

MURRAY RIVER NATIONAL PARK MANAGEMENT PLAN

(Including Rilli Island, Media Island and Kapunda Island Conservation Parks)

Murraylands

SOUTH AUSTRALIA



National Parks and Wildlife
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

MURRAY RIVER NATIONAL PARK MANAGEMENT PLAN

(Including Rilli Island, Media Island and Kapunda Island Conservation Parks)

Murraylands

SOUTH AUSTRALIA



National Parks and Wildlife
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

**This plan of management has been prepared and
adopted in pursuance of section 38 of the
National Parks and Wildlife Act, 1972-81**

**Published by Department of Environment and Natural Resources
August 1994**

© Department of Environment and Natural Resources

ISBN 0 7038 4665 2

**Prepared by Murraylands Region
National Parks and Wildlife
Department of Environment and Natural Resources**

**Cartography and Design by
Public Communications Branch FIS No. 14664
Community Education and Policy Development Group
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES**

FOREWORD

This document is the Management Plan for the Murray River National Park incorporating three sections; Katarapko, Lyrup Flats and Bulyong Island and the adjoining islands Rilli Island Conservation Park, Media Island Conservation Park and Kapunda Island Conservation Park.

The National Park situated on the Murray River in the Riverland is an important area for the conservation of Murray River floodplain habitat. It also has important recreational functions for camping, fishing, nature study and water sports, with high visitation during long weekends and school holidays.

The Katarapko section of the Murray River National Park was previously constituted as the Katarapko Game Reserve. A draft management plan for the Katarapko Game Reserve was released for public comment in early 1984. Significant public opposition to proposals for major capital expenditure on roads, a visitor centre and a staff residence, combined with the present stringent economic climate has resulted in the omission of these developments in the present version of the plan. As a result of the area being re-constituted as a National Park waterfowl hunting has also been excluded from the plan.

On the 8th of April 1993 the Murraylands Conservation Trust a Development Trust under section 45 of the National Parks and Wildlife Act 1972 was constituted. This community based management committee has the responsibility for day to day decision making in relation to the Murray River National Park, as well as a number of other Murraylands Regional N.P. & W. Act reserves.

In preparing the draft plans for both the Lyrup Flats and Bulyong Islands sections of the Murray River National Park, considerable public consultation occurred prior and during the writing of the plan. Only minor changes were needed to the Draft version of these plans due to the extensive public consultation.

This plan outlines proposals to effectively balance the recreational use of the Parks while conserving their natural and cultural values.

David Wotton

MINISTER FOR THE ENVIRONMENT AND NATURAL RESOURCES

CONTENTS

Page

FOREWORD

ACKNOWLEDGMENTS

v

MANAGEMENT CONTEXT

vi

The National Parks and Wildlife Act

vi

National Parks and Conservation Parks in S.A.

