A BOTANICAL SURVEY OF

NORTH ARTHUR RIVER WETLANDS

NATURE RESERVES

Prepared for:

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ABSTRACT

The 17 North Arthur River Wetlands Nature Reserves covered by this report, about 30 km southeast of Narrogin, constitute an irregular, 5,358 ha belt of lakes and wetlands, salt flats and neighbouring vegetation about 35 km long. The belt is in the typical wheatbelt climatic zone, the Dry Warm Mediterranean, and lies in a flat, broad paleodrainage valley with sand and sandy clay soils underlain by migmatites and gneisses.

The vegetation in the belt comprises a range of wetland communities and fringing shrublands and a variety of woodlands and shrublands. The principal vegetation units in the reserves are, in a broad sense:

- woodlands and forests of eucalypts, Swamp She-oak, she-oak (*Allocasuarina huegeliana*) and Moonah Paperbark,
- thickets and scrubs of Jam and various species of *Melaleuca*,
- lettered (A, B, C and D) heaths and scrubs dominated by a variety of shrubby species, particularly of *Acacia, Calytrix* and *Dryandra*,
- short succulent heaths of *Halosarcia, Sarcocornia* and *Frankenia*, and
- herbaceous plant communities, particularly tussock grass and sedge communities and stands of ephemeral weeds.

There are also extensive areas of dead trunks and stems of trees and *Melaleuca* shrubs, often with understoreys of samphires and sometimes with only bare ground beneath. Bare ground occupies many areas that are seasonally waterlogged.

Salinisation and inundation have led, and are still leading, to extensive alteration of shrub vegetation in the North Arthur River Wetlands surveyed, as well as deaths and loss of vigour in tree vegetation. The effects are principally on-site shifts in vegetation from eucalypt woodland or Swamp She-oak forest with low, open understoreys to thickets of *Melaleuca* spp. or *Gahnia -?Stipa* tussock sedgeland-grassland to samphire succulent low heath or scrub to bare ground. In some (or many) places, the sequence is truncated.

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PREFACE

The following statements describing the project to survey 17 North Arthur Wetlands Nature Reserves and the requirements of the project are largely taken from the Department of Fisheries and Wildlife's (now Department of Conservation and Land Management's) Consultancy Offer and Agreement.

This report deals mainly with the vegetation and flora:

- a preliminary vegetation map and annotated aerial photographs,
- descriptions of the vegetation units mapped,
- a list of dominant, characteristic and other species and
- a discussion of rare, geographically restricted and poorly collected species.

Other aspects of the work are being covered by staff members of the Department of Conservation and Land Management (CALM).

Project Description

The North Arthur River Wetlands form a system of permanent and semi-permanent lakes, all of which have become saline, except a few at the head of the system, principally Lake Toolibin. The wetland system of Lake Toolibin has been studied, but little work has been done on the wetland system below Lake Toolibin.

The majority of the lakes area and fringing vegetation of the North Arthur River Wetlands below Lake Toolibin are Nature Reserves and, though salty, are major areas of waterfowl occurrence and still support important areas of finging vegetation. The importance of this wetland system, the increasing problem of salinisation of the Wheatbelt landscape, and the concentrated attention given to the lakes in the upper reaches have created the impetus to look in more detail at the remainder of the wetland system.

Project Requirements

The original requirements of the project were to:

(a) Draw accurate fire access maps of the 17 Nature Reserve areas listed in Table 1 indicating such features as tracks and boatramps, and relevant features of the adjoining farmland such as dams, fencelines and gates.

(b) Survey the vegetation, identifying the major vegetation types and describing these by floristic/structural means, and map these general areas. Photographs of vegetation were not specifically required. They were, however, taken, but in 1985 two roles of film were too over-exposed to be of much use and a third role, along with the camera it was in, was lost. A second set of photographs was taken in 1989. Selections of photographs are reproduced in four Plates. Vegetation of most Vegetation Survey Sites is described in Appendix A.

(c) Prepare a composite plant species list for all reserves, with specific reserve occurrences being noted. Collection and preparation of herbarium specimens was not specified, but voucher herbarium specimens of plants were collected in the reserves and will be lodged with the Reserve Management Section of the Wildlife Research Centre at Woodvale and with the Western Australian Herbarium in due course. The native plant species collected and recorded in the Vegetation Survey Sites, and elsewhere, are listed in Table 5.

(d) Survey vegetation health, grade vegetation into several categories of salt-induced degradation, and map these areas.

The requirements of the project have been partially met.

Sources of Data

Most of the introductory and physical geography information and much of the vegetation classification presented in this report are based upon interpretation and organisation of aerial photographs, reports, maps and notes provided by Department of Conservation and Land Management staff, plus published (and unpublished) reports on other reserves and areas in the vicinity. The flora descriptions and plant species list are based principally upon collections and observations made during a field trip in June 1985, with additional information having been collected during an August 1989 field trip.

1. INTRODUCTION

The North Arthur River Wetlands is a chain of permanent and semi-permanent lakes and flats along the upper reaches of Arthur River, about 30 km east to south of Narrogin. The majority of the North Arthur River wetlands, with their fringing vegetation, are in a series of nature reserves running southwest from a point north of the Wickepin-Harrismith road almost to the Great Southern Highway. The chain of reserves is shown, but not outlined, in Figure 1, which is photocopied from Department of Lands and Surveys Williams District 1:50,000 scale cadastral maps. Outlines of the reserves are shown in a pair of supplementary maps. The reserves and their areas are listed in Table 1 in sequence from the most northerly to the most southerly.

All of the lakes in the middle and lower parts of the chain, between Yilliminning (Narrogin-Harrismith) Road and the Great Southern Highway, are now saline, and only Lakes Walbyring, Toolibin and Dulbining, north of the road in the upper part of the chain, have water fresh enough to support living trees (Halse 1988). Lake Toolibin is fresh to brackish and has the greatest known number of breeding species of water birds of any southwestern Australian wetland, but the lake appears to have increased in salinity over the past 15 years or so and its trees have been declining in vigour, especially along the western shore (Halse 1987). Though severely affected by salt, the Wetlands and fringing vegetation in the lower part of the chain are still ecologically and biologically important, especially as compliments to Lake Toolibin.

Since 1977, when the Northern Arthur River Wetlands Rehabilitation Committee was formed, Lake Toolibin and its catchment have been the primary focus of hydrological and biological research in the North Arthur River Wetlands. The Lake Toolibin catchment includes the Dulbining Lake reserve (9617), the Dingerlin Well reserve (15266) and Reserve 27286. Reports and publications on Lake Toolibin and its catchment include: Northern Arthur River Wetlands Rehabilitation Committee (1978), Froend (1983), Froend *et al.* (1987), Bell and Froend (1990), Halse (1987, 1988), Martin (1986), Mattiske (1982) and Stokes and Sheridan (1986).

There are no publications or reports dealing specifically with the other North Arthur River Wetlands, but various reports and publications, such as Astbury and Negus (1990?), contain relevant information, and data on the Wetlands can be compared with information in the Lake Toolibin reports.

2. PHYSICAL ENVIRONMENT

The North Arthur River Wetlands lie within the dry warm mediterranean climatic zone in the Bagnouls and Gaussen classification (Beard 1980a, 1980b). This classification is based upon the number and seasonal distribution of months with effective rainfall as indicated in ombrothermic diagrams, which are diagrams that superimpose graphs of monthly temperature averages and monthly rainfall averages. Beard gives ombrothermic diagrams for Corrigin and Katanning, the first of which is drier than the Wetlands and the second of which is wetter. The Wetlands have a mean annual rainfall of around 400mm and annual temperatures of around 10^{o} (mean minimum) to 23^{o} (mean maximum), with about 6 dry months a year.

The predominant landscape of the area is a gently undulating plain of kaolinised material capped by remnants of a lateritic duricrust, pisolitic gravel and sand (see Beard 1980a, 1980b), with a few, generally small, outcroppings of migmatite and granitic or gneissic rock above the valley. The Wetlands reserves are largely restricted to the Arthur River valley floor, which is mainly covered with alluvium, and range in elevation approximately from 280 m to 300 m (Western Australian Department of Lands and Surveys Williams District 1:50,000 scale cadastral maps Series R712, Edition 1, Sheets 2331-I, 2332-II, 2431-IV and 2432-III).

The Soil Conservation Land Class of most of the reserve land is 13, "well defined water courses which carry intermittent flows during most years" (Negus 1977?) bordered by Land Class 11, "flat to very gently undulating along valley floors next to the main creeks and rivers". Negus describes Class 11 soils as being shallow grey or deep brown sandy loam to clay loam topsoils overlying a strong clay or sandy clay. Astbury and Negus (1990?) show part of the Wetlands as having heavy clay and loamy-sand over clay soils.

3. DISTURBANCE HISTORY

The upper end of the North Arthur River chain of Wetlands, i.e. Lake Toolibin and the wetlands above it, has a catchment of about 440 km^2, approximately 90% of which has been cleared of native vegetation (Halse 1987). 1:100 000 scale Australian topographic survey maps indicate that clearing in the rest of the North Arthur River Wetlands and their catchments, mainly for agricultural purposes, exceeds 90% (see, e.g., Astbury and Negus 1990?). Up to one-third of the clearing was done prior to the mid-1930s, and most of the remainder was cleared in the late 1940s and early 1950s (Halse 1987). The effects of the clearing are still being felt: salt concentrations in the wetlands are increasing and vegetation in the reserves continues to decline in health and vigour.

Vegetation in the reserves has been cleared or damaged in and along *ad hoc* vehicle tracks and firebreaks, and there has been erosion in the tracks. Detailed comparisons of series of aerial photographs taken in different years should yield more precise estimates of times, areas and proportions of clearing in the reserves and their catchments.

While it is obvious that parts of the reserve are burnt periodically it appears that fires have not been frequent or extensive.

Old burn patterns that are obvious on the 1968 aerial photographs and which are restricted to the upland remnant sandplain have since been obscured by regrowth; they were not found on the ground during the 1985 and 1989 field work.

4. FIRE ACCESS

The degree of access to the reserves varies geographically through the Wetlands and temporally with the season and degree of wetness and inundation of the substrates. In general, there is access along fencelines and other firebreaks, major and minor roads and tracks that hunters, wood-cutters and off-road vehicle enthusiasts have made into the reserves. Furthermore, in many places vegetation is open and low enough to be fairly easily driven through and over.

The working maps in Appendix D show fencelines, gates, firebreaks and tracks in some of the Wetland reserves.

5. VEGETATION

5.1 Introduction

The postulated pre-clearing vegetation of the North Arthur River Wetlands and their catchments has been mapped at scales of 1:3,000,000, 1:1,000,000 and 1:250,000 by Beard (1981a, 1981b, 1980a, 1980b). The vegetation of the nature reserves is described by Beard (1980a) as belonging to the Narrogin System and is shown, at a scale of 1:250,000 (Beard 1980a, 1980b), as principally teatree and samphire succulent steppe (salt country) with areas of york gum, wandoo and salmon gum woodlands, scattered swamp oaks and scrub heath.

There has been no larger scale vegetation mapping of the wetland system below the Lake Toolibin reserve, but the vegetation of Lake Toolibin, its surroundings and reserves north of it have been mapped by Mattiske (1978; the map is reproduced by Froend (1983) at a scale of approximately 1:25 000). The Lake Toolibin vegetation map distinguishes 17 vegetation units, which are listed by Froend. Table 2, a copy of Froend's list, lists the 17 units. Most of the listed units are represented in the downsteam reserves, and most of the downstream vegetation belongs to listed units.

Ideally, for optimum accuracy, the maximum scale of a vegetation map should be no greater than half the scale of the aerial photographs from which the map is drawn (Kuchler 1967). Consequently, since the scale of the available aerial photographs covering all of the North Arthur River Wetlands is 1:40,000 the scale of the map drawn from them should be no larger than 1:80,000. However, a provisional map of Vegetation Survey Site locations and vegetation notes (Figure 2) has been traced from the complete set of aerial photographs at a scale of 1:40,000, then reduced to 1:50,000 to match the scale of Figure 1 and the cadastral maps covering the wetlands.

5.2 Methods

Field work was undertaken by me and my assistant, Anthony Bougher, during the first week in June 1985, and I returned in August 1989 to rephotograph sites (most of the 1985 photography was over-exposed or was lost before it was processed). Field notes for the vegetation survey were made on Vegetation survey Pro Forma sheets and directly onto 1:40,000 scale, black and white aerial photographs flown in 1972 (WA

1433 Corrigin and 1436 Dumbleyung, December 1972). The notes on the aerial photographs were made with erasible Mars-Omnichron yellow pencils and have been left on the photographs for current and future reference; for the most part, these notes consist of numbers to indicate the Sites and letter symbols to indicate vegetation units and their dominants.

The units are classified and described on the basis of field observations made along traverses over roads and tracks, along firebreaks, and on transects walked through the bush. The system used for classifying the vegetation is a slight modification of the one developed by Muir (1977) and shown in Table 3. Locations of numbered Vegetation Survey Sites and summarised symbols of selected vegetation units are shown in Figure 2, and photographs of many of the Sites are reproduced in Plates 1 - 4.

Typed sheets of information from Pro Forma sheets for 36 Vegetation Survey Sites are arranged numerically in Appendix A.

5.3 Principal Vegetation Units

The principal vegetation units in the reserves are, in a broad sense:

- woodlands and forests of eucalypts, Swamp She-oak, she-oak (*Allocasuarina huegeliana*) and Moonah Paperbark,
- thickets and scrubs of Jam and various species of *Melaleuca*,
- lettered (A, B, C and D) heaths and scrubs dominated by a variety of shrubby species, particularly of *Acacia, Calytrix* and *Dryandra*, between 0.5m and 1m tall,
- short succulent heaths of *Halosarcia, Sarcocornia* and *Frankenia* typically under 0.5m tall, and
- herbaceous plant communities, particularly tussock grass and sedge communities of *Gahnia trifida* and *?Stipa* sp. and ephemeral stands of annual everlastings and weeds.

There are also extensive areas of dead trunks and stems of eucalypts, Swamp She-oaks, paperbarks and *Melaleuca* shrubs, often with understoreys of samphires and sometimes with only bare ground beneath. Bare ground occupies many areas that are seasonally waterlogged.

5.4 Significant Communities

In general and at this point in time, all Swamp She-oak, Moonah Paperbark and other communities that are endangered by encroachment of salt are significant. The Swamp She-oak and Moonah Paperbark tree communities and other freshwater-lake-fringing vegetation in the wheatbelt are especially significant because so many of them in the wheatbelt have already been lost to salt encroachment and inundation (Froend *et al.* 1987).

Communities at three Vegetation Survey Sites were identified as being of particular significance for some of the species they contain. These are communities at Sites 4, 6 and 24.

Site 4 is a small area of mixed low heath vegetation with wandoo around it and she-oak woodland and *Melaleuca uncinata - M. hamulosa* thicket downslope from it. *Dodonaea bursarifolia* was, in 1985, rare on the site and was not recorded elsewhere during the surveys (although an understorey shrub at nearby Site 3 was tentatively identified as the same species). The collection of this species in the Western Australian Herbarium from the locality nearest the North Arthur Wetlands is from near Wagin. Otherwise, the species is recorded from the central and eastern wheatbelt.

The Site 4 vegetation is apparently high enough on the landscape not to be at risk from salt encroachment, at least in the short term.

The Site 6 Wandoo woodland has a 0.5m tall layer of understorey shrubs or mixed heath that is uncommon or rare in the survey area and is of particular phytogeographical interest for two of the wattles it contains. The two species are *Acacia leptospermoides* ssp. *leptospermoides* and *A. pulviniformis*. The first species is perhaps at the periphery of its range, and the second has not previously been recorded so far north.

The acacias and other shrubs in the heath were not noted in 1985 to be unhealthy, but it was noted during the August 1989 field trip that many of the shrubs were dead, apparently from the effects of salt encroachment, and many others looked unhealthy. Furthermore, many nearby Wandoo trees were dead in 1989 and others looked unhealthy.

The importance of Site 24 is indicated by the presence among the *Melaleuca uncinata* thicket of another *Acacia, A. glaucoptera,* which is well beyond its previously recorded range. This area is also low-lying and apparently also suffering effects of salt encroachment.

6. FLORA

The North Arthur River Wetlands are in the southern end of the floristically diverse and varied Avon Botanical District of the Southwest Botanical Province (Beard 1980c). The flora of the Wetlands reserves is generally typical of the district, although it is generally depauperate compared to its status prior to the clearing of the reserves' catchments and to the floras of many other Wheatbelt reserves.

The flora was recorded opportunistically during the June 1985 vegetation survey of the Wetlands, with collection of vouchers and herbarium specimens of many species not identified in the field.

6.1 Flowering Plant Species

One hundred and fifteen native species of flowering plants were recorded in the reserves. These species are listed in Table 5, along with a supplementary list of approximately 50 additional species and genera which have been recorded in the Lake Toolibin area by Froend (1983, Appendix 3) and M. Graham/B&G (pers. comm.: list). The majority of the additional species are herbaceous plants that flower in spring.

There are also numerous alien species in the ground layers of some communities, which like the herbaceous natives, are more prominent in the spring. No alien species is listed in Table 5.

With few exceptions, the names listed in Table 5 conform to Green (1985 & supplements). The decision as to whether or not an identified species is native was also based upon Green.

A comprehensive spring flora survey of the Wetland reserves would extend the flora list considerably, especially from woodlands and heaths that are higher in the landscape and not on land affected by salt-encroachment. For instance, a local resident said that the Site 12 wandoo woodland, which at the time of the survey was mostly open and grassy, with *Gahnia* and patches of *Allocasuarina humilis* and other shrubs, is excellent for orchids, everlastings and other wildflowers in the spring. Salt-affected areas appeared to be relatively poor in species.

6.2 Significant Species

The term 'significant species' refers to Declared Rare Flora (DRF) species, Priority species and other species believed to be rare, restricted or poorly collected, at least locally. These terms are defined, explained and discussed more fully in Appendix B.

Two sets of lists of significant species are presented here as Tables 6 and 7. Table 6 is the list of species gazetted as rare or endangered as of June 1990 and is annotated to indicate which species are recorded from the Wheatbelt. Table 7 is a set of lists of Priority species recorded from the Wheatbelt prepared in September 1989. As these Priority lists are updated through the year to accommodate new distributional information, they may now be somewhat out of date.

No DRF or Priority species were found during the survey of the North Arthur River Wetlands reserves, but three species of *Acacia* and one of *Dodonaea* collected are at the margins of their known ranges of distribution, and three of them are range extensions. These four species are *Acacia glaucoptera, A. pulviniformis, A. leptospermoides* ssp. *leptospermoides* and *Dodonaea bursarifolia.*

Two species of *Frankenia* were found during the survey. One, not identified to species, was common and widespread. The other, ASW 14750, tentatively identified as *Frankenia brachyphylla*, was uncommon or rare. If it is indeed *Frankenia brachyphylla*, the North Arthur River Wetlands record is a range extension since the species is otherwise an eastern Wheatbelt species.

Eremophila sp. (ASW 14721) (Plate 3A and 3B) was found at only one site in Vegetation Survey Site 1 in June 1985. Subsequently, in 1989, it was also found in the nearby road verge, at Site 14.

7. AVIFAUNA

Observations of the North Arthur River Wetlands birds have not been compiled into comprehensive lists, but Anthony Bougher and Leon Silvester listed the birds they identified during the June 1985 field work in the wetlands. Anthony Bougher's list does not specify in which reserves the birds were seen. Wildlife Officer Silvester's lists do.

These lists are reproduced in Appendix C, along with other lists of birds from North Arthur River Wetlands nature reserves and nearby reserves provided by Wildlife Officer Silvester. These lists could provide the basis for a comprehensive bird list, which might well be comparable in length and content to the list of species of Lake Toolibin and nearby areas.

The 41 species of waterbirds recorded in Lake Toolibin between 1967 and 1987 is the second highest number recorded in any south-western Australian wetland (North Arthur River Wetlands Committee 1987). Thirty-nine of the 99 waterbird species known in the south-west were seen in Lake Toolibin between 1981 and 1985. Twenty-two of these species were observed in breeding activity.

Lake Toolibin appears to be the southwest stronghold of the Freckled Duck, which between 1981 and 1985 was seen more frequently and in greater numbers than in any other south-western wetland (North Arthur River Wetlands Committee (1987). Although Blakers, Davies and Reilly (1984) do not record any Freckled Duck breeding activity in the broader North Arthur River Wetlands area, the North Arthur River Wetlands Committee (1987) states that Lake Toolibin is a particularly important breeding site for the species (and for Great Egrets, Yellow-billed Spoonbills, Rufous Night-herons and Great Cormorants). Its statement is based upon Royal Australasian Ornithologists Union surveys.

8. DISCUSSION

8.1 Vegetation Shifts

Froend and others (Froend1983; Froend *et al.* 1987) have compared and discussed the relative, and to some extent sequential, importance of increasing salinisation and inundation on deaths and loss of vigour of particular species of trees bordering wetlands in the North Arthur River valleys, specifically Lake Toolibin.

It was observed during this project that salinisation and inundation have led to extensive alteration of shrub vegetation in the North Arthur River Wetlands surveyed, as well as deaths and loss of vigour in tree vegetation. Most of the effects commented upon in the Vegetation Survey Site observation sheets (Appendix A) are, at least tentatively, attributed to salinisation rather than inundation. The effects described were principally on-site shifts in vegetation from eucalypt woodland or Swamp She-oak forest with low, open understoreys to thickets of *Melaleuca* spp. or *Gahnia -?Stipa* tussock sedgeland-grassland to samphire succulent low heath or scrub to bare ground. In some (or many) places, the sequence is truncated. An example of this shift is shown in Plate 2H.

8.2 Vegetation Mapping

Attempts to map in detail the vegetation of the wetlands on the 1972 1:40,000 scale black and white aerial photographs were abandoned because, in part, the vegetation units are too small and, in part, because the patterns on the photographs do not reflect the patterns as observed on the ground during the 1985 and 1989 field work. It is believed that the discrepancy is due principally to two factors. The first is that there have been significant changes in the vegetation betwen 1972 and 1985, due to salinisation and, possibly, inundation. The second is that the patterns in the lowest areas are caused by soil and water differences rather than vegetation differences.

Adequate photographic coverage of the wetlands to use for satisfactory, reliable vegetation mapping would require recently flown, larger scale, full colour aerial photographs. Until these are available, the yellow-annotated 1:40,000 scale aerial photographs and this report and its appendices can be used for identifying and comparing vegetation in the wetlands.

