.

4. Enhancement of vegetation in the lake and its adjoining reserves through grazing control, planting, and fire management, to improve regeneration and maintain waterfowl habitats.

5. Revegetation in the catchment to establish and maintain a more favourable hydrological equilibrium for the Lake Toolibin catchment in the long-term. This will be achieved through land management planning, the promotion of fodder crops, the

revegetation of salt affected land and the targeted but broadscale revegetation of groundwater recharge and discharge areas.

The Lake Toolibin Recovery Plan will be implemented by a major co-operative effort by Government Agencies, private consultants and the landholding community.

In 1992/93 the Lake Toolibin Catchment Group was successful in receiving $788 in funding from the One Billion Trees Program (OBT) towards the cost of a demonstration of direct seeding at Lake Toolibin (Figure 11). This has been the only OBT funding any group within the Shire has received to date.

An early major project in the Wickepin LCD was to offer a fencing subsidy to local farmers. Initially a $600 subsidy for a kilometre of fenced remnant bush was offered by the State Landcare Program to twenty nine farmers in the first year. The following year farmers were offered a subsidy in the form of either materials or money. The success of this project was twofold; it helped protect remnant bush from degradation and involved people throughout the Shire in a nature conservation project.

ALCOA Australia has made substantial contributions, both financial and advisory, to land and nature conservation in the Shire of Wickepin over the past few years. In 1991/92 ALCOA provided $17500 towards the cost of construction of nine drainage channels across Lake Toolibin Catchment (see Appendix 6-: State Landcare Projects) as well as making available their hydrologist, Ken McIntosh, to assist the planning group.

Road verges in the Shire of Wickepin were surveyed for their vegetation conservation status with the assistance of the Roadside Conservation Committee (RCC). The surveys were undertaken by community volunteers using the method developed by the RCC. The Shire of Wickepin was amongst the first in the state to complete the surveys of roadsides under their control. The survey was conducted between January 1991 and February 1992. Ninety three roads (1581 km) were surveyed for roadside conservation value. Within the Shire, 24.2% (382 km) of the road verges were classed as having high conservation value, 61.2% (968 km) of medium conservation value and 14.6% (230 km) of low conservation value (Lamont, 1993).

Road reserves classified as high conservation value generally have little weed invasion or disturbance and retain a high quality representative sample of the original vegetation with multiple layers of the vegetation being present. Medium conservation

road reserves usually have been disturbed with the lower layer of vegetation being lost or badly depleted. Weed species in this category of roadside vegetation are well established and have the potential to eventually dominate the native vegetation. Weeds usually dominate the low conservation category, with few native species from the original vegetation being present. Under the normal regime of roadside management, natural regeneration is highly unlikely. Rehabilitation by planting or direct seeding methods require an ongoing commitment of resources.

The Wickepin Conservation District Committee has endeavoured to reverse land degradation problems with assistance from several programs. The National Landcare Program (NLP) has primarily had the role of providing funding to train Landcare Assistants and employing National Landcare Program Project Officers. There have also been several State Landcare funded projects in the Shire of Wickepin since 1989/90, many of which have involved cooperation with neighbouring shires. Details of each of these projects are outlined in detail in Appendix 6.

Reducing the cost of conservation

It is now widely recognised that planting native trees and shrubs can be used to remedy land degradation problems. However the cost of revegetation is a relatively expensive practice. However there are methods of protecting remnant vegetation and planting native trees and shrubs in a cost-effective way. Initial costs are offset by long-term increases in productivity and decreases in land degradation.

To reduce the establishment costs for vegetation projects, a landholder could consider:

* cheaper fencing - (electric or re-cycled)
* collecting native plant seed from nearby sources instead of buying it (N.B. if the seed collector does not own the land, a licence will be needed. Check with CALM for details.)
* growing their own seedlings instead of buying in.
* direct seeding instead of planting seedlings
* include deep-rooted perennial fodder species for multiple use of revegetation areas.

Developing new products and industries from planted trees has the potential to provide farmers with an additional source of income. Some possibilities for the development of tree-farm products include eucalypt and tea tree oils; tannins from acacia and eucalypt species; cut wildflowers and wildflower seeds; and value-added wood products such as tool handles, craftwood and laminated wood products for

furniture manufacture. Some trial oil mallee plantations have already been established in the Shire under the Lake Toolibin Recovery Plan. Contact CALM Narrogin for advice (098) 811 444.