vi

Location and Regional Context

vi

Climate

viii

Management Objectives

viii

Administration

ix

Bookmark Biosphere Reserve

x

KATARAPKO

1. KATARAPKO DESCRIPTION

1

1.1 Geology

1

1.2 Geomorphology

1

1.3 Hydrology

2

1.4 Soils

4

1.5 Aboriginal Occupation

4

1.6 European Settlement

5

1.7 Vegetation

8

1.8 Fauna

14

1.9 Recreation

18

1.10 References

19

2 KATARAPKO MANAGEMENT OBJECTIVES

22

2.1 Zoning

22

2.2 Native Flora

22

2.3 Native Fauna

22

2.4 Plant and Vertebrate Pests

22

2.5 Fire

23

2.6 Aboriginal and Historic Resources

23

2.7 Facilities for Visitors

23

2.8 Roads and Tracks

24

2.9 Alien Tenures

24

2.10 Research and Monitoring

24

3 KATARAPKO MANAGEMENT PROGRAM

25

3.1 Zoning

25

3.2 Native Flora

26

3.3 Native Fauna

27

3.4 Plant and Vertebrate Pests

27

3.5 Fire

29

3.6	Aboriginal and Historic Resources	30
3.7	Facilities for Visitors	30
3.8	Roads and Tracks	32
3.9	Alien Tenures	32
3.10	Research and Monitoring	34
4	KATARAPKO MANAGEMENT ACTIONS	36
LYRUP FLATS		
1.	LYRUP FLATS DESCRIPTION	38
1.1	Landform and soils	38
1.2	Vegetation	38
1.2.1	Red Gum Woodland	38
1.2.2	Red Gum/River Box/River Coobah	38
1.2.3	River Box/River Coobah/Lignum Woodland	39
1.2.4	Degraded Red Gum/River Box/River Coobah Woodland	39
1.2.5	River Box Woodland	39
1.2.6	Hopbush/Native Pine Woodland	39
1.2.7	Lignum	40
1.2.8	Lignum/Chenopods	40
1.2.9	Samphire	40
1.2.10	Atriplex/Grassland	40
1.3	Native Animals	40
1.4	Wetlands	41
1.5	Hydrological Management	42
1.6	Pest Plants and Animals	42
1.7	Degradation	43
1.8	Wildfire	44
1.9	Access and Recreational Values	44
1.10	History	45
1.11	Hunting	45
2	LYRUP FLATS MANAGEMENT PROGRAM	46
2.1	Natural Resources	46
2.1.1	Native Flora	46
2.1.2	Pest Plants	46
2.1.3	Native Animals	47
2.1.4	Introduced Animals	47
2.1.5	Rehabilitation	47
2.2	Cultural Resources	48
2.2.1	Aboriginal	48
2.2.2	European	48
2.3	Visitors	48
2.3.1	Access	48
2.3.2	Camping and Picnicking	49
2.3.3	Fishing and Yabbying	49
2.3.4	Fires	50
2.3.5	Visitor Facilities	50
2.3.6	Walking Trails	51
2.3.7	Litter	51

2.3.8	Dogs	51
2.4	Other Interests	51
2.4.1	Disher Creek Disposal Basin	51
2.4.2	Mining and Petroleum Exploration	52
2.4.3	Old "Calperum" Homestead	54
2.4.4	Shack Site	54
2.4.5	Commercial Fishing	55
2.4.6	Quarries	55
2.4.7	Pumps and Pipelines	56
2.5	Fencing	56
2.6	Research, Inventory and Monitoring	56
3	LYRUP FLATS MANAGEMENT ACTIONS	58
	SELECT BIBLIOGRAPHY	62
	BULYONG ISLAND	
1.	BULYONG ISLAND DESCRIPTION	64
1.1	Landform and Soils	64
1.2	Vegetation	64
1.2.1	Red Gum woodland	64
1.2.2	Red Gum/River Box/River Coobah woodland	64
1.2.3	River Box	65
1.2.4	River Box woodland	65
1.2.5	Lignum/Chenopods	65
1.2.6	Samphire	65
1.2.7	Chenopod Shrubland	66
1.3	Native Animals	66
1.4	Wetlands	66
1.5	Pest Plants and Animals	66
1.6	Degradation	66
1.7	Wildfire	67
1.8	Access and Recreational Values	67
1.9	History	67
1.10	Hunting	68
2	BULYONG ISLAND MANAGEMENT PROGRAM	69
2.1	Natural Resources	69
2.1.1	Native Flora	69
2.1.2	Pest Plants	70
2.1.3	Native Animals	70
2.1.4	Introduced Animals	70
2.1.5	Rehabilitation	71
2.1.6	Wetland of International Importance	71
2.2	Cultural Resources	71
2.2.1	Aboriginal	71
2.2.2	European	72

2.3	Visitors	72
2.3.1	Access	72
2.3.2	Camping and Picnicking	73
2.3.3	Fishing and Yabbing	73
2.3.4	Fires	73
2.3.5	Visitor Facilities	73
2.3.6	Walking Trails	74
2.3.7	Information and Education	74
2.3.8	Litter	74
2.3.9	Dogs	74
2.4	Other Interests	75
2.4.1	Drainage Basin	75
2.4.2	Mining and Petroleum Exploration	75
2.4.3	Shack Sites	76
2.4.4	Commercial Fishing	77
2.5	Research, Inventory and Monitoring	78
3	BULYONG ISLAND MANAGEMENT ACTIONS	79
	SELECT BIBLIOGRAPHY	82

