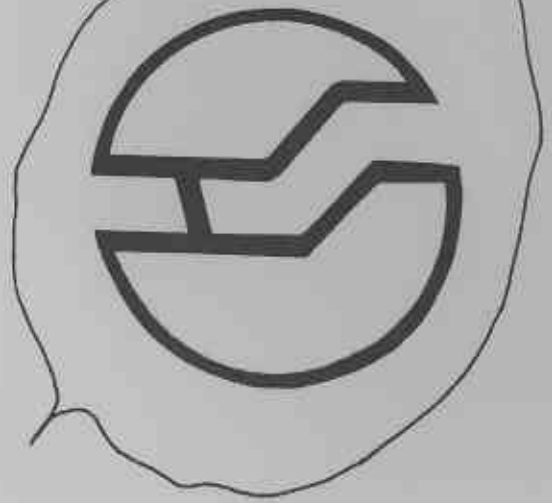
14/3

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

LAKE TOOLIBIN AND RESERVES

INTERIM MANAGEMENT GUIDELINES



Department of Conservation and Land Management

LAKE TOOLIBIN AND RESERVES

INTERIM MANAGEMENT GUIDELINES

Prepared for the Narrogin District

December 1989 — December 1994

PARTICIPANTS

Nick Casson - Principal Author, Consultant Biologist
Dr Ken Atkins - District Manager, Narrogin

Department of Conservation and Land Management
Narrogin District Headquarters
NARROGIN WA 6312

ACKNOWLEDGEMENTS

G Durell and R Brazell (CALM Narrogin and Pingelly respectively) re-familiarized the author with the reserves (the author's first visit was in 1983 to conduct tree water potential measurements) and provided a local perspective (including attitudes to recreational use of the reserves). With regard to the latter, P Page (CALM Recreation and Landscape) also made useful comments.

Other CALM officers who advised on matters specific to the reserves were M Graham (Katanning), L Silvester (Narrogin) and P Brown (Merredin). P Albone (CALM Planning) provided information and discussion on tree pests. Dr's E Mattiske (Consultant Botanist) and R Froend (UWA Wetlands Centre) provided information and clarified issues concerning vegetation. Similarly S Halse (CALM Research) and R Jaensch (RAOU) provided detailed input on waterbird issues. M Martin (Geological Survey) provided useful clarification on hydrological processes. Dr D King (APB) supplied detailed information on 1080 baiting. B Kennington (CALM Narrogin) and J Vann (CALM Katanning) did the typing.

Thanks are extended to all of the above and also to the staff of CALM Planning for their day to day assistance.

TABLE OF CONTENTS

TABLE OF CONTENTS

PURPOSE OF THE GUIDELINES

Lake Toolibin and Reserves Interim Management Guidelines were prepared for the Narrogin District Office of the Department of Conservation and Land Management; under whose jurisdiction the management of nature reserves fall. They are the property of the Department and will be used until superseded by approved CALM Management Plans.

FORMAT OF THE GUIDELINES

The guidelines are presented in the format of a management plan for several reasons:

1. Because a large amount of information exists on the water and salt dynamics at the reserves.

2. Because intermediate-term vegetation monitoring has been conducted at the reserves.

3. There has been little public use of the reserves, (with the notable exception of duck shooting).

4. In response to the delimitted threats to the reserves, manipulative management has already occurred under the auspices of the Northern Arthur River Wetlands Committee (NARWC).

5. Since the lapsing of the NARWC and the constitution of Land Conservation Districts there is an urgent need for one authority to assume the integrating role for all activities connected to the reserves.

6. The reserves have high conservation value in the context of the "wheatbelt" because of their size and remnant indigenous vegetation and fauna.

7. The reserves have a high conservation value because of the freshwater resource at Lake Toolibin and its use for breeding by as many waterbirds as anywhere else in the south-west of Western Australia.

USE OF THE GUIDELINES

The Interim Management Guidelines for Lake Toolibin and reserves can be used as a "stand alone" document. However they are intended for use with reference to the accompanying resource document. The resource document encompasses much of the large amount of fragmented information that has been gathered from the lake and surrounds over time, and brings it together in one place, with the aim of facilitating management.

The Agriculture Department Technical Report No. 75 entitled "Soil conservation and management strategies for the Toolibin catchment" by S J Hearn should be referred to for the agricultural perspective and reference to measures implemented in the wider catchment and their relative success.

When considering vegetation-hydrology interactions specific reports are Bell et at (1987), Ritson and Pettit (1988) and Schofield (1988).

PART A - LAKE TOOLIBIN

1.0 INTRODUCTION

At the beginning of the twentieth century the relatively wet, forested, south-western corner of Western Australia graded into the arid interior through a series of high and low woodlands and mallee scrubs of mixed eucalypt composition.

This belt also corresponded to the 300-500 mm rainfall zone and, as such, was designated suitable for broadacre farming with European settlement. In the study area, clearing began in 1905 and had claimed 85% of land by 1960. During that time the whole region became devoted to wheat and sheep and became known as the 'wheatbelt'.

One of the main consequences of the massive clearing of this ecosystem was the mobilization of salt which had been stored in the soil profile. Clearing halted the water-pumping action of the deep-rooted vegetation which increased runoff, raised watertables, and freed the salt which had been held in situ.

The first symptoms of salt movement were exhibited 30 years after clearing as fresh soaks became too saline to use. At the same time lakes of the North Arthur River wetland chain of which Toolibin is a part, filled for the first time in memory. After a further 25 years, the watertable had risen by 12 metres and salt incrustation became apparent in some of the lakes as a consequence of the evaporation of water from salty surface flows and from the saline water table residing near the surface.

To add to this problem, many saline areas which appeared on farmland in the intervening time were drained into natural flowlines and sumps.

In the North Arthur River wetlands only Lake Toolibin and a couple of small adjacent lakes retained emergent vegetation, while the rest succumbed to the salinity. Such lakes are now at a premium in the wheatbelt and vital to the management of the south-west water bird populations.

Size is another important feature of the reserves which total approximately 1 110 hectares. This is a large area in the context of the south-west wheatbelt, encompassing a diversity of habitat and species.

Lake Toolibin and reserves have two broad groups of habitat types. They are the flowlines and the ephemeral 'lake', and the terrestrial ecosystems.

The ephemeral, wooded, 'lake' is, in seasons of adequate rainfall, a significant habitat for a range of water birds of the south-west. Of special significance is the use of the lake by the Freckled Duck (Stictonetta naevosa), and also by a range of larger water birds.

Terrestrial associations comprise those composed of mixed eucalypt woodland (with a small, though significant, component of wandoo), and intergrading associations of rock sheoak (Allocasuarina huegeliana) and Banksia prionotes and B. attenuata. One species of rare fauna, the Red-tailed Wambenger (Phascogale calura), may well depend on such a combination of associations for habitat. Similarly, a range of bird species, typical of more western woodland, also depend on the mixed woodland of the reserves.

Proximity to another reserve of moderate size imparts further importance to Lake Toolibin and reserves. The reserve is the Dongolocking complex, of 1 061 hectares. It and Toolibin are separated by 10 kilometres, including the remnant heathland at Toolibin Townsite. Movement of birds may readily occur over such distances, while potentially, terrestrial vertebrates movement could be encouraged by prudent regional rehabilitation.

2.0 LOCATION AND TENURE

Lake Toolibin and Reserves are situated 45 kilometres east of the "wheatbelt" town of Narrogin in Western Australia (33°00'N 117°30'E) (Figure 1).

The present tenures are as nature reserves with class 'A' status. The group is vested in the National Parks and Nature Conservation Authority.

The reserves comprising 'Lake Toolibin and reserves' are:

NAME	LOCAL NAME	RESERVE NUMBER
-	"Dulbining Swamp"	27286
Dulbining Lake	Includes "North" and "South Dulbining" and "Footballer's" Lakes	9617
Toolibin Lake		24556
Walbyring Lake	"Mud Hut"	14398
Dingerlin Well		15266

(See Figure 2)

3.0 SURROUNDING LAND USE

Lake Toolibin and reserves are surrounded by arable farmland which is mostly cleared of its original vegetation. Wheat and sheep are the mainstays of the area's farming.

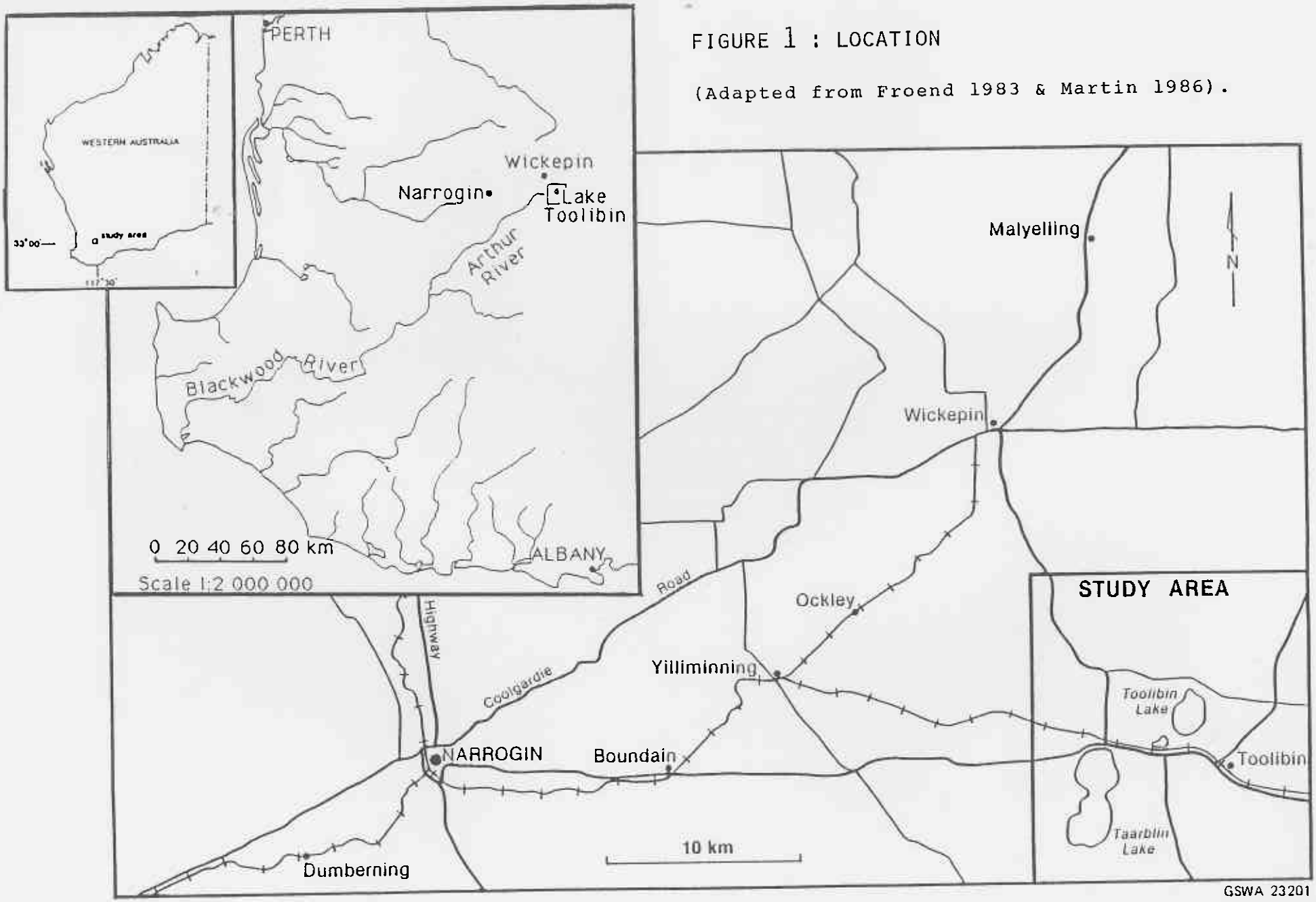


FIGURE 1 : LOCATION

(Adapted from Froend 1983 & Martin 1986).

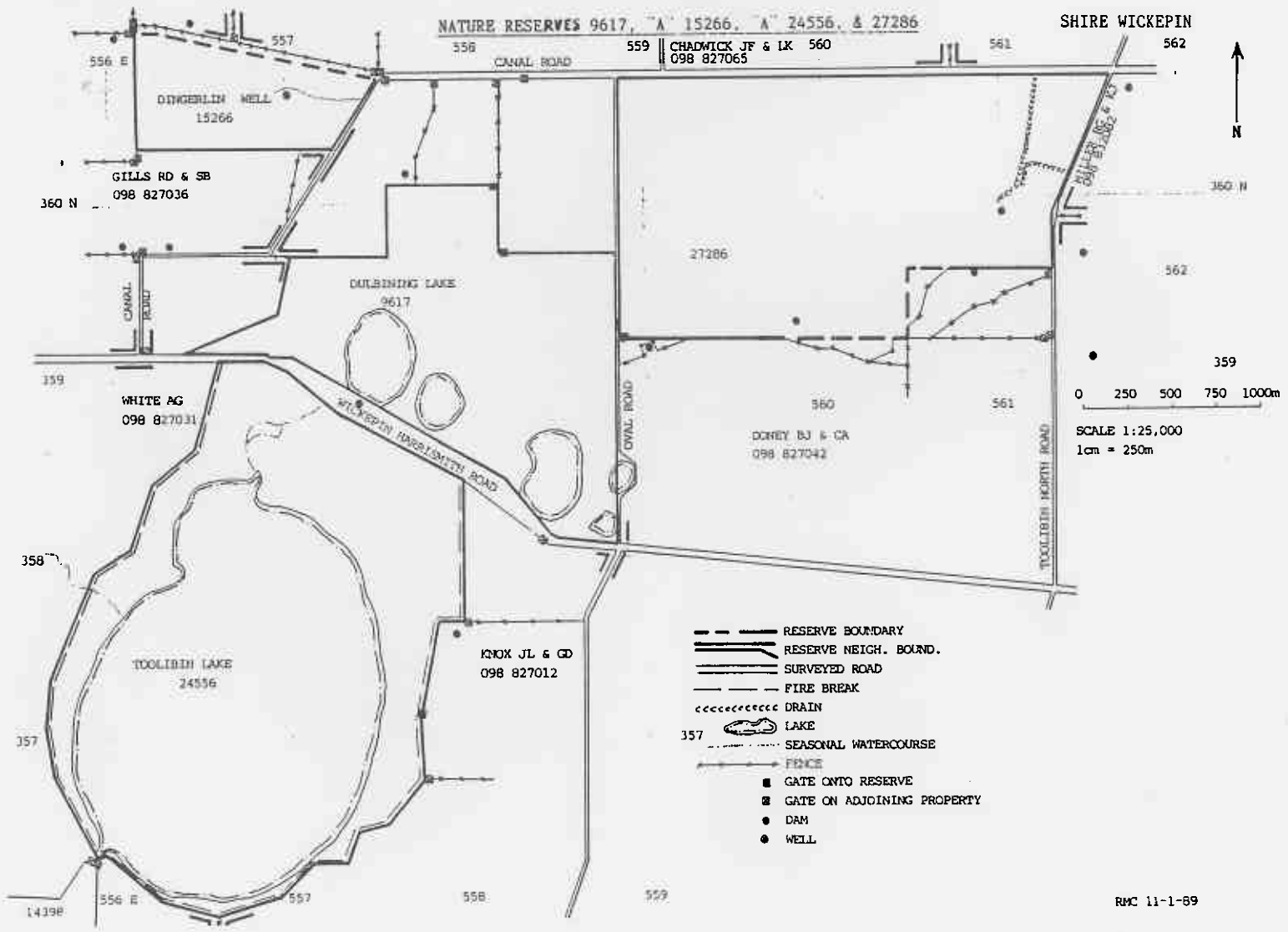


FIGURE 2 : THE RESERVES CENTRED ON LAKE TOOLIBIN.