9. ACKNOWLEDGEMENTS

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FIGURES

Figure 1

North Arthur River Wetlands Nature Reserves

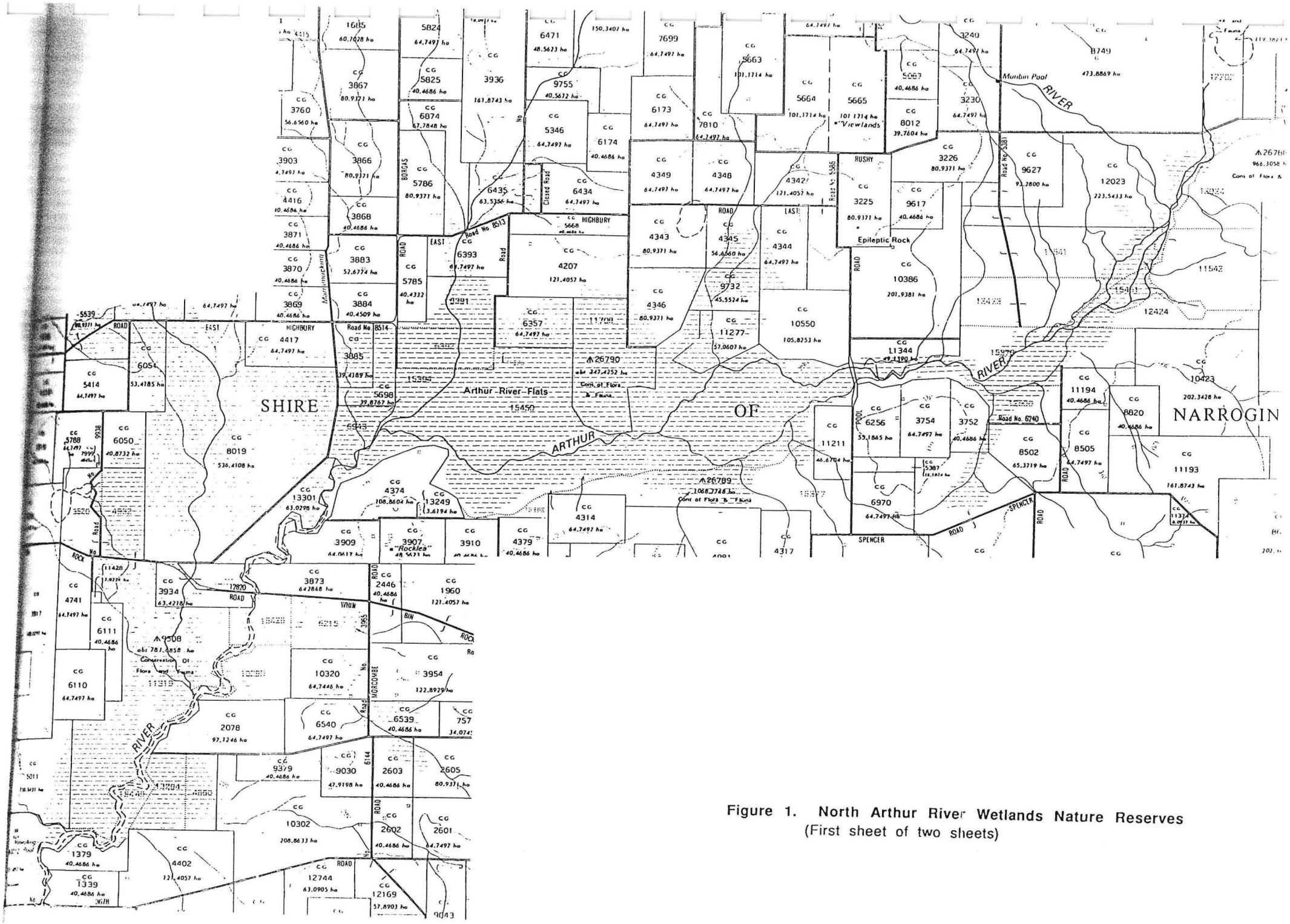

Figure 1. North Arthur River Wetlands Nature Reserves
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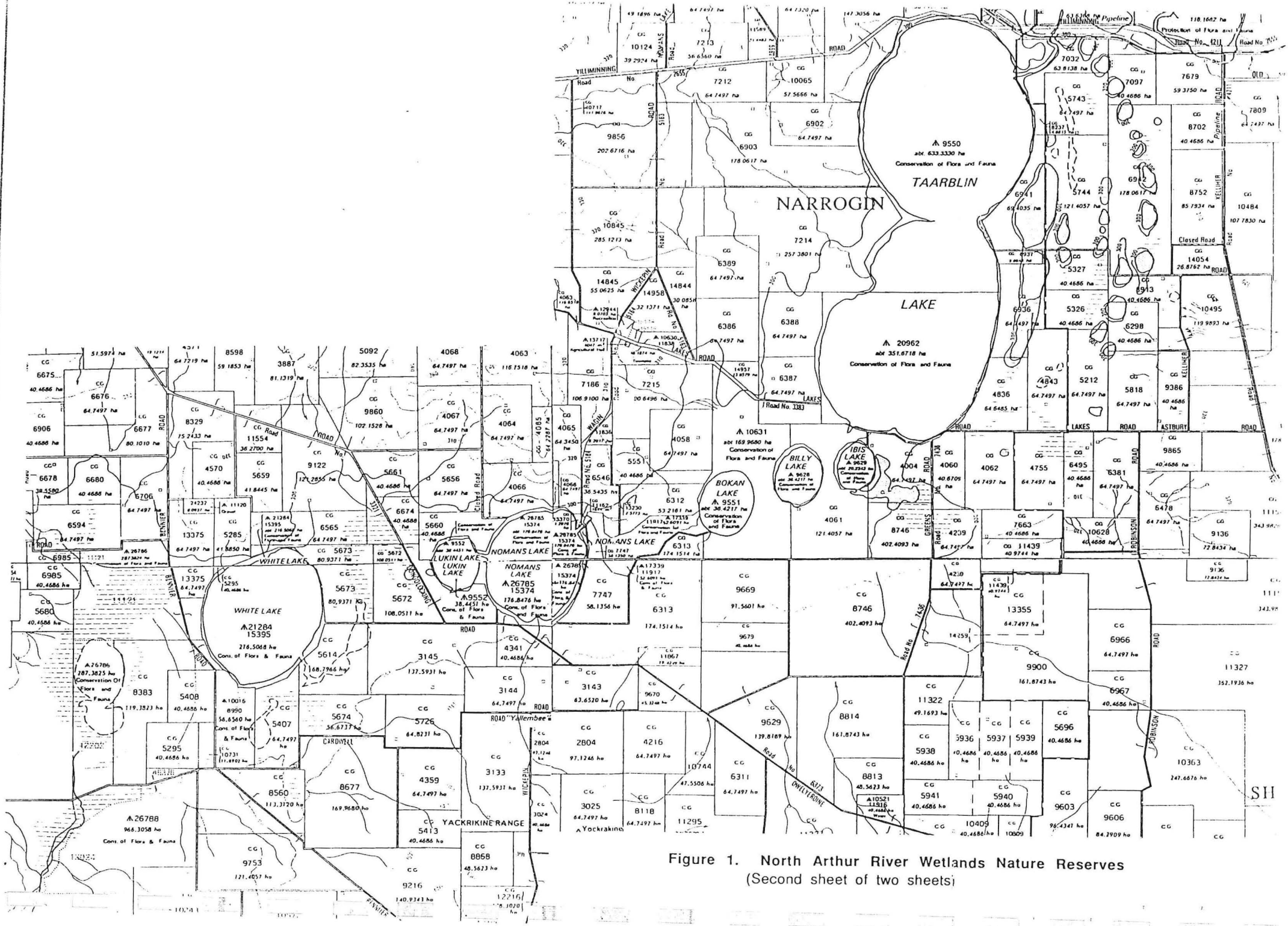
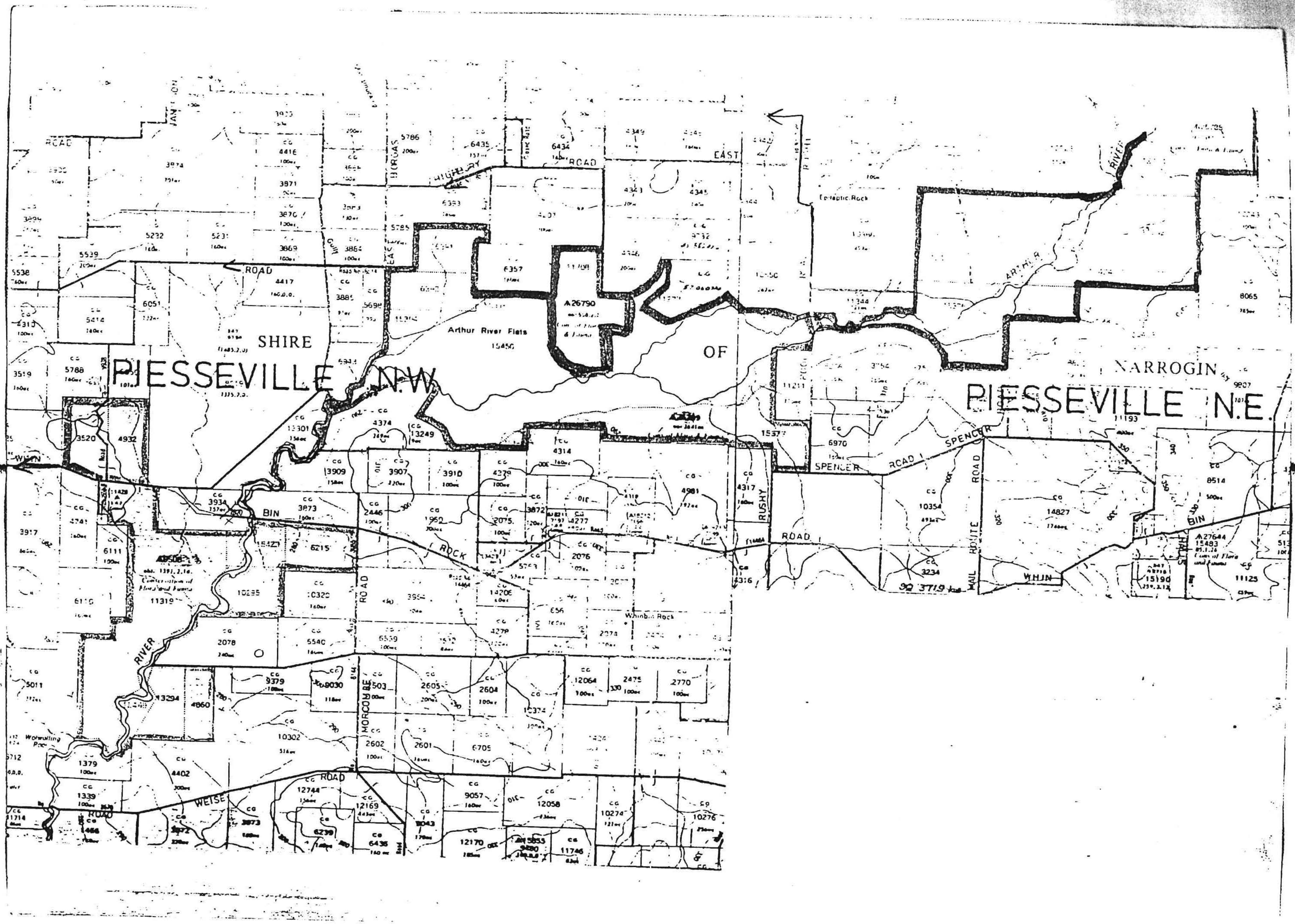


Figure 1. North Arthur River Wetlands Nature Reserves
(Second sheet of two sheets)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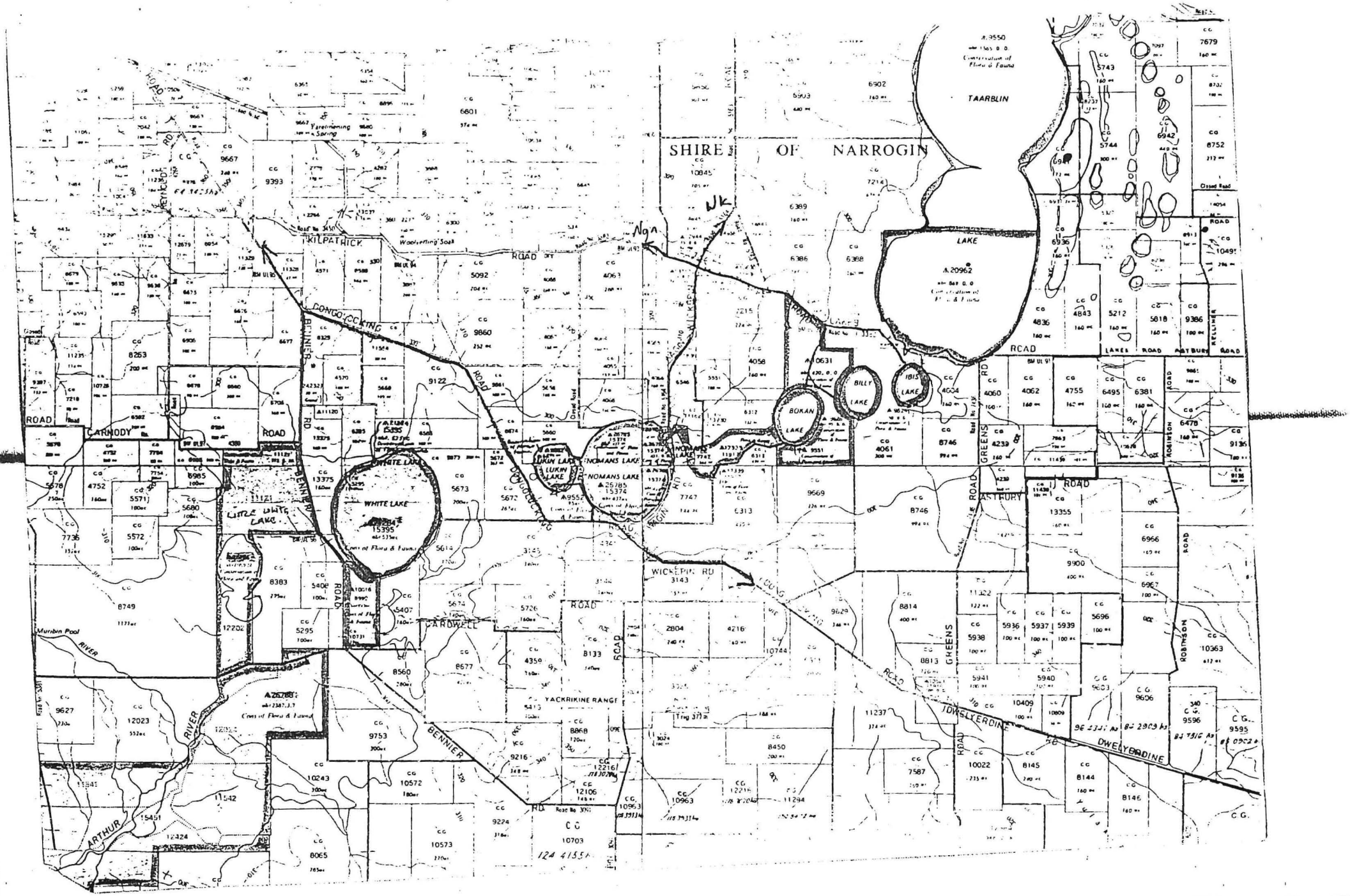
ROCK
RUSHY
SPENCER ROAD
WEISE ROAD
Whinbin Rock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CARNODY
ROAD
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LITTLE WHITE LAKE
LUKIN LAKE
NOMANS LAKE
BOKAN
LAKE
BILLY
LAKE
IBIS
LAKE
GREENS
ROAD
WICKEPIN RD
3143
CAROWELL
ROAD
YACKRIKINE RANGE
Trig 373
Murrin Pool
RIVER
BENNIER
ROAD
ARTHUR
RIVER
IDRISLYERDINE
ROAD
DWELYERDINE
ROBINSON
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KELLERBERRIN
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ASTBURY
ROAD
CG
10703
124 415A

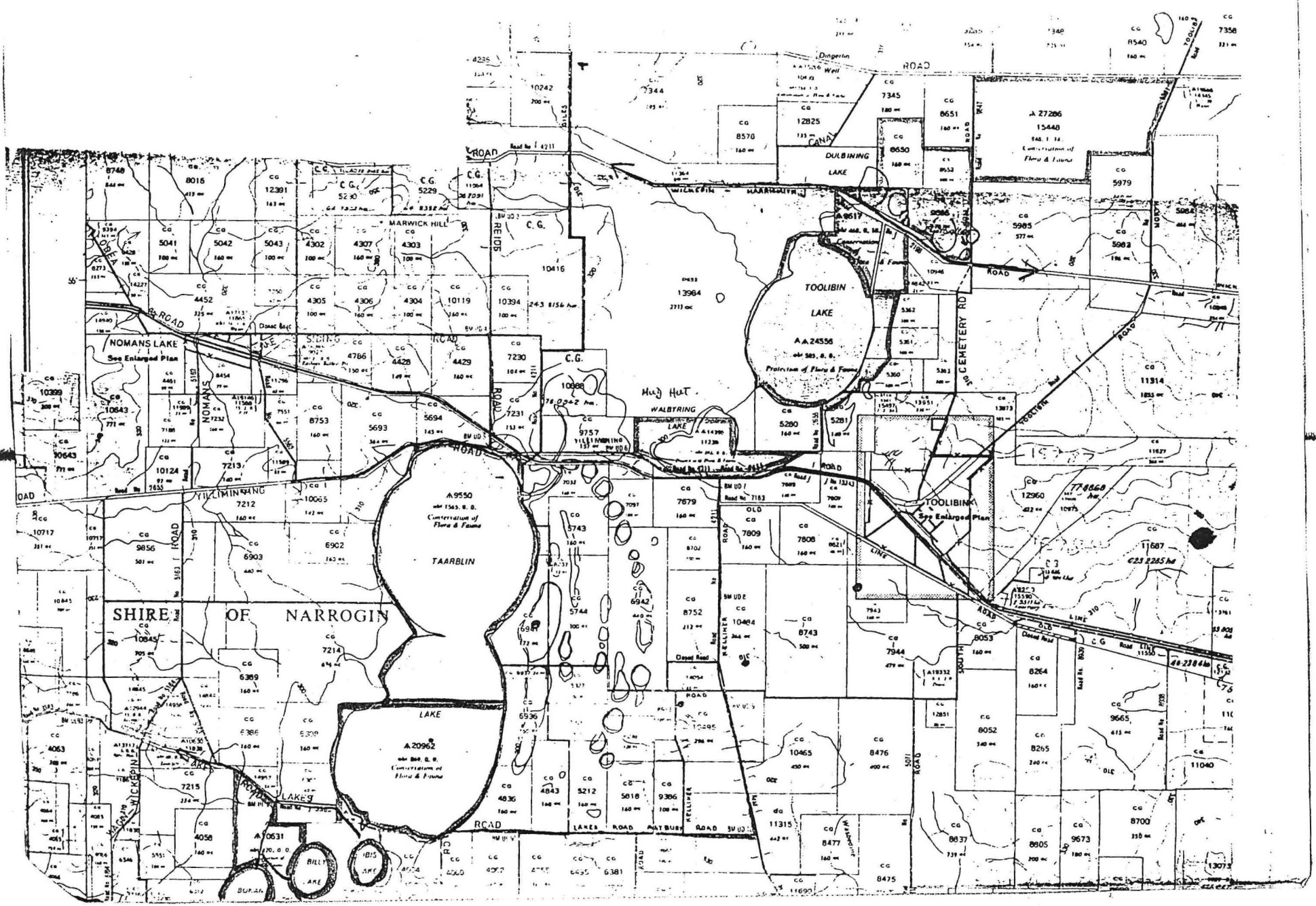
SHIRE OF NARROGIN
TOOLIBIN LAKE
A 24556
See Enlarged Plan
DULBINING LAKE
WALBYRING LAKE
TAARBLIN
A 9550
A 20962
A 10631
NOMANS LAKE
See Enlarged Plan
TOOLIBIN
See Enlarged Plan
MARWICK HILL
Mud Hut
CEMETERY RD
ROAD
LAKE

Figure 2

Vegetation Survey Sites and Notes

(North Arthur River Wetlands Nature Reserves)

see Table 4 for explanation of symbols

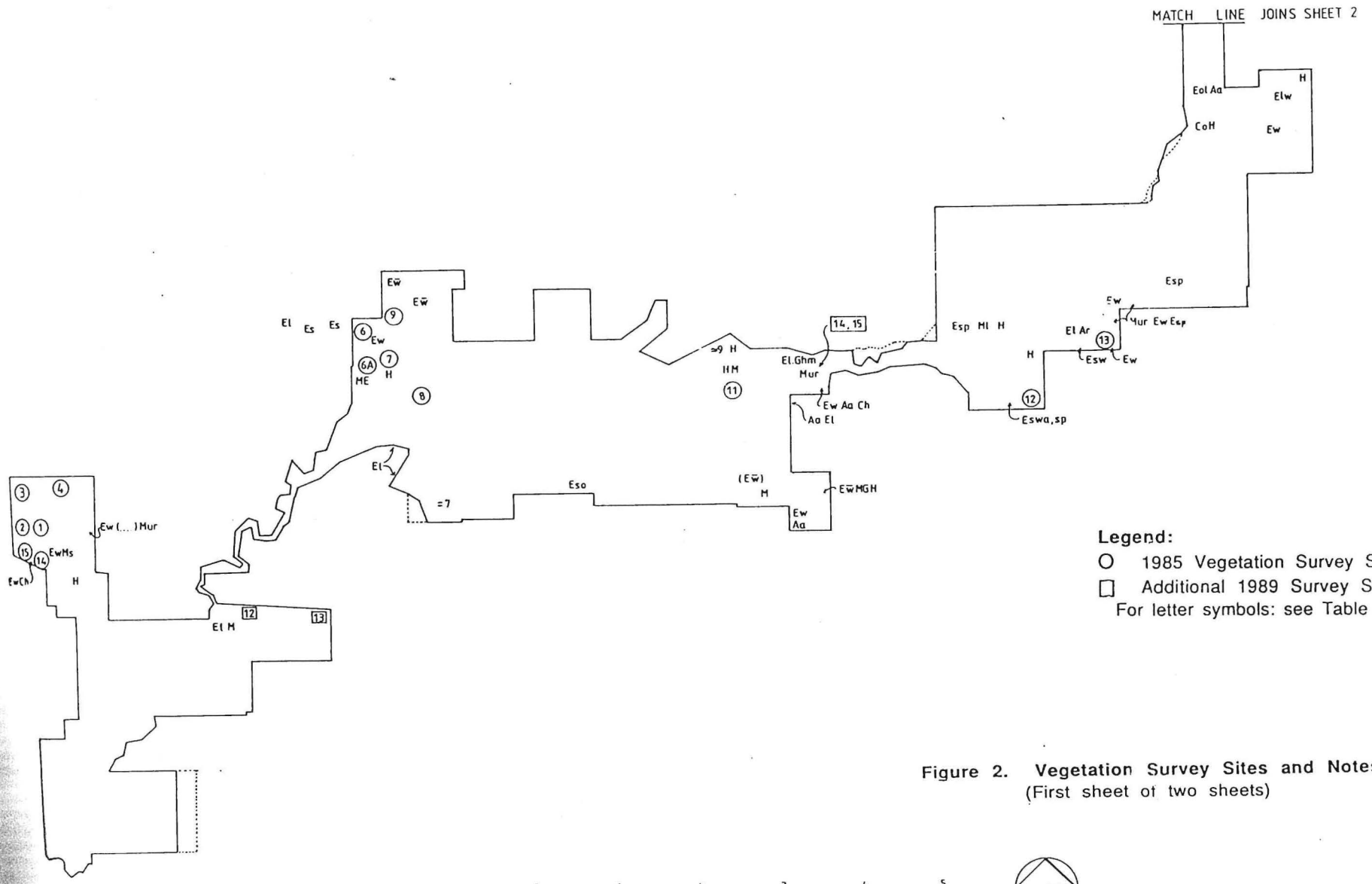

Figure 2. Vegetation Survey Sites and Notes
(First sheet of two sheets)

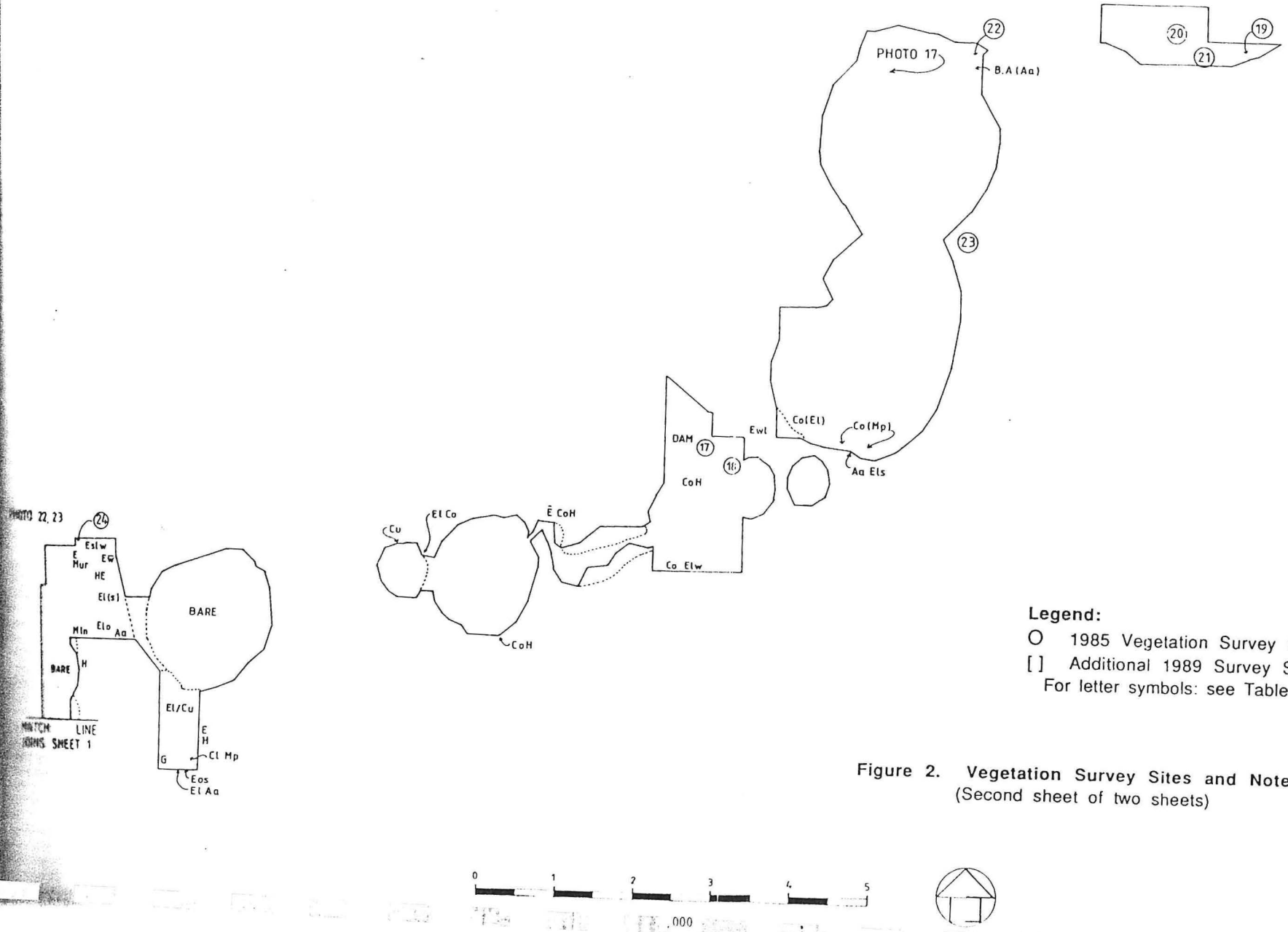

Figure 2. Vegetation Survey Sites and Notes
(Second sheet of two sheets)

TABLES

Table 1

North Arthur River Wetlands Nature Reserves

(from Department of Conservation and Land Management)

Table 2

Vegetation of Lake Toolibin Nature Reserves

(from Froend 1983, p. 9/10)