TABLES

Table 1	Vegetation Communities (Katarapko)	8
Table 2	Mammals Recorded in the Riverland	15

FIGURES

FIGURES		Following Page
Figure 1	Park Location	vi
Figure 2	Park Features and Visitor Facilities (Katarapko)	7
Figure 3	Zoning (Katarapko)	25
Figure 4	Existing Vegetation (Lyrup Flats)	38
Figure 5	Vegetation Decline (Lyrup Flats)	44
Figure 6	Park Features and Visitor Facilities (Lyrup Flats)	44
Figure 7	Existing Vegetation (Bulyong Island)	64
Figure 8	Vegetation Decline (Bulyong Island)	64
Figure 9	Park Features and Visitor Facilities (Bulyong Island)	69

ACKNOWLEDGMENTS

A wide cross section of views were sought during the preparation of this plan. Advertisements seeking public input were placed in local and state print media and known interest groups and individuals were consulted.

Rather than try to enumerate them all here and in order to illustrate individual contributions made attention is drawn to the following.

Katarapko

Consultant - biologist Bob Pressey engaged to prepare preliminary draft in 1982.

Scientific data contributed by staff of the South Australian Museum, the University of Adelaide and other tertiary institutions, the Departments of Agriculture, Lands, Fisheries and Environment and by public interest groups such as the Society for Growing Australian Plants, and the S.A. Field and Game Association.

Local residents made valuable contributions, particularly of species distribution records and of historic information.

Lyrup Flats

Following completion of a first draft of the plan additional comments were sought from the Murray River Reserves Working Group and from the National Parks and Wildlife Murraylands Consultative Committee. Both of these bodies include individuals from a cross-section of government, business, conservation and recreational interest groups.

Bulyong Island

This plan was compiled by a working group comprising representatives from the Corporation of the Town of Renmark and officers of the Department of Environment and Natural Resources.

In preparing the plan the working group sought expressions of interest from community interest groups and a public meeting was held at Renmark on 25 November 1991.

Following completion of the first draft by the Renmark Corporation/DENR working group additional points of view were sought from the Murray River reserves Working Group and from the National Parks and Wildlife Murraylands Consultative Committee.

The Department of Environment and Natural Resources acknowledges the inputs of the three groups whose time was given voluntarily.

This final version of the plan was subsequently prepared by staff of the Murraylands Region of the Department of Environment and Natural Resources.

MANAGEMENT CONTEXT

The National Parks and Wildlife Act

This Management Plan has been prepared in accordance with the *National Parks and Wildlife Act, 1972*.

Section 38 of the Act states that a management plan is required for each reserve (or park), and should "set forth proposals" in relation to the management and improvement of the reserve and the methods by which it is aimed to accomplish the objectives of the Act in relation to the reserve.

Upon completion of a draft plan an announcement is made in the *Government Gazette* and copies of the final plan are made available for sale to the public.

Once a plan of management is adopted, its provisions must be carried out in relation to the reserve in question and no operations undertaken unless they are in accordance with the plan. However, the Act does make provision for amending adopted plans, and this process is similar to the one described above.

This document is the approved Management Plan for the Murray River Park (including Rilli Island, Media Island and Kapunda Island Conservation Parks).