4.0 OTHER LAKES IN THE NORTHERN ARTHUR RIVER CHAIN

Below Lake Toolibin and reserves lies Lake Taarblin. This lake was fresh early in the century, but is now salt encrusted and resembles the playa lakes of the arid interior. Most of its emergent vegetation has died.

5.0 CLIMATE

Summers are hot and dry in the region, with daily maxima of c. 30°C from December through February. Winters are relatively wet with c. 60% of annual rainfall (420 mm) falling between May and August; this is also the period when rainfall can exceed evaporation. (See Figure 3).

6.0 THE RELATIONSHIP BETWEEN CLIMATE AND LAKE INPUTS AND OUTPUTS

Understanding of the cyclical nature of water-related processes is central to the management of Lake Toolibin and associated reserves.

In this respect it is important to recognise four artificial phases at the 'lake'; while recognising that they are in fact part of a continuum and that the cycle at the lake emphasizes groundwater fluctuations for the collective reserves. These phases are shown in figure 4.

The first phase is when the Lake is full (Figure 4A). It fills in response to c. 60 mm rainfall in the catchment. The first salty, trickling, flows are then overtaken by the major fresh flows and the lake is fresh. Evaporation is low and the lake remains fresh for some months during a period centred on August. During this time organic matter accumulated on the lake bed during its dry phase is re-suspended and aquatic invertebrates and algae proliferate, forming a resource base for waterbirds. Other conditions which favour the waterbirds nesting activities are the protective moat (of ≥1 metre deep) and the fresh water (≤3 300 ppm TSS) which the young are able to drink.

Phase two (Figure 4B) is early recession where surface inputs and outputs of water have virtually ceased and evaporation and tree transpiration are increasing. It is centred on Mid-December. The aquatic invertebrates decline and become part of the pool of decaying organic matter and the waterbirds' food resource diminishes. The maturing juvenile waterbirds can now tolerate the rising salinity of their drinking water. For some low lying trees prolonged inundation and initial salt accumulation may be causing stress. Acting in the lake's favour is a nett loss of surface water to the groundwater at this time which reduces the salt burden while concentration by evaporation occurs.

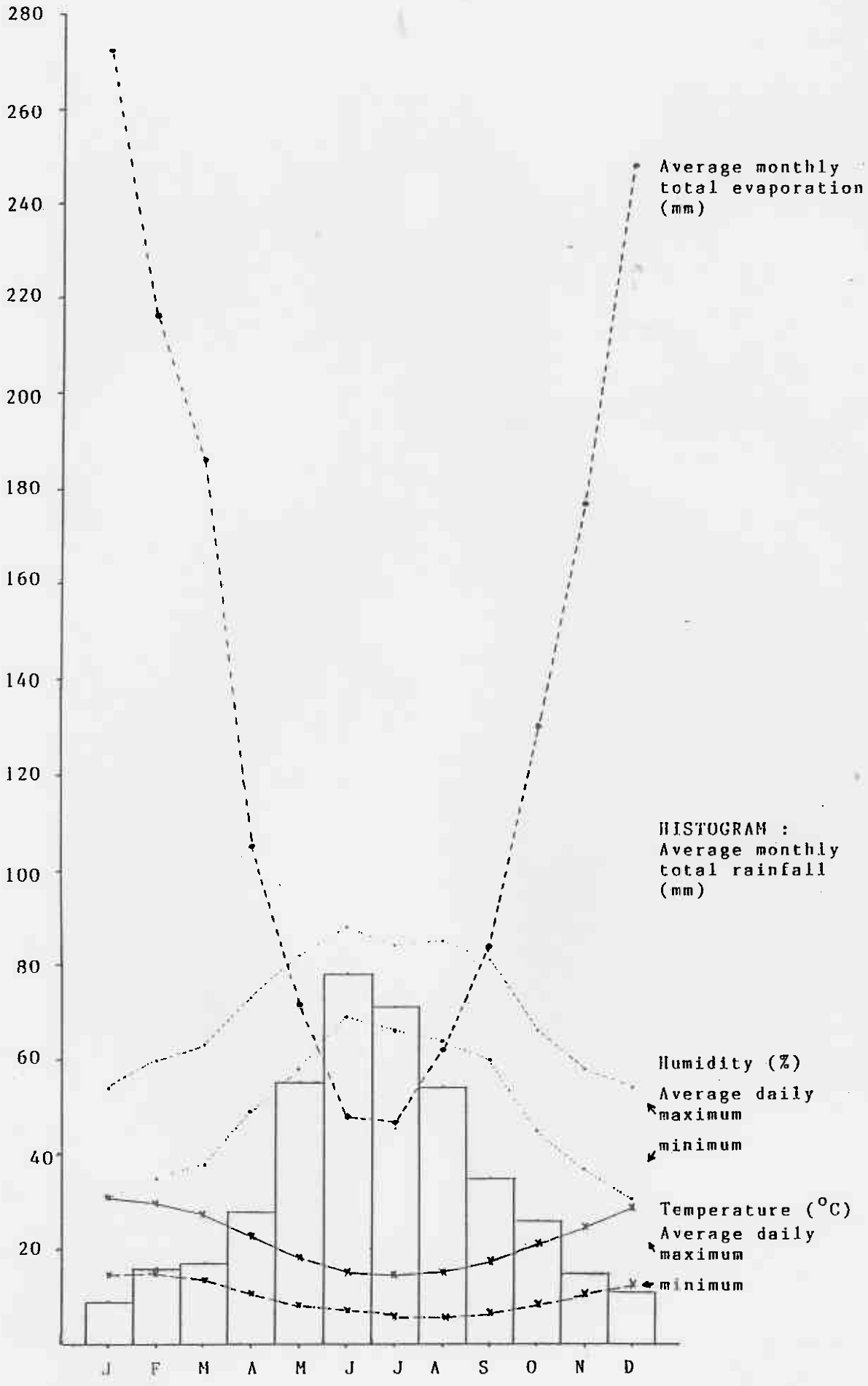
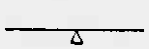


FIGURE 3 : Climatic data for Lake Toolibin (from Narrogin; except rainfall - Wickepin).