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Local Contacts

1. Wickepin Land Conservation District Committee Secretary- Audrey Bird- Phone (098) 827054

2. Shire of Wickepin Offices-Phone: (099) 281102

3. Conservation and Land Management District Office (Narrogin)
Phone: (098) 811 444.

4. Western Australia Department of Agriculture (Narrogin) - Phone: (098) 810022

5. National Landcare Program Project Officer, Jenny Crisp - Department of Agriculture (Narrogin) - Phone: (098) 810022

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Appendix 1.

Plant List-Dominant Species of the Corrigin System (Beard, 1976)
Reference List for Corrigin Vegetation System

Botanical Name	Common Names (if known)
Woodland Species	
Acacia acuminata	Jam
Anthrocnemum bidens	
Callistemon phoeniceus	Lesser Bottlebrush
Casuarina obesa	Swamp Sheoak
Ennaepogon caerulescens	Limestone Grass
Eucalyptus accedens	Powderbark Wandoo
Eucalyptus astringens	Brown Mallet
Eucalyptus gardneri	Blue Mallet
Eucalyptus longicornis	Red Morrel
Eucalyptus loxophleba	York Gum
Eucalyptus rudis	Flooded gum
Eucalyptus salmonphloia	Salmon Gum
Eucalyptus wandoo	Wandoo
Gahnia ancistrophylla	Hook-leaf Saw Sedge
Gastrolobium crassifolium	Thickleaf Poison
Hakea preissii	Needle Tree
Lepidosperma drummondii	
Lepidosperma tenue	
Melaleuca hamulosa	
Melaleuca laxiflora	
Santalum acuminatum	Quandong
Waitzia acuminata	Orange Immortelle
Mallee Species	
Acacia acuminata	Jam
Acacia brachyclada	
Acacia dermatophylla	
Acacia erinacea	
Acacia graffiana	Tan Wattle
Acacia merrallii	
Acacia microbotrya	Manna Wattle
Acacia multispicata	
Acacia sulcata	
Allocasuarina campestris	Tamma
Astroloma epacridis	
Calytrix brachyphylla	
Daviesia brevifolia	
Daviesia teretifolia	
Dodonaea amblyophylla	
Dodonaea caespitosa	
Eremophila aff. brevifolia	Spotted Eremophila
Eremophila lehmanniana	
Eucalyptus redunca	Black Marlock
Eucalyptus calycogona	Gooseberry Mallee
Eucalyptus flocktiana	Merrit
Eucalyptus loxophleba	York Gum
Eucalyptus wandoo	Wandoo
Eucalyptus ovularis	Small-fruited Mallee
Eucalyptus incrassata	Lerp Mallee

Eucalyptus eremophila	Tall Sand Mallee
Eucalyptus pileata	Capped Mallee
Exocarpus aphyllus	Leafless Ballart
Grevillea aff. acuaria	
Grevillea huegelii	
Hakea adnata	
Halgania sp.	
Leptospermum erubescens	Roadside Tea-tree
Lhotzkya violacaea	
Melaleuca acuminata	
Melaleuca adnata	
Melaleuca eleutherostachya	
Melaleuca hamulosa	
Melaleuca laterifolia	Gorada
Melaleuca laxiflora	
Melaleuca pauciflora	
Melaleuca scabra	Wongon Melaleuca
Melaleuca uncinata	Broom Bush
Olearia aff. adenolasia	Woolly-glandular Daisy Bush
Olearia muelleri	Goldfields Daisy
Olearia revoluta	Daisy Bush
Rhagodia preissii	
Rhagodia sp.	
Santalum spicatum	Sandalwood
Santalum acuminatum	Quandong
Templetonia sulcata	Kerosene Bush
Thomasia tenuivesta	

Kwongan Species

Allocasuarina campestris	Tamma
Dryandra cirsioides	
Eucalyptus macrocarpa	Mottlecah
Hakea subsulcata	