National Parks and Conservation Parks in South Australia

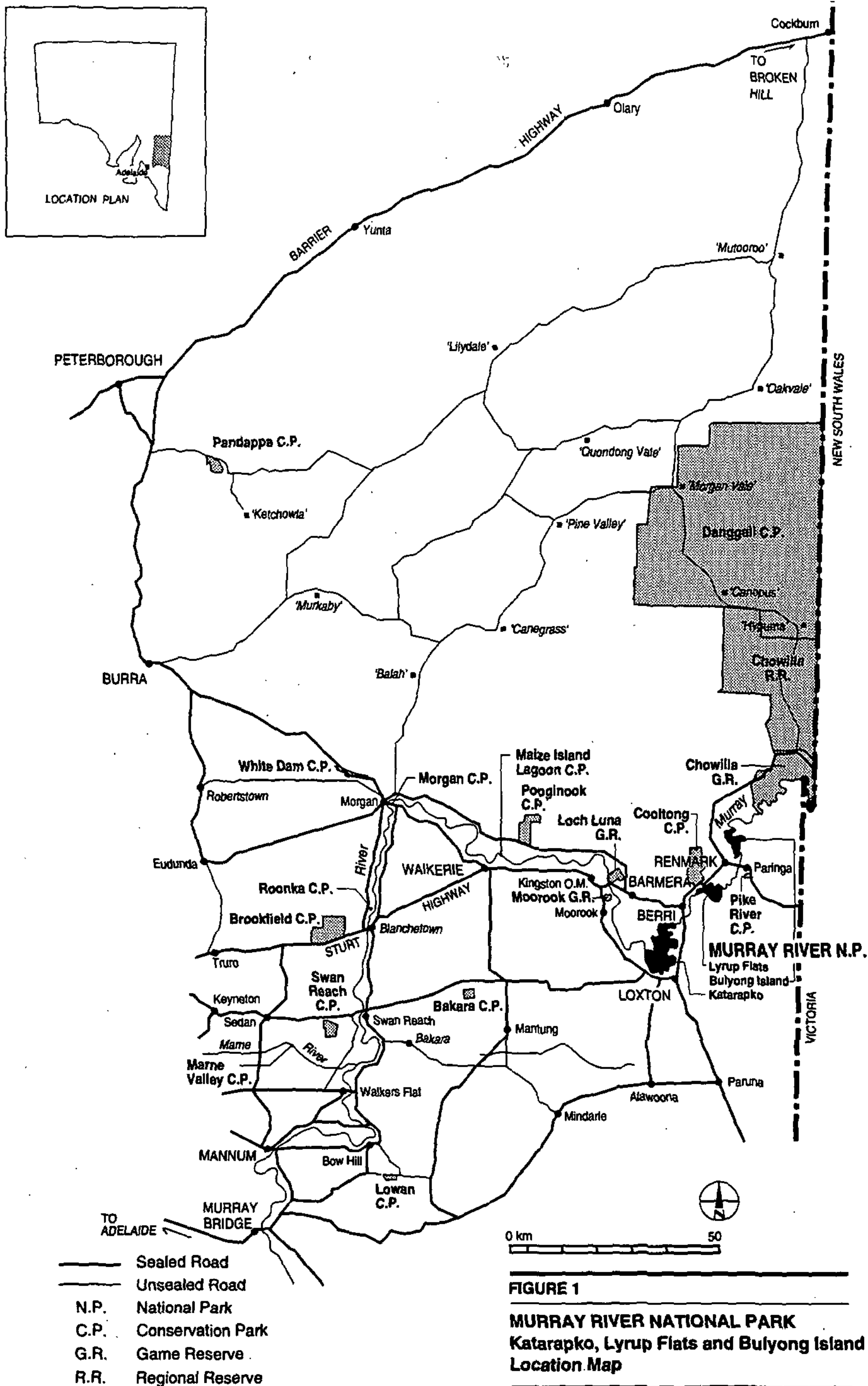
The classification which a reserve receives on being dedicated under the *National Parks and Wildlife Act, 1972* is a general statement of the Government's purpose for establishing the reserve. National Parks are areas with wildlife or natural features of national significance. They are usually popular visitor destinations. Conservation Parks are lands that should be protected or preserved to conserve wildlife, natural or historic features which they contain. Conservation is part of a regional pattern of land use.