KEY FOR FIGURE 4

- LOW SALINITY

- HIGH SALINITY



- WATERTABLE SURFACE

- SOIL SURFACE

N.W.C. - NORTH-WEST CREEK

N.A.R. - NORTHERN ARTHUR RIVER

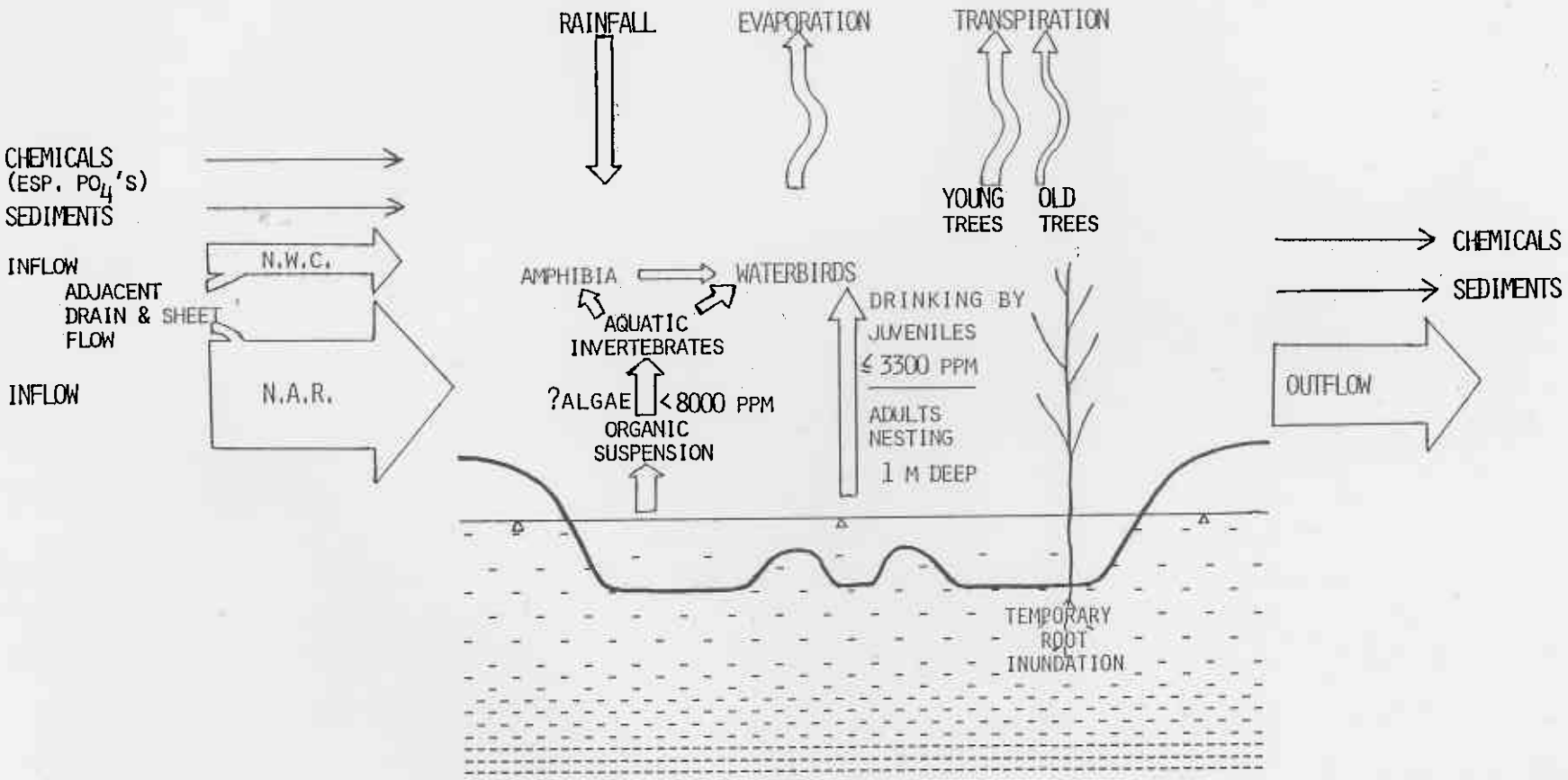


FIGURE 4A : FULL-LAKE PHASE AT LAKE TOOLIBIN

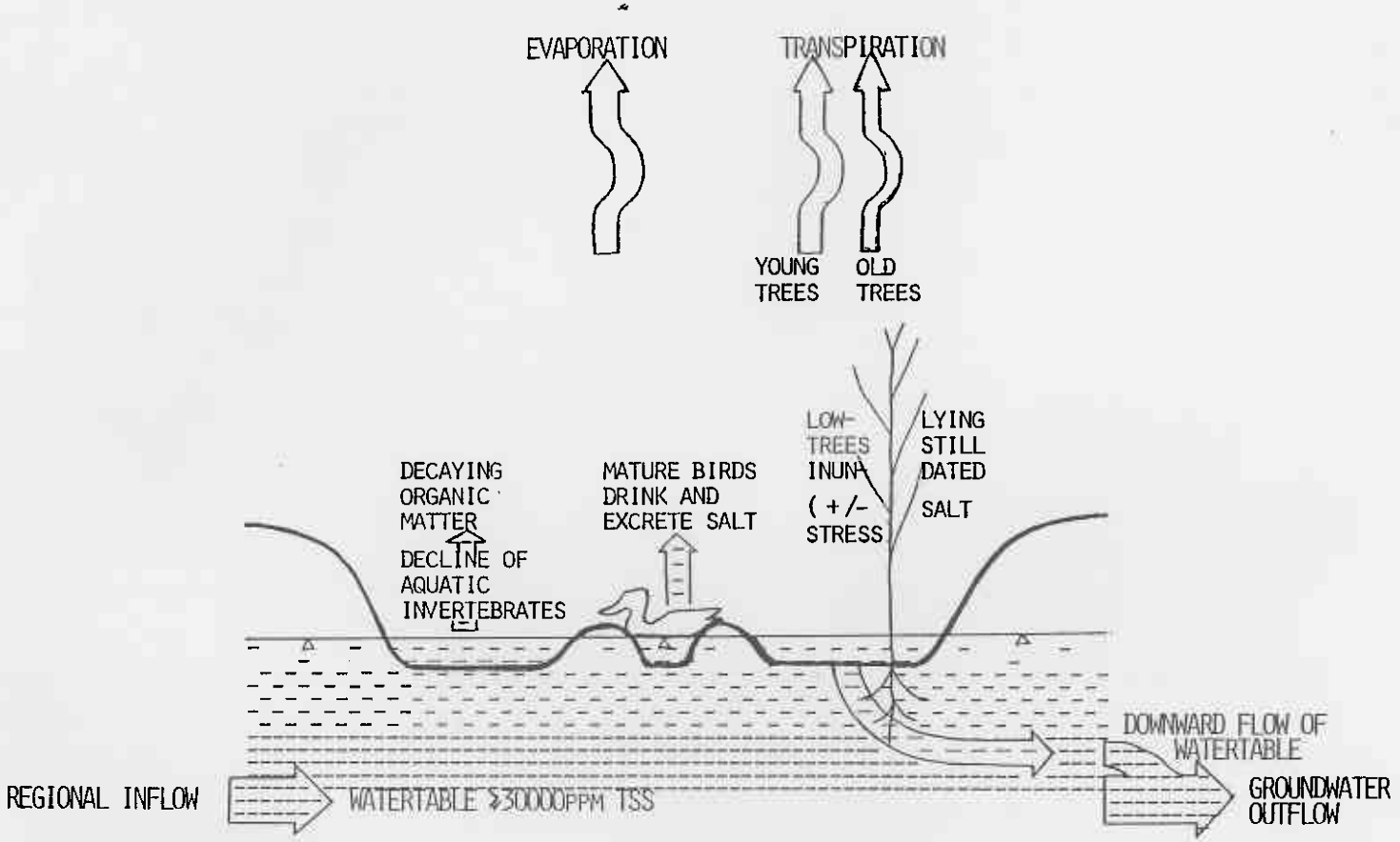


FIGURE 4B : EARLY-RECESSIONAL PHASE AT LAKE TOOLIBIN

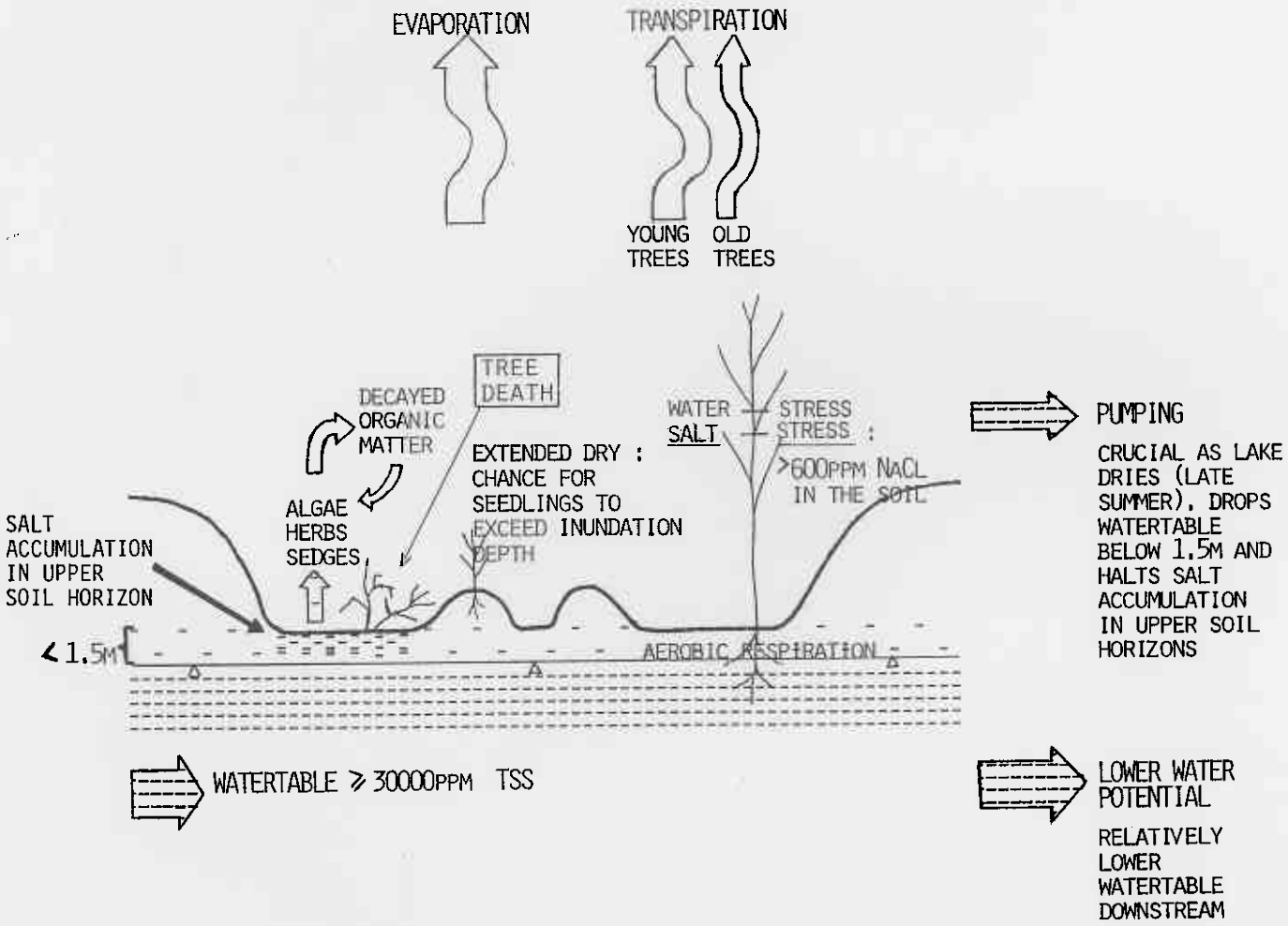


FIGURE 4C : LATE-RECESSIONAL PHASE AT LAKE TOOLIBIN

Phase three, late recession, (Figure 4C) is crucial to the long-term health of the emergent vegetation. At this point (generally late February) the watertable is near to and receding from the ground surface of the lake bed. The slower the rate at which the watertable falls away from the surface the more salt accumulates. This is because, when the watertable is close to the surface, water and salt are drawn to the surface where the water evaporates leaving the salt. This process ceases when the watertable resides less than 1.5 metres below the soil surface. Clearly any factor that quickly lowers the receding watertable to below 1.5 metres is advantageous to the health of the lake's emergent vegetation.

Phase four is the extension of the recession of phase 3 to a 'dry lake' condition (again see Figure 4C). Generally during this stage the watertable resides below 1.5 metres from the soil surface and salt accumulation is limited to rises in the watertable after rainfall. The dry period is important because it permits three things to happen. Firstly lake bed trees experience a period of aerobic root respiration. Secondly dry periods allow tree seedlings to grow to a size there they will not drown when the lake fills. Thirdly the decay of organic debris that will ultimately feed the algae, aquatic invertebrates and waterbirds occurs throughout the lake bed. This phase is most threatened by a continued rise in the watertable in the catchment.

Note that the phases described above usually extend over a period of two years rather than one, as significant water retention occurs from the first year. However, there is a general decline in the lake level, and numbers of breeding waterbirds in the second year.

PART B - MANAGEMENT OBJECTIVES

1.0 MANAGEMENT OBJECTIVES FOR NATURE RESERVES

The management objective for a nature reserve is.....

> 'to maintain and restore the natural environment, and to protect, care for, and promote the study of, indigenous flora and fauna'
> (Section 56 (1d), Conservation and Land Management Act, 1984).

2.0 MANAGEMENT OBJECTIVE FOR LAKE TOOLIBIN AND RESERVES

The general management objective for Lake Toolibin and reserves is to protect and enhance the range of indigenous flora and fauna. For Lake Toolibin there is special emphasis on the water bird habitat and in particular the requirements of the Freckled Duck.

3.0 ACHIEVEMENT OF OBJECTIVES

To achieve this objective manipulative management techniques will be used. This is necessary given the highly altered nature of the hydrology of the surrounding catchment and the disturbance and decline of vegetation on the reserves. Such management complies with the management objectives for nature reserves given in the CALM Act, namely to 'protect and care for.... indigenous flora and fauna'. This manipulative approach to management is accepted by the International Union for Conservation of Nature and Natural Resources (IUCN) as being the best way, in some instances, of guaranteeing the stability and survival of certain species and ecosystems. Where this approach has been adopted, the IUCN has used the term 'managed nature reserve'.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS

PART C - PLAN FOR MANAGEMENT

1.0. HYDROLOGY

1.1 GENERAL

Lake Toolibin's hydrogeology is the key to the persistence of it's indigenous vegetation in the face of increasing salinity.

Salt input is from the salinized agricultural catchment, whence it comes unevenly and irregularly. Two systems supply the lake, they are the Northern Arthur River and North-West Creek. The former supplies the greatest volume, while the latter has a greater relative salinity. Overall the most saline, combined, inflows are at the start and end of the winter rainfall season.

Salt is lost from the lake by surface and subsurface flow. Surface flushing of the lake occurs when sufficient rain falls in the catchment for lake volume to exceed 2×10^6 m^3. At lake levels less than overflow there is a nett loss of salt to the groundwater system beneath the lake. It is this loss that has permitted survival of vegetation on this lake, while other lakes in the same chain have succumbed to salinity.

If left unmanaged the likely trends are for salt inflows and groundwater levels to increase. The direct result will be rising salinity.

The first consequence will be that all seasonally submerged non-salt tolerant plants are placed in jeopardy. Their intrinsic conservation value and their role as a faunal habitat are both threatened. Concomitantly the likelihood of wildfowl successfully raising young at the lake will decline.

Solutions to the salinity problems confronting Lake Toolibin depend on reducing salt inputs and salt concentration and on increasing salt outputs. Short-term and long-term measures are of equal importance.

Any measure that raises the watertable, outside inflow periods, is to be avoided.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Salinity is encroaching on the lake and is expected to continue to do so. Groundwater levels have gradually risen indicating that the volume of subsurface water is increasing. This water has salinities ranging from 18 000 to 60 000 mg/l TSS (seawater 30 000 mg/l). Salt crusting occurs during periods when the lake dries out and this saline watertable resides less than 2 metres below the lake floor. Then salt is redistributed to the upper unsaturated zone of the soil and can be deposited by capillary rise. To date such crusting has been confined to sheltered sites on the south-west lake floor.		
1.2 PRINCIPLE OBJECTIVE		
* To manage all resources under CALM's jurisdiction to ameliorate the current trends in the hydrology of Lake Toolibin's catchment and the lake itself.		
1.3 CATCHMENT REHABILITATION		
SPECIFIC OBJECTIVE		
* To encourage catchment landholders to participate in rehabilitation.		
Denudation and grazing of the catchment have raised soil salinities and increased the amount of salt flushed from the soil by surface flow in the catchment.	A range of skills will need to be integrated in rehabilitating the catchment system.	* CALM will collaborate with farmers and other organizations to establish farming strategies that are economically and environmentally viable.
This is the consequence of the conversion of a heterogeneous and diverse natural system to one of uniform treatments and monocultures.		* CALM will foster community education about, and involvement in catchment rehabilitation.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Large areas of divergent, remnant habitat are present at Dongolocking and Toolibin Townsite. Such areas may well harbour indigenous fauna that could reinvade or outbreed at Lake Toolibin and reserves. (Note the two reserves are each 5 kilometres distant from Toolibin Townsite an area of heath that could form part of a corridor).	Opportunities to link reserves other than by land acquisition must be fully exploited.	* CALM will target opportunities to establish corridors between separate reserves by assistance and encouragement of neighbouring farmers in conjunction with the Department of Agriculture and in response to farmers' requirements.
	Grazing pressures by kangaroos on surrounding farmland will be heightened by corridors.	* Damage licences for kangaroos will be issued as appropriate (see also under faunal investigations).

1.4 LAND ACQUISITION

SPECIFIC OBJECTIVES

* To make additional land available for tree planting.

* To rationalize management of Lake Toolibin and reserves by adding strategic and under-represented land-units so that the reserves can be managed as an integrated whole.

Areas of land contiguous to the Reserves could extend management options and improve reserve integrity, if they were to be incorporated with them.	Future acquisition of land could be warranted.	* Land acquisition will be pursued where such additions are of strategic importance to the reserves.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
A contemporary example is the land between Lake Toolibin and the Toolibin Townsite. The area has five main merits, it: 1. is still partly vegetated; 2. would support trees that prefer an unsaturated profile, but which could make inroads into the watertable; 3. provides a south-east windbreak over summer; 4. has dunes which protect the lake; 5. could form a corridor to the Toolibin Townsite; and 6. is a landform that is poorly represented in the reserves. (NB: 1 to 3 have hydrological implications.)		* Land acquisition will be pursued where such additions are of hydrological importance to the reserves.
1.5 RESERVE REHABILITATION		
SPECIFIC OBJECTIVES		
* To use trees to manipulate the watertable of Lake Toolibin to arrest salination so as to ensure the persistence of the emergent vegetation of the lakebed.		
* To re-establish vegetation that is representative of the indigenous vegetation of the reserves.	Stock need to be sourced locally.	* Stock to be planted will, ultimately, all be raised from indigenous plant seed collected on the reserves.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
There are two categories of land for rehabilitation.		
1. Uncleared areas:		
Both extant plants and a soil seed reserve may be present.	Management can exploit these seed sources.	* Natural regeneration will be promoted within uncleared areas by burning degraded vegetation and soil disturbance under existing trees (provided machinery hygiene is observed and weeds and disease are unlikely to be promoted).
Understorey species may be impoverished. (For example Pimelea argentea has disappeared from vegetation plot 26 during monitoring.)	Some understorey species may need to be introduced.	* The appropriate understorey species for an area will be introduced where impoverishment is apparent. (Note that a number of the Banksia woodland species are rhizomal and might be re-introduced vegetatively).
2. Cleared Areas (acquired land) are of two types:		
Free-draining areas.	Water control is not required for such areas.	* Ripping and mechanical planting will be applied to free-draining land acquisitions.
Waterlogged areas.	Water control is required for such areas.	* V-notch mounding will be incorporated into a programme already involving planting and ripping on waterlogged areas.
Most indigenous plants are absent in cleared areas.	Re-introduction of indigenous plant species is necessary.	* Two phases of re-introduction will occur at revegetating sites: 1. tree planting 2. understorey introduction

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Casuarina obesa and Eucalyptus rudis have been consumed by kangaroos in particular. The kangaroos feed in the farmland and seek refuge in the reserves, so their numbers probably exceed the reserve's carrying capacity. It is highly likely that their numbers contribute to the poor status of the reserve's understorey.	Herbivore exclusion is clearly important for the establishment of some tree species, and is likely to feature in attempts to establish understorey.	* Herbivore numbers will be kept to a level commensurate with low revegetation impact.
Considerable rehabilitation has been conducted on newly acquired land fringing the reserves. The work has centred on land acquired on the western and south-western borders of Lake Toolibin Reserve and to the north-west of Reserve 9617. The main purpose of acquiring and planting such land was to lower the watertable through evapotranspiration. All species used were indigenous to the areas. The efficacy of this work has yet to be determined.	The tree planting programme and rehabilitation generally, will need to be reactive. It will need to react to the changes in hydrology and vegetation as the two interact.	* The Lake Toolibin and reserves' tree planting programme may be formalized by the following prescriptions:
Some tree species may transpire water at different rates and times to others. This means that some tree species may be better at lowering the watertable than others. The issue is still contentious.	The most effective tree-selection for lowering the watertable may include a range of non-indigenous species.	1. To accommodate the future use of non-indigenous native tree species. Planting strategies are required to facilitate the eventual removal of exotics when the hydrological situation stabilizes.
Different age and density combinations of trees vary widely in their demands for water.	Control of age and density can be used to influence the local watertable.	2. So that contingency plans are devised for tree density manipulation in response to watertable levels. The extremes of thinning and secondary over-planting should be accommodated (see monitoring below).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
The main axis of sub-surface flow is north and NNE and south and SSW. These are the areas of entry and exit respectively. This system is effective in nett salt and water loss from Lake Toolibin.	The pattern of planting should complement existing hydrology.	3. So that further planting is emphasized in areas peripheral to the main subsurface flow passing below Lake Toolibin. Suitable areas are the north-west and south-east.
Lakebed trees experience peak stress over summer. The predominant winds at this time are south-easterlies. Windbreaks could be established to diminish the effect of these winds.	Buffering lakebed trees from prevailing winds could reduce one degree of stress and the chance of mortality.	4. To include an effective (ca. 40% porous) windbreak of mixed species to the south-east.
The north-west corner of Reserve 9617 and part of Lake Toolibin's floor are already salt affected; the likely trend is for more land to become saline.	Managers may have to contend with increasing salinity.	5. The best procedure for rehabilitating saltland, incorporating current techniques, is to be established. (For example "hardening" seedlings prior to planting.)
Lake Walbyring and Lake Taarblin are situated directly below Lake Toolibin. They are part of the same hydrogeological system. They are also under CALM's jurisdiction and candidates for management. (Note that Lake Walbyring also has emergent vegetation persisting through much of its bed.)	The watertable may be lowered by a general initiative on other CALM lands, in conjunction with regional rehabilition works.	* CALM will consider rehabilitation on other lakes in the Northern Arthur River chain where this fits into regional rehabilitation works.
1.6 THE ROLE OF INDIGENOUS VEGETATION		
Extant vegetation plays a part in maintaining the watertable level.	Maintenance of all water pumps is important.	* The health and vigour of existing vegetation will be maintained or improved. (See Indigenous Vegetation section.)