LEGEND

1. Woodland Melaleuca sp. - C. obesa (dense understorey).

2. Woodland Melaleuca sp. - C. obesa (varying understorey).

3. Woodland Melaleuca sp. - C. obesa (unhealthy sick trees - evidence of salt on soil surface).

4. Open woodland of Melaleuca sp. - C. obesa (Chorizandra enodis - ground cover).

5. Open woodland of E. rudis ranging to herbland of Wilsonia rotundifolia.

6. Open woodland of Melaleuca sp. - C. obesa (salt crusting, samphires, dead tree stratum).

7. Open woodland of E. rudis - Melaleuca sp. ranging to fringing woodland of E. loxophleba.

8. Woodland of E. loxophleba.

9. Open woodland of E. loxophleba.

10. Low open forest of C. huegeliana - Banksia spp.

11. Heath.

12. Halophytic Complex.

13. Open woodland of E. oleosa var. longicornis.

14. Open woodland of E. salmonophloia with admixture of E. wandoo, (open understorey and older Salmon Gum).

15. Open woodland of E. salmonophloia (understorey of Melaleuca spp. and younger Salmon Gum).

16. Open woodland of E. salmonophloia (dense understorey of Melaleuca spp., Salmon Gums dead in sections).

17. Closed scrub of M. lateriflora.

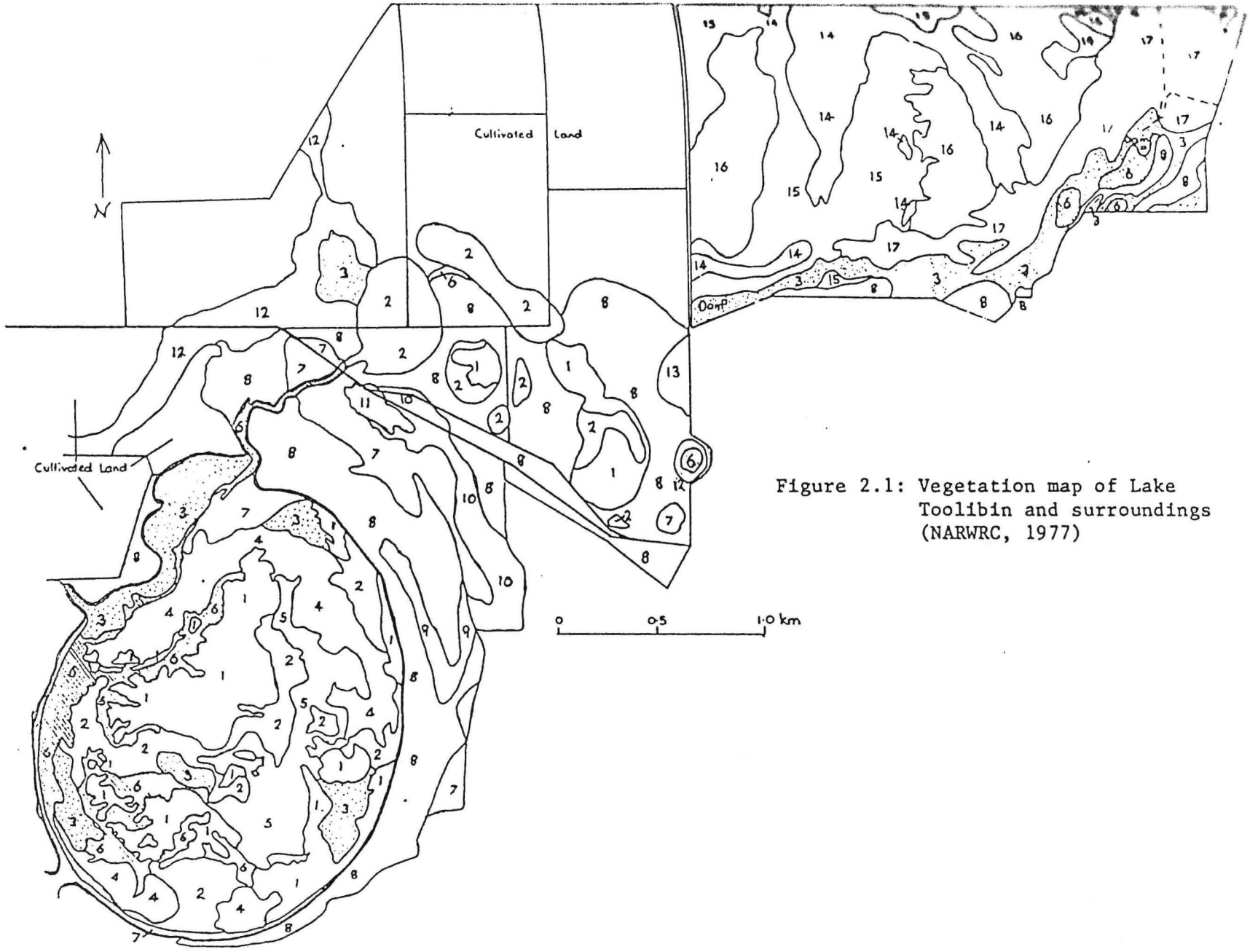

Figure 2.1: Vegetation map of Lake Toolibin and surroundings (NARWRC, 1977)

Table 3

Vegetation Classification System

(from Muir 1977, p.11)

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	DENSE 70-100% d	MID-DENSE 30-70% c	SPARSE 10-30% i	VERY SPARSE 2-10% r
T Trees >30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
M Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland
LA Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
LB Trees <5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
KT Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very [illegible] Tree Mallee
KS Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	V[illegible] rub Mallee
S Shrubs >2m	Dense Thicket	Thicket	Scrub	
SA Shrubs 1.5-2.0m	Dense Heath A	Heath A	Low Scrub A	
SB Shrubs 1 0-1.5m	Dense Heath B	Heath B	Low Scru[illegible]	
SC Shrubs 0.5-1.0m	Dense Low Heath C	Low Heath C	Dwar[illegible]	
SD Shrubs 0.0-0.5m	Dense Low Heath D	Low Heath D	D[illegible]	
P Mat plants	Dense Mat Plants	Mat Plants		
H Hummock Grass	Dense Hummock Grass	Mid-Dense Hummo[illegible]		
GT Bunch grass >0.5m	Dense Tall Grass	Tall [illegible]		
GL Bunch grass <0.5m	Dense Low Grass	[illegible]		
J Herbaceous spp.	Dense Herbs			
VT Sedges >0.5m	Dense Tall Sedg[illegible]			
VL Sedges <0.5m	Dense Low [illegible]			
X Ferns	D[illegible]			
Mosses, liverwort				

Table 4

Vegetation Units of

North Arthur River Wetlands Nature Reserves

Table 4

Vegetation Units of North Arthur River Wetlands Nature Reserves

Formations Map Symbols	Dominant Species	Sites	Plates
FORESTS, WOODLANDS and TREE MALLEES			
Ch	*Allocasuarina huegeliana*	10, 13	
Co (Co, Co)	*Casuarina obesa*	2, 2A, 10, 18, 20, 23	1D, 4D
E, (E, E)	*Eucalyptus* species	(dead: e.g. 5, 6A	3E)
El	*E. loxophleba*	1, 1A, 17, 19, 23	1A, 1B, 1C
Em, Eo	*E. longicornis*	3A	1E, 3C
Em	*E. kondininensis*	3B	3D
Er	*E. rudis*	10	
Es	*E. salmonophloia*	17	
Esp.	*E. sheathiana, E.* sp.	11	3G
Ew	*E. wandoo*	3C, 6, 12, 14, 17	1C, 1F, 3H
Mp	*M. preissiana/strobophylla*	18, 23	
THICKETS and SCRUBS over 2m Tall			
Aa	*Acacia acuminata*		
Mi	*M. incana (?)*	13	
Ma, Mh, Mun	*M. acuminata, M. hamulosa, M. uncinata*	6A, 8, 9, 10, 11, 14(I), 18, 21, 22, 24	2B, 3G, 4E
Mur	*M. urceolaris (?)*	5A	
HEATHS and Shorter SCRUBS			
Dc	*Dryandra conferta*	13	
H	*Acacia/Calytrix*	6	1F
H	Mixed	4A	
SUCCULENT HEATHS and SCRUBS and GRASSES, SEDGES and HERBS			
G	*Gahnia - ?Stipa*	15, 17	2D, 2F
S (Ha)	Samphire (e.g. *Halosarcia*)	5, 7, 14(J)	2E, 3E, 3F, 4B

Table 5

Native Flowering Plant Species

(North Arthur River Wetlands Nature Reserves)

Table 5

NATIVE FLOWERING PLANT SPECIES LIST

Table 6 comprises two lists. The first is a list of the native species of angiosperms (flowering plants) recorded from North Arthur River Wetlands nature reserves during field trips in August 1989 and, principally, June 1985. The list gives site numbers for one or more Vegetation Survey Sites in which each species was recorded and collection number(s) for each species on the list of which herbarium collections were made. The second list a supplementary list of additional native species recorded from Lake Toolibin reserves. Families and their numbers are listed in numerical sequence according to the Census of Western Australian Plants (Green 1985), and species are listed alphabetically within families.

The list can be modified and extended as more plants are collected in the reserve, identified and redetermined. Determinations for some groups of plants in the current list are tentative because, as in Proteaceae and Campanulaceae, the Western Australian Herbarium collections were away on loan to other herbaria at the time determinations were made. Some determinations are being made by botanical specialists in other herbaria.

It is imperative that collectors' names and their collection numbers be listed for all species in any species list that is to be kept meticulously accurate and up to date. Without voucher specimens there is no proof that a species name listed reflects a correct identification.

KEY TO ABBREVIATIONS AND SYMBOLS

BEFORE GENUS NAME

? Questionable determination to genus ('?' in middle of species name indicates that determination to species is questionable)

AFTER SPECIES NAME

dd. Doubtful determination.

TABLE 5
NATIVE FLOWERING PLANT SPECIES
NORTH ARTHUR RIVER WETLANDS

(partial, and mostly excluding lateritic and sand heath species)

SPECIES	SITE NO. (incomplete)	COLLEC. NO.
31 POACEAE		
Amphipogon turbinatus R.Br.	14	14753
Poa sp.	3A	
?Stipa sp.	15	14755
32 CYPERACEAE		
Gahnia ancistrophylla Benth.	12	14752
Gahnia trifida Labill.	5, 15	14734, 14756
Lepidosperma angustatum R.Br.	1	14722
Lepidosperma brunonianum Benth.	3A	14726
Lepidosperma drummondii Benth.	13B	14762
39 RESTIONACEAE		
?Loxocarya sp.	13B, 14	14763A
?Restio sp.	6	
54 LILIACEAE		
Borya spp.	3A, 4A, 6, 14	
Dianella longifolia R.Br.	1, 10, 14	14749
Lomandra collina (R.Br.)Ewart	3A	14725
Lomandra effusa (Lindl.)Ewart	6	14743
Lomandra micrantha (Endl.)Ewart	6	14744
Lomandra rupestris (Endl.)Ewart		
Wurmbea tenella (Endl.)Benth.	14	14754
Xanthorrhoea ? preissii Endl. in Lehm.	13	
56 AMARYLLIDACEAE		
Hypoxis ? glabella R.Br.	9	14748

60 IRIDACEAE

Patersonia sp.	1	

66 ORCHIDACEAE

Lyperanthus ? nigricans R.Br.	14	
Pterostylis nana R.Br.	1	

70 CASUARINACEAE

Allocasuarina huegeliana (Miq.)L.Johnson	1, 6, 10, 12, 13	
Allocasuarina humilis		
Casuarina obesa Miq. in Lehm.	2, 10	

90 PROTEACEAE

Banksia prionotes Lindl.	19?/21?	
Banksia sphaerocarpa var. caesia	13	
Dryandra aff. armata (=Pingelly 270)	13	
Dryandra conferta Benth.	13	14759
Dryandra ? cuneata		
Dryandra ? fraseri	13	
Dryandra sp.	4A	
Grevillea spp.	10	
Hakea franciscana F.Muell.		
Hakea gilbertii Kipp. ex Meissn.	13	14758
Hakea ? incrassata	13	
Hakea invaginata B.L.Burtt		
Hakea ? lissocarpha	24	
Hakea preissii Meissn. in Lehm.	5	
Hakea trifurcata (Sm.)R.Br.	6	
Isopogon teretifolius	13	

92 SANTALACEAE

?Exocarpos sp.		
Santalum acuminatum (R.Br.)A.DC.	3A	
Santalum spicatum (R.Br.)A.DC.		

97 LORANTHACEAE

Amyema sp.	6	

105 CHENOPODIACEAE

Halosarcia ? halocnemoides (Nees)Paul G. Wilson	2, 5, 5A, 6	
Halosarcia sp.		
Rhagodia nutans R.Br. (=Einadia)	19	
Sarcocornia quinqueflora (Bunge ex Ung.-Sternb.)A.J.Scott		

110 AIZOACEAE

Carpobrotus sp.	10	
Disphyma crassifolium (L>)L.Bolus	17	

131 LAURACEAE

Cassytha sp.	13, 24	

143 DROSERACEAE

Drosera bulbosa Hooker	1	14719
Drosera ? erythrorhiza Lindl.	14	
Drosera macrantha Endl.	14	

149 CRASSULACEAE

Crassula sp.	1	

152 PITTOSPORACEAE

Pittosporum sp.	23	
Sollya heterophylla Lindl.	3A	14727

163 LEGUMINOSAE SUBFAM. MIMOSOIDEAE

Acacia acuminata Benth.	6, 14	
Acacia ? erinacea Benth.	3A	
Acacia glaucoptera Benth.	24	14765A
Acacia leptospermoides Benth. ssp. leptospermoides	6	14741
Acacia microbotrya Benth.	19?	

Acacia ? multispicata Benth.	13	
Acacia pulviniformis Maiden & Blakely	6	14740A
Acacia pulchella R.Br. in Ait.	19	
Acacia saligna (Labill.)H.L.Wendl.	10	

164 LEGUMINOSAE SUBFAM. CAESALPINOIDEAE

Cassia nemophila Cunn. ex Vogel	23	

165 LEGUMINOSAE SUBFAM. PAPILIONOIDEAE

Daviesia horrida Preiss ex Meisn. in Lehm.	19	
Jacksonia furcellata (Bonpl.)DC.	6, 10	

207 SAPINDACEAE

Dodonaea bursarifolia Behr. & F.Muell.	4	14730

215 RHAMNACEAE

Cryptandra nutans Steud. in Lehm.	13	14757

236 FRANKENIACEAE

Frankenia ? brachyphylla Summerh.		14750
Frankenia spp.	2, 5, 8	

263 THYMELAEACEAE

Pimelea sp.		

273 MYRTACEAE

Baeckea ? crispiflora		
Callistemon phoeniceus Lindl.	6, 10	
Calytrix leschenaultii (Schauer) Benth.	6	14742
Calytrix sp.	4A	
Eremaea pauciflora (Endl.)Druce	6	14746
Eucalyptus kondininensis Maiden & Blakely	3B	14728
Eucalyptus loxophleba Benth.	1	
Eucalyptus rudis Endl.	10	

Eucalyptus salmonophloia F.Muell.	3B	
Eucalyptus spathulata Hook.	11	14751
Eucalyptus wandoo Blakely	1, 3A, 6, 12, 14	
Eucalyptus sp.	3A	14724
Melaleuca acuminata F.Muell.	6, 11	14739, 14767
Melaleuca conferta Benth.	13	14759
Melaleuca hamulosa Turcz.	6	14732, 14737
Melaleuca ? incana R.Br.	13	
Melaleuca ? lateriflora Benth.	8	14747
Melaleuca ? platycalyx	13	
Melaleuca ? preissiana Schauer	2	14723
Melaleuca ? pungens Schauer in Lehm.	13	
Melaleuca scabra sens. lat.	13	
Melaleuca ? seriata	13	
Melaleuca strobophylla	25	14768
Melaleuca uncinata R.Br.	4,10	14731
Melaleuca ? urceolaris F.Muell. ex Benth. (grey)	5A, 7, 10	14736
Melaleuca ? viminea Lindl.	White Lake	14769
Melaleuca spp.	4, 6, [25]	14733,14740, 14766
Verticordia ? chrysantha Endl.	4A	
Veticordia sp.	4A	

288 EPACRIDACEAE

Astroloma epacridis (DC.)Druce	1, 13	14720,14761
Astroloma pallidum R.Br.	4	14729

326 MYOPORACEAE

Eremophila sp.	1	14721
Myoporum sp.	23	

341 GOODENIACEAE

Dampiera spp.	4A, 14	
Lechenaultia ? formosa	14	

345 ASTERACEAE

Helipterum sp.	1	
Podolepis aff. microcephala Benth.	1	14718

UNDETERMINED TO FAMILY

ASW 14735	5
ASW 14745	6
ASW 14765	[19]

Supplementary List

Additional Native Species Recorded from Lake Toolibin Reserves

(from Froend 1983 Appendix 3 and a list of identifications by M. Graham; many, if not most, probably also occur in the middle and lower parts of the North Arthur River chain of wetland nature reserves)

31 POACEAE

Agrostis sp. ?
Bromus sp. ?
Neurachne alopecuroides
Danthonia sp.
Poa sp.
Stipa elegantissima
Stipa spp.

32 CYPERACEAE

Chorizandra enodis

39 RESTIONACEAE

Leptocarpus sp.
Lyginia barbata
Restio deformis
Restio sp.

66 ORCHIDACEAE

Caladenia flava
[Caladenia ? bicolor] ?
Caladenia dilatata
Caladenia saccharata
Pterostylis recurva

70 CASUARINACEAE

Allocasuarina campestris
Allocasuarina microstachya

90 PROTEACEAE

Banksia attenuata
Dryandra sessilis
Hakea baxteri
Hakea incrassata
Hakea lissocarpha
Hakea varia

92 SANTALACEAE

Santalum murrayanum

105 CHENOPODIACEAE

[Arthrocnemum bidens]?

111 PORTULACACEAE

Calandrinia spp.

165 LEGUMINOSAE SUBFAM. PAPILIONOIDEAE

Gastrolobium spinosum
Gompholobium tomentosum
Templetonia sulcata

167 GERANIACEAE

Pelargonium havlasae

170 LINACEAE

Linum marginale

207 SAPINDACEAE

Dodonaea viscosa

215 RHAMNACEAE

Cryptandra pungens

263 THYMELAEACEAE

Pimelea argentea

273 MYRTACEAE

Calytrix brachyphylla (=C. leschenaultii)
Eucalyptus accedens
Eucalyptus longicornis
Kunzea preissiana
[Melaleuca preissiana =M. strobophylla)]
Melaleuca viminea
Pericalymma ellipticum

281 APIACEAE

[Apium australe]

307 CONVOLVULACEAE

Wilsonia rotundifolia

341 GOODENIACEAE

Goodenia viscida
Goodenia sp.

345 ASTERACEAE

Cotula sp.
Gnaphalium sp.
Helichrysum spp.
Podotheca sp.
Senecio glossanthus
Senecio lautus
Waitzia acuminata
Waitzia sp.

Table 6

Gazetted Rare Species

(from Department of Conservation and Land Management: Government Gazette, WA 1June 1990, pp. 2486-87)

Wheatbelt species are preceded with an 'x'

WILDLIFE CONSERVATION ACT

019882F3701

Pursuant to the provisions of subsection (2) of section 23F of the Wildlife Conservation Act, I hereby declare that protected flora of the taxa listed in the schedule to this Notice growing in its original state and not in its domesticated or cultivated state are rare flora throughout the whole of the State.

The previous Notice relating to rare flora published in the *Government Gazette* on 14 July 1989 is hereby cancelled.

BOB PEARCE, Minister for the Environment.

DECLARED RARE FLORA SCHEDULE
1990

Acacia anomala
Acacia aphylla
Acacia argutifolia
Acacia denticulosa
Acacia depressa
Acacia forrestiana
Acacia guinetii
Acacia lanuginosa
Acacia merrickiae
Acacia pharangites
Acacia semicircinalis
Acacia simulans
Acacia vassalii
Acacia sp. (Chiddarcooping) J. Brown 59 & A. Williams
Acacia sp. (Dandaragan) S. van Leeuwen 269
Acacia sp. (Wongan Hills) K.F. Kenneally 7496
Adenanthos cunninghamii
Adenanthos dobagii
Adenanthos ellipticus
Adenanthos eyrei
Adenanthos ileticos
Adenanthos pungens
Adenanthos velutinus
Allocasuarina fibrosa
Allocasuarina tortiramula
Anigozanthos bicolor subsp. *minor*
Anigozanthos humilis subsp. *chrysanthus*
Anigozanthos viridis subsp. *terraspectans*
Apium prostratum subsp. (Porongurups) G.J. Keighery 8873
Aponogeton hexatepalus
Asplenium obtusatum
Asterolasia drummondii
Asterolasia grandiflora
Asterolasia nivea
Baeckea arbuscula
Banksia brownii
Banksia cuneata
Banksia goodii
Banksia oligantha
Banksia sphaerocarpa var. *dolichostyla*
Banksia tricuspis
Banksia verticillata
Billardiera mollis
Boronia adamsiana
Boronia revoluta
Caladenia bryceana
Caladenia cristata
Caladenia dorrienii
Caladenia huegelii
Caladenia integra
Caladenia wanosa
Caladenia sp. (Cape Naturaliste) S.D. Hopper 4518
Caladenia sp. (Dunsborough) S.D. Hopper 5520b
Caladenia sp. (Esperance) D.R. Voigt 36
Caladenia sp. (Leeuwin-Naturaliste) S.D. Hopper 4670
Caladenia sp. (Moresby Range) G.J. Keighery 3328
Caladenia sp. (Muir) S.D. Hopper 3521
Caladenia sp. (Murchison) S.D. Hopper 3270
Caladenia sp. (Northampton) S.D. Hopper 3347
Caladenia sp. (salt lakes) S.D. Hopper 4162
Caladenia sp. (southern forest) S.D. Hopper 3553
Calectasia sp. (central wheatbelt) K. Dixon 861 – P1 - W
Chamelaucium sp. (Busselton) G.J. Keighery 3655
Chamelaucium sp. (Cataby) G.J. Keighery 11009
Chamelaucium sp. (S. coastal plain) R.D. Royce 4872
Conospermum toddii
Conostylis drummondii
Conostylis lepidospermoides
Conostylis micrantha
Conostylis misera
Conostylis rogeri
Conostylis scorsiflora subsp. *trichophylla*
Conostylis wonganensis
Coopernookia georgei
Corybas sp. (Albany) L. Byrne 10
Darwinia acerosa
Darwinia apiculata
Darwinia carnea
Darwinia collina
Darwinia macrostegia
Darwinia masonii
Darwinia mecboldii
Darwinia oxylepis
Darwinia squarrosa
Darwinia wittwerorum
Darwinia sp. (Scott River) G.J. Keighery 3582
Darwinia sp. (Stirling Range) G.J. Keighery 5732
Daviesia euphorbioides
Daviesia purpurascens
Daviesia spiralis
Daviesia sp. (central wheatbelt) M.D. Crisp 6612
Daviesia sp. (Eneabba) S.D. Hopper 4829
Daviesia sp. (Norseman) M.D. Crisp 5943
Daviesia sp. (Ravensthorpe) M.D. Crisp 6065
Daviesia sp. (Stirling Range) K.R. Newbey 5113
Daviesia sp. (Three Springs) M.D. Crisp 6480
Diuris drummondii
Diuris purdiei
Diuris sp. (Kwinana) A.P. Brown 10.9.84
Diuris sp. (Northampton) A.P. Brown 203
Drakaea elastica
Drakaea sp. (Great Southern) S.D. Hopper 3461
Drakaea sp. (Kalbarri) A.P. Brown 8.82
Drakaea sp. (south west) S.D. Hopper 3566
Drosera fimbriata
Drosera occidentalis
Drummondita ericoides
Drummondita hassellii var. *longifolia*
Dryandra mimica
Dryandra serratuloides
Dryandra sp. (Kamballup) M. Pieroni 20.9.88
Dryandra sp. (Stirling Range) F. Lullfitz 3379
Eremophila caerulea subsp. (eastern wheatbelt) S. D. Hopper 1
Eremophila denticulata
Eremophila inflata
Eremophila microtheca
Eremophila nivea
Eremophila racemosa
Eremophila resinosa
Eremophila serpens
Eremophila ternifolia
Eremophila verticillata
Eremophila virens
Eremophila viscida
Eremophila sp. (Lake King) S.D. Hopper 1807
Eremophila sp. (Newdegate-Kondinin) L. Haegi 1087
Eriostemon wonganensis
Eucalyptus beardiana
Eucalyptus bennettiae
Eucalyptus brevipes
Eucalyptus burdettiana
Eucalyptus ceracea
Eucalyptus cerasiformis
Eucalyptus coronata
Eucalyptus crucis subsp. *crucis*
Eucalyptus crucis subsp. (Paynes Find) S.D. Hopper 1842
Eucalyptus erectifolia
Eucalyptus goniantha subsp. *goniantha*
Eucalyptus insularis
Eucalyptus johnsoniana
Eucalyptus latens
Eucalyptus lateritica
Eucalyptus merrickiae
Eucalyptus mooreana
Eucalyptus rhodantha
Eucalyptus steedmanii
Eucalyptus suberea
Eucalyptus synandra subsp. (wheatbelt) A.S. George 16203
Eucalyptus sp. (Badgingarra) M.I.H. Brooker 9026

Eucalyptus sp. (Cape Naturaliste) K.H. Rechinger 58888
Eucalyptus sp. (Dandaragan) M.I.H. Brooker 9744
Eucalyptus sp. (E. Nambung) M.I.H. Brooker 9025
Eucalyptus sp. (Eneabba) M.I.H. Brooker 9736
Eucalyptus sp. (Lake Minigwal) M.I.H. Brooker 9686
Eucalyptus sp. (Midlands Highway) M.I.H. Brooker 8734
Eucalyptus sp. (Moresby Range) S.D. Hopper 2759
Eucalyptus sp. (Norseman) S.D. Hopper 2736
Eucalyptus sp. (N. Coomallo) M.I.H. Brooker 8823
Eucalyptus sp. (Northampton) M.I.H. Brooker 9196
Eucalyptus sp. (Pingaring) M.I.H. Brooker 9109
Eucalyptus sp. (Wagerup) M.I.H. Brooker 9807
Eucalyptus sp. (Yanchep) M.I.H. Brooker 8608
Eucalyptus sp. (Yandanooka) M.I.H. Brooker 9205
Gastrolobium appressum
Gastrolobium callistachys – not a P species
Gastrolobium glaucum
Gastrolobium graniticum
Gastrolobium hamulosum – P2 – W, GRE
Gastrolobium tomentosum
Grevillea cirsiifolia
Grevillea dryandroides
Grevillea inconspicua
Grevillea infundibularis
Grevillea involucrata
Grevillea prostrata
Grevillea saccata
Grevillea scapigera
Grevillea sp. (Dandaragan) S.D. Hopper 6350
Hakea aculeata
Hakea megalosperma
Halosarcia bulbosa
Hemiandra gardneri
Hemiandra rutilans
Hemigenia viscida
Hensmania chapmanii
Hibbertia bracteosa
Hydrocotyle lemnoides
Isopogon uncinatus
Kennedia beckxiana
Kennedia glabrata
Kennedia macrophylla
Lambertia echinata
Lambertia fairallii
Lambertia orbifolia
Laxmannia jamesii
Lechenaultia chlorantha
Lechenaultia laricina
Lechenaultia pulvinaris
Lechenaultia superba
Lepidium catapycnon
Leucopogon obtectus
Melaleuca sciotostyla
Microcorys eremophiloides
Microtis globula
Myoporum cordifolium
Myoporum turbinatum
Myriophyllum petraeum
Pandanus spiralis var. *flammeus*
Pimelea rara
Pittosporum moluccanum
Pityrodia augustensis
Pityrodia scabra – P1 – W
Prostanthera carrickiana
Prostanthera magnifica
Pterostylis sp. (Northampton) S. D. Hopper 3349
Ptychosema pusillum
Pultenaea pauciflora
Rhagodia acicularis
Rhizanthella gardneri
Ricinocarpos trichophorus
Roycea pycnophylloides
Spirogardnera rubescens
Stawellia dimorphantha
Stylidium coroniforme
Stylidium galioides
Stylidium plantagineum
Stylidium scabridum
Tetratheca aphylla
Tetratheca harperi
Thelymitra benthamiana
Thelymitra psammophila
Thelymitra stellata
Thomasia montana
Thomasia sp. (York) A.S. George 8075
Thryptomene wittweri
Tribonanthes purpurea

Verreauxia verreauxii
Verticordia fimbrilepis
Verticordia helichrysantha
Verticordia hughanii
Verticordia staminosa
Verticordia sp. (Fitzgerald) C.A. Gardner 9148
Villarsia calthifolia
Wurmbea drummondii
Wurmbea tubulosa
Wurmbea sp. (Cape Naturaliste) S.D. Hopper 5871
Xyris sp. (Stirling Range) G.J. Keighery 7951

A75671-2

Deleted from 14-1-1989 list:
Eremophila merrallii (Bruce Rock Eremophila), a wheat belt species

Table 7

Wheatbelt Reserve Priority Species

(from Western Australian Wildlife Research Centre,
see Hopper *et al.* 1990)

RESERVE SPECIES LIST

WHEATBELT REGION

(SVL 13/9/89)

Key:

PRIORITY CODES

Priority One Species which are known from one or a few localities on lands under immediate threat, e.g. road verges, urban areas, active mineral leases, areas grazed by feral animals, etc. These species are under consideration for declaration as rare flora but are in need of urgent high priority further survey.