Location and Regional Context

The Katarapko Section of the Murray River National Park "Katarapko" lies on the upper River Murray approximately 180 kilometres from Adelaide (Figure 1). It lies opposite the town of Loxton and is 4 kilometres south west of Berri by road. The eastern and southern boundaries are formed by the River Murray, while to the west and north, the reserve adjoins areas of mallee and the Eckerts Creek floodplain. The total area of the reserve is 9148 hectares, 44.6 percent of which is Katarapko Island. The remainder of the reserve to the west and north of Katarapko Creek is accessible by bitumen road from the Sturt Highway between Berri and Barmera and by crossing the floodplain south west of Berri to Eckerts Creek. Roads and tracks within the reserve are either gravel or natural surface.

The park consists of sections 73, 74, 76, 77, 78, 79, 89, 91, 92, 93 and 94 in the Cobdogla Irrigation Area, Hundred of Katarapko, County of Hamley and section 1958, Berri Irrigation Area, Out of Hundreds. Land beneath the waterway of Katarapko Creek is also part of the park.

In 1970 Section 73 on Katarapko Island was declared under the Fauna Conservation Act, 1964. At the same time the remainder of Katarapko Island (Section 74) was declared a National Park under the National Park Act, 1966. Nature conservation legislation was reviewed in 1972 when the National Parks and Wildlife Act, 1972 was passed. The whole of Katarapko Island was then declared a Game Reserve under this Act. Since that time other land has been added progressively to the reserve for the conservation of floodplain habitat.



On June 20th 1991 the Katarapko Game Reserve was abolished and constituted as part of the Murray River National Park. At the same time two other parcels of land Bulyong Island and Lyrup Flats were also gazetted as part of the Murray River National Park.

The Katarapko Creek and River Murray adjoining Katarapko are popular recreation areas. Activities include, small-boating, canoeing, house boating and fishing. Associated activities on the banks of these waterways are camping and general relaxation.

Adjacent to the eastern boundary of Katarapko in the mainstream of the River Murray lie three small reserves; Rilli Island (4 hectares), Media Island (1 hectare) and Kapunda Island (1 hectare) Conservation Parks. These islands are only accessible by boat except during low river flows when both Rilli and Media Islands are accessible by foot, from the south bank of the River Murray.

Lyrup Flats

The Lyrup Flats section of Murray River National Park ("Lyrup Flats") is located some 230 km north east of Adelaide on the northern bank of the River Murray midway between the Riverland towns of Berri and Renmark (Figure 1). It occupies a total area of approximately 2,000 hectares between the River Murray, the Sturt Highway and Renmark Golf Club. It comprises Sections 269, 456, 477, 478, 479, 963, 966, 1265, 1267, 1268 and 1272 and Deposited Plan No 23939 and allotment B in Deposited Plan No. 23940, County of Hamley, Out of Hundreds (Renmark).

Prior to establishment of the National Park in June 1991 part (Section 269) of Lyrup Flats was a Drainage Reserve vested in the Minister of Water Resources and used as a drainage water balancing storage for the Noora Drainage Basin. A condition of park establishment was an agreement between the National Parks and Wildlife Service and the Engineering and Water Supply Department which would enable the basin to continue to be managed under the terms of the Noora Drainage Basin Statement of Intent while optimising natural values of the area.

Vegetation around the Disher Creek Basin has been affected by elevated water levels resulting from the installation of banks and weirs. The most obvious effect of this is the occurrence of numerous dead river red gum and river box trees although there have been extensive changes in species composition as plant communities have adjusted to the altered hydrological regime.

Portions of the floodplain are seasonally inundated when River Murray flows exceed 30,000 to 50,000 ML/day, (ie approximately every 2-3 years), with about 75 percent inundation occurring in floods of 100,000 ML/day (average return period of 8-10 years).

The River Murray adjoining Lyrup Flats is a popular recreation area. Activities include canoeing, small-boating, house-boating and fishing. Associated activities within the park area are camping and general relaxation. A complex, often unsightly, network of tracks has developed as a result. Visitor impacts such as revegetation denudation, scattered old fireplace remnants and litter are particularly evident in waterfront areas.