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Casuarina obesa trees on the lakebed appear to recruit at widely spaced intervals in time. Evidence for this is that only three cohorts of trees of different sizes can be recognised on the lake. It is assumed that this is because they require a particular combination of moist and generally dry years. The former would stimulate germination, while an ensuing period of dry years would permit the plants to reach a height where they would not drown at the next filling of the lake.	Young trees of Casuarina obesa, at less than two metres, will always be susceptible to inundation when the lake fills.	* No attempts will be made to artificially maintain an aboveground lake-level without the effects on current Casuarina obesa recruitment having first been determined.

1.7 HYDROLOGICAL INVESTIGATIONS

SPECIFIC OBJECTIVES

* To monitor sufficient hydrological parameters to determine catchment inflow and watertable trends at the reserves.

* To monitor sufficient hydrological parameters to enable the effects of management practices on the watertable and salinity at the reserves to be gauged.

* To monitor sufficient hydrological parameters to be able to predict the effects on the reserves of amending management practices.

INFORMATION SUMMARY

Preliminary hydrological investigations were conducted to 1986 under the auspices of the N.A.R.W.C. by the Water Authority and Geological Survey of Western Australia. These indicated that de-watering part of the lakebed was the best option to test.

It was recommended that de-watering trials were to be continued and that hydrological parameters concerned with the trial were to be measured at least at quarterly intervals.

The effectiveness and economics of full-scale de-watering await further results. 'Effective pumping' will bring the watertable of the western lakebed to greater than 2 metres below the surface so preventing salt deposition.

MANAGEMENT IMPLICATIONS

This information is critical to formulating a decision on a full-scale de-watering scheme to lower the watertable of Lake Toolibin.

PROPOSED PRESCRIPTIONS

* CALM will assume full responsibility for hydrological investigations at Lake Toolibin.

Responsibilities will include running and maintaining the production bore and monitoring the gauging bores and lake levels, stream flow, and salinities at all locations. Measurements will be taken at least at quarterly intervals.

* CALM will assume responsibility for capital works of a hydrological nature at Lake Toolibin.

* CALM will seek and co-ordinate the expertise of other government departments for analysis and interpretation of hydrological data, and planning any ensuing capital works.

* Records of processed hydrological data will be held by CALM.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
A number of the short-term measures have been proposed apart from de-watering. They are: 1. Creating a by-pass for inflow to Lake Toolibin. 2. Using a weir to alter the water level of the lake. 3. Pumping out surface water when the salt concentration passes a predetermined limit.	Other options are possible. Their feasibility will vary as a function of social priorities and economics.	* Records of relative costs and operational advantages of other engineering prescriptions will be collated so that their feasibility can be reassessed as circumstances change. (NB: Water Authority did costings on the by-pass option.)
The patch work nature of existing regeneration means that there will be differential effects on the water table of various areas at any time. The Lake Toolibin water table level will be a product of the sum of these parts at any one time. For example, the vigour of the undisturbed vegetation will decline before that of the revegetated areas on the west bank of Lake Toolibin and the rolled and burnt sections of Reserve 9617.	Monitoring bores are required in each of the compartments which have been rehabilitated, so that the time of their maximum effective pumping rate can be seen and compensatory management adjustments made. Later adjustments to density and vigour will also need to be followed to determine their greatest effectiveness. Such a study would provide bench-mark information.	* CALM will install the minimum number of monitoring bores in each revegetated locality to watch the effect of stages of re-growth on the watertable at each locality. This work should have priority over plant based measurements such as transpiration. The arrangement must be simple and easily and readily assessed. Patchy revegetation will be conducted as necessary in response to measured hydrological change.
The greater catchment has a similar role to play in the watertable level at the lake.	An outline of the effect of minimal catchment rehabilitation is required against which to base maximum land acquisition and revegetation at Lake Toolibin and reserves.	* CALM will specifically seek information from the Department of Agriculture on the Lake Toolibin catchment hydrology and salinity.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS

1.8 DRAINAGE INTO THE RESERVES

Apart from North-West Creek and the Northern Arthur River there are several ill defined areas of semi-channelled flow impinging mostly upon Reserve 27286. A large amount of water ponding occurs on Avon Locality 7348 to the north and to a lesser extent around Avon Locality 7358. Partial solutions have been found to the former by directing a drain to the north boundary of Dulbining Reserve and the latter by 'cleaning out' an old drain that runs into Reserve 27286 (neither activity was sanctioned by CALM). The root of the problem at both localities appears to be an increased water harvest from the denuded catchment and the existing gradual drainage is not able to cope with the increase. Both drains do not reach natural flowlines and so it is very likely that water is mounding at the end of both before joining the regional subsurface flow. Tree decline is evident at the end of the drain impinging on Dulbining Reserve and a generally poor state exists at Reserve 27286 which can be seasonally surrounded by ponded water. In addition it is highly likely that even when ponding does not occur at the above localities, that the watertable and capillary salt accumulation will be raised.

There is a need for the seasonal water ponding problems to the north and east of Reserve 27286 to be alleviated. This may be achieved by increasing free-drainage around and, necessarily, through the reserves.

Improved flow of saline water into the drainage system would be detrimental to Lake Toolibin.

* Improved drainage from localities around Reserve 27286 will be assessed.

Provisos may be that:

i) there is a trade-off where surrounding farmers undertake to direct very shallow, broad channels to the inlet channels of the reserves from a significant distance back into the catchment. This will have the effect of directing the bulk of fresh catchment flow through nearby salinized land

ii) the first lake to receive water will be either footballers or artificial depressions created on acquired farmland. This will have the effect of collecting silt and, more importantly, absorbing the bulk of the start-up and tail end seasonal flows which are of high salinity, so buffering Lake Toolibin.

iii) the disturbance to the reserve is minimised by taking the shortest route that does not corrupt land units and that follows existing features. For example, a main channel could be levelled along the southern boundary of Reserve 27286 and the eastern boundary of Dulbining Reserve.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
2.0. INDIGENOUS VEGETATION		
2.1 GENERAL - TERRESTRIAL VEGETATION		
Various vegetation types on the reserves are impoverished of understorey and generally senescent. Examples include the stands dominated by Eucalyptus loxophleba and some of the mixed E. loxophleba, Banksia prionotes, B. attenuata woodlands.	Recruitment of the full range of species for each vegetation type needs to be stimulated.	* The health and vigour of indigenous vegetation will be managed so as to maintain or improve their current states. * Diversity and vegetation structure will be managed so as to maintain or improve their current states and to encourage outbreeding. (The plant species associations in the resource document should be used as a minimum bench mark). * Seed sowing and planting of indigenous species will be investigated for vegetation types which are impoverished of species. * Current techniques for regeneration will be applied to problem areas. * Seeds and cuttings will be collected from reserves with the same vegetation types (for example, Dongolocking Reserve) where external propagating material is required.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
2.2 FIRE AND TERRESTRIAL VEGETATION		
The advanced senescence and lack of seedlings of species such as Jacksonia furcellata suggest that fire regeneration opportunities have been few on most of the reserves. This contrasts strongly with the vigour of areas burnt on the reserves. Many native plant species require fire as a pre-condition to successful germination and establishment. Fire reduces competition for factors such as light, nutrients and water. It also stimulates the germination of many species particularly those that are 'hard-seeded'.	Fire is clearly a major tool that is available to manage the reserve's vegetation.	* The status of vegetation types potentially requiring burning will be assessed by measuring diversity, abundance and vigour. * Trial burns will be instituted in subsamples of appropriate vegetation types to gauge the response to fire. (Tests should be combined with exclosures to remove grazing pressures). * A fire-free interval will be maintained after rejuvenating burns. Such an interval should allow the majority of indigenous vegetation to set seed and achieve maximum cover. (Refer to fire section for further prescriptions).
Some of the eastern dune association on Lake Toolibin Reserve appears to be in good condition, with understorey, and saplings and seedlings of Banksia's present.	Burning may not be necessary for all terrestrial associations.	* Burning will only be conducted where community senescence is approaching, deterioration in vigour is apparent, or hydrological necessity requires it.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
2.3 LAKE BED VEGETATION		
Dead patches of swamp sheoak (Casuarina obesa), flooded gum (Eucalyptus rudis) and Melaleuca strobophylla are present on Lake Toolibin's bed. The death of sheoak is attributable to salinity, while that of flooded gum is the result of raised salinity and inundation. The cause of M. strobophylla death has not been established but is likely to be the same as flooded gum. Some decline of York gum (Eucalyptus loxophleba) is also present on the lake's periphery, and this is attributable to salinity. Generally, on the lake bed, soil salinities increase with decreasing elevation. This can be linked to intrusion of shallow, saline groundwater, evaporation of surface water and differences in soil permeability (clay presence seems to relate to high soil salinity and also to lower sites).	Any prescription which lowers the watertable (particularly during peak seasonal insolation) should reduce salt accumulation and potentially also innundation; tree mortality should hence decline. Similarly draining or flushing surface water from the lake before evaporation concentrates its saltload should also be remedial for the vegetation.	* CALM will pursue new and old hydrological prescriptions aimed at reducing salt influx, and concentration. (See under Hydrology).
2.4 FIRE AND LAKE BED VEGETATION		
The presence of tree seedlings on unburnt lake bed suggests that fire is not necessary for the regeneration of lake bed emergents. In addition, fire on the lake bed would add one more degree of stress to already stressed trees.	Fire exclusion is indicated for Lake Toolibin's bed.	* Fire exclusion will be maintained on the bed of Lake Toolibin.
2.5 GRAZING AND INDIGENOUS VEGETATION		
Grazing pressure from native and non-native animals may be contributing to the vegetation's decline on the reserves.	Grazing pressure most affects young plants and regeneration from seed.	* Exclusion of herbivores may be necessary in the early phases of plant establishment and growth.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
		* Adjacent landholders will remain responsible for the maintenance of stock-proof fences on adjoining boundaries. * Also refer to the Fauna section.
2.6 INSECTS AND OTHER VEGETATION PESTS		
Leaf miners have affected the older flooded gums at vegetation sites such as number 2 (resource document); they are associated with poor tree condition in these trees (Mattiske, 1986). This is likely to be a member of the Perthidia genus (P. Albone pers com). Wandoo is susceptible to sawfly (Phylacteophaga froggatti) and Armillaria. York gum and salmon gum are at present considered tolerant.	Managers will need to be aware of the potential for pest development and means of reducing or preventing their impact. Patchy rehabilitation and isolated remnant vegetation may be most affected.	* Diversity of the reserves' flora, especially trees, will be maintained, and the effect of fire on diversity will be closely monitored. Access for insect predatory birds will be encouraged by maintaining moderate cover and density and by buffering from the effects of insecticides. Cover will be maintained so that it has an element of continuity; with corridors between patches of remnant vegetation.
3.0 INTRODUCED VEGETATION		
3.1 SPECIFIC OBJECTIVE		
* To control exotic plants that threaten the conservation values of the reserves.		

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
3.2 GENERAL		
Introduced weed species of the reserves are mostly grasses or herbs. The herbaceous plants are scattered and comprise clovers, members of the Caryophyllaceae and of the Asteraceae. Grasses, however, are present in greater numbers and bulk. Particularly on the reserve periphery. At intervals they may post threats, as competitors to native plants, and as a fire fuel matrix amongst other plants. A large part of the problem is their ceaseless invasion from the surrounding farmland. The other components are the opening of opportunities through habitat disturbance and an impoverished native vegetation.	Management should aim to reduce opportunities for weed species. Grass control measures may be necessary.	* Soil disturbance will be kept to a minimum. Maintaining a limited number of access tracks and firebreaks is important in this regard. * Problem areas should be heavily seeded with native species (especially understorey; viz. grasses) so that they provide competition. * Windbreaks will be consolidated to reduce the numbers of weed propagules blowing onto the reserves. * Woody, perennial, introduced plant species are best dealt with by physical removal. * A fire-free interval will be maintained that enhances competitive exclusion of weeds by indigenous plants. * CALM will liaise with the Agriculture Protection Board and landholders adjacent to the reserve to control declared plants and also weeds which may threaten the value of the reserves and adjacent private land.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
3.3 DRAINS		
Some drains are directed at the borders of the reserves (Dulbining Reserve in particular) and are already impacting on salinity.	Other adverse affects of the drains need to be noted.	* The effect of drains impinging on the reserves should be investigated. Signs of siltation, fertilization or weed invasion should be noted and presented as evidence for drain realignment to the vested parties.
3.4 HERBICIDES AND NON-TARGET SPECIES		
The reserves still have a representative complement of native grasses. Some of which may be at the edge of their original range. an example on Lake Toolibin Reserve is the species Plectrachne dielsii. Such native grasses may be affected by practices designed to target introduced grasses, in particular by herbicides. (An area with relatively vigourous sedge and native grass (Stipa sp.) cover is indicated in the resource document; it did not form a heavy fuel load in 1989).	CALM officers need to recognize native grasses (and, potentially, also herbs) to be sure management practices positively discriminate for their increase, rather than their decline. These species may be obscure, rather than rare. (Though the same principle applies to rare species.)	* Non-residual herbicides can be applied to weed control only where native species (in particular native grasses) are readily distinguished and avoided. (Rehabilitated farmland is an example). * A field herbarium will be compiled to permit ready identification of unfamiliar plant species. * CALM officers will use such a herbarium in assessing the potential impact of a control measure.
The problem applies to all non-target plant species generally.		
Residual herbicides are not suitable for use on saltland rehabilitation. Synergistic effects between herbicide, salt and waterlogging can adversely affect young tree seedlings. With the added complication that the bared surface will exacerbate the salt accumulation.	Herbicidal weed control is not practicable on saltland.	* Herbicides will not be applied to salt affected land. * CALM will liaise with reserve neighbours to encourage reductions in herbicide use on land adjoining saltland or rehabilitation treatments on the reserves.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
4.0 FIRE		
4.1 OBJECTIVES		
* To protect life and property.		
* To promote regeneration of impoverished vegetation.		
* To protect fire-sensitive habitats, (particularly the Casuarina obesa of the lake bed).		
* To manage habitats so as to maximise indigenous faunal diversity.		
4.2 GENERAL		
Fire has two facets in the context of the reserves. One is constructive, the other destructive. Burning senescent vegetation can lead to its rejuvenation, if the intensity, duration and extent are constrained. Alternatively, a large conflagration could remove most of the reserve's transpiring leaf canopy. The result of which is likely to be a rise in the watertable and, potentially, salinization. (See also under Indigenous Vegetation).	A fire management strategy is required for the reserves that is sensitive to the hydrology.	* The influence of any burning on vegetation status and the watertable will be gauged. * Management will reassess the burning regime in the light of any hydrological changes. * Only a percentage of the reserves, derived as a consequence of the two proceeding prescriptions, will be burnt at any one time.
4.3 FLORA AND FAUNA		
Some vegetation types on the reserves are of small area and could easily be covered by one fire. This would induce even-aged stands of component species.	Some poorly represented plant species could be threatened.	* Burning will be confined to a proportion of any one vegetation type on the reserves.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Similarly large burns reduce suitable faunal habitat and leave few individuals to start the process of recolonisation. (Note that the non-avifaunal species of the reserves are poorly documented.)	Both rare and more common fauna could be threatened. Care is warranted in the absence of information.	* Burning will be confined to a proportion of any one vegetation type on the reserves.
Fire frequency is a deciding factor in the balance between ephemeral plant species (particularly grasses) and perennial species. Greater frequency favours the former and longer intervals the latter.	Vegetation composition can be altered using fire.	* Refer to sections on Indigenous and Introduced Vegetation. Fire suppression will be a necessary part of maintaining a fire-free interval.