Shrubs

Astroloma serratifolium	Kondrung
Baeckea crispiflora	
Banksia sphaerocarpa	Round-fruited Banksia
Beaufortia micrantha	Little Bottlebrush
Calytrix empetroides	
Choretrum pritzelii	
Cryptandra myriantha	
Daviesia benthamii	
Gastrolobium acanthaclona	
Gastrolobium parviflorum	Berry Poison
Gastrolobium spinosum	Pickly Poison
Grevillea hookeriana	Red Toth Brushes
Hakea baxteri	Fan Hakea
Hakea incrassata	Marble Hakea
Hakea scoparia	
Hibbertia pungens	
Isopogon divergens	Spreading Coneflower
Leptospermum erubescens	Roadside Tea-tree
Leucopogon carinatus	
Leucopogon crassifolius	
Lysinema ciliatum	Curry Flower
Melaleuca seriata	
Opercularia vaginata	Dog Weed

Petrophile trifida	
Persoonia striata	Kauberry
Phebalium tuberculatum	
Pityrodia axillaris	Native Foxglove
Santalum acuminatum	Quandong
Synaphea polymorpha	Albany Synaphea

Herbaceous Species

Chamaexeros fimbriata	
Dampiera juncea	Rush-like Dampiera
Ecdeiocolea monostachya	Cord Rush
Harperia sp.	
Lepidosperma drummondii	
Lyginea barbata	
Mesomelaena uncinata	
Schoenus subbulbosusm	

Appendix 2.

Plant List - Dominant Species of the Pingelly System (Beard, 1976)

Reference List for the Pingelly Vegetation System

Botanical Name	Common Names (if known)
Trees	
Acacia acuminata	Jam
Casuarina huegeliana	Rock Sheoak
Eucalyptus accedens	Powderbark Wandoo
Eucalyptus wandoo	Wandoo
Shrubs	
Acacia acuminata	Jam
Acacia lasiocalyx	Wilyurwur
Acacia lasiocarp	Panjang
Acacia pulchella	Prickly Moses
Astroloma pallidum	Kick Bush
Acacia serratifolium	Kondrung
Calytrix aff. *fraseri*	Pink Summer Calytrix
Casuarina humilis	Scrub Sheoak
Cacuarina microstachya	
Choretrum glomeratum	Common Sourbush
Comesperma scoperia	Broom Milkwort
Daviesia brevifolia	
Daviesia cardiphylla	
Dodonaea bursariifolia	
Dryandra cirsioides	
Dryandra hewardiana	
Eucalyptus falcata	Silver or White Mallet
Eucalyptus redunca	Black Marlock
Gastrolobium crassifolium	Thick-leaf Poison
Gastrolobium hookeri	
Gastrolobium spinosum	Prickly Poison
Hakea lissocarpha	Honey Bush
Hakea petiolaris	Sea Urchin Hakea
Hakea prostrata	Purple-flowered Hakea
Hibbertia pungens	
Isopogon formosus	Rose Coneflower
Jacksonia racemosa	
Olearia revoluta	
Persoonia striata	Kauberry
Persoonia aff. *rufiflora*	
Spyridium tridentatum	
Thomasia aff. *foliosa*	
Westringia cephalantha	
Westringia rigida	Stiff Westringia
Xanthorrhoea reflexa	Skirted Grass Tree
Herbaceous	
Borya nitada	Pincushions
Caustis dioica	
Dampiera aff. *coronata*	Wedge-leaved Dampiera
Dampiera juncea	Rush-like Dampiera
Dianella revoluta	Blueberry Lilly

Glischrocaryon flavescens	
Harperia laterifolia	
Lepidosperma tenue	
Lomandra effusa	Scented Matrush
Loxocarya fasciculata	
Schoenus compressus	
Stipa elegantissima	Feather Speargrass
Stypandra imbricata	Cluster-leaved Blindgrass

Appendix 3.

Plant List - Dominant Species of the Narrogin Vegetation System (Beard, 1976)
Reference List for the Narrogin Vegetation System