Priority Two Species which are known from one or a few localities on lands not under immediate threat, e.g. nature reserves, national parks, vacant crown land, water reserves, etc. These species are under consideration for declaration as rare flora but are in need of urgent high priority further survey.

Priority Three Species which are known from several localities, some of which are on lands not under immediate threat. These species are under consideration for declaration as rare flora but are in need of further survey.

Priority Four - taxa presumed extinct
Species which have not been collected or reliably observed in the wild over the past 50 years, or whose total known wild population has been destroyed more recently.

Priority Five - taxa for high priority monitoring
Species which are considered to have be adequately surveyed and not endangered or in need of special protection, but could be if present circumstances change. These species are usually represented on reserves.

OTHER CALM REGIONS

CF	Central Forest
GAS	Gascoyne
GLD	Goldfields
GRE	Greenough
M	Metropolitan
NF	Northern Forest
SC	South Coast
SF	Southern Forest

Priority One

Species	Distribution	Flowering Period	Other CA Region
Acacia inceana	Lake O'Grady, Hines Hill, Kalannie, Cowcowing	Aug-Sep	
Acacia aff. ixiophylla [P146] (R. Lane s.n. 7/82)	Hyden, Pederah	Jul-Sep	
Acacia kingiana	Wagin	Sep	
Acacia aff. kochii [P153] (A.P. Brown 112)	Helena and Aurora Range	Sep-Dec	
Acacia aff. merrallii [P101] (K.R. Newbey 3263)	Lake Cobham, Lake Bryde, Lake Magenta	Aug-Sep	
Acacia aff. merrallii (K.R. Newbey 4774)	Pingrup	Aug-Sep	SC
Acacia microneura	Cranbrook	Sep-Oct	SC
Acacia aff. multilineata (B.R. Maslin 3405)	Wyalkatchem, Kununoppin, Tammin, Korrelocking	Aug-Sep	
Acacia aff. multilineata [P7] (B.R. Maslin 3399)	South Kumminin, Yorkrakine	Jul	
Acacia sciophanes	Mukinbudin	Sep-Jan	
Acacia sclerophylla subsp. teretiuscula	Bendering, Bruce Rock, Lake Grace	Aug-Sep	
Acacia aff. uncinella (B.R. Maslin 3864)	Lake King, Lake Ace	Oct	
Acacia aff. vassalii (K.R. Newbey 3399)	Nyabing	Jun-Aug	
Andersonia bifida	Dryandra State Forest	Sep	
Bentleya spinescens	Newdegate	Sep-Oct	
Caladenia caesarea subsp. "subditas"	Woodanilling	Oct	
Caladenia caesarea subsp. "transiens"	Williams	Sep	
Calothamnus blepharantherus	Wattengutten Hill	Jul	
Calytrix creswellii	Bungalbin Hill	Nov-Dec	
Calytrix parvivallis	Minnivale	Oct	
Coleanthera coelophylla	East of Katanning	May	
Conostylis setigera subsp. dasys	Kojonup	Oct-Nov	
Cyphanthera odgersii subsp. occidentalis	Cowcowing	Sep-Dec	
Dampiera glabrescens	Ballidu	May	
Dampiera orchardii	Lake King	Oct-Nov	SF,SC
Dampiera scaevolina	Bencubbin, Holt Rock, Beacon	Oct-Nov	
x "Drakodenia ornata"	Pithara	Sep	
Drosera sp. (K.R. Newbey 5514)	Lake King	Jul-Aug	
Dryandra aff. drummondii (A.S. George 16695)	Nyabing	Jul	
Eremophila sp. (W.E. Blackall 3937)	Kalannie, Wubin, Dalwallinu	Sep	
Eucalyptus "continens"	Lake Lockhart	-	
Eucalyptus "mimica"	Newdegate, Lake Biddy	-	
Gompholobium asperulum	Wongan Hills	Sep-Oct	GRE
Goodenia sp. (A.S. George 7291)	Lake King	Nov	
Grevillea christiniae	Mortlock River, Goomalling	Sep	
Grevillea kenneallyi	Wongan Hills, Elphin	Aug	
Grevillea lissopleura	North of Mt Holland	Aug	
Grevillea lullfitzii	Digger Rock	Dec	
Grevillea pilosa subsp. dissecta	Mt Holland	Feb	
Grevillea rosieri	Mollerin, Bunketch	Jul	
Grevillea tenuiloba	Kirwan,	Sep	GRE
Halgania tomentosa	Moorine Rock	Nov	SC
Hannafordia aff. kesselli	Bendering	Feb-Jun	
Hydrocotyle muriculata	Lake Grace, Lake Cairlocup	Sep	

Priority One (cont.)

Species	Distribution	Flowering Period	Other CALM Regions
Lachnostachys ferruginea var. ferruginea forma reticulata	Tarin Rock	Oct	
Lepidium merrallii	Marvel Loch, Mt Jackson	Aug-Sep	
Leptospermum sp. (J. Thompson s.n.)	Mt Jackson	-	
Leucopogon alternifolius	Kent River	Aug-Oct	SF,CF
Leucopogon blepharolepis	Geekabee Hill	Aug	SC
Levenhookia octomaculata	Bolgart	Nov	GRE
Mirbelia densiflora	Lake King, Newdegate	Jan	SC
Mitrasacme palustris	Beaufort River	Oct	M
Muelleranthus crenulatus	South of Mt Holland	Jul	
Phebalium drummondii	Dowerin, Bonnie Rock, Wialki	Oct-Nov	
Pimelea halophila	Lake King	Sep	SC
Pityrodia scabra	Cowcowing	May,Nov?	
Scaevola tortuosa	Kellerberrin, Wyola	Nov	
Stylidium aff. caricifolium (D.J. Coates 4688)	Ironcaps, Forrestiana	Sep-Oct	
Symonanthus bancroftii	Bruce Rock, Lake King	Sep	
Thomasia dielsii	Cranbrook	Sep	SC
Thomasia tenuivesta	Wongan Hills	Jul,Sep-Oct	GRE
Thysanotus acerosifolius	Newdegate, Pallarup Rocks	Dec	
Thysanotus lavanduliflorus	Newdegate	Jun,Nov-Dec	
Thysanotus sabulosus	Newdegate, Lake Grace	Dec	
Verticordia sp. (E. Berndt 78)	Woodanilling	Nov	
Verticordia sp. (E. Berndt s.n.)	Brookton	Dec	

(SVL 13/9/89)

Priority Two

Species	Distribution	Flowering Period	Other CALM Regions
Acacia aff. abrupta (S.D. Hopper 6405)	Chiddarcooping Hill	Jul-Oct	
Acacia botrydion	Wongan Hills	Jul-Sep	
Acacia campylophylla	Tammin, Wyalkatchem	Jun-Sep	NF
Acacia cliftoniana subsp. nov. (B.R. Maslin 3807)	Wongan Hills, Elphin	Aug-Sep	
Acacia aff. congesta (J.S. Beard 8124)	Boyagin Rock	Sep-Oct	NF
Acacia deflexa	Toolibin, Bendering	Aug	
Acacia aff. densiflora (B.R. Maslin 2361)	Belka, Lake King, Hyden, Lake Magenta	Aug-Sep	
Acacia aff. dielsii [P64] (B.R. Maslin 3424)	Camel Peaks, Kulin, Jitarning	Jul-Sep	
Acacia dura	Piawaning, Wongan Hills, Elphin, Yerecoin	Aug-Oct	
Acacia grisea	Nyabing, Peringillup	Jun-Aug	
Acacia kerryana	Lake Cronin	Dec-Feb	SC,GLD
Acacia aff. myrtifolia [P130] (R.F. Maslin s.n.)	Bottle Rock, Holt Rock, Digger Rock	Jul	
Acacia aff. pachypoda [P43] (K.R. Newbey 5820)	Ironcaps, Lake Cronin, Mt Holland, Lake Seabrook	Jul-Oct	
Acacia sclerophylla subsp. nov. (J.S. Beard 8181)	Dumbleyung, Doodlakine	Aug-Oct	
Acacia subflexuosa (granite)	Wandering, Bruce Rock,	Aug-Jan	NF
Acacia aff. wilhelmiana [P9] (B.R. Maslin 6015)	Mt Caroline, Mooranoppin Rock, Jilakin Rock	Apr-Sep	
Acrotrichne patula	Marvel Loch	Sep	SC
Angianthus axilliflorus	Lake Magenta, Lake Bryde	Oct	
Beaufortia sp. (column)	Brookton, Corrigin	Nov	
Blennospora phegmatocarpa	Cunderdin, Cowcowing	Oct	
Boronia ericifolia	Wongan Hills	Aug-Oct	GRE,NF
Calocephalus stowardii	Meckering, Cowcowing	Oct	
Chamelaucium sp. (D. Rose 446)	Dryandra, Boyagin Rock	Oct	
Conostylis albescens	Booraan	Aug	
Daviesia lineata	Lake Grace	Sep	
Drakaea "confluens subsp. isolata"	Lake Chinokup	Sep	
Dryandra aff. erythrocephala (A.S. George 16743)	Nyabing, Kulin	-	
Dryandra aff. proteoides (A.S. George 16746)	Kulin	-	
Dryandra shanklandiorum	Dowerin, Merredin	Jun-Aug	
Eremophila sp. (R.J. Chinnock 7362)	Chiddarcooping Hill, Wilgoyne Hill	Sep-Oct	
Eucalyptus aff. georgei (S.van Leeuwen 390)	Lake Cronin	-	
Eucalyptus orbifolia subsp. nov. (S.D. Hopper 1852)	Dromedaries Hill	-	
Frankenia glomerata	Waeel, Cunderdin, Lake King	Mar,Nov	NF
Gastrolobium densifolium	Dudinin, Kukerin, Lake Grace	Sep-Oct	
Gastrolobium hamulosum	Wongan Hills	Aug-Oct	GRE
Gastrolobium rigidum	Mt Gibbs, Mt Madden, Tarin Rock, Mt Madden Lake King	Oct-Nov	SC
Gastrolobium rotundifolium	Wagin	Aug-Sep	GRE
Gonocarpus ericifolius	Dragon Rocks N.R.	Jan	
Grevillea nana subsp. abbreviata	Wubin, Dowerin, Mukinbudin	May-Oct	
Grevillea petrophiloides subsp. magnifica	Mt Stirling, Mt Caroline	Jul	

Species	Distribution	Flowering Period	Other CALM Regions
Grevillea roycei	Goomalling, Cunderdin, Dowerin	Aug	
Grevillea spinosissima	Manmanning, Wongan Hills, Mawson	Jun	
Grevillea tetrapleura	Yellowdine, Duladgin Rock, Bungalbin Hill	Jul	
Hemigenia brachyphylla	Mt Churchman	Oct	
Isoetes brevicula	Graham Rock	Sep	
Lasiopetalum cardiophyllum	Wandering	Nov	NF
Lepidium genistoides	Walyahmoning Rock	Oct-Dec	GLD
Logania gracilis	South Ironcap, Mt Holland	Sep-Oct	
Nemcia coriacea	Narrogin, Kojonup, Williams	Aug-Oct	
Petrophile crispata	Wagin, Tutanning	Sep-Oct	
Petrophile incurvata	Cadoux	Sep-Oct	GRE
Phyllota gracilis	Narrogin, Kojonup	Dec-Mar	CF
Pimelea graniticola	Chiddarcooping Hill	Sep-Dec	SC
Platysace cirrosa	Wongan Hills	Mar	NF,GRE
Podotheca pritzelii	Wongan Hills, Kwolyin	Oct	GAS
Pomaderris intangenda	Walyahmoning Rock	Oct	SC
Regelia cymbifolia	Tambellup, Trayning	Aug-Feb	
Schoenus aff. obtusifolius (E.A. Griffin 3841)	Wongan Hills	Oct-Nov	GRE
Tetratheca deltoidea	Mt Caroline	Aug-Sep	
Thysanotus cymosus	Muntadgin	Sep-Oct	SC
Thysanotus gageoides	Cranbrook	Oct-Nov	SC
Verticordia aff. mitchelliana (S.D. Hopper 6702)	Mt Hampton, Nargalyerin Rock	Sep-Oct	
Verticordia aff. penicillaris (S.D. Hopper 6466)	Yellowdine, Duladgin	Nov	
Xanthorrhoea brevistyla	Narrogin	Oct-Nov	SC

(SVL 13/9/89)

Priority Three

WHEATBELT

Species	Distribution	Flowering Period	Other CALM Regions
Acacia aff. dielsii (B.R. Maslin 550)	Hyden, Lake King, Lake Grace	Jul-Sep	
Calothamnus brevifolius	Tammin	Jan-Feb	GRE
Calytrix nematoclada	Lake King, Lake Lockhart, Cairlocup, Bendering	Nov-Jan	
Calytrix plumulosa	Bencubbin, Koorda	Oct-Nov	GRE
Cassytha micrantha	Badgebup	Jan-Feb	SC
Daviesia debilior subsp. sinuans	Wongan Hills	May-Jul	
Dicrastylis glauca	Newdegate, Tone River, Lake Magenta	Dec	
Dicrastylis obovata	Lake King	Nov-Dec	SC
Diuris picta	Mt Caroline - Chiddarcooping Hill	Oct	
Drosera aff. bulbosa (A.P. Brown 362)	North Ironcap	Jul-Aug	SC
Dryandra aff. horrida (A.S. George 9446)	Digger Rocks, South Ironcap	Jul-Sep	SC
Eucalyptus aff. eremophila (M.I.H. Brooker 8848)	Lake Ace, Lake King	Dec-Feb	
Eucalyptus "microschema"	Newdegate, Dunn Rock	-	
Frankenia drummondii	Hyden, Lake King, Johnston Lake	-	
Gastrolobium stenophyllum	Narembeen	Oct-Nov	SC
Grevillea asparagoides	Wongan Hills	Jul-Sep	GRE
Grevillea erectiloba	Bungalbin Hill, Mt Jackson	Sep	
Grevillea georgeana	Die Hardy Range	Jul	GLD
Lachnostachys ferruginea var. paniculata forma obtusifolia	Pingelly, Lake Grace, Kulin	Aug-Oct	GRE
Leucopogon amplectens	Tammin, North of Kellerberrin	Apr-Sep	
Mirbelia subcordata	Cranbrook	Oct-Dec	SC
Mirbelia subcordata	Cranbrook	Oct-Dec	SC
Rinzia crassifolia	Meckering	Aug-Sep	GRE,M
Scholtzia eatoniana	Cunderdin	Nov-Dec	NF
Stylidium lepidium	Wagin, Albany	Sep-Nov	SC
Tetratheca retrorsa	Wongan Hills, Tutanning	Oct	
Thysanotus tenuis	Wagin	Sep	NF
Triglochin stowardii	Koorda, Highbury	Sep	GRE,M,CF

(SVL 13/9/89)

Priority Four - Taxa presumed extinct

WHEATBELT

Species	Distribution	Flowering Period	Other CALM Regions
Calothamnus accedens	Piawaning	Feb	
Eremophila adenotricha	North of Hyden - Glenelg Hills	Sep-Nov	
Eriostemon falcatus	Yellowdine	Oct	
Gonocarpus intricatus	Kellerberrin	Nov	SC
Grevillea flexuosa	Brookton, Kojonup, Wagin,	Oct-Jan	
Gyrostemon reticulatus	Wubin, Kalannie	Oct-Nov	
Jacksonia hemisericea	Merredin	Nov	
Leucopogon marginatus	Tammin-Kellerberrin	Sep	
Melaleuca arenaria	Bendering	Nov	
Menkea draboides	Yilgarn	Aug	GRE
Nemcia lehmannii	Cranbrook	Sep-Oct	
Phlegmatospermum drummondii	Mid Wheatbelt	Aug	
Ptilotus fasciculatus	Cunderdin	Nov	
Stylidium merrallii	Near Lake Brown	-	
Tetratheca fasciculata	Lake Wagin	-	
Thomasia gardneri	Mt Holland	Sep	

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Priority Five - Taxa for high priority monitoring

WHEATBELT

Species	Distribution	Flowering Period	Other CALM Regions
Calothamnus rupestris	Boyagin Rock	Aug-Oct	NF
Darwinia aff. purpurea (S.D. Hopper 6944)	Chiddarcooping Hill, Billyacatting Hill	Jul-Sep	
Drosera graniticola	Lucy Rock, Mt Hampton, Holt Rock, Varley Rock	Aug-Sep	
Eucalyptus aspersa	Farrar, Wandering	-	NF,CF
Eucalyptus caesia subsp. caesia	Boyagin Rock, Mt Caroline, The Humps, Yanneymooning Rock	May-Aug	
Eucalyptus caesia subsp. magna	Chiddarcooping Hill, Billyacatting Hill, Chutawalakin Hill	Apr-Aug	
Eucalyptus deflexa	Mt Madden, Lake King	Aug-Oct	SC
Eucalyptus exilis	Boyagin Rock, Wandering	Dec-Apr	GRE,NF
Eucalyptus formanii	Mt Jackson, Pigeon Rock	Dec-Apr	GLD
Eucalyptus georgei	Hyden	Jan-Mar	SC
Nemcia stipularis	Boyagin Rock, Dryandra, Brookton	Oct-Nov	
Hibbertia montana	Boyagin Rock, Dryandra	Jul-Sep	NF
Pomaderris bilocularis	Dongolocking, Tutanning	May-Nov	
Prasophyllum triangulare	Hyden	Sep-Oct	SC,CF
Stylidium expeditionis	Tutanning	Sep-Oct	
Stylidium tenuicarpum	Tutanning	Oct	

(SVL 13/9/89)

PLATES

CAPTIONS - PLATE 1

Vegetation of the North Arthur River Wetlands (1989)

A ***Eucalyptus loxophleba*** **(York Gum) Low Forest A** (El)
With Jam, She-oak, many of which in 1989 were dead, occasional wandoo and a gound cover of grasses, graminoid plants and other herbaceous plants; many weeds and dead understorey shrubs. Southeast of big lake. (Site 1, (C); ASW 89-8-NAR1-3)

B ***Eucalyptus loxophleba*** **(York Gum) Low Woodland A** (El)
With Jam, She-oak and occasional wandoo. East of big lake.
(Site 1A, (D); ASW 89-8-NAR1-5)

C ***Eucalyptus loxophleba*** **(York Gum) -** ***Eucalyptus wandoo*** **(Wandoo) Low Forest A and Low Woodland A** (Elw, Ewl)
With abundant Jam and She-oak and with lots of dead trunks and branches, probably of Jam, on ground; no shrubs. North side of big lake. (Site 3C, (E); ASW 89-8-NAR1-7)

D ***Casuarina obesa*** **(Swamp She-oak) Low Forest B** (Co)
Dead trees and trunks in and at eastern edge of big lake, with live she-oaks and, in 1989, a few *Melaleuca strobophylla* trees at west end of smaller lake to the east.
(Sites 2 and 2B, (B); ASW 89-8-NAR1-1)

E ***Eucalyptus ? longicornis*** **(Red Morrell) Forest** (Em)
Tall eucalypts (probably two or three species in Series Oleosae: no mature buds or fruits for identification) with canopy cover of over 50% and very little ground layer. (Site 3A, (E); ASW 89-8-NAR1-6)

F ***Eucalyptus wandoo*** **(Wandoo) Low Woodland A** (Ew) and ***Acacia/Calytrix*** **Low Heath D** (H)
Wandoo, Jam and *Melaleuca hamulosa* overstorey with a 0.5 m tall heath which includes the significant species *Acacia leptospermoides* and *A. pulviniformis* (the rounded dark shrubs in photo). Many of the shrubs that were alive in 1985 were dead in 1989, and there were dead trees nearby. (Site 6; ASW 89-8-NAR1-16)

G ***Melaleuca hamulosa, M. uncinata, M. acuminata*** **and** ***M. ? urceolaris*** **Thickets** (Mh, Mun, Ma, Mur)
With dead Wandoo trees and occasional samphire plants. Site 6A is much like a transformed Site 6, with the *Melaleuca* thicket apparently replacing the Wandoo woodland with increasing salinisation of the soil. (Site 6A; ASW 89-8-NAR1-17)

A

B

C

E

D

F

G

Plate 1

CAPTIONS - PLATE 2

Vegetation of the North Arthur River Wetlands (1989)

A *Eucalyptus wandoo* (Wandoo) Low Woodland A (Ew)
With scattered Jam and dense patches of She-oak and a largely native ground layer which includes *Borya* and *Lechenaultia ? formosa*.
(Site 14, (H); ASW 89-8-NAR1-9)

B *Melaleuca uncinata* and *M. ? urceolaris* Thickets (Mun, Mur)
With patchy *Gahnia trifida* and *?Stipa* tussocks. Apparently replacing wandoo woodland on saltier soils. (Site 14A, (I); ASW 89-8-NAR1-10)

C Samphire Succulent Low Heath (mainly species of *Halosarcia* and *Sarcocornia*) (S)
With skeletons of *Melaleuca*, which the Samphire heath apparently replaces on saltier soils. (Site 14B, (J); ASW 89-8-NAR1-11)

D *Gahnia trifida* and *?Stipa* sp. Tussock Community (G)
Mainly *Gahnia* sedge tussocks, which in 1989 appear to be dying, with *Halosarcia* in depressions and dead Jam and York Gum tall shrubs and trees (even in 1985, when, however, there were still live York Gum and Jam over bare ground between Sites 14 and 15).
(Site 15, (A); ASW 89-8-NAR1-0)

E *Halosarcia* Samphire Succulent Low Heath (Bokan Lake's N side)
Casuarina obesa (Swamp She-oak) Low Forest B (far SE shore)
Eucalyptus loxophleba (York Gum) Low Woodland A and
Melaleuca Thicket (beyond far shore) (Site 17A; ASW 89...NAR1-19)

F *Gahnia ? trifida* Tussock Community (G)
With grasses and graminoid plants and intergrading with Succulent Low Heath. Most of the tussocks have been burnt since 1985 and most of the remnants are dead or dying. (Site 17; ASW 89-8-NAR1-20)

G Grasses and graminoid annuals on knolls and succulent seedlings in depressions, a difference which perhaps refelects differences in soil salinity and waterlogging. (Site [13]); ASW 89-8-NAR1-13)

H 'Salinity succession' west of lake: (1) Trees (probably Wandoo - the largest ring-barked), all now dead; (2) *Melaleuca* thickets (in left background); (3) *Gahnia* tussocks (e.g. in front left of tree), now dead; (4) *Halosarcia* succulent samphire, some live and many dead and dying, and with many seedlings and; nearby, (5) salt encrustations on soil.
(Site 1±, (G); ASW 89-8-NAR1-8)

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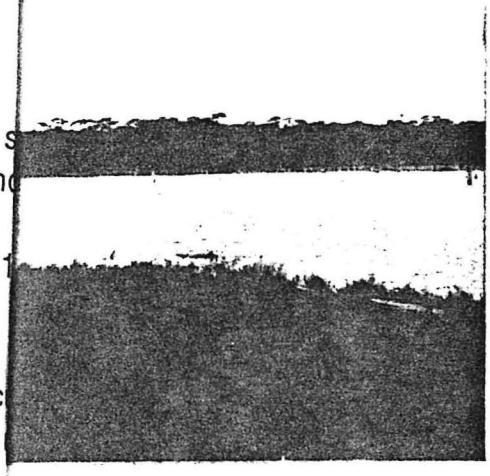
A


B


C


D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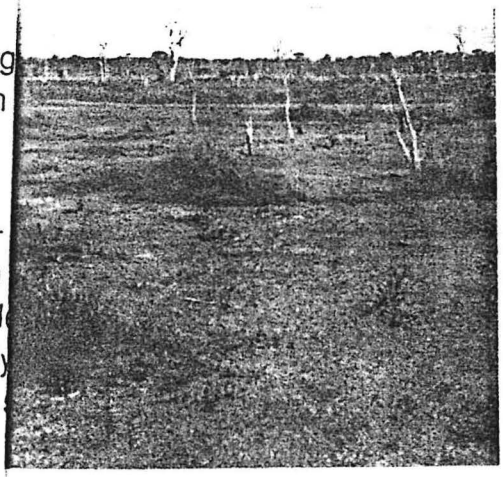
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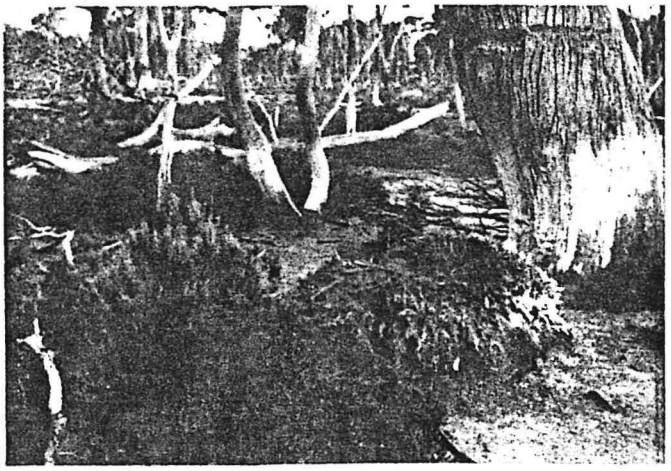
H

Plate 2

CAPTIONS - PLATE 3

Vegetation of the North Arthur River Wetlands (1985)

A ***Eremophila*** **sp.** (ASW 14721).
A green-flowered species found during the surveys only, and rarely, in Sites 1 and 14. (Site 1; AB-85-NAR1-18)

B ***Eremophila*** **sp.** (ASW 14721).
Close-up of an inflorescence of plant in Plate 3A.
(Site 1; AB-85-NAR1-19)