4.4 BUFFERING

Two types of potential fire threat can be distinguished for the reserves; they are external and internal.		
External problems may arise from the entry to the reserves of burning-off on neighbouring farms.	Peripheral buffers to fire are required.	* Existing peripheral firebreaks will be consolidated.
The precedent exists for farmers neighbouring the reserves to maintain firebreaks (for example, Chadwick on Reserve 9617).	The neighbours are involved in mutually beneficial reserve maintenance.	* Where ploughing firebreaks is required neighbouring farmers will be given first priority as contractors. A CALM officer will liaise and guide any operation.
Internal problems are possible because of ground-fires and vehicles. Traditionally there has been little camping or picnicing on the reserves; so this is little problem.	The likelihood of chance fires has increased.	* CALM will inform staff and members of the public of the need to keep vehicles to cleared tracks.
The vehicular problem is a consequence of the heat generated by catalytic converters on new vehicles. The heat of these units is sufficient to ignite cured pasture. As a result it is now common practice amongst regional Agriculture Department staff to park outside stubbled paddocks.		* CALM will promote the use of alternatives to ground fires.

INFORMATION SUMMARY

MANAGEMENT IMPLICATIONS

Buffers are required inside the reserves. However, the emphasis is upon diversifying the vegetation age-structure, rather than just fuel reduction.

PROPOSED PRESCRIPTIONS

* A small-scale fire mosaic system will be established on the reserves.

* Lakebed trees will be excluded from firing.

* Wildfires and strategic burns will be contained to the smallest possible effective area.

  This will be accomplished by direct attack or back-burning from established firebreaks or low fuel zones (taking into consideration the likely threats to life and property).

  Management will consider additional factors such as soil and fuel moisture, humidity, temperature and wind direction and intensity in planning strategic burns.

* Records will be kept of the date, location, dimensions and relative intensity of all fires on the reserves.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Fire intensity is a function of separate elements such as temperature, wind, fuel configuration, quantity and moisture. (For example, a peak summer management burn could be considered where firebreaks are prepared, pastures are bare, wind is consistent and fuel loads are known.)	Simulation of wildfire events will entail a certain risk that a management burn will not have the configuration or size originally anticipated.	* CALM will recognize that management burns engender a certain risk that more than the designated area will be burnt. Managers should be free to proceed on this basis and to adjust future fire plans to incorporate irregular burns that occur. Peripheral firebreaks and the protection of neighbours will still be priorities. * CALM will give one months notice to neighbours of its intention to conduct management burns on adjoining reserves.

4.5 REHABILITATED AREAS

The purchased land to the west of Lake Toolibin has a significant cover of pasture grasses mixed with juvenile trees.	A potential for fire damage to the young saplings exists.	* Fire exclusion is necessary for this area over summer. * Limited fuel reduction may be conducted during mild conditions.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
4.6 FIRE CONTROL		
Lake Toolibin and reserves nearest neighbours are farmers. They are likely to be the first to notice fires and to attempt control measures. CALM officers have some distance to travel to reserves, as well as limited resources.	Local residents must be incorporated into CALM procedures for dealing with fires.	* Responsibility for first attack on a fire will reside with local residents. * CALM officers will attempt to attend all fires on or adjacent to the reserves. * All adjoining landholders to the reserves will be advised in December of each year of procedures for contacting CALM in the advent of fire on the reserves or adjoining lands. * CALM will ensure that all members of the local community, who may be involved in fire control, are fully conversant with the fire protection objectives for the reserves and appropriate procedures.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
5.0 TERRESTRIAL FAUNA		
5.1 GENERAL		
Few terrestrial vertebrates, apart from birds, have been recorded at Lake Toolibin and reserves.	More information is required about terrestrial vertebrates other than birds. Comparisons could then more confidently be drawn between Dongolocking Reserve and Lake Toolibin and reserves.	* See under Investigations.
Comparison with Dongolocking Reserve highlights the dearth of frogs and reptiles in particular. (*Caution is warranted when assessing the 1977 figures, as no indication is given of the intensity of sampling and a different group was involved to that at Dongolocking [Goodsell et al (1978); Chapman et al (1978)]. Note also that specialists, in this case herpetologists, are more effective than generalists at finding resident species. A third mitigating factor was that sampling at Toolibin was after two consecutive low rainfall seasons).	If the fauna at Dongolocking is more diverse, then some reintroductions to Lake Toolibin and reserves may be warranted; provided they are in tandem with re-invigoration of the vegetation.	
In North America it has been established that animal abundance and diversity is associated with two types of vegetative diversity (MacArthur and MacArthur (1961); Wilson (1974)):	Active management of the reserve vegetation is implicated as being central to faunal conservation.	* In the absence of further information the vegetation must be managed to maximise diversity and vigour so as to provide opportunities for fauna.
1. Diversity of numbers of vegetative species		
2. Diversity of spatial arrangement of vegetation. For example, vegetative communities with 3 layers of ground cover, shrub layer and canopy cover, 'usually' provide refuge for more animals and a greater variety of species than those with one or more layers missing.		

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Red-tailed Wambenger		
The Red-tailed Wambenger occurs at the reserves while its habitat preferences have been summized from other locations. (See under Faunal Investigations).	The requirements of the Red-tailed Wambenger should feature in habitat management.	* Specific information on the habitat requirements of the Red-tailed Wambenger will be sought and applied to habitat management.
5.2 KANGAROOS		
At least 40 Western-Grey Kangaroos were dwelling in the vicinity of the rehabilitated land, acquired from Avon Location 13984 in 1988. They preferentially graze Casuarina obesa seedlings, which are the most salt and water-logging tolerant trees available to plant. Fencing (including electric) is an expensive option, and it does not meet farmers requirements for crop and grazing control. Neither does it address the broader option of natural regeneration within the whole set of reserves and grazing pressure upon that.	Kangaroo culling appears to be a necessary method of managing the reserve for the benefit of its biota, including kangaroos.	* Kangaroo culling will be used as a management tool where populations are shown to be of a size detrimental to the reserves and their neighbours. Several factors must be considered prior to culling: 1. that kangaroos are the cause of any vegetation damage 2. no alternative measures exist 3. suitable kangaroo numbers occur on the reserve and the general area 4. ability for migration occurs to the culled area 5. defined kangaroo numbers only are to be culled 6. records of culling are to be maintained.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
		Such information must be submitted to the Nature Conservation Branch so that the Department and the Minister can defend it against criticism, and the NPNCA can endorse it. Other, Regional Management requirements are that: 1. Monitoring of kangaroo and rabbit populations is undertaken by spotlight for 2 months prior to a control programme and continued until further control work is considered unnecessary. Monitoring will be monthly and include assessment of grazing on planted seedlings.
Crop protection measures, (damage licences), set a precedent in that they target specific areas to protect.	Culling should be undertaken on the "crop", in this case planted areas.	2. Shooting only occurs on target areas (rehabilitation) and not within remnant vegetation. 3. Neighbours will be informed of the details of the programme.
5.3 TERRESTRIAL BIRDS		
There are 93 terrestrial bird species on Lake Toolibin and reserves. This is of significance because the total outranks that known for any other regional reserve. Another factor of significance is the presence of a complement of species characteristic of the south-west forests.	Management must consider the broader context of the reserves when considering birdlife.	* Terrestrial habitat diversity will be maintained or improved (See above and also under Fire). The outlying elements of south-west forest (viz. wandoo) require special attention.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS

6.0 WATERBIRDS

6.1 LAKE FEATURES

Lake Toolibin represents a winter (to early summer) refuge to waterbirds at which time it supplies fresh drinking water, invertebrate protein and a diversity of emergent vegetation habitats. All these factors are important, although the last is the most distinctive feature of the lake.

This combination of features has meant that the lake is recorded as having hosted 50 species of waterbird.

Importance

In terms of importance to waterbirds, it is clear that:

1. large numbers of individuals of Grey Teal, Freckled Duck, and Eurasian Coot utilize the lake.

   Any management that focuses on the wetland resources of Lake Toolibin and minor lakes must consider the community of waterbirds and their requirements.

2. more species breed at the lake than at any of 251 south-west wetlands. Breeding by a total of 24 species places the reserve in a class of its own.

3. the reserve caters to the special needs of the 'gazetted rare' Freckled Duck and is a major stronghold for the species.

   The species specifically requires fresh to brackish water and dense tree vegetation to breed.

   Special attention needs to be given to the requirements of the Freckled Duck.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
6.2 FACTORS DETERMINING WATERBIRD PRESENCE		
Salinity		
If salinity exceeds 10 ppt TDS (in September of any year) it is likely 11 species will cease to breed at Lake Toolibin. They are Great Cormorants, Little Black Cormorants, Great Egrets, Rufous Night Herons, Yellow-billed Spoonbills, Freckled ducks and Blue-billed Ducks.	Management must aim for salinity levels which are below 10 ppt TDS.	* CALM will endeavour to keep Lake Toolibin's salinity levels below 10 ppt TDS. (With the exception of the first seasonal and tail-end flows).
Depth		
Currently (1986) waterbirds breed at Lake Toolibin if the water level of sections exceeds one metre prefering a modal depth of 1.2 metres. There appears to be a broad tolerance of nesting birds to fluctuations of ± 20 cm (a 40 cm range). It seems a rapid rate of change (either nest inundation or exposure to predators) is potentially more disruptive of breeding than lake level per se.	Water depth is not an issue at Lake Toolibin so much as water retention (given that levels exceed 1 metre in parts of the lake; see below).	
Manipulation of Lake Levels		
Lake level manipulation could provide a means to drain saline water from the lake when the lake only partially fills, or, during the drying phase it may also provide a means of lowering the lake level should too frequent filling occur.	Manipulation of the lake level may provide a means of removing saline water after breeding seasons, and preventing too prolonged filling. The impact on aquatic invertebrates and emergent vegetation must be monitored.	* CALM will investigate the feasibility of an adjustable dam on the south-west lake outlet. * An outlet dam (if installed) will be used to retain breeding season water levels (>1 m depths in the main lagoons) until nestlings are capable of flight and then will be used to release salinizing water from the lake. (See also Climate Change).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Emergent Vegetation		
A diversity of habitat is provided by Lake Toolibin's emergent vegetation.	Management must maintain the emergent vegetation.	* The emergent vegetation of Lake Toolibin will be maintained as habitat for the waterbird community and especially the Freckled Duck. (See Indigenous Vegetation). Provision for a seasonal drying out is inherent in such a commitment.
Aquatic Invertebrates		
An abundance of aquatic invertebrates is implicated as a key factor in the abundance of breeding waterbirds at Lake Toolibin. Apparently seasonal drying permits decay of plant matter and on inflow this is suspended and then converted by invertebrates to protein biomass.	The effect on aquatic invertebrates of any hydrological manipulations at Lake Toolibin must be considered.	* The diversity and abundance of aquatic invertebrates will be maintained at Lake Toolibin. Provision for a seasonal drying out is inherent in such a commitment.
6.3 DUCK SHOOTING		
Lake Toolibin is an important waterbird feeding and breeding area, particularly for the Freckled Duck; a rare and endangered species. As a habitat type it is at a premium in the wheatbelt. (It is closed to shooting; Government Gazette 3 January 1975.)	There is no guarantee that freckled ducks would not be shot in any duck shooting event.	* Lake Toolibin will remain closed to duck shooting.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Several factors ensure survival of hunted duck species. Duck shooting now has a January opening so that most breeding is over and most young can fly. (Freckled Ducks breed mainly during September and October, and so the young are fully fledged by January.) Other mitigating factors are the low average mortality due to shooting (11%) (Freckled Duck might make only 5% of any populations that are targeted), and, 'compensatory mortality', where the individuals which are least fit are killed. (In any one year 30% of adults and 60-70% of juveniles will die of natural causes.)	A case could be raised for duck shooting on present evidence from a few principle species. This cannot be justified for Lake Toolibin however, as the risk to rare species and the status of the lake as a sanctuary is too great.	CALM should oppose any proposal to open Lake Toolibin to duck shooting.
Lake Toolibin may hold significant amounts of water for 2 or more years. In response some species may breed over the year (and through the shooting season).	Reproductive effort and investment of some waterbirds will be disrupted.	CALM should oppose any proposal to open Lake Toolibin to duck shooting.
There have been problems with gazetted status in the past. Changing the reserve status from open to closed for hunting and shooting was not associated with making the more recent status referable. In short the reserve was closed in the Open Season Notice, but still classified as a Hunting and Shooting Area.	An ambiguous situation arises where managers and hunters may have diametrically opposed or wrong information. Such ambiguity may flow on to public signs.	* Changes in Reserve Classification will be confirmed and made referable from the date of institution. Physical manifestations of such changes, such as signs and pamphlets will be changed accordingly.
Lead shot has accumulated to enormous levels in lakes in Britain and America. This has lead to contamination of bottom feeding waterfowl. In Lake Toolibin's favour is its alkalinity under which lead is immobilised; shot would need to be ingested for poisoning to occur.	Duck shooting activities on other lakes may have long-term effects other than just selection of evasive birds. This could compound the problems already existing because of salinity.	* Resource material will be sought on lead accumulation in the environment from the northern hemisphere. * The issue will be reviewed. Particularly with regard to the lead status of other lakes in Australia and the State.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Lakes Walbyring and Dulbining form natural adjuncts to Lake Toolibin. Lake Walbyring has had 7 species breeding in it in the past. Included are several duck species and the Pacific Heron. It may also be suitable for Freckled Ducks (which have been sighted there). Up to 1 000 individual birds may use the lake at any one time.	The status of Lake Walbyring and Lake Dulbining is currently "open" for duck shooting (Duck Shooter's guide 1987). This means that late breeding attempts would be disrupted by shooting in an open season. Any breeding habitat is at a premium in the Arthur River System. Again, Freckled Ducks might be inadvertently shot.	* The status of Lake Walbyring and Lake Dulbining will be recommended to be changed from "open" to "closed" for the purposes of duck shooting.