Botanical Name	Common name (if known)
Trees	
Acacia acuminata	Jam
Casuarina huegeliana	Rock Sheoak
Eucalyptus astringens	Brown Mallet
Eucalyptus accedens	Powderbark Wandoo
Eucalyptus wandoo	Wandoo
Eucalyptus loxophleba	York gum
Eucalyptus rudis	Flooded gum
Shrubs	
Acacia pulchella	Prickly Moses
Astroloma pallidum	Kick Bush
Adenanthos cygnorum	Common Woollybush
Borya nitada	Pincushions
Billardiera variifolia	
Bossiaea eriocarpa	Common Brown Pea
Calothamnus quadrifidus	One-sided Bottlebrush
Conostylis setigera	Bristly Cottonhead
Cryptandra dielsii	
Dianella revoluta	Blueberry Lilly
Dryandra cirsioides	
Dryandra hewardiana	
Gastrolobium microcarpum	Sandplain Poison
Gastrolobium spinosum	Pickly Poison
Grevillea pulchella	Beautiful Grevillea
Gastrolobium hookeri	
Glischrocaryon flavescens	
Hakea lissocarpha	Honey Bush
Hemiandra pungens	Snakebush
Hovea chorizemifolia	Holly-leaved Hovea
Hovea pungens	Devil's Pins
Jacksonia floribunda	Holly Pea
Jacksonia furcellata	Grey Stinkwood
Leptospermum erubescens	Roadside Tea-tree
Leschanaultia biloba	Blue Leschenaultia
Leucopogon conostephioides	
Neurachne sp.	
Pimelea aff. *microcephala*	Shrubby Riceflower
Santalum murrayanum	Bitter Quandong
Stylidium repens	Matted Triggerplant
Xanthorrhoea preissii	Blackboy
Xanthorrhoea reflexa	Skirted Grass Tree
Herbaceous	
Harperia laterifolia	
Lepidosperma pubisquameum	
Lepidosperma tenue	
Lepidosperma gracile	Slender Sword Sedge
Lomandra effusa	Scented Matgrass
Stipa elegentissima	Feather Speargrass

Appendix 4.

Bird Species seen in the Shire of Wickepin (Garstone, 1970)

Common Name	Scientific Name
Red Wattle bird	*Anthochaera carunculata*
Yellow throated miner	*Manorina flavigula*
Brown honeyeater	*Lichmera indistincta*
Australian magpie	*Gymnorhina dorsalis*
Australian Raven	*Corvus coronoides*
Black face Cuckoo shrike	*Corocina novaehollandiae*
Elegant Parrot	*Neophema elegans*
Grey teal	*Anas gibberifrons*
Port Lincoln Parrot	*Barnadrius zonarius*
Wedge tail eagle	*Aqualis audax*
Willy wagtail	*Rhipidura leucophrys*
Black Faced wood-swallow	*Artamus cinereus*
Yellow rumped thornbill	*Acanthiza chrysorrhoa*
White-cheeked Honeyeater	*Phylidonyris niger*
Restless flycatcher	*Seisura inquieta*
Silvereyes	*Zosterops gouldi*
Rufous whistler	*Pachycephala rufiventris*
Singing Honeyeater	*Meliphaga viricens*
Galah	*Cacatua roseicapella*
Tree Martin	*Ptrochelidon nigricans*
Grey Fantail	*Rhipidura fuliginosa*
Weebill	*Smicrornis brevirostris*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Striated Pardalote	*Pardalotus substriatus*
Square-tailed Kite	*Lophoictinia isura*
Grey Butcherbird	*Cracticus torquatus*
Rainbow Bee-eater	*Merops ornatus*
Brown Songlark	*Cinclorhamphus cruralis*
Peregrine Falcon	*Falco peregrinus*
Red-tailed Black Cockatoo	*Calyptorhynchus magnificus naso*
Port Lincoln Ringneck	*Barnardius zonarius*
Horsfield's Bronze-Cuckoo	*Chrysococcyx plagosus*
Tree Martin	*Ptrochelidon nigricans*
Black-faced Cuckoo-shrike	*Corocina novaehollandiae*
White-winged Triller	*Lalage suerii*
Red-capped Robin	*Petroica goodenovii*
Darter	*Anhinger rufa*
Black Cormorant	*Phalacrocorax carbo*
Little black cormorant	*Phalacrocorax sulcirostris*
Little pied cormorant	*Phalacrocorax melanoleucos*
Great crested grebe	*Podiceps cristatus*
White-necked heron	*Ardea pacifica*
White egret	*Egretta alba*
Nankeen night heron	*Nycticorax caledonicus*
White ibis	*Threskiornis spinicollis*
Yellow-billed spoonbill	*Platalea flaviceps*
White-eyed duck	*Aythya australis*
Blue-billed duck	*Oxyura australis*
Little falcon	*Falco longipennis*

Appendix 5.

Sources of funding for projects aimed at land and nature conservation

Remnant Vegetation Protection Scheme

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

To be granted a subsidy, the area of vegetation to be fenced must be five hectares or more, and must be in good condition or able to be rehabilitated to good condition.