Bulyong Island

The Bulyong Island Section of Murray River National Park ("Bulyong Island") is located 240 km north east of Adelaide on the eastern bank of the River Murray just upstream of the town of Renmark (Figure 1). It is physically separated from the town of Renmark by Ral Ral Creek, an anabranch of the River Murray which flows along its eastern margin. The total area under consideration in this plan is approximately 2382 hectares and comprises Sections 176, 177, 198, 199, 210 and 374 Ral Ral Division, Chaffey Irrigation Area, County of Hamley, Out of Hundreds (Renmark) and Section 456, County of Hamley, Out of Hundreds (Renmark). The northern boundary of Section 456 adjoins Calperum Station.

Prior to establishment of the National Park in June 1991 part of Bulyong Island was a commonage under the care and Control of the Minister of Lands. Section 374 was formerly included in a Drainage Reserve used as a saline drainage water disposal basin by Renmark Irrigation Trust and the Engineering and Water Supply Department.

The water table under Bulyong Island has been affected by both elevated river levels resulting from the installation of Lock 5 (located approximately 6 km downstream) and the use of the area as a saline drainage water disposal basin. High water tables have led to significant tree deaths and soil salinisation. The vegetation communities on the island are still adjusting to the altered hydrological regime.

Portions of the island are seasonally inundated when River Murray flows exceed 30,000 to 50,000 ML/day, (ie approximately every 2-3 years), with about 99 percent inundation occurring in floods of 100,000 ML/day (average return period of 10-12 years).

Although inaccessible by land, Bulyong Island is a highly valued and popular recreation area for a variety of activities including canoeing, small-boating ("tinnies"), house-boating, fishing, camping and general relaxation.

Climate

The Murraylands region has a temperature climate with cool winters and warm to hot summers. Diurnal and seasonal temperature variations can be significant, and because the area is in the rain-shadow of the Mount Lofty Ranges, it is considered within the southern-most extension of the arid zone in South Australia. Annual rainfall is low and irregular, varying between 150 and 550 mm, but averaging 250 mm, with a slight winter and spring predominance.

Management Objectives

The *National Parks and Wildlife Act, 1972* describes the general objectives of managing National Parks in South Australia as:

- * preservation and management of wildlife;
- * preservation of historic sites, objects and structures of historic or scientific interest;
- * preservation of features of geographical, natural or scenic interest;
- * destruction of dangerous weeds and eradication or control of noxious weeds and exotic plants;
- * control of vermin and exotic animals;
- * control and eradication of disease of animals and vegetation;
- * prevention and suppression of bush fires and other hazards;
- * encouragement of public use and enjoyment of reserves, and education in, and a proper understanding and recognition of their purpose and significance; and
- * generally the promotion of the public interest.

Specific objectives for management of the Murray River National Park are:

to provide opportunities for recreation in a near natural environment

to ensure long term protection of the riverine environment and associated values

to encourage natural regeneration of degraded areas

to manage the Katarapko Island and Disher Creek Evaporation Basins for drainage water management whilst enhancing its wetland habitat values

Administration

Minister for Environment and Natural Resources/Murraylands Conservation Trust

As a reserve established under the provisions of the *National Parks and Wildlife Act, 1972*, administrative responsibility for "Murray River National Park" rests with the Minister for Environment and Natural Resources and, subject to delegation, the Chief Executive of the Department of Environment and Natural Resources and the Director of National Parks and Wildlife.

"Murray River National Park" lies within the Murraylands Region of the Department for Environment and Natural Resources which is administered from Berri. Day to day management of reserves in the region is undertaken by Departmental staff in accordance with State Government and Departmental policies and according to the provisions of any approved plan of management.

The National Parks and Wildlife Act enables the Minister to grant leases and licences for entry, use or occupation of reserves. Also, when any lease of licence is in force immediately before a reserve is constituted such lease of licence remains in force for the remainder of the term for which it was granted as if it were a lease granted by the Minister of Environment and Natural Resources.