7.0 INTRODUCED FAUNA

7.1 RABBITS

Rabbits inhabit the reserves, causing some problems for the reserves and for their neighbours. Regeneration of the reserves is affected as the rodents graze young plants and seedlings. Weed invasion is encouraged by dispersal and disturbance. Neighbouring farms suffer incursions of rabbits into their crops and the Agriculture Protection Board is obliged to respond.	Rabbit numbers must be contained to aid regeneration of indigenous vegetation.	Control measures will be implemented for rabbits. Short term measures will include: . Poisoning by 1080 bait laying on the reserve perimeter. The 'perimeter' will be considered to be around the whole of the reserve, including recently rehabilitated acquisitions (i.e. less than 6 years old) and also between such acquisitions and the older reserves. (The latter will have the effect of encircling rehabilitated areas.) . Phosphine gassing will be a secondary option to be followed by habitat destruction.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
		. Habitat destruction of warrens under trees using explosives ('ampho') or ripping. Windrows which rabbits are inhabiting will be dispersed in preference to piling and burning. . Fencing of some areas which have been subject to regeneration burns for rehabilitation.
7.2 FOXES AND CATS These two carnivores are more likely to impact on the terrestrial fauna (e.g. the Red-tailed Wambenger) than on breeding waterfowl, although anecdotal information refers to foxes raiding waterfowl nests.		. 1080 meat baits will be laid inside the reserve boundary for fox and cat control. . Guidelines as listed under "Effects on non-target species" will be followed for such operations. . Neighbours will be informed when baiting is to occur, of its duration, and of the life-expectancy of the baits; so that they can make allowances for farm animals.
7.3 1080 BAITING AND NON-TARGET SPECIES There are two types of '1080' bait that may be used in the vicinity of the reserves; they are grain and meat baits.		

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Grain which is laid for rabbit control, can often consist of oats where 1 oat in 100 ('1 shot') holds 5.5 mg of 1080. As an average rabbit of 2.5 kg can only tolerate 1 mg of 1080, one such grain is sufficient to kill it. Of native species likely to take the grain, Ring-Neck and Regent Parrots are most susceptible. Their 'LD5O' is 1.6-2.6 mg total which is similar to rabbits. These are followed by the Crested Pigeons and Western Rosellas (4.4-6.0 mg). All the preceding are potentially susceptible to 1 shot. They are followed by the Wood Duck which may tolerate nearly 2 doses (8-12 mg).	Dosage, placement and timing must be adjusted to minimise impact on non-target species.	* 1080 bait must be thoroughly mixed so as to be as dilute as possible. Where possible bait should be placed near vegetation; making it less attractive to foraging ducks which prefer good visibility. * Consideration to be given to using conventional 1080 oat baiting.
Peak breeding season for terrestrial birds is October-November. (Note that late Summer is when rabbits are most susceptible to baiting due to low water availability.)		* Baiting is best conducted between January and August.
Maned Duck, Wood Duck and Shelduck feed in the open on pasture; they prefer good visibility.	These ducks are unlikely to take baited seed in undergrowth.	* Where the undergrowth is open baited grain trails will be laid at least 200 metres from the lake's edge. Some flexibility will be allowed where barriers (particular understorey) prevent waterfowl movement towards the baits. * Baited grain trails will be laid in undergrowth where possible. (See also under Effects on Non-Target Species).
Meat baits are inherently variable but mostly equate to 7.2 mg 1080 in 110 g; though $^1/_3$ of this amount, if wholly consumed, is sufficient to kill a cat or a fox. (Wild dog baits are an alternative of 6 g of meat with 5 mg 1080.)		Wild dog baits are too potent. Meat baits (not wild dog baits) and eggs should be used. The dose should be kept at less than or equal to 5 mg/110 g of bait.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
At the former rates Phascogale calura would need to eat 10 g of meat to reach its 0.7 mg LD50. While a Fat-tailed Dunnart would only need to consume 7g to reach 0.05 mg LD50.		
An option targeted at the fox is the use of dosed eggs which are buried. This places the bait out of reach of birds (e.g. Crows) and small marsupials; Goannas, however have to be avoided by placement during the cooler months (viz Autumn and Winter).		
Winter and Spring are the periods of peak energy demands for the female and male Red-tailed Wambengers respectively, so that Autumn is the most suitable period.	Regular intervals of baiting over the year should not be used.	Only Autumn and late-Summer baiting programmes should be instituted.
Foxes by contrast can be successfully baited at any time.		
		Farmers will be warned in the advent of meat baiting programmes.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS

8.0 THE DESIRE TO TIDY UP

The desire to tidy up is symptomatic of human managements interaction with the reserves and its effects.

The desire to tidy up seems to be deeply ingrained in the western persona. On private land this includes moving debris and obstacles, particularly dead vegetation and burning it. On reserves this would amount to much the same thing, with some such action being effective in controlling rabbits by removing habitat. Unfortunately removing some types of habitat for rabbits may not be mutually exclusive of removing habitat or resources for indigenous fauna. For instance the echidna relies on the productivity of termites which in turn depend on the dead wood. A similar argument could be raised for the use of debris as habitat for goanas. While plants can also opportunistically germinate in litter refugia.

In short, cosmetic appeal does not necessarily correspond to health and diversity on a reserve.

Management must carefully consider the consequences of any action which influences habitat, and the value of every manageable material on the reserves. Conservation applies to non-living material as well as to living.

* CALM will endeavour to place all management action in context. Specifically, CALM will establish guidelines for desirable methods in relation to:

. removing rabbit warrens. Namely, piled debris will be dispersed, rather than burnt. (The aim is to remove structural support for burrowing).

. windrowing will be discouraged; existing windrows will be dispersed.

. burning will not be conducted simply to remove debris. Rather burning will only be carried out as part of an integrated scheme related to the diversity and vigour of flora and fauna (See under Fire).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
9.0 CHANGING CLIMATE (THE GREENHOUSE EFFECT)		
Greenhouse effect predictions for the south-west suggest a decrease in reliable winter rainfall with some increase in the influence of summer cyclonic patterns. In the latter case, this may be associated with shorter, more intense, rainfall events and strong winds; though these are unlikely to compensate for the diminished winter rainfall.	Under such circumstances management must aim to maintain diversity of all resources. In particular, measures which maximise out-breeding, and minimise in-breeding, of species on the reserves and allow some opportunity for movement in the face of adversity are indicated.	* The actions which management must take are compatible with others outlined elsewhere. Specifically: . size will be optimised by a combination of acquiring and/or aiding strategic rehabilitation of land between regional reserves. . vigour of the reserves habitat types will be maximised by controlled burning, planting and seeding, and by minimising hydrological and salinity impacts (see elsewhere). . secondarily buffering by shelterbelts and maintaining continuity of cover should be attended to as means of preventing windthrow and branch and leaf stripping of reserve trees (see also under Fire).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
	For the lakes with emergent vegetation one contingency may be long-term drying, which could decrease salinity caused by having the watertable close to the surface. In the shorter term the occurrence (albeit irregular) of successive winter and summer rainfall events could lead to either more frequent cycles of filling, drying and salt incrustation or longer periods of inundation. both could lead to tree death.	* CALM may need to appraise means of controlling the surface water level in Lake Toolibin. (See also under Hydrological Investigations.)

10.0 OTHER INVESTIGATIONS

10.1 INFORMATION FROM COMPATIBLE CLIMATIC ZONES

International literature on secondary salinity and lake systems have not been reviewed (for example, only Ijjas (1969), Lii Ken (1962) and Yaalon (1963) are mentioned in Froend (1983)).	Much innovation is occurring overseas in areas such as agroforestry and water harvesting. It is likely that some principles adopted in other regions will be applicable in confronting salinity at Lake Toolibin and/or in the hinterland.	* CALM should conduct a literature search for current world parallels on the Northern Arthur River situation. Topics may cover hydrology, earthworks, re-vegetation and conservation, with the emphasis on solutions. (Ideally sources should be from similar climatic and geological zones).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
10.2 SEISMIC LINES		
Existing data on sediment depths are confined to cores from Lake Toolibin's bed. Soils and rock outcrops are generally outlined in the C.S.I.R.O. Atlas of Australian Soils (for example, the north-west sector adjoining the lake).	The controlling influence of rock outcrops on ground water movement needs to be determined so that this can be recognised in future assessment of remedial measures. Some action may also be possible to increase water potential away from Lake Toolibin or to improve salt flushing from Lake Taarblin (viz. breaching the migmatite wall below the latter).	* CALM will undertake to have seismic testing conducted to: . determine the depth of sediments between the lakes . determine the depth of sediments around the lakes . elucidate the position of migmatite (especially immediately north-west of Lake Toolibin and south of Lake Taarblin).
Shallow rock and clay layers have not been delimited on land adjoining the reserves. The presence of such areas may influence the salinity of water entering the lake across them (namely salt accumulation would be expected in such areas from capillary rise).	Once delimited such areas can be drained around (unlike a deep watertable reaching the surface). Intercepting water before it reaches such areas and draining it directly to the lake is likely to reduce the lake's salt load.	* CALM will undertake to delimit areas of impervious substrate at shallow depth. * If shallow impervious layers are extensive, the option of intercepting and draining the water directly into the lake will be pursued.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
10.3 LAKE BED CLAYS		
The structure of the soil profile in Lake Toolibin's bed is known for a west-east section. Only a couple of these are to bed-rock.	The addition of complementary east-west transects at higher and lower latitudes on the lake, and with deeper cores, may better describe the substrate and clarify what control it may have over ground water flow. A better understanding of management actions ramifications would result.	* CALM will undertake to have further deep cores of lake bed material taken and the strata identified at transects complementary to those already studied. - Drilling will be conducted so as to cause minimum impact on the lake bed. Viz. the most clear access, lightest rig, and widest tyres will be used.
The strata in Lake Taarblin's bed are unexplored.	Comparison of Lake Toolibin's sediments with those of Lake Taarblin would clarify the reasons for the latter's early demise.	* CALM will undertake to have coring of at least one transect on Lake Taarblin's bed conducted.
The type of clay present in the lake bed has not been determined, its hydraulic conductivity and ionic exchange capability are unknown.	Identifying the type of clay would facilitate modelling the hydraulic conductivity and salt storage capability of the lake strata.	* CALM will undertake to have the clay/s of the lake bed section identified and their ionic exchange capability determined.
10.4 LAKE BED SOIL SALINITY		
The soil salinities of Lake Toolibin's bed have not been widely delimited.	Soil salinities will reflect the degree of salt accumulation and plant stress.	* Soil samples will be taken from representative sites when the lake is dry at depths of 0, 25, 50 and 100 cm in the profile and TSS will be determined on the fully hydrated soils.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
10.5 EXISTING PIEZOMETERS		
A region of bores with a rising watertable trend exists to the north of Lake Toolibin. There are several factors that may act in such a trend. They are: the ponding of water on farmland to the north of Dulbining Reserve (Now mostly redirected by a drain to the reserve) and at Reserve 27286; the transient immature status of rolled and burnt vegetation on the Dulbining Reserve; the status of vegetation on 27286; and the culvert and the weir at the outlet of Dulbining reserve. (Note that the dam and the drain are more recent than the others, and will have had little historical influence).	The cause of this rising trend needs to be determined so that the effectiveness of present measures or the need for new measures can be judged.	* Data from existing piezometers to the north of Reserve No. 27286, from the rolled and burnt part of Dulbining Reserve, and surrounding Lake Dulbining up to the weir will be assessed as groups to ascertain the relative level of the watertable at each area. New data will be collected at least quarterly intervals and old data will be re-assessed. Then appropriate options such as drainage, further re-vegetation or lowering the weir can be assessed. (Note that new piezometers, as mentioned below, would improve data for such assessment).
10.6 ADDITIONAL PIEZOMETERS		
Piezometers are concentrated on Lake Toolibin's bed and to the north-east and west of the lake. This means the majority of Reserve No. 27286 (which shows signs of tree decline) is not monitored and neither is the drain along Oval Road; that empties into the north of Dulbining Reserve (where mounding of water is believed to be causing salinization); or the areas of re-vegetation and regeneration.	Additional piezometers are required for specific purposes and to even the density of piezometers around the reserves. Knowing the relative contribution of different ages of vegetation to water-drawdown will enable management to make informed decisions about firing vegetation, and density adjustments (viz. thinning or ameliorative planting).	* CALM will undertake to have more (shallow) piezometers installed in Reserve No. 27286, in the areas of re-vegetation and at the end of the drain into Dulbining Reserve. The number will be determined in consultation with other Government Departments; with the objective being to have each vegetation type and/or age stratum monitored.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Piezometers are situated around the trial groundwater pump in Lake Toolibin. No piezometers extend from this out through the replanted fringe and into the farmland. Such a series would give information on the effect of the planted trees on the watertable, as compared to the pumping.	Additional piezometers are required to test the effectiveness of replanting for watertable pull down.	* CALM will install a series of piezometers from the pump across the west margin of the lake and replanted area and into the paddock.
10.7 TRIAL DAM		
Lake outflow could be controlled in order to regulate the duration of inundation within the lake. Long-term inundation could be restricted to the lower portions of the lake; which were regularly flooded in the "pre-clearing", pristine, conditions. At the same time this would leave the majority of the lake bed to dry so that the tree roots could breath and organic debris could decay to feed the freshwater inwater invertebrates on the next inundation.	Such action might enhance the survival of the lacustrine vegetation (namely the reeds) and improve the flushing out of accumulated salts. Secondarily such action might permit more waterbirds to become resident at the lake.	* A trial dam with adjustable height (viz. weirboards) will be installed at the outlet of Lake Toolibin. Its effects on lake level will be observed and adjusted so that only the most low-lying areas with lacustrine vegetation receive extended inundation. Other preconditions are that: . extreme salinities are not engendered by such action. This will only be attempted when evaporation is low (namely late Autumn to early Spring) . sufficient drying occurs for lake productivity to remain unimpaired . Lake Walbyring receives water of a quality that will serve to flush it of salt (rather than increase salt load) when the dam is opened. All of the preconditions require monitoring and adjustment.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
10.8 FAUNAL INVESTIGATIONS		
Waterbirds are the most intensively studied group at Lake Toolibin. They have been observed on a casual basis by CALM officers over a number of years and studied at seasonal intervals by the RAOU from 1981 to 1985. Terrestrial birds rank second (again from the observations of CALM officers). Amphibia, reptiles and mammals are poorly recorded; most information being derived from one day sampling of Lake Toolibin and its periphery (the lake was dry). Only recently has the presence of the Red-tailed Wambenger been confirmed at the reserves. Aquatic invertebrates have been sampled on two occasions by CALM Research from Walbyring Lake; otherwise invertebrates are virtually unknown. These form a vital link between organic decomposition and protein provision for many breeding waterbird species. Only two fish species are known from the lakes, these were introduced and have not been seen since the early 1970s.	There is inadequate knowledge of much of the resident fauna against which to base objectives. Particular attention needs to be given to the role of aquatic invertebrates in the wetlands. While the non-avian vertebrate fauna requires investigation throughout the terrestrial habitat.	* Sampling of the aquatic invertebrates of the lakes will be conducted as a matter of priority. . Ideally this should be in tandem with waterbird and algae and macrophyte (see vegetation investigation) survey and water volume and salinity measurements; so relationships can be derived. . Several lakes should be investigated over different periods of time and water levels so that community responses to a range of salinities and conditions can be gauged. . Quantitative measurements of biomass should be determined per unit volume. * Surveys of terrestrial vertebrates will be conducted on Reserve No. 27286, Dulbining Reserve, and the east of Lake Toolibin Reserve, and the heathland at Toolibin Townsite.. . The sampling pattern should attempt to sample each type and age of vegetation. . Sampling should be conducted in 4 successive seasons (so that population dynamics are outlined); with spring sampling as the minimum datum if this is not possible.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
		. Attention could also be given to the interaction between the reserves and Toolibin Townsite and Dongolocking Reserve, especially for mobile elements of terrestrial birds.
Red-tailed Wambenger There is no information on the effects of fire on the Red-tailed Wambenger (Phascogale calura) at the reserves. Its occurrence generally correlates with a thick canopy of mature wandoo and rock-oak (Allocasuarina huegeliana) which would be threatened by widescale burning. Such areas are now generally confined to the wheatbelt.	Information on the habitat preferences and population size of the Red-tailed Wambenger must be gathered so that the anticipated management burns can be tailored to strike a balance between the need for rejuvenation and habitat preservation.	* Priority will be given to a survey of the habitat preference and population size of the Red-tailed Wambenger.
Western Grey Kangaroos The population size and carrying capacity of the reserve's for the Western Grey Kangaroo has not been determined. At present the status of the vegetation suggests that numbers exceed the reserve's carrying capacity. That is the kangaroos are adding to the demise of the vegetation by consuming regrowth (especially sheoaks) while utilizing farmland for major sustenance. Such activity presents a threat to other fauna as well as vegetation.	The Western Grey Kangaroos require study to determine the minimum number that will suffice to perpetuate the genetic stock represented by their present population. The carrying capacity of the reserve in poor and good condition needs to be derived as a realistic basis for interim and long-term management of numbers.	* The actual carrying capacity of Lake Toolibin and reserves for the Western Grey Kangaroo on the basis of indigenous vegetation will be determined for the reserve in poor (current) condition and in future good condition. . The capacity at each state must provide for the regeneration and vigour of the indigenous vegetation, and must be subject to review. . Areas of high impact need to be identified. (Namely those that will suffer highest use because of the proximity of water, desirable forage and shelter).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
10.9 VEGETATION INVESTIGATIONS		
Algae and Macrophytes		
The role of algae and macrophytes in the food chain of Lake Toolibin, which support waterbird breeding, has not been elucidated.	The significance of tree decline and compositional changes (viz. to halophytes such as samphires) to the productivity of the lake and so to waterbird breeding cannot be factored into management.	* Sampling of the algae and macrophytes of the lakes will be conducted. . Ideally in tandem with the parameters for an aquatic invertebrate study. . Several lakes should be investigated at different times and water-levels so that community responses to a range of salinities and "potential futures" can be gauged. . Quantitative measurements of biomass should be determined per unit area (when dry) and per unit volume (when inundated).
Differences in relative rates of evapotranspiration for different tree species are not known for this region. The hydrological measurements that are taking place at Toolibin provide a means to link evapotranspiration to the watertable.	Knowing each tree species relative contribution to lowering the watertable would improve future species composition adjustments on re-vegetation on similar soil types and within the same climatic district.	* The transpiration rates of tree species in different vegetation types and ages will be measured. Measurements will be Circadian and at least one a quarter (in conjunction with hydrological measurements) when the lake is empty or in recession. * All current literature on the relative water pumping ability of different native Australian tree species will be sought and reviewed.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Monitoring of the reserve's vegetation has clearly indicated decline of tree species, and of diversity, in various vegetation types.	Monitoring has clearly demonstrated both vegetation decline and recruitment. It will continue to be necessary so as to judge the efficacy of remedial treatments.	* The vegetation plots on the reserves will continue to be monitored at intervals of at least 3 years. (This could be strengthened by aerial photography, which would add accuracy and coverage).
Establishment of a 'cohort of Casuarina obesa has been documented.	It is extremely important that the conditions necessary for C. obesa establishment are understood; particularly if the lake level is to be manipulated.	* Vegetation plots with C. obesa seedlings will be monitored annually until their density stabilizes.
The vegetation of the eastern dunes on Lake Toolibin's fringe has not been monitored. It holds a large part of the Banksia woodland that seems to be (at least in part) in a better state than the site on Dulbining Reserve which is monitored.	Another Banksia woodland plot would better represent the state of this vegetation type on the reserve.	* At least 1 vegetation plot will be installed in the Banksia woodland to the east of Lake Toolibin.
Despite its having persistent emergent vegetation Lake Walbyring has not been surveyed.	The resource at Lake Walbyring needs to be clearly documented.	* Lake Walbyring reserve's vegetation will be surveyed and mapped. * In consequence the species lists will be updated and the species strengths of the reserves will be re-assessed.
Opportunistic collecting for rare or restricted species has not been conducted on the reserves. For example, the heath and the eastern dunes have not been sampled.	Some measure of relative scarcity is pivotal to attempting to maintain the species diversity of the reserves.	* Wide ranging, opportunistic sampling of the vegetation will be conducted to attempt to identify plant species that have not been recorded. (Spring is the optimum time for such a task.)