C ***Eucalyptus ? longicornis*** **(Red Morrell) Forest** (Em)
Tall eucalypts (probably two or three species in Series Oleosae - no mature buds or fruits for identification - and *E. kondininensis*) with canopy cover of over 50% and very little ground layer; scattered *Sollya heterophylla, Acacia ? erinacea, A. ? pungens* and *Dodonaea ? bursarifolia* and tussocks of *Lepidosperma brunonianum, Lomandra effusa* and *Poa* sp. Top and south side of hill. (Also see Plate 1E)
(Site 3A; AB-85-NAR1-20)

D ***Eucalyptus kondininensis*** **Low Forest A** (Em)
Eucalyptus kondininensis with over 70% canopy cover and *E. salmonophloia* with under 10%; with *Poa* sp. Generally on laterite on north side of hill. (Site 3B; AB-85-NAR1-21)

E **Samphire Succulent Low Heath** in Dead Eucalypt Woodland (S, E)
With *Halosarcia* spp. and *Frankenia ? brachyphylla,* with *Gahnia trifida* at the edge. (Site 5; AB-85-NAR1-22)

F **Samphire Succulent Low Heath** of Dwarf Scrub D (S)
With *?Halosarcia* spp. and, around their bases, annual herbaceous plants germinating and growing on slightly raised ground; many dead wandoo, melaleucas and samphires and, in 1985, dying samphires.
(Site 7; AB-85-NAR1-25)

G ***Eucalyptus sheatheana*** **Tree Mallee** (Esp)
Eucalyptus sheatheana mallee with over 50% cover and understorey of ***Melaleuca acuminata*** **Dense Thicket/Thicket** (Ma).
On higher ground near river. (Site 11; AB-85-NAR1-31)

H ***Eucalyptus wandoo*** **(Wandoo) Low Woodland A** (Ew)
Mostly open and grassy woodland but with patches of heath. The neighbour says the woodland is excellent for spring wildflowers.
(Site 12; AB-85-NAR1-32)

(1985)

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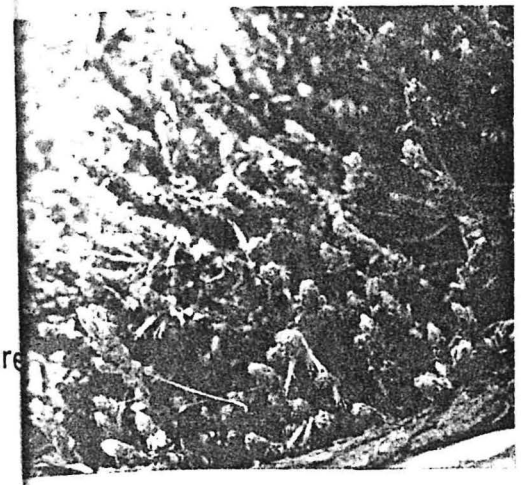
spring wildflower


A


B


C


D


E


F


G


H

Plate 3

CAPTIONS - PLATE 4

Vegetation of the North Arthur River Wetlands (1985)

A ***Eucalyptus wandoo*** **(Wandoo) Low Woodland A** (Ew)
Mostly open and grassy woodland but with patches of heath, and, as in this plate, bordering on ***Acacia acuminata*** **Low Forest B** (Aa), ***Allocasuarina huegeliana*** **Low Woodland A** (Ch) and ***Eucalyptus salmonophloia*** **Woodland** (Es).
(Site 12; AB-85-NAR1-34)

B Erosion in track near Site 15 and colonisation in track by *Halosarcia*.
(Site 15A; AB-85-NAR1-36)

C ***Eucalyptus wandoo/E. loxophleba/E. salmonophloia*** **Woodland**
And dam; in 1985 all of the trees, except a few on dam wall, were dead; the woodland had been replaced by *Gahnia sedge* tussocks, *Halosarcia* samphires and *Disphyma*; in 1989 many of these plants were also dead. (Also see Plate 2F) (Site 17; AB-85-NAR2-4)

D ***Casuarina obesa*** **Low Forest A** (Co)
Dense, but in parts dead and dying, as in this photo; dead parts with samphires and live parts without. (Site 20; AB-85-NAR2-15)

E ***Acacia acuminata*** **Low Woodland/Low Forest A** (Aa)
With many alien, weedy plants as a gound layer.
(Site 21; AB-85-NAR2-16)

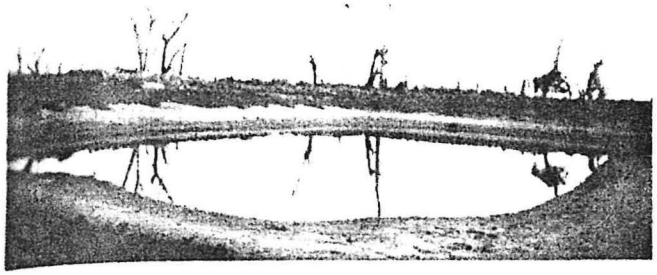
F Dead, dense thicket of *Melaleuca* in centre band, with dead *Casuarina obesa* in foreground. (AB-85-NAR2-24)

G ***Melaleuca acuminata*** **Dense Thicket** (Ma)
With scattered *Eucalyptus loxophleba*, most of which are dead.
(Site 22; AB-85-NAR2-25)

H ***Melaleuca strobophylla*** **Low Forest (to Low Woodland)**
With *Hakea preissii, Halosarcia* spp. and *Disphyma* sp.
(Site 18, Type 1, AB-85-NAR2-6)

A

B



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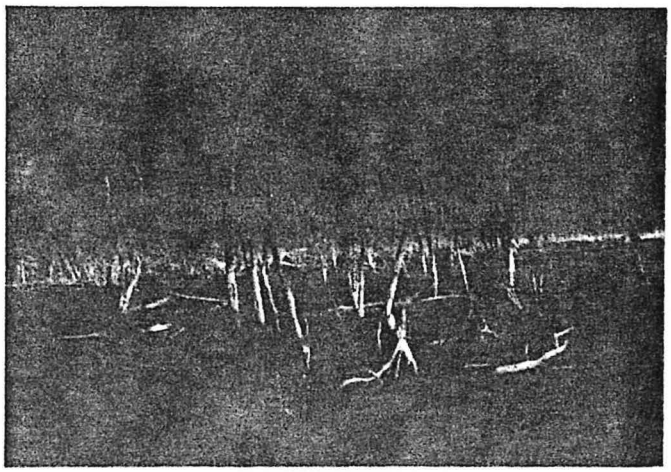


F

Plate 4

APPENDICES

APPENDIX A

VEGETATION SURVEY SITE DESCRIPTIONS

APPENDIX A

VEGETATION SURVEY SITE DESCRIPTIONS

Each site description begins with the map symbol and latin name of the site's dominant species, the site's number and approximate location, the photographs and plates in which the vegetation is illustrated, the Muir classification designation of its tallest stratum and, for some of the sites, the Muir code or notation for the vegetation unit. Each phrase in the code preceding the "/" and standing alone (e.g. eLAi) or separated from others by full stops (e.g. eKTc.nmSc.) describes one stratum. Commas separate members of a mosaic or mixture in a stratum. The lower case letter or letters at the beginning of each phrase, the floristic code symbols, designate dominant genera: a=*Acacia*, c=*Allocasuarina*, e=*Eucalyptus*, m=*Melaleuca*, n=other genus, x=mixed species. The upper case letters indicate height class and the lower case letter following them denotes density class.

Information about the dominant species - and others - in each stratum, such as names, height range, cover canopy density range and dispersion, is given under 'Vegetation'.

In some cases the site descriptions also include observations of litter types, depths, densities and dispersions and subjectively estimated flammability ratings based primarily upon litter and understorey characteristics. Summary descriptions of vegetation at the sites and observations about fire effects and other disturbances are given under 'Comments'.

Information given in the site descriptions is based upon field observations made during the June 1985 field trip to the North Arthur River Wetlands, supplemented by the August 1989 field trip.

Site 1 El *Eucalyptus loxophleba* (York Gum)

Location: Arthur River Reserve 9508 (3520)
East of east side of western lake, south of north-east corner

Muir Code: eacLAc.xJd Low Forest A Dates: 5 . 6. 85, 13. 8. 89

Photos: ASW 4, 5; AB1-14, 1-15, 1-16, 1-18, 1-19 Plates: 1A, 1B, 3A, 3B

Vegetation:

Stratum1- *Eucalyptus loxophleba* 8-10(-18) m tall with 30-40% canopy cover, plus *Acacia acuminata* and *Allocasuarina huegeliana* (to 8 m tall) with 20-30% canopy cover and occasional *Eucalyptus wandoo.*

(Shrub stratum)- Scattered low (0.5 m tall) shrubs of *Astroloma epacridis* and *Eremophila* sp. ASW 14721, which is locally rare.

Stratum 2- Grasses, graminoid plants and other herbacous plants with a total canopy cover of 80-90%: *Lepidosperma angustatum, Stipa* sp., *Lomandra ? collina, Dianella longifolia, Podolepis* aff. *microcephala, Pterostylis nana, Patersonia ? occidentalis, Crassula* sp. and various weeds, grasses and species of Restionaceae.

Litter: There are many dead understorey shrubs; they may be *Acacia acuminata* or young eucalypts. They have not died recently.

Flammability Rating: Moderate or higher (3/5-4/5), due to abundance of dead branches lying on ground.

Soil: Sandy loam.

Comments: The *Eremophila* is shown in Plates 3A and 3B and was found during the surveys only in Site 1 and in the road verge on the south side of Whin Bin Road at its eastern bend bordering Loc. 3520 (Site 14). Signs of rabbit activity and exotic plants (weeds) are abundant.

(Field notes 89C`)

Site 1A El *Eucalyptus loxophleba* (York Gum)

Location: Arthur River Reserve 9508 (3520)
East of east side of western lake, south-east of Site 1 and merging with it.

Muir Code: eLAc.xJd Low Forest A Date: 13. 8. 89

Photos: ASW 2, 3 Plate: 1B

Vegetation:

Stratum1- *Eucalyptus loxophleba* 8-10(-18) m tall with 30-40% canopy cover. Many skeletons, probably of *Acacia acuminata* and *Allocasuarina huegeliana.*

(Shrub stratum)- Scattered low (0.5 m tall) shrubs, including *Astroloma epacridis* .

Stratum 2- Grasses, graminoid plants and other herbacous plants with a total canopy cover of under 70%.

Litter: There are many dead understorey shrubs and branches lying on the ground; they may be *Acacia acuminata* or young eucalypts. They have not died recently.

Flammability Rating: Moderate or higher (3/5-4/5), due to abundance of dead branches lying on ground.

Soil: Sandy loam.

Comments: Signs of rabbit activity are abundant.

The Site ! vegetation is a variation of the Site 1A vegetation, with which it is continuous and merges.

(Field notes 89C)

Site 2 Co *Casuarina obesa* (Swamp She-oak)

Location: Arthur River Reserve 9508 (3520) (5759?)
East side of western lake.

Muir Code: Low Forest B (vegetation dead) Dates: 5. 6. 85, 13. 8. 89

Photos: ASW 1; AB1-17 Plate: 1D

Vegetation:

Stratum 1- Dead *Casuarina obesa* trees and trunks on lakeside and in lake. The northwest corner of the smaller lake east of the larger (western) lake has live *Casuarina obesa* and a few *Melaleuca ? strobophylla* trees over 4 m tall.

Stratum 2- One or two species of *Halosarcia* and rare tussocks of *Dianella longifolia.* Also small annuals.

Litter: Insignificant

Flammability Rating: Low (1/5-2/5)

Soil: Generally water-logged soil with high salt content

Comments: The *Melaleuca* has shorter, broader, thicker, more pungent leaves than typical *Melaleuca preissiana.*

(Field notes 89B)

Site 2A Co *Casuarina obesa* (Swamp She-oak)

Location: Arthur River Reserve 9508 (3520) (5759?)
East side of western lake.

Muir Code: cLBc.hSDc Low Forest B Date:13. 8. 89

Photo: ASW 1 Plate: 1D

Vegetation:

Stratum 1- *Casuarina obesa* trees above lakeshore and bank.

Stratum 2- One or two species of *Halosarcia* and rare tussocks of *Dianella longifolia*.

Litter: Insignificant

Flammability Rating: Low (2/5)

Soil:

Comments: Site 2A live Swamp She-oak Low Forest A occurs in an 8-10m wide belt parallelling the east shore of the lake. The belt slightly overlaps with the York Gum Low Forest A of Site 1, and dead understorey 'trees' to over 6m tall occur in the forest.

(Field notes 89B)

Site 3A Em, Eo *Eucalyptus ? longicornis* (Red Morrel) (ASW 14723)

Location: Arthur River Reserve 9508 (3520)
Top and south side of hill north of lakes

Muir Code: eMc Forest (almost Dense Forest) Dates: 5. 6. 85, 13. 8. 89

Photos: ASW 6; AB1-20 Plates: 1E, 3C

Vegetation:

Stratum1- *Eucalyptus ? longicornis* 16-18 m tall with over 50% canopy cover and *Eucalyptus ? wandoo* with under 10% cover, plus shorter*Santalum acuminatum* providing less than 2% canopy cover.

(Shrub stratum)- Scattered shrubs of *Acacia ? erinacea, A. ? pungens* and *Dodonaea ? bursarifolia* to 50cm tall.

(Herb stratum)- Scattered tussocks of *Lepidosperma brunonianum, Lomandra effusa,* and *Poa* sp.

Litter: Many dead twigs, fallen branches and leaves to depth of 1cm.

Flammability Rating: moderate or higher (3/5-4/5), due to dead leaf and twig litter.

Soil: Sandy, loamy clay

Comments: Also *Sollya heterophylla.*
Small, local, dense stand on higher ground; apparently above area affected by increasing salinity.
There is a patch of *Borya* on laterite gravel south of road to small lake, with a species of native grass.

(Field notes 89E)

Site 3B Em *Eucalyptus kondininensis*

Location: Arthur River Reserve 9508 (3520)
North of Site 3A forest and merging with it

Muir Code: eLAc.pGLi Low Forest A Date: 5. 6. 85

Photo: AB1-21 Plate: 3D

Vegetation:

Stratum 1- *Eucalyptus kondininensis* ('? anceps') 8-10m tall with over 70% canopy cover and *Eucalyptus ? salmonophloia* with under 10% cover.

Stratum 2- *Poa* sp. with about 30% cover.

Flammability Rating: low? (2/5-3/5)

Soil: laterite, generally

Comments: Small, local, dense stand on higher ground; apparently above area affected by increasing salinity.

Site 3C Ewl *Eucalyptus wandoo* and *E. loxophleba*

Location: Arthur River Reserve 9508 (3520)
Above north side of western (larger) lake

Muir Code: eLAc.xJi Low Forest A (& Low Woodland) Date: 13. 8. 89

Photo: ASW 7 Plate: 1C

Vegetation:

Stratum 1- *Eucalyptus wandoo* and *E. loxophleba* 8-10 m tall with over 40% canopy cover, *Eucalyptus salmonophloia* with under 10% cover and lower *Allocasuarina huegeliana* and *Acacia acuminata* trees.

Stratum 2- Annual herbaceous plants with under 30% cover, many of them weeds.

Litter: Many dead trunks and branches lying on ground, but:

Flammability Rating: low? (2/5-3/5)

Soil: Gravelly (sandy) loam

Comments: (Field notes 89E/89F)

Site 4A H Mixed Low Heath

Location: Arthur River Reserve 9508 (?) (3520)
Midslope, north-east of lakes

Muir Code: xSD(C)c.xJc Low Heath Date: 5. 6. 85

Photo: none Plate: none

Vegetation:

Stratum1- *Hakea* sp., *Verticordia ? chrysantha, Verticordia* spp., *Grevillea* sp., *Calytrix* sp., *Astroloma pallidum, Dryandra* sp. and other shrubs around 50 cm tall and varying in canopy cover from about 30% to 70%.

Stratum 2- Variable herbaceous layer of *Dampiera* spp., *Borya* sp. and species of Restionaceae.

Litter:

Flammability Rating: low?

Soil: laterite ?

Comments: Site 4A is a small area of heath vegetation with wandoo around it and she-oak/melaleuca downslope. *Dodonaea bursarifolia* is rare in the site - and was not recorded elsewhere during the survey (though one collection, in Site 3A was identified as *Dodonaea ? bursarifolia*) the nearest collection in the W. A. Herbarium is from near Wagin; otherwise, the species is recorded from the east and central wheatbelt.

Site 4B C *Allocasuarina* sp. (*A. huegeliana*?), and
Mh, Mun *Melaleuca hamulosa* and *M. uncinata*

Location: Arthur River Reserve 9508 (?) (3520)
Midslope, north-east of lakes, below Site 4A

Muir Code: Thicket Date: 5. 6. 85

Photo: none Plate: none

Vegetation:

Stratum 1- *Allocasuarina* sp. (*A. huegeliana* ?)

Stratum 2- *Melaleuca uncinata* to 4 m tall and *M. hamulosa* to 3 m tall.

Litter:

Flammability Rating: low?

Soil: laterite ?

Comments: *Gahnia ? ancistrophylla* nearby

Site 5 E Dead eucalypt woodland, and
S Samphire Succulent Low Heath

Location: Arthur River Reserve 9508 (?) (13301?)
Low-lying flat

Muir Code: sSDi Dwarf Scrub D Date: 5. 6. 85

Photo: AB1-22 Plate: 3E

Vegetation:

Stratum 1- Scattered dead trees to ca. 8m tall

Stratum 2- *Halosarcia* samphires and *Frankenia ? brachyphylla* shrubs under 0.5m tall.

Litter: Little

Flammability Rating: Low

Soil:

Comments: There are a few *Hakea preissii* shrubs nearby and *Gahnia trifida* sedges at the edge of the site.

Site 5A Mur *Melaleuca ? urceolaris*

Location: Arthur River Reserve 9508 (?) (13301?)
Low-lying flat

Muir Code: Thicket/Scrub (dying) Date: 5. 6. 85

Photo: none Plate: none

Vegetation:

Stratum 1- Dying *Melaleuca ? urceolaris* shrubs

Stratum 2- Dying samphires (*Halosarcia* sp(p).)

Litter:

Flammability Rating:

Soil:

Comments: Adjacent to Site 5 vegetation.

Site 6 Ew *Eucalyptus wandoo* (Wandoo, White Gum) and
H *Acacia/Calytrix* (Low Heath D)

Location: Arthur River Reserve 26789 (6392)
Flat near junction of Borgas Road and East Highbury Road

Muir Code: eLAi.aSDc Low Woodland A Dates: 6. 6. 85, 13. 8. 89

Photos: ASW 16; AB1-23 Plate: 1F

Vegetation:

Stratum 1- *Eucalyptus wandoo* trees 8-10m tall with a little over 10% cover.

Stratum 2- *Acacia acuminata* and *Eucalyptus wandoo* 4-5m tall with cover less than 10%, and a few *Melaleuca hamulosa* 2-3m tall.

Stratum 3- *Acacia leptospermoides* ssp. *leptospermoides* and *Calytrix leschenaultii* 0.5m tall and each providing about 30% cover, but somewhat patchy. *Hakea lissocarpha* common nearby, and in flower in August 1989.

Litter: Scattered fallen branches. Dead trees nearby.

Flammability Rating: Patchy (2/5-4/5)

Soil: (Sandy) clay loam

Comments: Two species of *Acacia* found in the Site 6 heath, *A. leptospermoides* and *A. pulviniformis,* are interesting for geographical reasons. The first species is perhaps at the periphery of its range, and the second has not previously been recorded so far north. In 1989 many of the *Acacia* shrubs were dead or were alive but in poor condition.

Site 6A Mh, Mun, Ma *Melaleuca hamulosa, M. uncinata* and *M. acuminata* (and Ew - dead wandoo)

Location: Plain, south down track from Site 6, Res. 26789 (6392)

Muir Code: Thicket Dates: 6. 6. 85, 13. 8.89

Photos: ASW 17; AB1-24 Plate: 1G

Vegetation:

Stratum 1- Wandoo woodland, but most of trees are dead.

Stratum 2- Thicket of three species of *Melaleuca* which are 2.0-2.5m tall.

Litter: Moderate amount of dead branches on ground.

Flammability Rating: Moderate or higher (3/5-4/5)

Soil: Sandy loam (?)

Comments: Site 6A is much like Site 6, but the Thicket appears to replace the Woodland. The Thicket is denser, more widespread and with more species than in Site 6, and there is the occasional samphire.

Site 7 S Samphire (*?Halosarcia* spp.)

Location: Arthur River Reserve 26789 (6392)
Samphire flat at end of Borgas Road

Muir Code: sSDc-i Succulent Low Heath D or Dwarf Scrub D

Date: 6. 6. 85

Photos: AB1-25 Plate: 3F

Vegetation:

Samphire, with many dead samphires and some emergent dead *Melaleuca uncinata* and *M. ? urceolaris* shrubs

Litter:

Flammability Rating: Low

Soil:

Comments: There are annual herbaceous plants germinating and growing on the slightly raised ground around the bases of samphire plants.

There are many dead plants of *?Halosarcia, Melaleuca* spp. and wandoo in the site. In the southern part of the site, or immediately south of it, the plants are dead and dying. This vegetation merges into Site 8.

Site 8 Mun *Melaleuca ? uncinata* Scrub

Location: Arthur River Reserve 26789 (15450)
Plain/Flat south-east of Site 7 and south of Arthur River

Muir Code: Date: 6. 6. 85

Photo: AB1-26 Plate: none

Vegetation:

Melaleuca Scrub of *M. uncinata* 3-5m tall with over 50% cover, *M. ? lateriflora* 3-4m tall and *M. ? urceolaris* under 2.0m tall.

Litter: Mainly few small branches

Flammability Rating: Moderate

Soil:

Comments: The thicket may be denser than 70% but somewhat patchy. *Halosarcia, Frankenia* and and annual herbs and scalds also occur in the site.

Site 9 Mla *Melaleuca ? lateriflora - M. acuminata*

Location: Arthur River Reserve 26789 (6391)
East from 20-30 m south of corner of reserve

Muir Code: Dense Heath A Date: 6. 6. 85

Photos: AB1-27 Plate: none

Vegetation:

Stratum 1- *Melaleuca ? lateriflora* and *M. acuminata* 1-1.5m tall and with more than 70% cover, somewhat patchy.

Stratum 2- *Melaleuca ? uncinata* 0.5m tall and with about 50% cover. Mostly in openings among the Stratum 1 populations.

Stratum 3- Ground layer: weeds in some places; also *Drosera* sp. and *Hypoxis ? glabella*.; bare areas.

Litter:

Flammability Rating:

Soil: Clay-loam

Comments: The stand is regenerating after a fire which destroyed the previous woodland, probably between 1975 and 1980 and certainly more recently than the 1972 fire which burned widely through the wetlands. There appear to be three pyroseral stages represented in Site 9.

The site was all wandoo, but it appears to have all been killed by the fire and is not regenerating. There is some wandoo still along the fence, but it is in poor condition.

There are salt-affected scalds and dying patches in the *Melaleuca* regrowth, which may be due to salt, or to drought, or to both. There are also many old signs of rabbit occupation.

A reserve number, 5785, is on a dead tree in the corner.

Site 10 Er,Co,Ch *Eucalyptus rudis, Casuarina obesa* and *Allocasuarina huegeliana*
Mun,Mur,Msp. *Melaleuca uncinata, M. ? urceolaris* and *M.* sp.

Location: Arthur River Reserve 26789

Muir Code: Mosaic of Low Woodland A and Thicket Scrub Date: 6. 6. 85

Photo: none Plate: none

Vegetation:

Type 1 - *Eucalyptus rudis, Casuarina obesa* and *Allocasuarina huegeliana* trees around 12m tall

Type 2 - *Melaleuca uncinata, M. ? urceolaris* and *M.* sp. 3-4m tall

Litter:

Flammability Rating:

Soil:

Comments: The trees, *Melaleuca* shrubs and other, generally shorter shrubs, including *Callistemon phoeniceus, Grevillea* sp. and *Acacia saligna,* occur as mixed or mosaic vegetation. *Carpobrotus* occurs in the ground layer.

Site 11 Esp. *Eucalyptus sheathiana* Tree Mallee, and
Ma *Melaleuca acuminata* Dense Thicket/Thicket

Location: Arthur River Reserve 26789 (15450)
Higher ground but almost next to river on south side

Muir Code: Tree Mallee x Dense Thicket/Thicket Date: 6. 6. 85

Photo: AB1-31 Plate: 3G

Vegetation:

Stratum 1- *Eucalyptus sheathiana* mallee 8-10m tall with much more than 50% cover

Stratum 2- *Melaleuca acuminata* shrubs 2-3m tall with about 70% cover

Litter: Little

Flammability Rating:

Soil:

Comments: Extensive stand.

Little on ground.

Difficult or impossible to distinguish from *Melaleuca*.

Site 12 Ew *Eucalyptus wandoo*

Location: Arthur River Reserve 26788 (12500)
Spencer Road

Muir Code: Woodland Date: 6. 6. 85

Photos: AB1-32 , 1-33, 1-34(?) Plate: 3H, 4A

Vegetation:

Eucalyptus wandoo 16-20m tall

Litter:

Flammability Rating:

Soil: Washed gravel and sand on surface

Comments: Mostly open and grassy woodland, but with patches of *Allocasuarina humilis*, other shrubs, including *Hakea* sp. and *Astroloma* sp., and *Lomandra* and *Gahnia*. The neighbour says the woodland is excellent for everlastings, orchids and other wildflowers in the spring.

Photo AB1-34(?) shows the Salmon Gum woodland next door to Site 12.

Site [12] Mun *Melaleuca uncinata*

Location: Arthur River Reserve 9508 (15429)
Whin Bin Road

Muir Code: Dense Thicket

Date: 13. 8. 89

Photos: ASW 12

Plate: none

Vegetation:

Melaleuca uncinata thicket 3m to over 6m tall with over 70% canopy cover, with rare 6-8m tall emergents of *Casuarina obesa*

Litter: Little

Flammability Rating: Medium to high (3/5-4/5), due to density of vegetation

Soil:

Comments:

Site 13 Dc *Dryandra conferta* Heath B, as dominant in a vegetation catena

Location: Arthur River Reserve 26788 (15376)

Muir Code: Heath B catena Date: 7. 6. 85

Photos: AB2-0, 2-1 Plate: none

Vegetation Catena:

Type 1 - *Dryandra conferta* 1.0-1.5m tall

Type 2 - *Melaleuca ? incana*

Type 3 - *Allocasuarina huegeliana* to 5m tall

Litter:

Flammability Rating:

Soil: lateritic gravel

Comments: On the west side of Site 13 this vegetation merges with 14-18m tall Wandoo Woodland and becomes the woodland's understorey.