National Landcare Program

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

In 1992/93, the Community grants section of the National Soil Conservation Program (NSCP), the One Billion Trees Program (OBT), the Save the Bush Program (STB) and the Federal Water Resources Assistance Program were integrated into a one-stop-shop for community grants under the National Landcare Program. The aim of the NLP is to encourage community groups to responsibly manage and conserve land, water and biological diversity in their area.

One Billion Trees

The One Billion Trees (OBT) Program was initiated in 1989 by the Federal Government with the aim of catalysing revegetation projects aimed at land and nature conservation. It is administered in Western Australia by Greening Western Australia. The program provides grants for revegetation projects through the one-stop-shop for community groups under the National Landcare Program.

Save the Bush

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

Ribbons of Green

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

Plants for Conservation

The aim of Plants for Conservation (PFC) is to support groups and individuals undertaking revegetation projects aimed at land and nature conservation.

The Plants for Conservation program provides more than 300,000 seedlings each year for revegetation projects aimed at land and nature conservation. It is managed by Greening Western Australia and sponsored by ALCOA of Australia and by the Hamel Nursery. With the sponsors support, Greening Western Australia provides the seedlings. Participating groups and individuals contribute additional seedlings, materials and labour towards the projects.

Gordon Reid Foundation for Conservation

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

* the conservation of the Western Australian environment with emphasis on native flora and fauna;
* the identification and conservation of critical habitats and ecosystems;
* the conservation of rare, threatened and endangered species in WA;

* public education and awareness of environmental issues within WA;
* and research or other studies into other matters related to any of the above.

State Landcare Program

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

Appendix 6

Projects in the Shire of Wickepin which have been successful in receiving financial support through the State Landcare Program include:

1). (1989/90) **Project Title:** Wogolin Creek Catchment-Stage 1

Project Location: 40 km east of Wickepin (eight farms involved)

Project Description: The eight farmers involved are in the Wogolin Catchment which runs from Dudinin down to Yealering Lake. Between the eight farmers there is 3400 ha of land which is at risk of becoming salty. At present only 20% of this land is affected by salinity. There is a need for more surface drainage to help alleviate some of the waterlogging problems. 15000 trees have been planted by farmers since 1989. The intention of this project is to sink 200 bore holes to measure the level of the water table, to study the soil profile in some problem areas, conduct a magnotrometer and EM survey to study dolerite dykes and salt concentrations in the landscape and to hire a land care assistant to plan and survey most of the surface drainage area.

State Assistance Provided: $8400.

Contact Person: Mr Ashley Lewis
RMB 126 East Wickepin WA
Phone No.: (098) 886 040

2). (1989/90) **Project Title**: Wickepin Project 11-Windbreak Network for the Upper Toolibin Lake Catchment.

Project Location: Twenty properties in the Upper Toolibin Catchment, south-east of Wickepin.

Project Description: Toolibin Lake is an important wetland area threatened by a rising salt water table. This project aims to address recharge problems in the catchment in two ways. The main approach focuses on the planting of a major regional windbreak system with three-row windbreaks, at a rate of 20 km per year for the next five years. The second strategy involves fencing off 2000 ha of deep sand for Tagasaste establishment and management.

State Assistance Provided- $25000

Contact Person: Mrs L. Chadwick
PO 386 Narrogin WA 6312
Phone No.:(098) 827 065

3).(1988/89) **Project Title:** Wickepin Soil Conservation Register

Project Location: Wickepin

Project Description: Detailed survey of land management and conservation practices has just been carried out throughout the 140 farms in the Shire of Wickepin. One of the principle aims of the survey is to identify, document and map the location of outstanding on-farm projects in the fields of soil and water conservation. This information will then be published and made available as a reference guide for all landowners in the Shire.

State Assistance Provided: $2000

Contact Person: Mrs L. Chadwick
PO Box 386
Narrogin WA 6312
Phone No.: (098) 827065

4). (1991/92) **Project Title**: Demonstration of co-ordinated and planned valley floor drainage.

Location: Wickepin Shire

Project Description: This demonstration requires the construction of nine drains to channel floodwaters across Lake Toolibin Flats and around/through the reserve to Lake Toolibin lake. This main drain is 8.6 km long and 13m wide and will separate salt and freshwater flows of surface water.

State Assistance Provided: $15000

Contact Person: Mrs Mary Taylor
PO Box 37
Tincurrin WA 6361
Phone No.: (098) 83 2044