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
More information is required on the response of plant species to fire. The main sources of information about fire on the reserves are the decline of some long unburnt vegetation, the vigour of rolled and burnt vegetation (both groups are of mixed vegetation type) and exclosures installed in Dulbining Reserve's Banksia woodland after a trial burn.	Fire is an important management tool. It is also one that requires striking a fine balance. The release of competition for nutrients, and germination is balanced against hydrological considerations at Lake Toolibin.	* The effects of any management burns will be monitored by establishing vegetation plots in the areas. It is important that: . plant responses be linked to measures of fire intensity. . new recruitments and mature plant survivors are recorded (until more is known about recruitment large exclosures or an effective herbivore exclusion programme is to be used). . the state of maturity of the vegetation is correlated with its reproductive success so optimal burning ages can be derived. . the area that can be burnt without the watertable rising is determined.
Burning, especially on a regular basis encourages annual weed species into natural vegetation areas.	Vegetation degradation and an increased fire hazard result.	* Specific research and a literature review are required, in tandem with the above, to determine: . both indigenous and introduced grass seed longevity in the soil and response to competition (in particular canopy cover). . the regenerative response of plant species to fire (viz. whether sprouting and/or germination are stimulated).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
		. nutrient dynamics under various burning regimes. * A suitable fire-free interval will be derived for each vegetation type on the basis of all accumulated information including hydrology. This will be subject to review in light of further information.
Limited assessment of the success of re-vegetation and rehabilitation of treated parts of the reserves has occurred.	Quantitative assessments of plant numbers are required to determine further planting and seeding amendments in treated areas and stocking rates in areas yet to be treated.	* Rehabilitated areas will be assessed for density, vigour, and growth for each species at each different, treated area.
A couple of tiny remnant patches of the rush Juncus pallidus are confined to farmland neighbouring Lake Toolibin. They are in a unique water-gaining position at the bottom of cultivation lines and may also be at the end of a natural soak. Recollections of duck shooters and CALM officers suggest that this rush was once a significant component of the lake's vegetation. One sighting suggests that the Australasian Bittern may have once utilized the lake. It is very likely that these are the only patches remaining in the upper lake system. As this is a large, robust rush it is very likely that it made a significant contribution to diversity of habitat for waterbirds.	The conservation value of these rushes may be high, both intrinsically and in the broader context of the Lake Toolibin Reserve. Management needs to assure their future and to attempt to re-incorporate a bed of the rushes into Lake Toolibin or its environs.	* An integrated strategy for the management of these rushes is required. i) The owner of the farmland should be encouraged to continue to participate in conserving the rushes by directing water and its solutes to them. ii) The rush should be cultivated by CALM to preserve its genotype (note that its rhizomes should facilitate this) iii) Land acquisition of the remaining pockets of vegetation to the south-east and that fraction of farmland safeguarding the rushes will be pursued.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
		iv) The feasibility of redirecting westerly flowing water from the property adjoining the east of Lake Toolibin to the vegetated small lake (of the two to the south-east of the lake) will be investigated.
10.10 IMPACT OF PESTICIDES AND HERBICIDES FROM NEIGHBOURING LAND		
A number of insecticides and herbicides may be used on the land adjoining the reserves. Of these, the organophosphates (e.g. "Rogor", "Chlorpyrifos" and "Dichlorvos" representing insecticides) and the bipyridyls (such as the paraquot and diquot contained in the herbicide "Sprayseed") are moderately to extremely toxic. They are of short residual life (excepting chlorpyrifos at 1-3 years) of a matter of months. They differ in that the organophosphates are soluble only in organic solvents, while the bipyridyls are soluble in water. The implications are that the former could be concentrated in the fat bodies of terrestrial insects and/or small mammals (e.g. mice) and their predators (such as the Red-tailed Wambenger). The bipyridyls would be borne into the watertable and the lake with the next rainfall.	There may be little point in active management of the reserves to provide optimum habitat (for both flora and fauna) if the controlling factor is pesticides.	* CALM will undertake research on the effects of spraying pesticides on land adjacent to the reserves on reserve fauna. Instigation will require a census of what general pesticides are used immediately adjacent to the reserves and what water soluble pesticides are used in the catchment.
Beyond this, information on the ramifications of the use of pesticides on neighbouring farmland is lacking.		Further tests will check for the presence of the more toxic and residual pesticides in: i) terrestrial and aquatic invertebrates, and the lake water ii) target indigenous fauna (viz. blood samples) iii) the interaction between time, processing and residual activity (much of this information will be collected in pursuing (i)).

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
		* CALM will negotiate with landholders adjoining the reserves to establish buffer regions where limited pesticide use is practiced. (Note such areas should be rationalized with the landholder's desire for rehabilitated land wherever possible). * See also 'Herbicides and Non-target Species'.
10.11 IMPACT OF FERTILIZERS FROM NEIGHBOURING LAND		
Historically the lakes have been subjected to more inflow as a result of farmland runoff, and it is likely that a higher nutrient input can be associated with this. It is already evident that there is high invertebrate productivity in the lakes, and it is possible that this is linked to increased nutrient inflow through plant matter production.	As efforts are directed to rehabilitating the catchment its inflow contributions to the lakes are likely to change. Management requires some idea of the current nutrient status quo in order to allow for such change. It is necessary to know whether Toolibin Lake is under high nutrient-load in order to determine whether to actively maintain the level of productivity for waterbirds.	* Nutrient contributions to the reserves will be determined. Special reference will be made to the lake where sampling of water borne nutrients will be made at positions corresponding to the major hydrological monitoring points. Namely the Northern Arthur River and North West Creek inflows and several points traversing the length and breadth of the lake. (Note that macronutrients, especially phosphorous, should be targeted and that these should ideally be sampled at several times during initial, main and tail-end flows.)
Terrestrial ecosystems may also be affected. (In general - it is likely that indigenous plants will be less tolerant of extra nutrients than will introduced, 'weedy', species).	The vegetation at the northern end of the reserves is likely to suffer the most from nutrient inflow (Reserve No. 27286).	* An additional inflow quality test needs to be made at the north-eastern end of Reserve No. 27286. The same guidelines should apply as in the preceding point.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
10.12 DATA INTEGRATION		All biogeographic, geomorphological and hydrological information on the Northern Arthur River wetlands should be incorporated into CALM's Geographical Information System (G.I.S.)
11.0 SIGNS		
Signs at Lake Toolibin and reserves have been both contradictory and outdated. Signs have used generic names "Toolibin Nature Reserves": and have failed to distinguish individual reserve boundaries and status (particularly with respect to duck shooting). They have even included "Shooting, Hunting.... is prohibited." and "Duck Shooting on this reserve is permitted only during a declared season." Fisheries and Wildlife logos remain.	Signs are often the public's only source of information for a reserve. Obscurity, inconsistencies and deterioration can only make them ineffective and enforcement of public management regulations more difficult.	* CALM signs on Lake Toolibin and reserves will be: . replaced with CALM standard signs when the reserve names are gazetted. . kept current and in good condition by inspection every 2 years. . placed at major entry points on the boundary of the gazetted area. . designate "shooting prohibited" for reserves closed to duck shooting.
12.0 LAKE TOOLIBIN ACCESS		
Access to Lake Toolibin has been along peripheral firebreaks and a northern track parallelling the Northern Arthur River. The latter has greatly disturbed a northern sand dune and has been indiscriminately branched at places.	Part of the sand dune is denuded and requires rehabilitation, this can only happen after the track is consolidated.	* The northern access track will be consolidated and clearly delimited so that the sand dune which it traverses can be rehabilitated.

INFORMATION SUMMARY	MANAGEMENT IMPLICATIONS	PROPOSED PRESCRIPTIONS
Frequent traversing by vehicles can cause severe soil compaction and form a barrier to subsurface flow. At Lake Toolibin vehicle tracks may also form ruts at which salt incrustation may seed.	Both where and how frequently vehicles access the lake bed needs to be considered as a factor in disturbance and as a potential catalyst to vegetation decline.	* Vehicular access to the lake bed should be minimised.
Barriers can be used to prevent access.	Barriers have to be of a form that is effective in preventing access.	* Where barriers are required they will be constructed of wire and pickets; as that is the form that is respected in the District.
13.0 LIAISON		
Many groups are involved with Lake Toolibin and reserve (See appendix). Land acquisition is one example where several parties are involved in one process.	CALM has to liaise, and co-operate with various groups. There is a need to ensure this occurs and that it is efficient.	* A district file will be established with the concerns and contact of all parties likely to be involved in the lake's management.
Neighbouring landholders may observe most activity on CALM land and are in a position to take an interest in the reserves.	If neighbours are made aware of CALM activity they may alert CALM to irregular activity. Notification may also foster empathy with CALM management activity.	* Adjoining landholders will be contacted by CALM officers where access is required through their land, or where maintenance (including firebreaks, fencing, baiting and burning) or capital works will take place on the reserves.
Wickepin Land Conservation District meetings bring together all groups involved in the management of the Lake Toolibin Catchment.	Wickepin Land Conservation District meetings provide an opportunity to keep abreast of any developments in the catchment.	* High priority should be given to a CALM district representative attending each Wickepin Land Conservation District meeting.