To the north, the Site 13 vegetation ends at Wandoo Woodland which has *Acacia acuminata* and *Allocasuarina huegeliana*. and very little understorey other than a few sedge-like plants and herbaceous plants.

Site [13] Grasses, graminoids and succulent seedlings

Location: Arthur River Reserve 9508 (6215)
Flat on Whin Bin Road

Muir Code: Open to Very Open Herbs Date: 13. 8. 89

Photos: ASW 13 Plate: 2G

Vegetation:

Succulent seedlings (*Halosarcia* ?) in depressions and grasses and graminoid annuals on knolls

Litter: Little

Flammability Rating: Low

Soil:

Comments:

Site 14 Ew *Eucalyptus wandoo*

Location: Arthur River Reserve 9508 (3520)
North side of Whin Bin Road

Muir Code: Low Woodland A Date: 7. 6. 85

Photos: ASW 9, 10, 11; AB1-34 Plate: 2A, 2B, 2C

Vegetation: Date: 7 June 1985

Stratum 1- *Eucalyptus wandoo* 12-14m tall with over 10% and 10-12m tall with under 30% cover

Stratum 2- *Acacia acuminata* 6-8m tall and with less than 10 cover; patchy *Allocasuarina huegeliana* 8-10m tall with 50% cover

Stratum 3- ground layer of *Amphipogon turbinatus, ?Loxocarya, Borya* and *Drosera ? erythrorhiza* providing 10-30% cover and rare or occasional *Lechenaultia ? formosa* and *Eremophila* sp. ASW 14721

Litter: Little

Flammability Rating: Low (2/5)

Soil: Sandy loam

Comments: Plate 2B is of neighbouring *Melaleuca* Scrub (14(I) with occasional, mostly dead Wandoo and tussocks of *Gahnia* and *?Stipa*. Scrub 14(I) grades into 14(J): skeletons of dead *Melaleuca* with *Halosarcia* on waterlogged soil.
(Field notes 89A, H, I, J)

Site [14] Co *Casuarina obesa*, mostly dead
S Samphire (*Halosarcia* spp.)

Location: Arthur River Reserve 26790 (15450?)
Arthur River downstream (west) from Pool Road

Muir Code: Fringing, and Low Heath D Date: 13. 8. 89

Photos: ASW 14 Plate: none

Vegetation:

Swamp She-oak, mostly dead, fringing the river's channel, bordering an with an understorey of samphire.

Litter: Little

Flammability Rating: Low

Soil:

Comments:

Site 15 G *Gahnia trifida* and *?Stipa* sp. Tussock Community

Location: Arthur River Reserve 9508 (3520)
Plain on north side of Whin Bin Road

Muir Code: inadequate Date: 7. 6. 85, 13. 8. 89

Photos: ASW 0; AB1-35, 1-36, 1-37 Plate: 4B

Vegetation:

Gahnia trifida and *?Stipa* sp. tussocks with cover of 30-50%; with *?Daviesia, ?Wurmbea* and various species of small herbaceous plants

Litter: Very little

Flammability Rating: Medium high (3/5)

Soil: Sandy loam to clay

Comments: Mainly *Gahnia* sedge, which appears to be dying, with *Halosarcia* in depressions and dead Jam and York Gum, which apparently are salt-affected.

In 1985 it was noted that there were live York Gum and Jam trees over bare ground between Sites 14 and 15.

Plate 4B is of Site 15A, a nearby eroded track being colonised by samphires.

Site [15] Co *Casuarina obesa*, mostly dead
S Samphire (*Halosarcia* spp.)

Location: Arthur River Reserve 26790 (15450?)
Arthur River upstream (east) from Pool Road

Muir Code: Fringing, and Low Heath D Date: 13. 8. 89

Photos: ASW 15 Plate: none

Vegetation:

Swamp She-oak, mostly dead, fringing the river's channel, bordering an with an understorey of samphire.

Litter: Little

Flammability Rating: Low

Soil:

Comments:

Site 17 Ewls *Eucalyptus wandoo, E. loxophleba* and *E. salmonophloia* that is 99% dead

Location: Arthur River Reserve 10631
Dam area north of Bokan Lake

Muir Code: Date: 7. 6. 85, 13. 8. 89

Photos: ASW 18, 19, 20; AB2-3, 2-4, 2-5 Plates: 2E, 2F, 4C

Vegetation:

Stratum 1- *Eucalyptus wandoo, E. loxophleba* and *E. salmonophloia* that is at least 99% dead

Stratum 2- *Gahnia* sedge tussocks

Stratum 3- *Halosarcia* spp. and *Disphyma* sp.

Litter: Little

Flammability Rating: Low (1/5-2/5)

Soil:

Comments: A few of the *Eucalyptus wandoo, E. loxophleba* and *E. salmonophloia* trees on the dam wall in Site 17 were still alive in 1985, but those trees below that level were, and still are, all dead.

Plate 2E is a photograph of Bokan Lake and bordering vegetation taken on the north side of the lake looking southeast from near the depth marker beyond the end of track from Lakes Road: Site 17B. Photograph AB2-5 is a similar shot.

Site 17A Mp,Co Dead trees in lake

Location: Arthur River Reserve 10631
Billy Lake east of Site 18

Muir Code: Date: 7. 6. 85

Photo: none Plate: none

Flammability Rating: Nil

Soil: Zero

Comments: The dead trees in the lake are probably *Melaleuca strobophylla* and *Casuarina obesa*. There is a rim of live *Casuarina obesa* around the lake, with some *Melaleuca strobophylla*.

Site 18 Mp, Aa, *Melaleuca strobophylla, Acacia acuminata* and Co *Casuarina obesa*

Location: Arthur River Reserve 10631
Billy Lake's western margin

Muir Code: Low Forest A and B Date: 7. 6. 85

Photo: AB2-6 Plate: 4H

Vegetation, in three types:

Type 1 - *Melaleuca strobophylla* 5-6m tall with about 30% cover, *Hakea preissii, Halosarcia* spp. and *Disphyma* sp. (Photo AB2-6)

Type 2 - *Acacia acuminata* 4-5m tall with about 70% cover, *Casuarina obesa* 5-7m tall with 1% cover and weedy grasses

Type 3 - *Casuarina obesa* 5-6m tall with over 70% cover and *Melaleuca strobophylla* 4-5m tall with under 10% cover: a dense fringe around lake and separating Type 1 from Type 2.

Litter: Little

Flammability Rating: Low

Soil: Type 1 - clay; Type 2 - raised sand

Comments: Dead trees in lake are *Casuarina obesa* and *Melaleuca strobophylla.* The *Casuarina obesa* trees produced adventitious roots from their trunks before they died.

Numerous shotgun shells were found in the site.

Site 19 El *Eucalyptus loxophleba* (with Salmon Gums and Wandoo)

Location: Arthur River Reserve 14398 (11239)
East of Walbyring Lake

Muir Code: Low Woodland A Date: 8. 6. 85

Photo: AB2-12 Plate: none

Vegetation:

Stratum 1- *Eucalyptus loxophleba* 6-8m tall with less than 30% cover, and a few *Eucalyptus wandoo* and *E. salmonophloia*

Stratum 2- *Daviesia horrida* 1m tall with about 30% cover and short *Melaleuca ? preissiana*

Stratum 3- *Rhagodia nutans*, ASW 14765, *Acacia microbotrya, A. pulchella,* other small native shrubs and herbaceous plants, and wild oats and various other alien herbaceous plants.

Litter:

Flammability Rating:

Soil: Clay

Comments: A number of the trees in the site were dead.

Site 20 Co *Casuarina obesa*

Location: Arthur River Reserve 14398 (11239)
Walbyring Lake

Muir Code: Low Forest A Date: 8. 6. 85

Photos: AB2-13, AB2-15 Plate: 4D

Vegetation:

Stratum 1- Dense *Casuarina obesa*, with occasional *Eucalyptus rudis* and *Melaleuca uncinata* joining it around the edge of the site.

Stratum 2 - *Halosarcia* spp.

Litter:

Flammability Rating:

Soil:

Comments: The stand is dead on the east side, with samphires, but it is still alive on the west side and with no samphires. There are dead paperbarks on both sides.

Site 21 Aa *Acacia acuminata*

Location: Arthur River Reserve 14398 (11239)
Next to Walbyring Lake on the lake's southeast side

Muir Code: Low Woodland/Low Forest A Date: 8. 6. 85

Photos: AB2-14, AB2-16 Plate: 4E

Vegetation:

Acacia acuminata 5-7m tall with *Banksia pionotes* up to 7m tall

Litter:

Flammability Rating:

Soil: Sand bank

Comments: Jam woodland in two parts: the larger part is old, has been damaged by insects and has been thinned by pole-cutters, but has some young growth. The smaller part of the stand is younger.

There is a lot of *Avena* sp., *Ursinia, Rumex* and other aliens as a ground layer.

There are Salmon Gums and York Gums to the east.

Site 22 Ma *Melaleuca acuminata*

Location: Arthur River Reserve 9550
Flat northeast of Taarblin Lake's northeast corner.

Muir Code: Dense Thicket Date: 8. 6. 85

Photos: AB2-17, AB2-18, AB-2-19, AB2-20 Plate: 4G

Vegetation: *Melaleuca acuminata* 3-4m tall with 90% cover and *M. lateriflora* 2-4m tall with 10% cover, and scattered *Eucalyptus loxophleba*, most of which are 6-8m tall and most of which are dead.

Litter:

Flammability Rating:

Soil:

Comments: A band of *Casuarina obesa* - taller and dark green - separates Site 22 from the dead lake.

There are dead paperbarks in the channel depression (Photo AB2-19), and *Casuarina obesa*, *Disphyma* and *Carpobrotus* above the southern bank.

AB2-17 is a photograph of a band of woodland at the northwest corner of Taarblin Lake.

Fox scat was noted.

Site 23 Co,M?p *Casuarina obesa, Melaleuca ? strobophylla* and
El *Eucalyptus loxophleba*
(mainly in contiguous but separate stands)

Location: Arthur River Reserves 9550/20962
Eastern margin of Taarblin Lake at the lake's central neck

Muir Code: Low Forest A Date: 8. 6. 85

Photos: AB2-21(?) Plate: none

Vegetation:

Band 1- *Casuarina obesa* in water, where it is dead, and on bank

Band 2- *Eucalyptus loxophleba* beyond bank

Band 3- *Melaleuca ? strobophylla* between Bands 1 and 2

Litter:

Flammability Rating:

Soil: Sandy loam for at least Band 2

Comments: In 1985 there were more dead *Casuarina obesa* plants than appeared in the 1972 aerial photographs, and there were no young she-oaks.

There is also *Halosarcia* sp. in Band 1.

Other species in Band 2 include *Cassia nemophila, Myoporum* sp., *Acacia microbotrya, Pittosporum* sp. and *Rhagodia nutans.*

Site 24 Mun *Melaleuca uncinata*

Location: Arthur River Reserve 26786 (11121)
North of Little White Lake near road

Muir Code: Thicket Date: 8. 6. 85

Photos: AB2-22, AB2-23 Plate: none

Vegetation:

Melaleuca uncinata with over 70% cover and 1m tall, with scattered emergent dead eucalypt trunks. Also with *Santalum acuminatum, Hakea lissocarpha, ?Leptomeria* sp. and *Acacia glaucoptera* (Photo AB2-22).

Mallee wandoo 1.5-2.0m tall in northeast corner of reserve.

Litter:

Flammability Rating:

Soil:

Comments:

Site 25 Msp. *Melaleuca* sp. ASW 14766

Location: Arthur River Reserve 26786
Little White Lake

Muir Code: Thicket Date: 8. 6. 85

Photos: none? Plate: none

Vegetation:

Stratum 1- *Melaleuca* sp. ASW 14766 3m tall

Litter:

Flammability Rating:

Soil:

Comments: *Casuarina obesa* is relatively minor (though common) in and around lake.

Most of the inner fringe of Melaleucas is dead.

The centre of the lake is bare of vegetation. However, four islands in the lake have healthy stands of *Halosarcia* spp. Only one island has *Casuarina obesa*: - four apparently healthy plants.

APPENDIX B

SIGNIFICANT FLORA

APPENDIX B

SIGNIFICANT FLORA

In 1975 Western Australia's Fauna Conservation Act was retitled as the Wildlife Conservation Act, and in 1979 the Act was amended to provide protection for specified species of flora as well as of fauna. The first plant species to be declared by the Minister as protected rare flora under the Act were listed in the Government Gazette, WA, of 14 November 1980. Periodically, the Minister publishes notices in the Government Gazette deleting and adding species to the list of protected flora. While a species, or other taxon, is gazetted as protected no-one is allowed to "gather, pluck, cut, pull up, destroy, dig up, remove or injure" a plant belonging to a wild population of that species, or to cause or permit it to be done, without special written consent of the Minister (Hopper *et al.* 1990). Fines may be imposed for breaching provisions of the Act.

The first list of gazetted flora comprises 100 species, including a variety of one of the species. The current list, printed in the Government Gazette, WA, of 1 June 1990, comprises two and a half times as many species. Some of the species first gazetted in 1980 are absent from the current list, presumably because they have been found to be more abundant or wide-ranging than previously indicated by collections and records or because they appear to be well-protected in nature reserves and national parks.

In general, species are gazetted or declared as rare flora (DRF) not only because they are rare (i.e. because fewer than a few thousand reproductively mature plants of the species are known to exist in the wild) or geographically restricted but also because their continued, long-term survival in the wild is believed to be threatened (Hopper *et al.* 1990).

Gazetted rare species are not the only Western Australian plants that are rare, geographically restricted, threatened or vulnerable. In fact, they probably constitute only a small proportion of such species. For example, Marchant and Keighery (1979) listed more than 2,000 species that were rare or poorly collected or were geographically restricted to a range of less than 160 kilometres.

1. Published Lists of Rare, Restricted and Poorly Collected Species

Australia-wide treatments of rare, geographically restricted and endangered species by Specht, Roe and Boughton (1974), Hartley and Leigh (1979), Leigh, Briggs and Hartley (1981) and Briggs and Leigh (1988) also contain Western Australian lists, which are based upon publications or other information provided by botanists in the various states. They cover presumably rare or threatened plants but do not deal with the adequacy of collection of any species.

Extinct and Endangered Plants of Australia, by Leigh, Boden and Briggs (1984), lists endangered and presumably extinct species and the presumed threats to their survival. The book also describes and illustrates many endangered and extinct species, discusses the inconsistent use of terms to indicate various degrees of threat and rarity, and describes the binary system developed by Hartley and Leigh (1979) to classify rare, restricted and threatened species.

The first Western Australian publication on rare and restricted flora, by Marchant and Keighery (1979), is based upon the numbers of specimens of each native Western Australian species lodged in the Western Australian Herbarium and the geographical range of the collections for each species. Marchant and Keighery classify most of their 2,022 listed species as geographically restricted, presumably rare or poorly collected.

Four reports dealing with rare, restricted and threatened species have been published by the Department of Fisheries and Wildlife. One, by Rye (1982), lists geographically restricted south-western plants, and another, by Rye, Hopper and Watson (1980), is concerned with the distribution and conservation status of commercially exploited native plants. The first two lists of gazetted rare Western Australian flora are presented and the listed species are described and illustrated in Rye and Hopper (1981) and Patrick and Hopper (1982).

The nineteen eighties publications have,to a large extent, been superseded by the recently published Western Australia's Endangered Flora (Hopper *et al.* 1990), which lists and discusses reserve Priority species as well as Endangered and Declare Rare Flora. The book provides an illustration and brief description of each Endangered species.

2. 'Significant' Species

The term 'significant species' as used in this report refers to species that are:

- rare, geographically restricted or apparently rare or restricted because they are poorly collected or recorded,
- at the limits of their ranges or in areas outside their normal ranges or habitats,
- particularly susceptible or vulnerable to environmental changes, especially ones caused by humans, either directly or indirectly,
- diminishing significantly in abundance or geographical range due to clearing and other environmental changes associated with agriculture, mining, recreation, urbanisation and provision of services, or
- poorly represented in secure conservation reserves.

The term 'significant' is used in this report instead of 'vulnerable', 'threatened', 'depleted' or 'endangered' because these terms either are too limited in their scope or implications or, as Leigh, Boden and Briggs (1984) put it, "have become highly emotive through popular usage, making it difficult to develop objective criteria for use in ascribing species to various categories". Leigh, Boden and Briggs discuss appropriate teminology in more detail.

All of the species in the lists referred to in Section 1 are significant species. Some significant species are gazetted as rare species; most are not.

The completeness and accuracy of most lists of significant Western Australian species are limited by the fact that they do not contain varieties, subspecies or undescribed species, some of which are also rare, and in that the intensity, uniformity and seasonal coverage of collecting and systematic surveying have been insufficient to distinguish between genuinely rare (and restricted) species and species which only appear to be rare (or restricted) because they have been poorly collected. Systematic surveying and collecting by Western Australian Wildlife Research Centre (WAWRC) botanists, and others, are slowly correcting this deficiency.

In some cases, significant species are found in areas where they were not previously known to occur. For instance, *Villarsia submersa*, a small water-lily type plant, was believed to be restricted to a few small seasonal ponds between Bunbury and Busselton until recent years, when it was found near Denmark, west of Manjimup and, in 1989, in a few ponds in the Metropolitan Region. *Synaphea pinnata* is a plant species previously gazetted as rare (Government Gazette, WA, of 14 November 1980) which has since been found to be more common or widespread or better conserved than previously believed and is no longer gazetted.

In other cases, species are no longer found in areas where they have been previously recorded, often due to habitat destruction or alteration. However, there are are many species which emerge and flower for only one or a few years after fire, then disappear until after the next burn. For example, a population of the gazetted orchid *Drakaea jeanensis* recorded in the Metropolitan Area a few years ago has not been found recently.

Other sources of incompleteness and ambiguity in distribution and abundance information are:

- insufficient locality information given on the labels which accompany herbarium specimens,
- inaccurate identification of specimens, and
- treatment of groups of species as single species.

So little is known about the abundance, distribution and taxonomy of nonvascular plants that few, if any, such species are gazetted as rare flora or are included in lists of rare species, although many of them may also be rare or geographically restricted.

3. Gazetted Rare Species (DRF)

The first list of declared rare flora, gazetted in 1980, was based upon assessment of the Marchant and Keighery (1979) list, addition of newly described species and local botanists' knowledge of species distributions and abundance. Gazettal of a species is now generally preceded by relatively detailed searches made in the field to locate populations of the species proposed as rare.

The gazetted list of flora does not include all, or probably even a majority of, rare species. The current list (1 June 1990) concentrates on the south-western part of Western Australia and particular groups of species, which have, in general, been studied in greater detail than others. For example, members of the families Proteaceae, Myrtaceae, Leguminosae and Orchidaceae account for more than 150, well over half, of the gazetted species on the June 1990 list. It is likely that in the south-west alone there are many more ungazetted rare and restricted species than gazetted ones.

The two lists of gazetted rare flora in Rye and Hopper (1981) and Patrick and Hopper (1982) comprise fewer than 150 species, and the 1990 list contains fewer than 250 species, probably only a small proportion of Western Australian plants that could be considered as rare. Another list, in Rye (1982), contains 527 species of southern Western Australian flowering plants that are geographically restricted and includes most, if not all, of the species gazetted at that time as rare. The Rye list is based upon investigation of collections upon which the Marchant and Keighery (1979) list was based, taxonomic publications and rare plant records of the WAWRC.

Since the early 1980s WAWRC botanists have been compiling lists, descriptions, illustrations and records of significant species on a regional basis throughout Western Australia. The lists were originally compiled from herbarium records of the species listed in Rye (1982) and Marchant and Keighery (1979) and from taxonomic literature. These lists and records, along with relevant taxonomic studies, provide the basis for the lists of species proposed for gazettal and being considered for gazettal.

The WAWRC now has continuing programmes of research and, in addition to the list of gazetted species, has five unofficial reserve priority lists of rare and restricted species for each of the eleven management regions into which CALM has divided the state:

- Priority One Species - species known from only a few localities, which are on lands under immediate threat, and are in urgent need of further survey work,
- Priority Two Species - species known from only a few localities, which are on lands not under immediate threat, and are in urgent need of further survey work,
- Priority Three Species - species known from several localities, some of which are on lands not under immediate threat, and are in need of further survey work,
- Priority Four Species - species presumed to be extinct, and
- Priority Five Species - species considered to have been adequately surveyed and are not endangered or in need of special protection but could be if circumstances change.

These lists are modified and updated as relevant information and results of survey work become available. Priority One, Two and Three species are under consideration for declaration as rare flora, pending the outcome of further survey work.

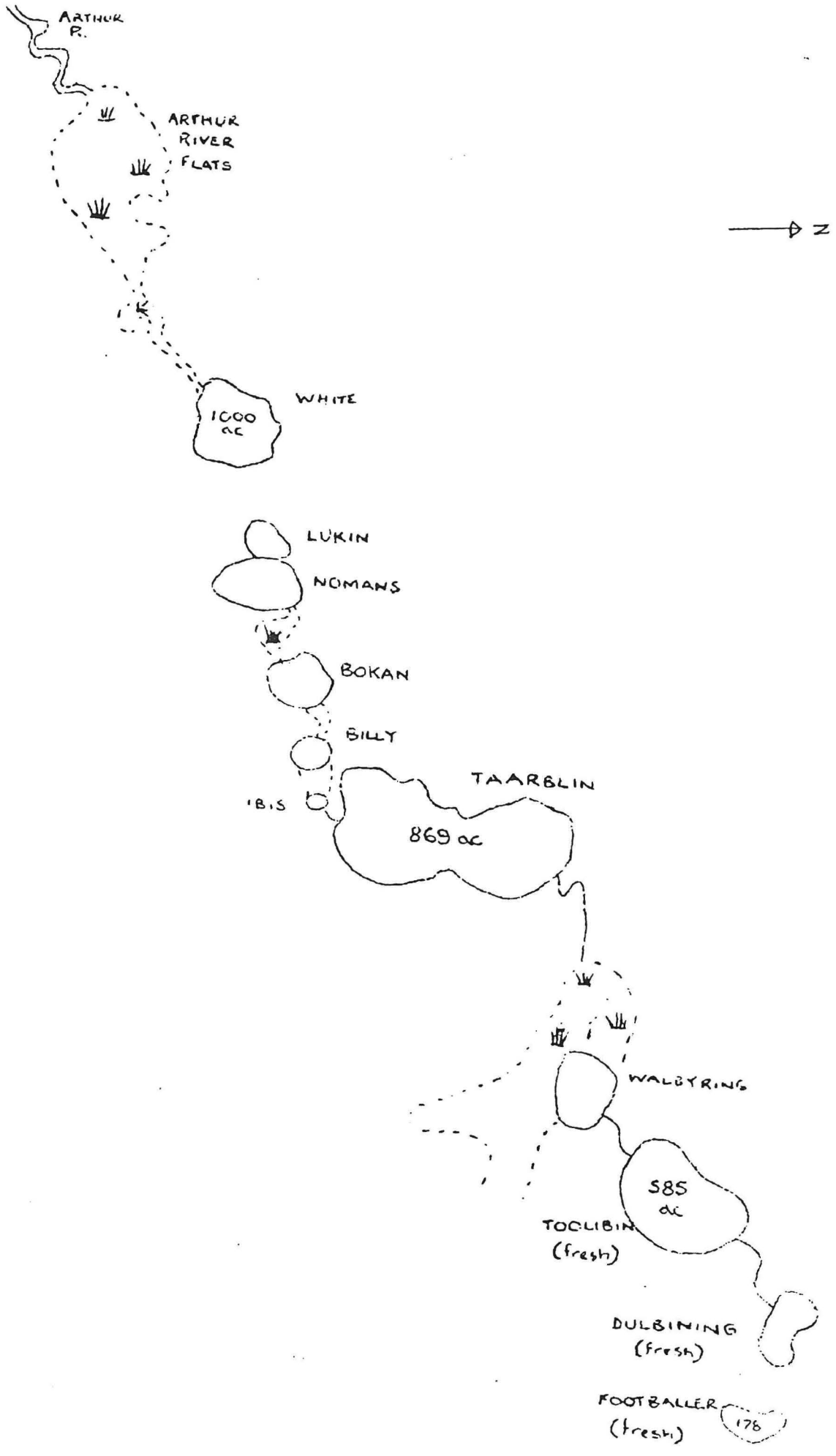
APPENDIX D

WORKING MAPS OF

NORTH ARTHUR RIVER WETLANDS NATURE RESERVES

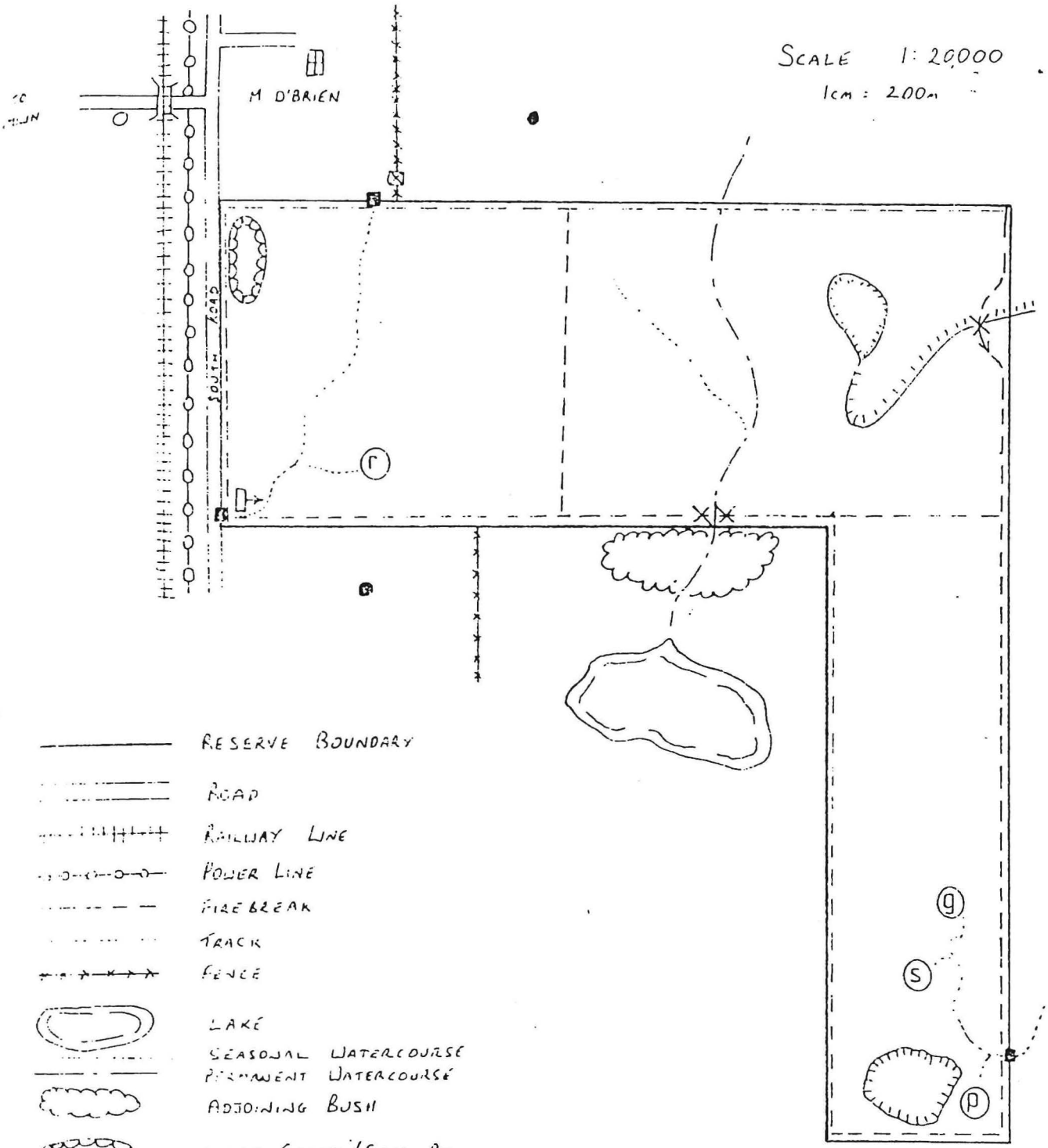
FIGURE 21

ARTHUR RIVER WET LANDS



ATKINS' NATURE RESERVE 15356

Area 67.013 h.



RESERVE BOUNDARY
ROAD
RAILWAY LINE
POWER LINE
FIREBREAK
TRACK
FENCE
LAKE
SEASONAL WATERCOURSE
PERMANENT WATERCOURSE
ADJOINING BUSH
LARGE GRAVEL/SAND PIT
UPSLOPE / DOWNSLOPE BREAKAWAY
ROCK
(g) GRAVEL PIT
(s) SAND PIT
(p) PICNIC AREA
GATE OUT OF RESERVE
GATE ON ADJOINING LAND

HOUSE
DAM
TANK / STANDPIPE
BRIDGE / CROSSING
RESERVE SIGN
(r) RUBBISH TIP
BOGGY PATCH
DIFFICULT ACCESS

KJA 27.2.86

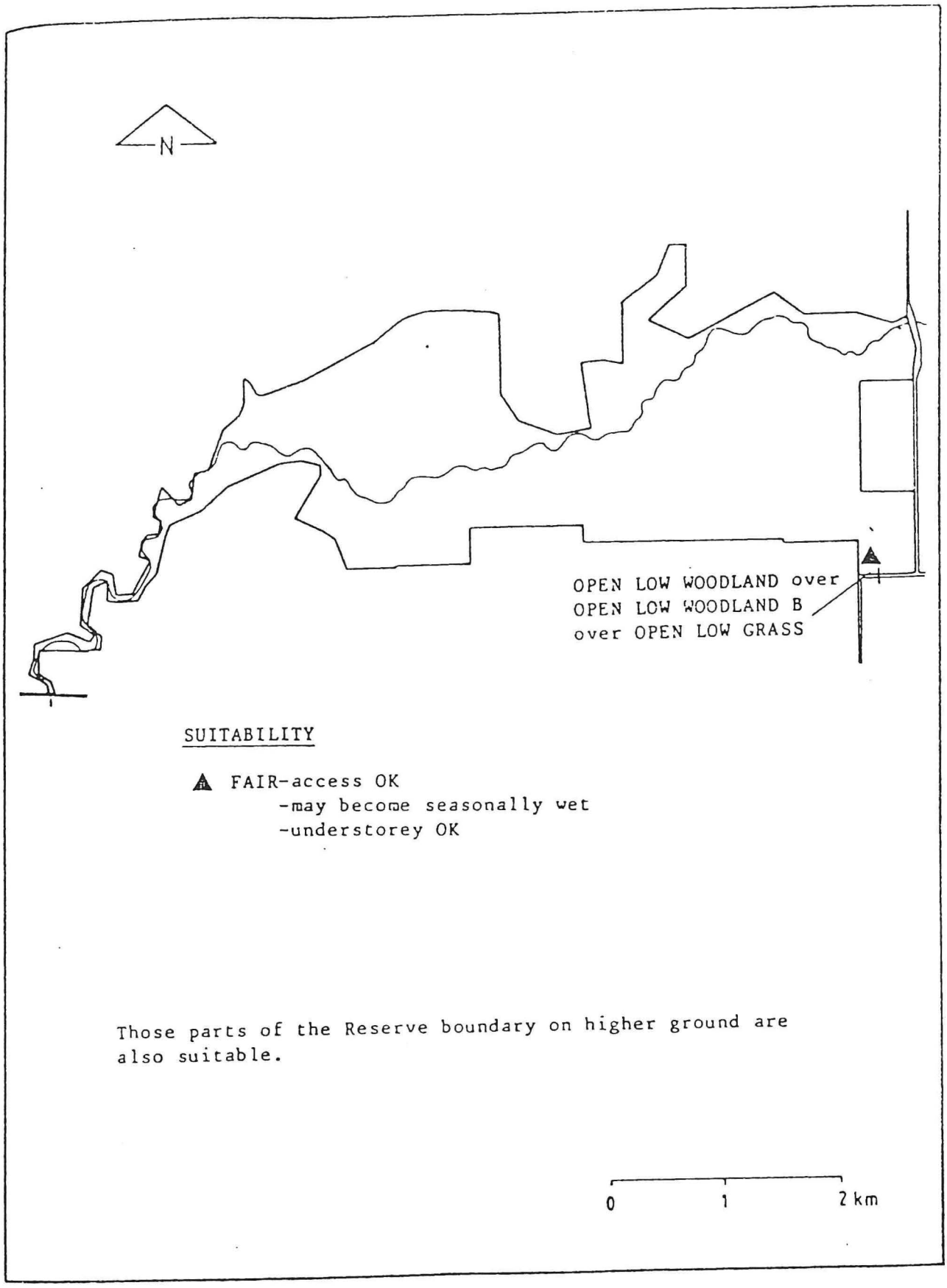
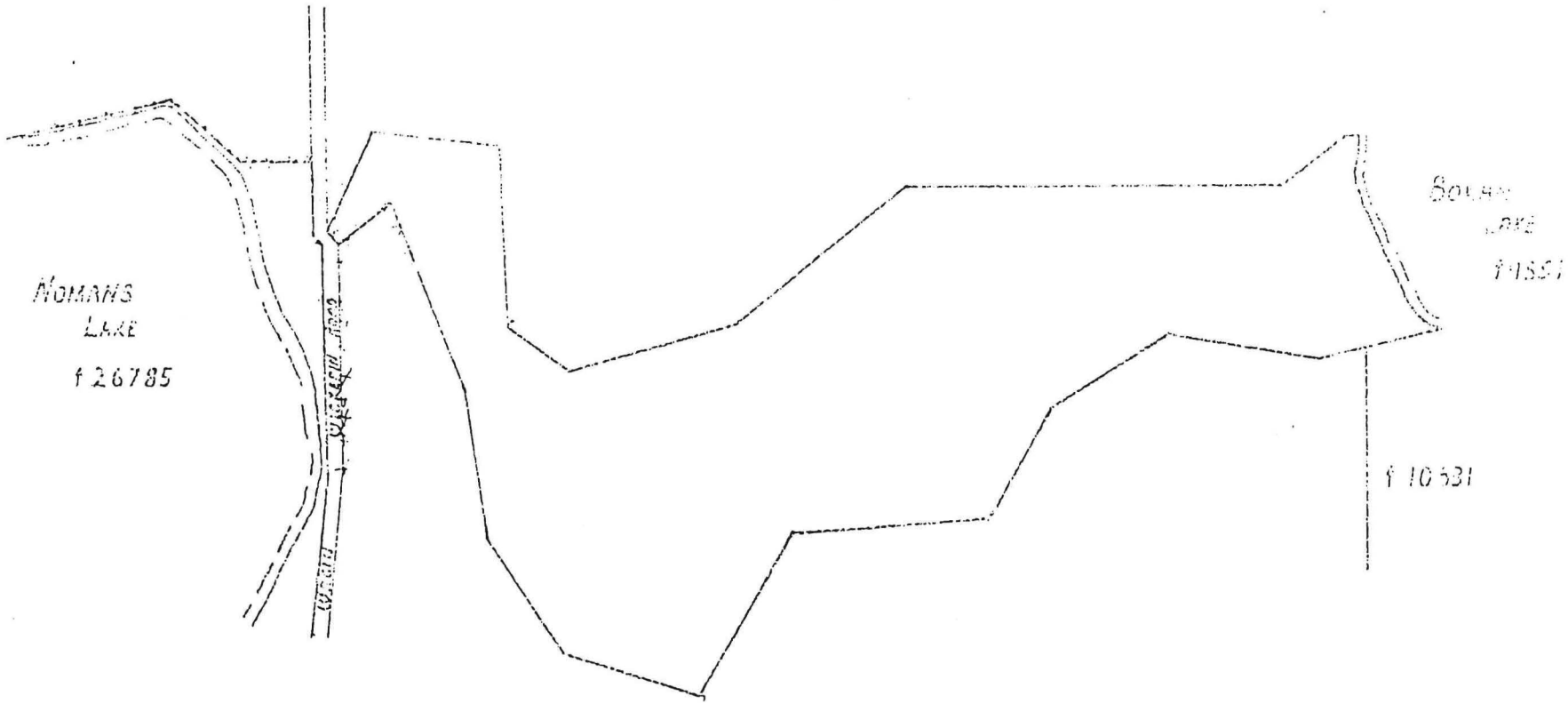


Figure 17. Suitability for beekeeping of Arthur River Flats Nature Reserve (Reserve No. 26789).

NATURAL RESERVE ... f 7337



RESERVE BOUNDARY

ROAD

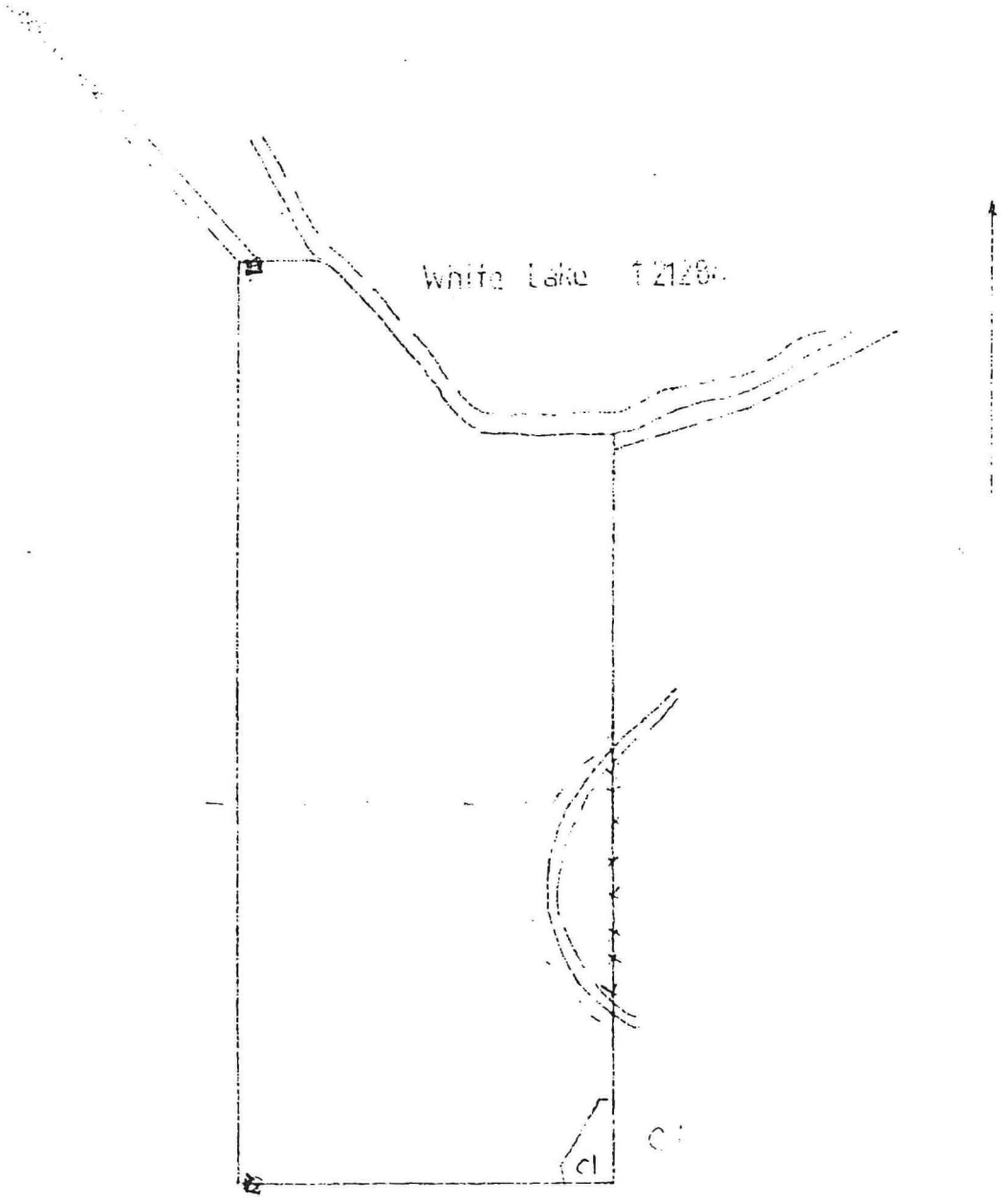
LAKE

SCALE 1-10,000

1cm 100m

AREA 52.6091 ha

NATURE RESERVE 10016

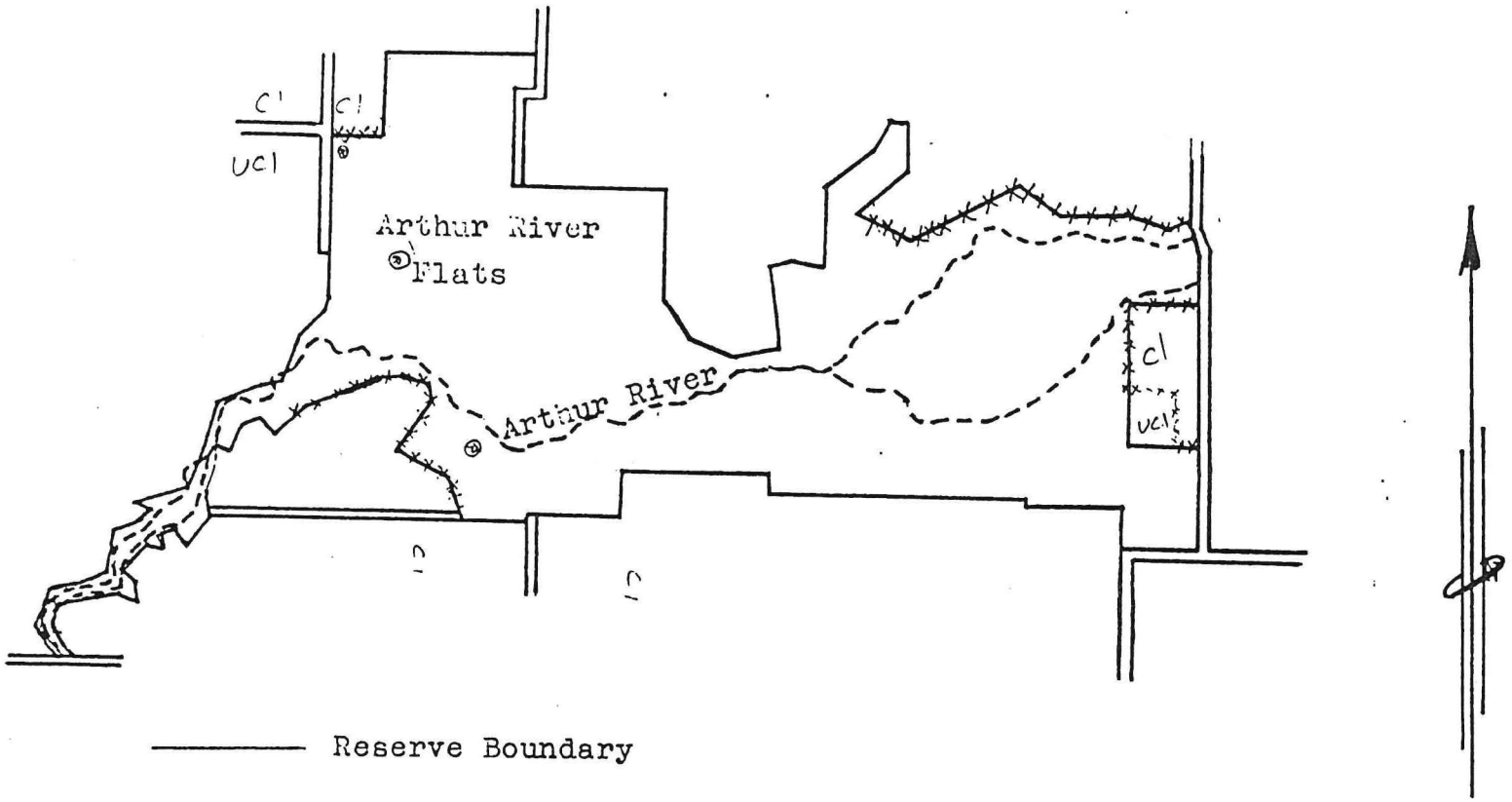


Reserve Boundary
Road
Lake

Scale 1:10,000
1cm = 100 m
Area 56.65 ha

RIB 13 5-81

RESERVE 26789.



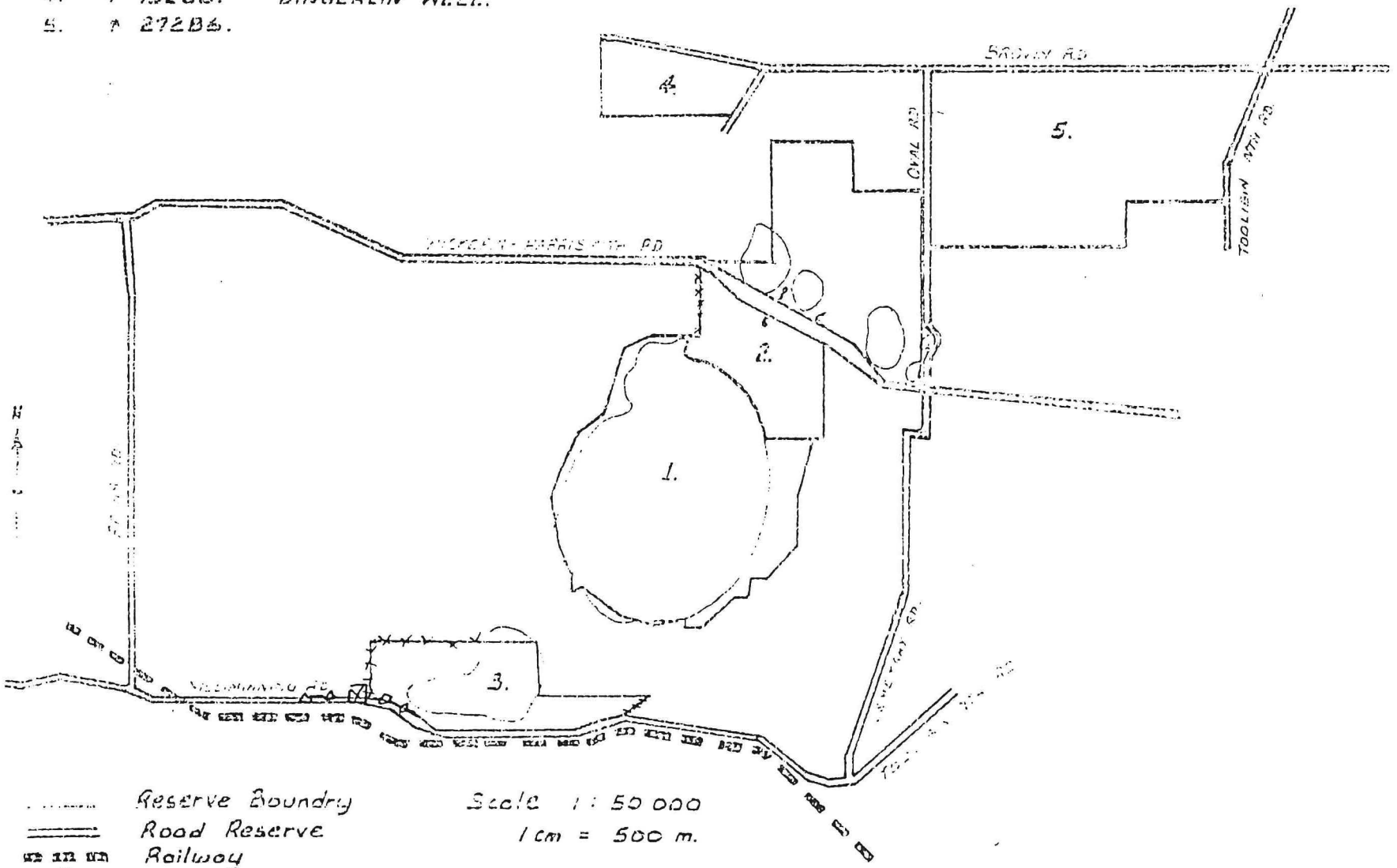
Reserve Boundary

Road

River

SCALE: 1cm. = 500m.

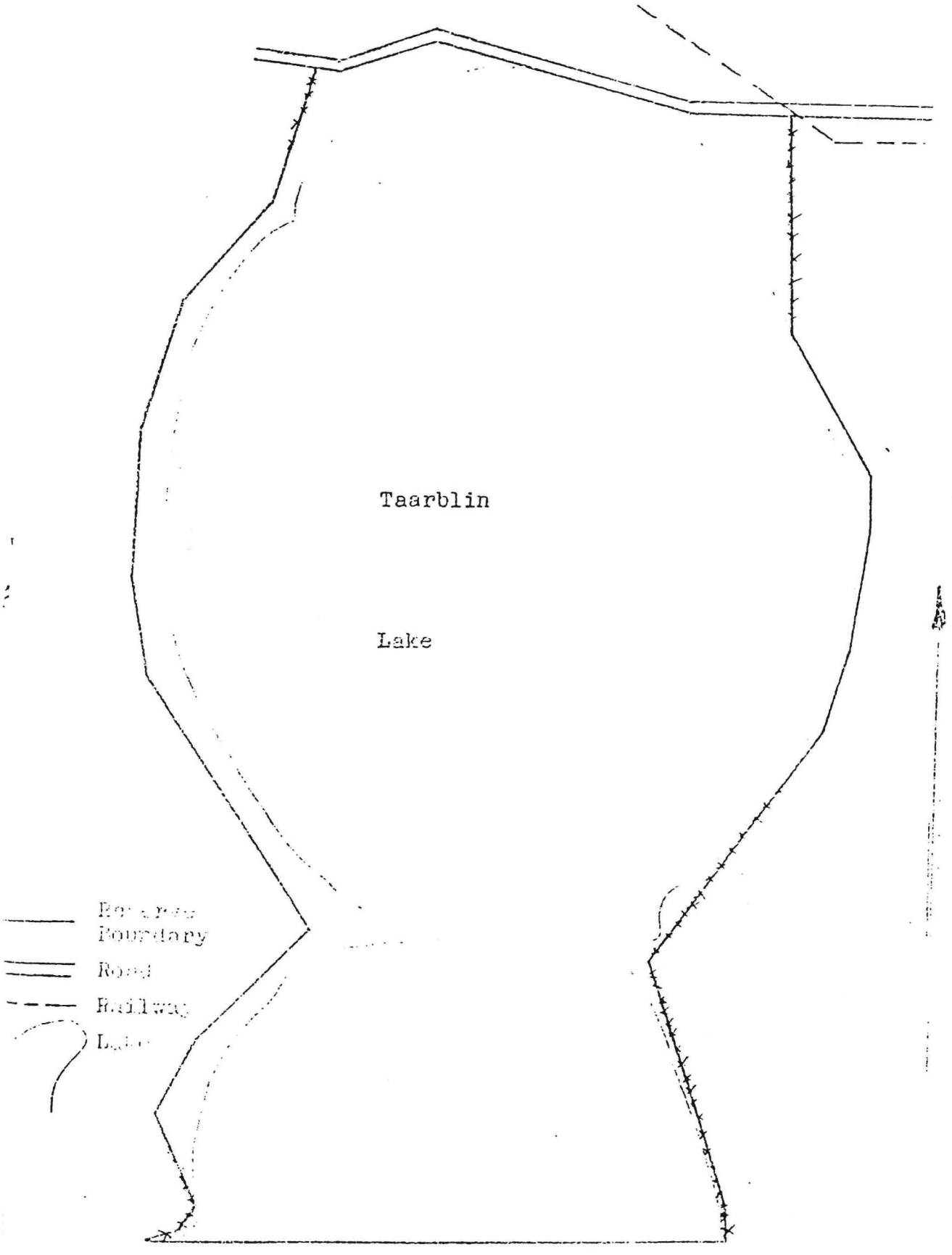
1. ↑ 24556. TOOLIBIN LAKE
2. ↑ 9617. DULDINING LAKE
3. ↑ 14398. WALBYRING LAKE
4. ↑ 15266. DINGERLIN WELL.
5. ↑ 27285.