PART D - REFERENCES

ABBOTT, I (1985) "Forest Entomology Research in Western Australia". Conservation and Land Management of W.A., Technical Report No. 2

BAILEY, I.A.E. and WILLIAMS, W.D. (1973) "Inland waters and their ecology". Longman Press, Victoria.

BELL, R.W., LOH, I.C., and BORG, H. (1987) "The effect of non-valley forestation on water quality in the Padbury Reservoir catchment and its regional implications. Water Authority of Western Australia, Report No. WS 5.

BRAZELL, R (1985) Note on Reserve No. 27286 in Narrogin CALM file No. 304/64-AG.

CHAPMAN, A., and DELL, J. (1978) "Reptiles and Frogs of Dongolocking Nature Reserve" pp 71-77 in Chapman, A., Dell, J., Kitchener, D.J., and Muir, B.G., (1978) "Biological Survey of the Western Australian Wheatbelt: Dongolocking Nature Reserve" Records of the Western Australian Museum Supplement No. 6.

CROME, F.H.J. (1988) "To drain or not to drain? - Intermittent swamp drainage and waterbird breeding". Emu 88: 243-248.

DELL, J. (1978) "Birds of Dongolocking Nature Reserve" pp 59-70 in Chapman, A., Dell, J., Kitchener, D.J., and Muir, B.G. (1978) in "Biological Survey of the Western Australian Wheatbelt: Dongolocking Nature Reserve" Records of the Western Australian Museum Supplement No. 6.

ENGEL, R. and NEGUS, T. (1988) "Controlling saltland with trees. Dept. Agriculture, Farmnote #46/88.

FRITH, H.J. (1977) "Waterfowl in Australia" Reed Sydney (cited in Halse, 1986).

FURNESS, L.J. (1978) "Preliminary report on the hydrogeology of Lake Toolibin". For the Geological Survey of W.A., in Northern Arthur River Wetlands Rehabilitation Committee: Progress Report, 1978.

FROEND, R.H. (1983) "Impact of increased flooding and salinity on the tree vegetation of Lake Toolibin". Honours thesis, Botany Department, University of Western Australia, unpublished.

FROEND, R.H., HEDDLE, E.M., McCOMB, A.H. and BELL, D.T. (1987J) "Effects of salinity and water-logging on the vegetation of Lake Toolibin, Western Australia". Aust. J. of Ecology 12 : 281-298.

GOODSELL, J., GARSTONE, R., and LAMBERT, P. (1978) "Guidelines to the Management of the fauna of Lake Toolibin Nature Reserve and other nearby nature reserves" for the Department of Fisheries and Wildlife, in Northern Arthur River Wetlands Rehabilitation Committee: Progress Report, 1978.

HALSE, S.A. (1986) "The probable effect of increased salinity on the waterbirds of Lake Toolibin". Department of Conservation and Land Management. Technical Report No. 15.

JAENSCH, R.P. (1986) "RAOU waterbird usage studies in south-western Australia; wetland nature reserves of the south-west and Eucla land division". Department of Conservation and Land Management (in press; cited in Halse, 1986).

KITCHENER, D.J., and CHAPMAN, A. (1978) "Mammals of Dongolocking Nature Reserve" pp 53-58 in Chapman, A., Dell, J., Kitchener, D.J., and Muir, B.G., (1978) "Biological Survey of the Western Australian Wheatbelt: Dongolocking Nature Reserve" Records of the Western Australian Museum Supplement No. 6.

LAMBERT, P.M. 1978) "Terrestrial Fauna of Lake Toolibin". Forest Department Report No. 273.

MacARTHUR, R.H., and MacARTHUR, J.W. (1961) "On bird species diversity". Ecology 594-598.

MARTIN, M.W. (1986) "Hydrogeology of Lake Toolibin". Geological survey of W.A. Record 1986/13. Department of Mines, Western Australia.

MATTISKE, E.M. (1982) "N.A.R.W.R.C. Progress Report - Lake Toolibin vegetation study". Department of Fisheries and Wildlife.

MATTISKE, E.M. (1986) "Progress Report - Lake Toolibin vegetation study, December 1986". For the Department of Conservation and Land Management and the Northern Arthur River Wetlands Rehabilitation Committee.

MUIR, B.G., (1978) "Vegetation of Dongolocking Nature Reserve" pp 17-52 in Chapman, A., Dell, J., Kitchener, D.J., and Muir, B.G., (1978) "Biological survey of the Western Australian Wheatbelt: Dongolocking Nature Reserve" Records of the Western Australian Museum Supplement No. 6.

N.A.R.W.C. (1987) "The status and future of Lake Toolibin as a wildlife reserve" Water Authority Report No. WS2.

RITSON, P. and PETTIT, N. (1988) "Research to improve reforestation techniques for saline groundwater discharge control on water resource catchments in the south-west of Western Australia. Water Authority Report No. WA 25.

SCHOFIELD, N.J. (1978) "Methods of determining reforestation area and distribution for salinity control". Water Authority of Western Australia Report No. WS 31.

SCUDDER, G.G.E. (1969) "The fauna of saline lakes on the Frazer Plateau in British Columbia". Verh. Internat. Limnol. pp 430-439. cited in Goodsell et al (1978).

SMITH, S.T. (1956/57) Unpublished salinity survey data. For the Department of Agriculture, in the Northern Arthur River Wetlands Rehabilitation Committee Progress Report (1978).

STOKES, R.A. and SHERIDAN, R. (1985) "Hydrology of Lake Toolibin" Water Authority of Western Australia. Report No. WH 2.

WATKINS, D., HENDERSON, P., LANE, J., and MOORE, S. (1987) "Benger Swamp Nature Reserve Management Plan 1987 - 1992". Department of Conservation and Land Management, Management Plan No. 7.

WATSON, A.N. (1976) "Feasibility study on aspects of Toolibin Lake and catchment management." As soil conservation adviser for the Department of Agriculture in the Preliminary report; Arthur River Wetlands.

WATSON, A.N. (1978) (1) "The clearing history of the Toolibin area and some of its effects". For the W.A. Department of Agriculture, in the Northern Arthur River Wetlands Rehabilitation Committee Progress Report (1978).

PART E - SUMMARY

1.0 HYDROLOGY AND SALINITY

Issues

The general trend in the Lake Toolibin catchment is for watertables to rise and salt to accumulate in low-lying areas. Salt accumulation has been limited at Lake Toolibin because there is a nett loss of salty water to the watertable as the lake dries. However, the rising watertable threatens this mechanism in the long term.

The cause of the rising watertable and salt mobilization has been wholesale clearing. This removed the water-pumping and salt-immobilizing action of deep-rooted vegetation.

Strategies

1. CALM will collaborate with other vested parties to establish farming practices that ameliorate the salinity problem in the Lake Toolibin catchment.

2. CALM will foster community interest ;in catchment rehabilitation.

3. CALM will target opportunities, linked to catchment rehabilitation, to establish corridors between reserves (note that this is now more important in the face of uncertainties about future climate).

4. Other areas of CALM reserves on the Northern Arthur River will be rehabilitated.

5. Land acquisition will be pursued where such additions are of conservational and/or hydrological importance to the reserves.

6. Within the reserves impoverished indigenous vegetation types will be re-invigorated through manipulation so as to maximise water pumping.

7. Additions to reserves will be rehabilitated with indigenous species sourced in the locality of the reserves. Except where other species can be demonstrated to be more efficient in transpiring water and lowering the water table.

8. CALM will assume full responsibility for hydrological investigations at Lake Toolibin (including liaison with other departments).

9. CALM will assume responsibility for hydrological works at Lake Toolibin.

10. Free drainage will be improved near and through the reserves so that water ponding is alleviated, and water mounding is prevented within the reserves.

2.0 INDIGENOUS VEGETATION

2.1 GENERAL STATUS

Various vegetation types on the reserves are impoverished and generally senescent. Recruitment of the full range of species for each type needs to be stimulated.

Strategies

1. The appropriate fire regime to stimulate recruitment and seed set of each vegetation type will be determined by the use of trial burns and monitoring.
2. Suitable fire regimes will be implemented as vegetation types require it.
3. Supplementary seed sowing and seedling planting will be conducted as required.
4. Herbivore exclusion and/or control will be implemented to protect the early phases of plant establishment and growth.

2.2 FIRE EXCLUSION

Issues

The presence of tree seedlings on the lake bed suggests that fire is not necessary for the regeneration of lake bed emergents. In addition, fire may further stress lake bed trees. Neither is it desirable in healthy vegetation types and in newly rehabilitated areas.

Strategies

1. Fire exclusion will be maintained on the bed of Lake Toolibin, in healthy vegetation types and in rehabilitated areas (until plants establish).

3.0 INTRODUCED VEGETATION

Issues

Introduced weed species occur largely on the reserve periphery and in recently rehabilitated areas. There will continue to be a requirement for weed control along firebreaks and amongst saplings to exclude fire.

Strategies

1. Due consideration will be given to the effect of manipulations upon weed species.

2. Herbicide use will be limited to areas which do not have native grasses and/or herbs that might be targeted.

4.0 FIRE

Issues

Fire has two facets in the context of the reserves. A burn confined to senescent vegetation could lead to its rejuvenation. Alternatively, a large conflagration could reduce the reserve's transpiring leaf canopy. With a resulting rise in the watertable.

Strategies

1. The influence of any burning on vegetation status and the watertable will be gauged.

2. Management will re-assess the burning regime in the light of any hydrological changes.

3. Only a percentage of the reserves, derived as a consequence of the two proceeding prescriptions, will be burnt at any one time.

4. Existing peripheral firebreaks will be consolidated.

5. A small-scale fire mosaic system will be established on the reserves.

6. Local residents will be incorporated into CALM procedures for dealing with unplanned fires.

5.0 INDIGENOUS FAUNA

5.1 FLIGHTLESS VERTEBRATES

Issues

Few indigenous terrestrial vertebrates, apart from birds, have been recorded at Lake Toolibin and reserves.

It is known that the Red-tailed Wambenger (Phascogale calura) occurs at the reserves. This is a species of restricted distribution.

Strategies

1. Specific information on the habitat requirements of the Red-tailed Wambenger, (and other flightless vertebrates) will be sought and applied to habitat management.

2. In the absence of further information the vegetation must be managed so as to maximise diversity and vigour to as to provide opportunities for fauna.

3. Litter will be left in patches to provide a resource for fauna.

5.2 TERRESTRIAL BIRDS

Issues

A large terrestrial bird complement occurs at the reserves.

Strategies

1. Terrestrial habitat diversity will be maintained or improved.

5.3 WATER BIRDS

Issues

Lake Toolibin supplies fresh water invertebrate protein and a range of nesting habitats to water birds. For these reasons it has had more water bird species breeding at it than at any of 251 south-west wetlands. Such factors also cater for the 'gazetted rare' Freckled Duck. The requirement is that the water bird community must be managed in a way that also encompasses the Freckled Duck.

Strategies

1. CALM will undertake to keep Lake Toolibin's salinity levels below 10 ppt TDS.

2. The feasibility of an outlet dam to retain breeding season water levels (>1 metre) until nestlings are capable of flight, after which time the salinizing water will be released, will be investigated.

3. The emergent vegetation will be managed so as to maintain or improve vigour and structure.

4. The diversity and abundance of aquatic invertebrates will be maintained at Lake Toolibin.

5. Lake Toolibin and reserves will be closed to duck shooting.

6.0 INTRODUCED FAUNA

RABBITS

Issues

Rabbits inhibit regeneration on the reserves by grazing young plants and seedlings.

Strategies

1. 1080 grain baiting, gassing and habitat destruction will be used as appropriate.

FOXES AND CATS

Issues

Foxes and cats are more likely to impact on the terrestrial fauna than on breeding water fowl.

Strategies

1. 1080 meat baiting will be used as appropriate.

7.0 FURTHER INVESTIGATIONS

7.1 GEOLOGY

Geological investigations including seismic lines and coring will be conducted.

7.2 SOIL SALINITY

More lake bed soil salinities will be monitored to a greater depth and wider extent.

7.3 HYDROLOGY

1. More monitoring bores are required through the reserves to gauge the effect of management practices on the reserves.
2. New and existing bores will be monitored by CALM at at least quarterly intervals.
3. The effects of a trail dam of adjustable height at Lake Toolibin's outlet will be monitored.

7.4 FAUNA AND FLORA

1. Sampling of the aquatic invertebrates of the lakes will be conducted as a matter of priority.

2. The former will be in tandem with a water bird, algae and aquatic macrophyte survey and water volume and salinity measurements so relationships can be derived.

3. Surveys for terrestrial vertebrates will be conducted in all vegetation types over the range of seasons. Toolibin Townsite should be included in such a survey. Priority will be given to survey of the habitat preference and population size of the Red-tailed Wambenger.

4. The interaction of fauna and vegetation regeneration throughout the reserves will be quantitatively assessed.

5. The transpiration rates of tree species in different vegetation types and ages will be measured and related to hydrological measurement.

6. Current literature on the water pumping ability of various native Australian tree species will be sought and reviewed so that it can be applied where appropriate.

7. The vegetation plots on the reserves will continue to be monitored (and added to where appropriate).

8. Opportunistic sampling of the reserve's flora will be conducted to complement the fixed vegetation plots.

9. Current information on the fire-biota interaction will be reviewed so that prescriptions can be applied where appropriate.

10. The possibility of re-incorporating the rush Juncus pallidus into the habitat structure at the reserves will be investigated.

7.5 CHEMICAL INPUTS

The effects of incoming pesticides and fertilizers on the reserve's biota will be investigated.

8.0 ACCESS AND SIGNS

1. The main access to the lake bed will be consolidated while vehicular access to the lake bed will be minimised.

2. Signs will be kept up to date with current reserve status and with sign prescriptions.

9.0 LIAISON

CALM will liaise with all parties concerned with the reserves; in particular the members of the Wickepin Land Conservation District.

PART F - PHOTOGRAPHS

1. PIED STILTS LANDING ON THE FLOODED LAKE (M. GRAHAM, 1972)

2. RED-CAPPED ROBIN IN DEAD TEA-TREE (MELALEUCA STROBOPHYLLA) (M. GRAHAM, 1975)

3. SWAMP SHEOAKS ON MOUNDS ON THE CENTRAL LAKE BED (R. FROEND, 1983)

4. ARTHUR RIVER CHANNEL WITH SAMPHIRES AND DEAD FLOODED GUMS (EUCALYPTUS RUDIS) (R. FROEND, 1983)

5. UPROOTED AND DEAD SWAMP OAK (CASUARINA OBESA) ON THE DRY WESTERN LAKE BED (R. FROEND, 1983)