Reserve Boundry
Road Reserve
Railway
Lakes

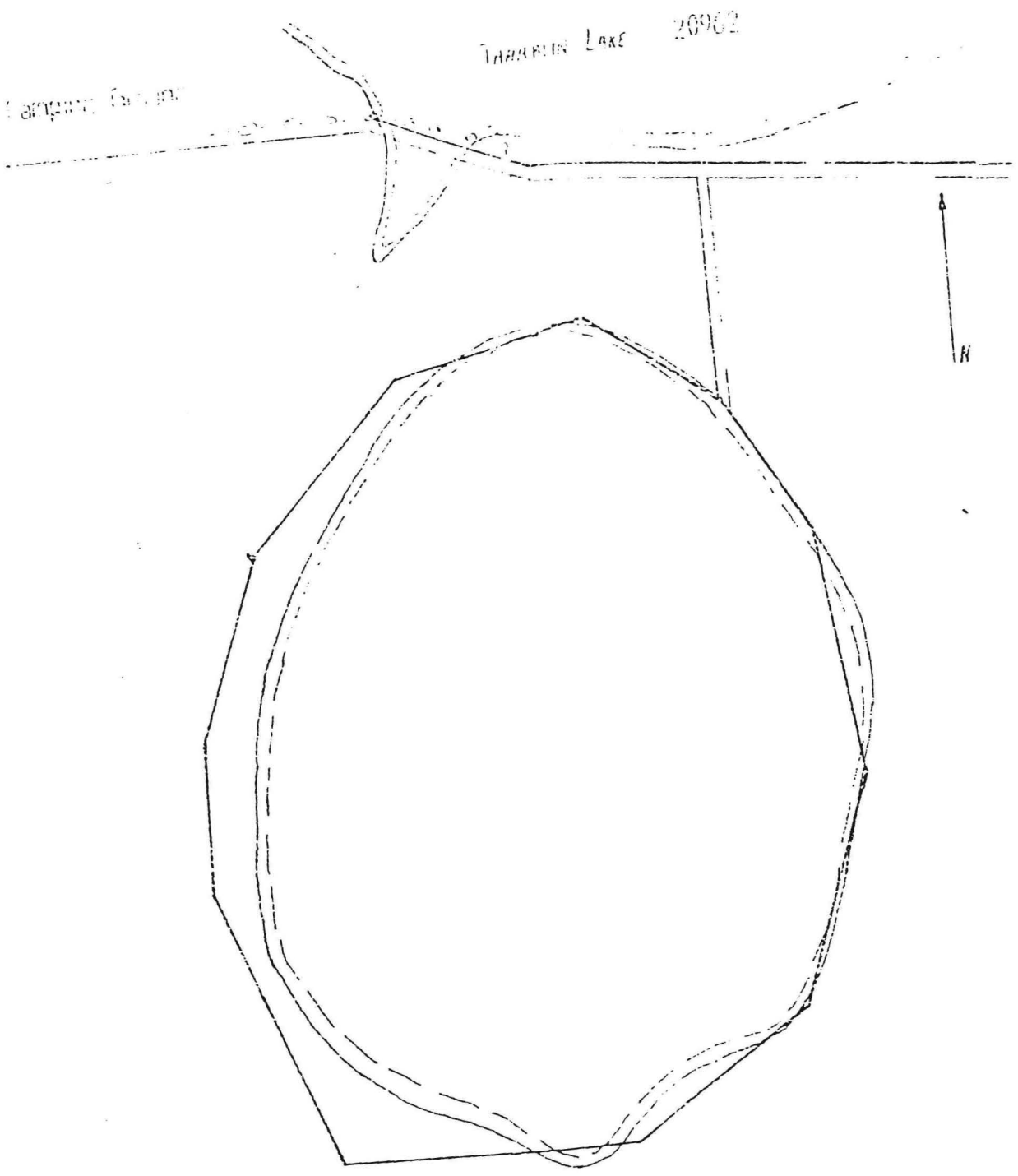
Scale 1 : 50 000
1 cm = 500 m.

RESERVE [illegible]



SCALE: 1cm. = [illegible].

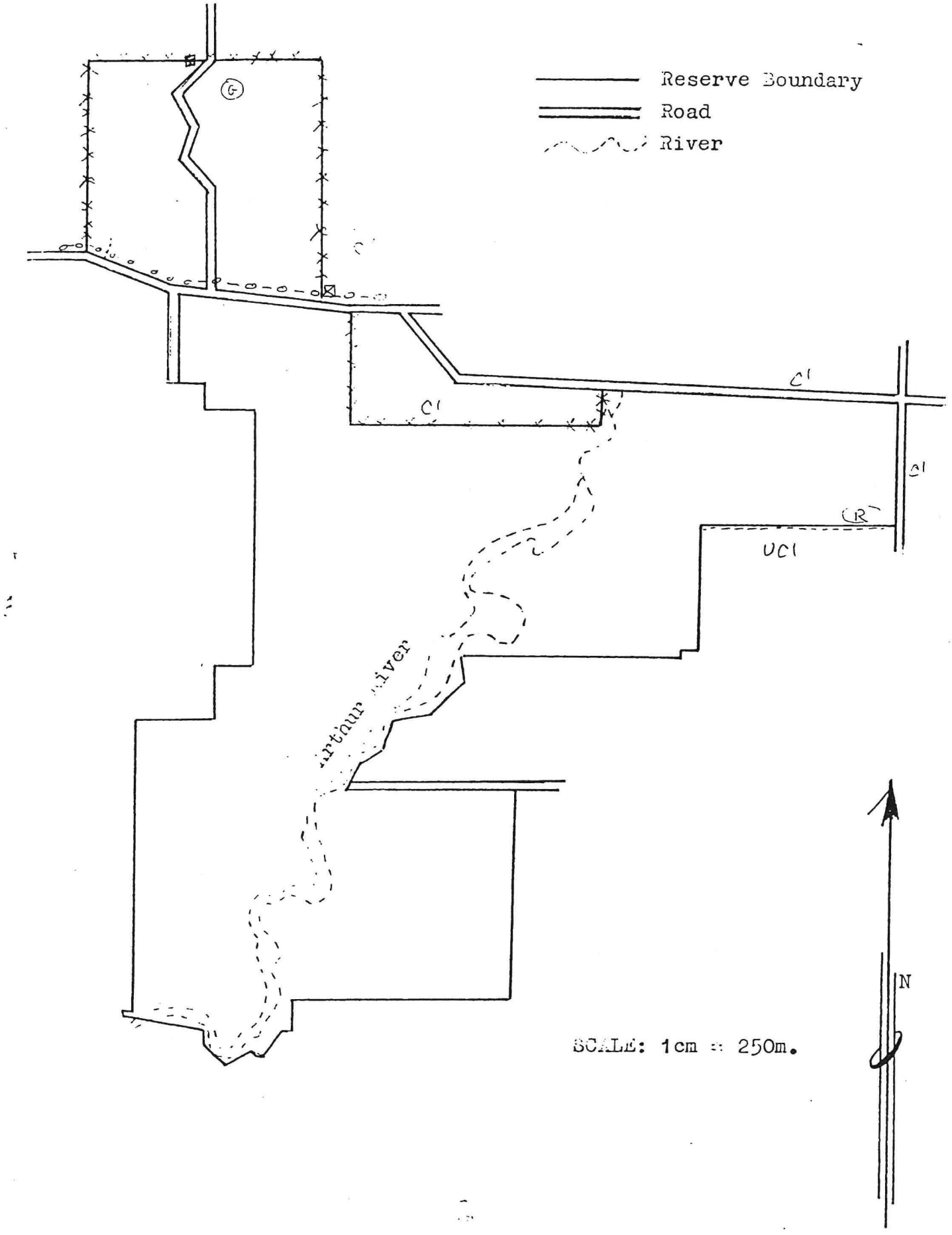
[illegible] LAKE NATURE RESERVE

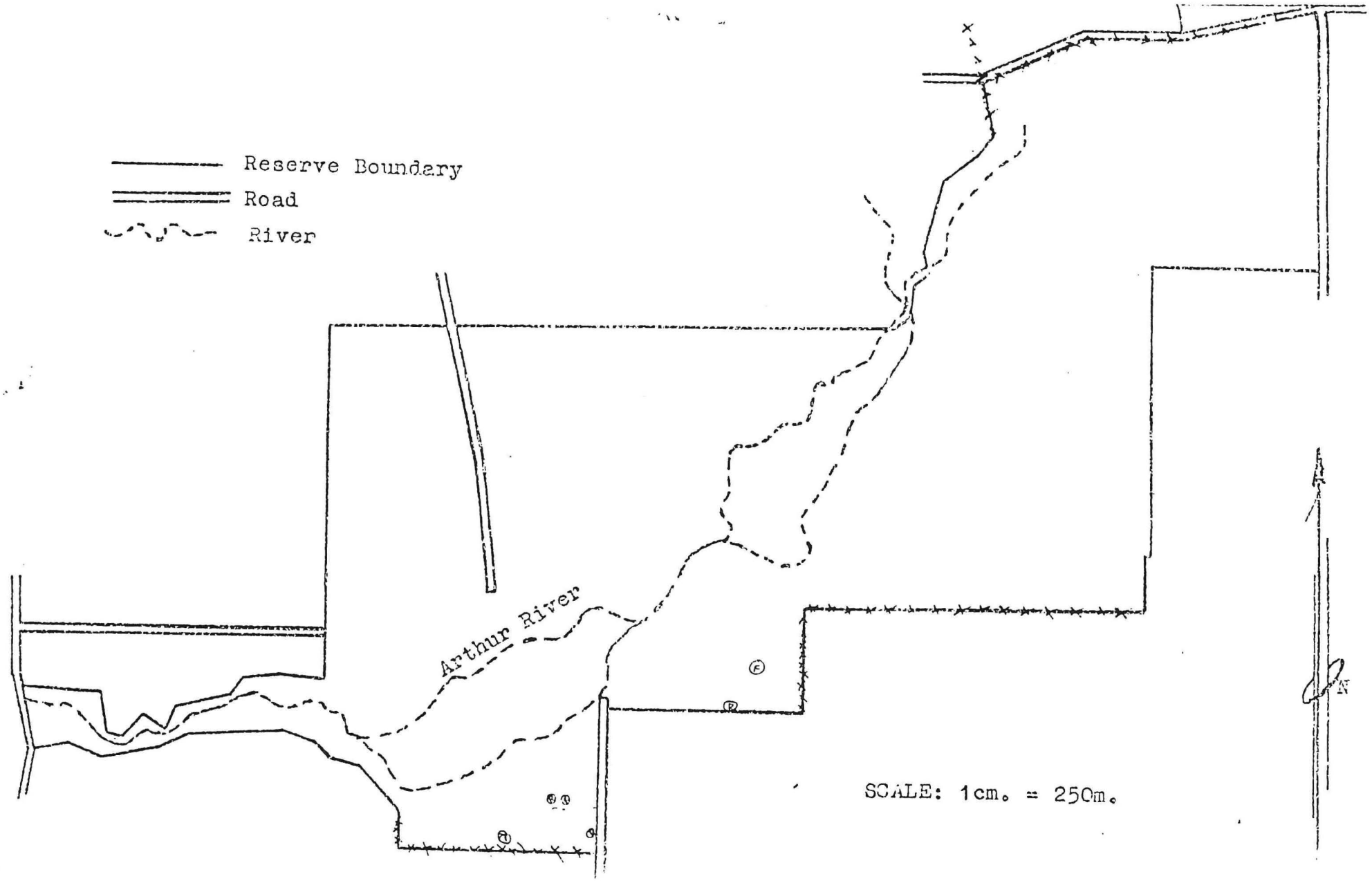


RESERVE BOUNDARY
ROAD
LAKE

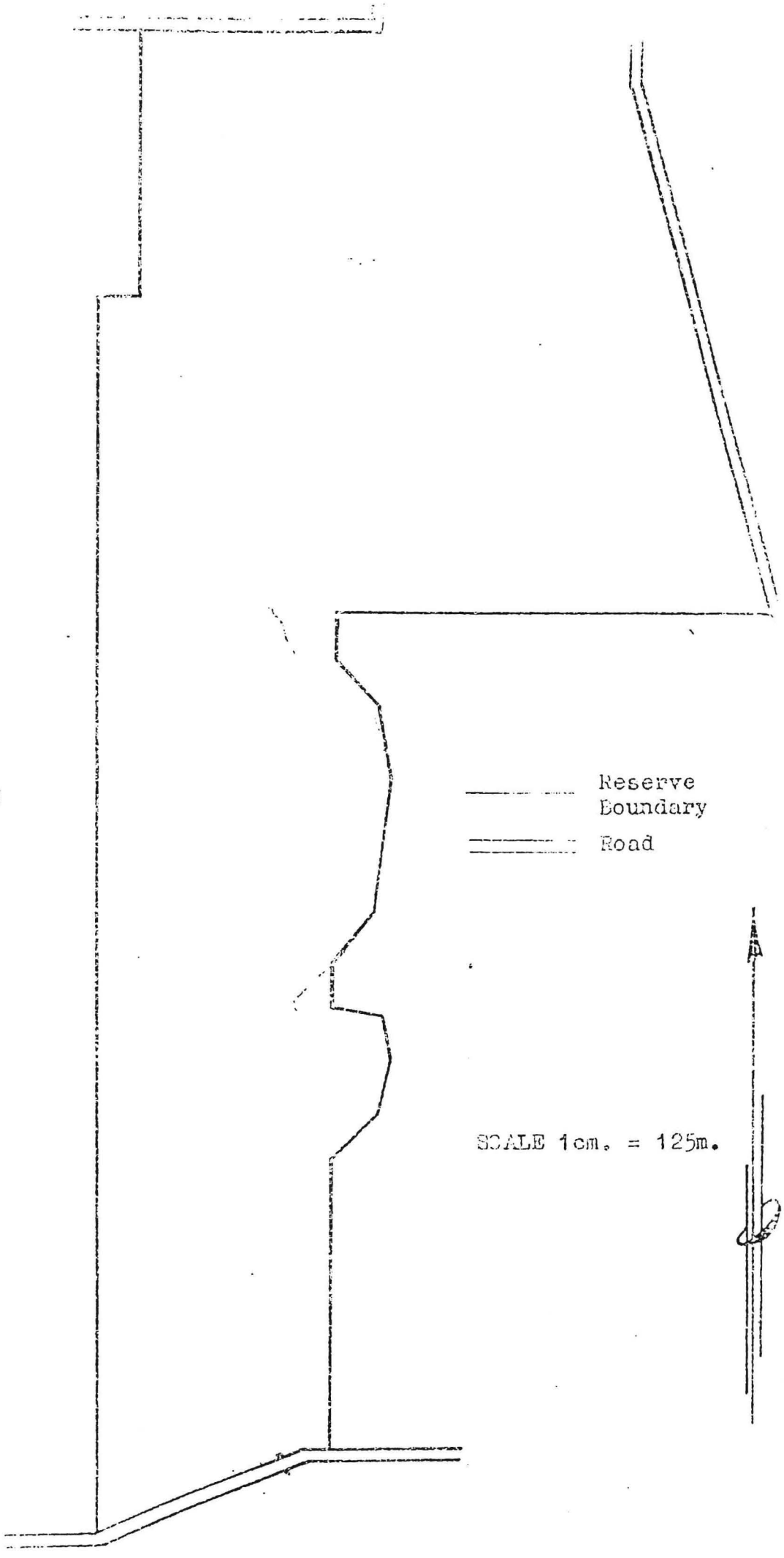
SCALE 1:5000
1 cm = 50 m
AREA 20.23 ha

RESERVE 9508.




Reserve Boundary
Road
River
Arthur River
SCALE: 1cm. = 250m.

...VE 26766.

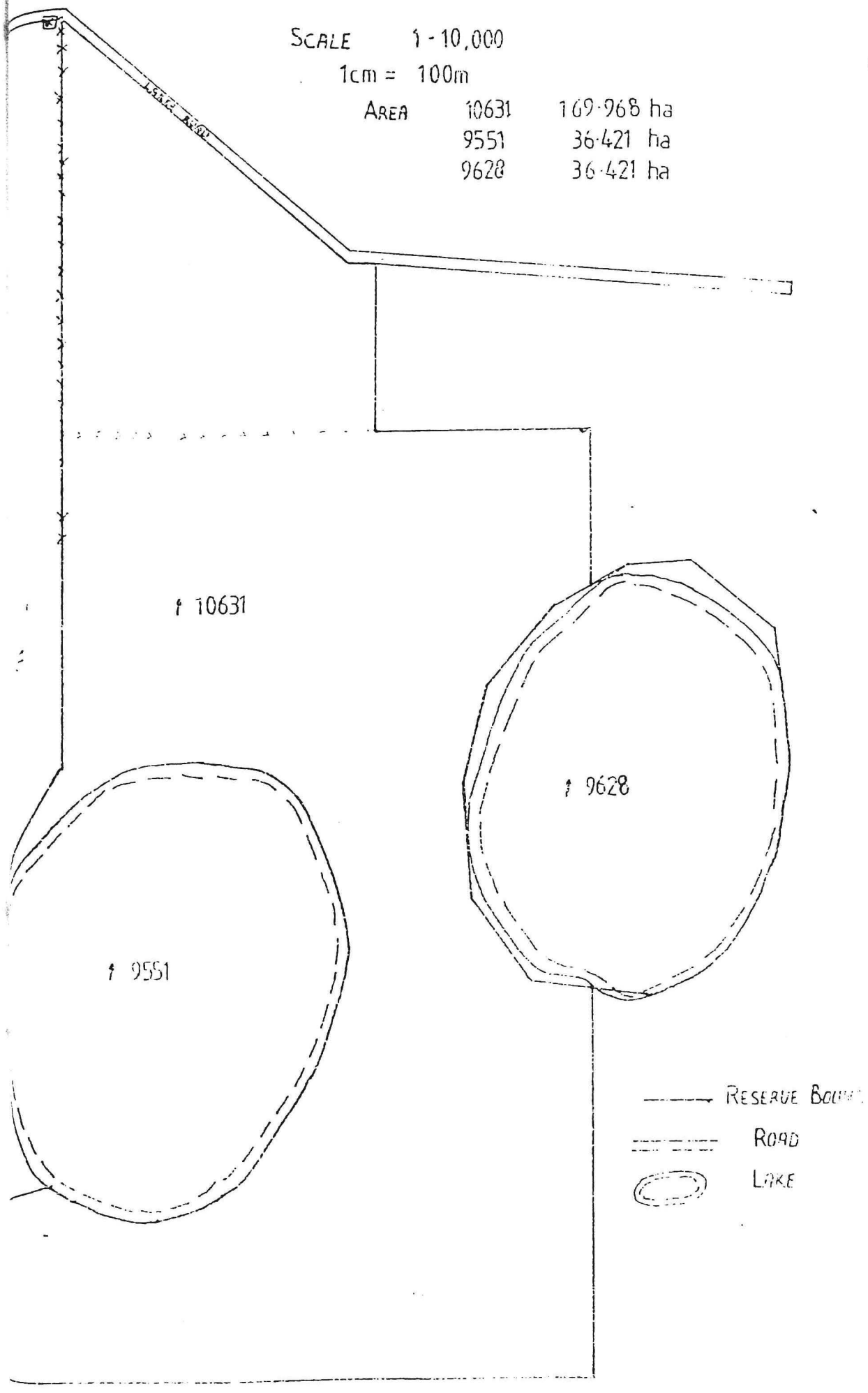


NATURE RESERVES 10631, BOKAN LAKE 9551 & BILLY LAKE 9628

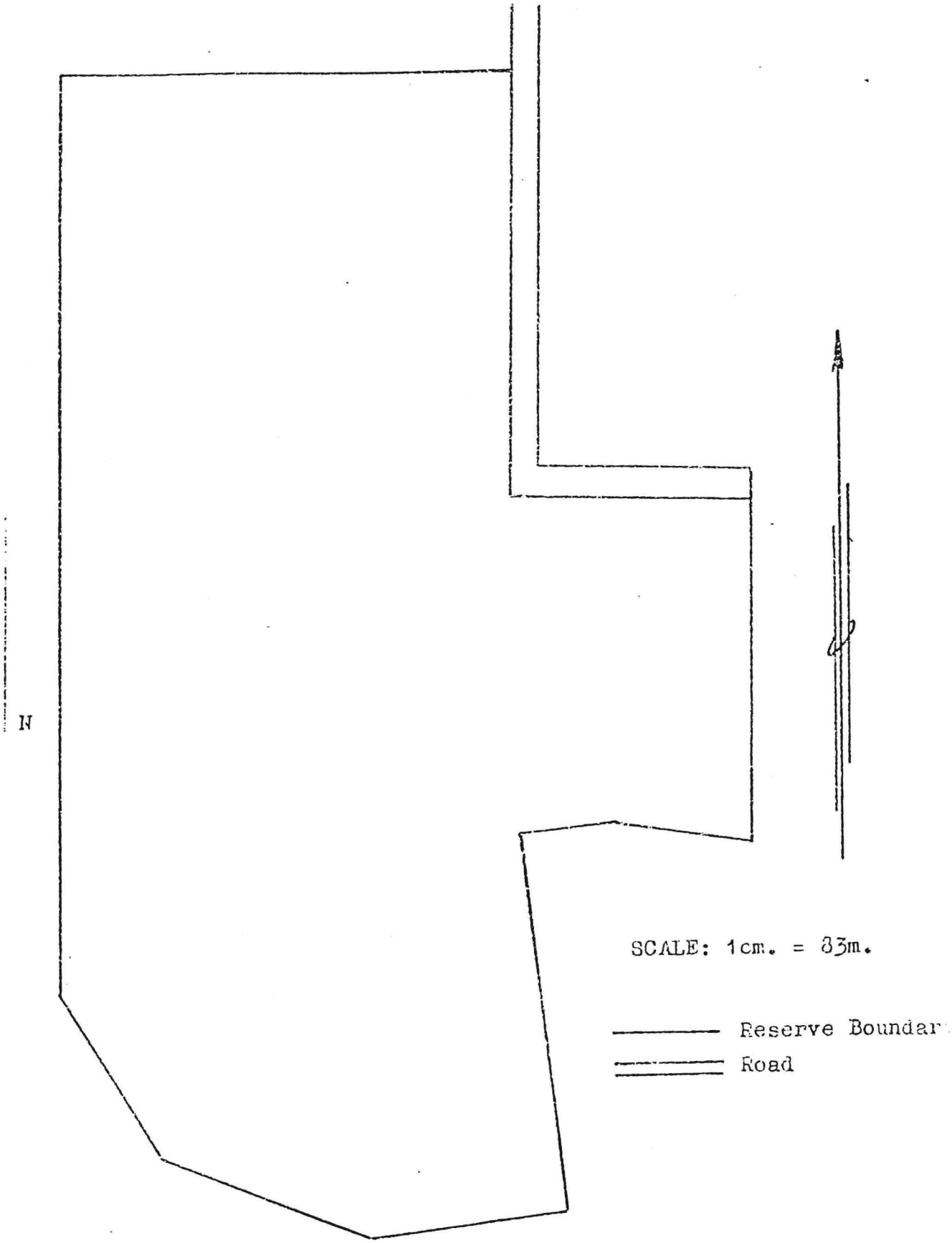
SCALE 1 - 10,000

1cm = 100m

AREA	10631	169·968 ha
	9551	36·421 ha
	9628	36·421 ha



RESERVE 26790.

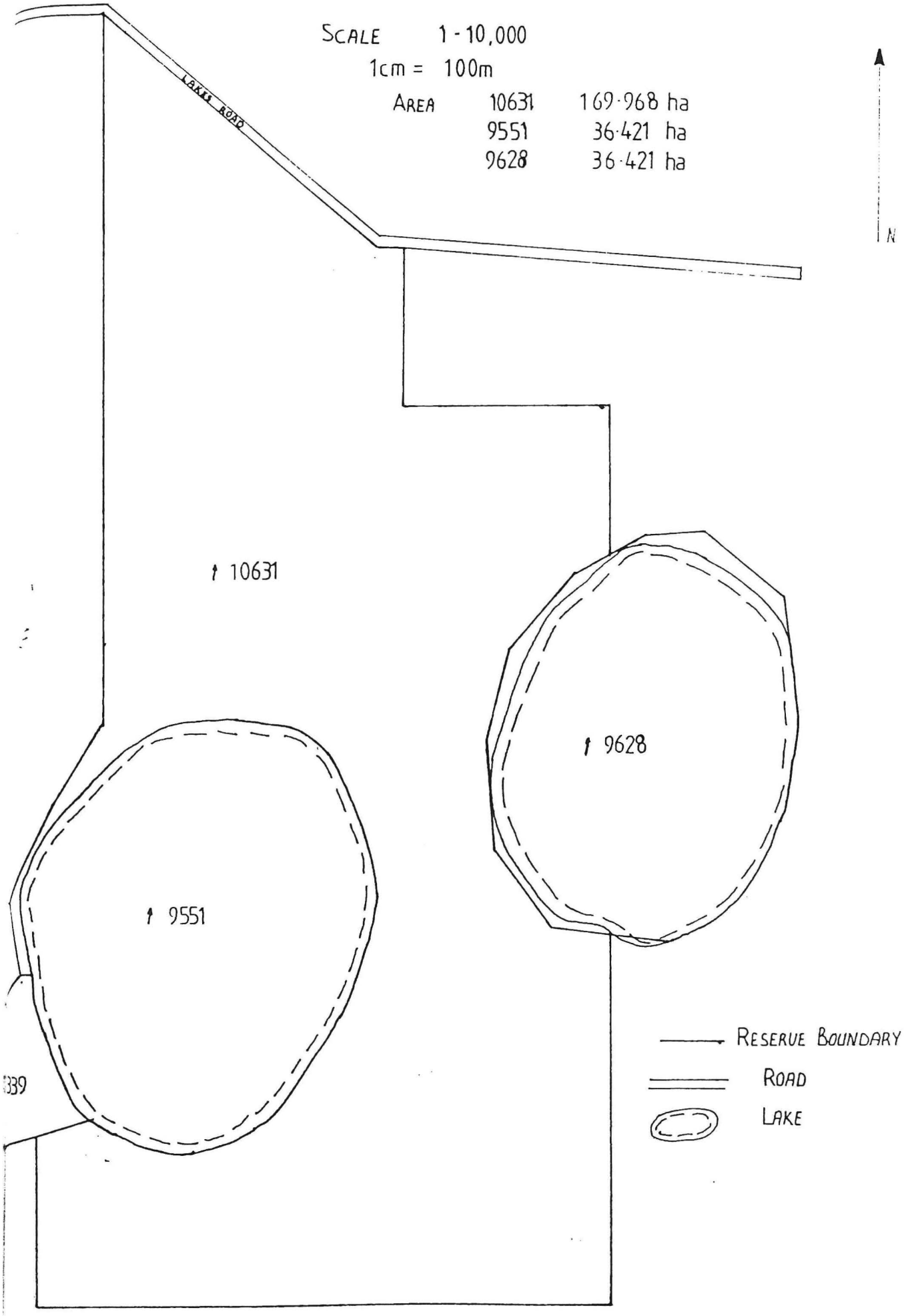


NATURE RESERVES 10631, BOKAN LAKE 9551 & BILLY LAKE 9628

SCALE 1 - 10,000

1cm = 100m

AREA		
	10631	169·968 ha
	9551	36·421 ha
	9628	36·421 ha



LUKIN LAKE NATURE RESERVE 2552

SCALE 1:5000

1cm = 50m

AREA 58.445ha