Sections 45a - 45l of the National parks and Wildlife Act provides for the establishment of Development Trusts for reserves. Such Trusts are considered to be a body corporate and;

- (a) are capable of suing and being sued
- (b) are capable of holding, acquiring, dealing with and disposing of real and personnel property
- (c) are capable of acquiring or incurring other rights and liabilities
- (d) have powers, rights, duties, and functions conferred, imposed or prescribed by or under the National Parks and Wildlife Act or any other Act;

and

- (e) hold property on behalf of the Crown

Development Trusts may also delegate powers, functions or duties to any committee appointed by it, or to any member of the Trust or officer or employee of the Trust.

The Department of Environment and Natural Resources has established a consultative network for each of its administrative regions and the Murraylands Consultative Committee provides a forum for community advice back to the Department of Environment and Natural Resource's Murraylands Region. The Murraylands Consultative Committee presently comprises representatives from a variety of general and special interest groups including, Local and State Government representatives, recreational interests, landowners, conservation groups and educators.

Policies

- * to manage the "Murray River National Park" in accordance with the provisions of this management plan

- * to administer a range of leases and licences for the following purposes:-
 - commercial guided tours
 - other tourism activities
 - water pumping
 - commercial fishing
- * to delegate day to day decision making in relation to the reserve to a Development Trust, called the Murraylands Conservation Trust (gazetted on the 8th April, 1993).
- * to use the Department for Environment and Natural Resources as the operational arm of the Murraylands Conservation Trust to organise and undertake reserve management programs.
- * to maintain the Murraylands Consultative Committee as a consultative forum for provision of advice to the Minister and Department of Environment and Natural Resources.
- * to continue to liaise with user groups, interested bodies and adjacent landholders on matters of mutual concern.

Actions

- * support the Murraylands Conservation Trust
- * utilise available permanent and casual staff to implement the fundamental provisions of this plan
- * seek external funds from funding sources such as the Murray-Darling Basin Commission to enable completion of projects which have a regional significance
- * maintain the Murraylands Consultative Committee as a forum for community consultation
- * negotiate management agreements with government, private enterprise and community interest groups in the provision of natural resources and visitor services. Formalise such agreements with leases, licences and other instruments.

Bookmark Biosphere Reserve

The Man and the Biosphere (MAB) Program is a world-wide program of international scientific co-operation dealing with people-environment interactions in the whole range of bio climatic and geographic situations of the biosphere - from polar to tropical zones, from islands and coastal areas to high mountain regions, from sparsely populated regions to dense human settlements. Research under the MAB Program is designed to provide the information needed to solve practical problems of resource management. It also aims to fill the still significant gaps in the understanding of the structure and function of ecosystems, and of the impact of different types of human intervention. Key ingredients in implementing the program are the involvement of decision-makers and local people in research projects, training and demonstration in the field and the pooling of disciplines from the social, biological and physical sciences in addressing complex environmental problems.

One of the primary themes of the MAB Program is conservation of natural areas and the genetic material they contain. Under this theme the concept of the "biosphere reserves" was developed. Such reserves were intended to be an international network of protected areas which would demonstrate the value of conservation and its relationship with development.

Today, there are approximately three hundred biosphere reserves in more than 70 countries. Representatives of organisations such as FAO, UNEP and IUCN meet together regularly to co-ordinate action.

In 1983 the first International Biosphere Reserve Congress adopted an Action Plan for Biosphere Reserves (UNESCO, 1984). This Plan had three main thrusts:

- * improving and expanding the network
- * developing basic knowledge for conserving ecosystems and biological diversity, and
- * making biosphere reserves more effective in linking conservation and development

To date, two Biosphere Reserves have been established in South Australia, one of which is Dangali Conservation Park. Of particular relevance to the Murray River National Park situation are the following aspects of the MAB Action Plan for Biosphere Reserves:

- Action 5* In order to make the network of aquatic and wetland biosphere reserves more complete and effective, IUCN should convene a working group to examine the special managerial, legislative and institutional problems related to such reserves and develop necessary guidelines for their solution.
- Action 15* In order to develop the research potential of the biosphere reserve network, governments should be encouraged to set up co-operative, bilateral or multilateral pilot projects involving: (a) basic and applied research; (b) comparative research involving managed and natural ecosystems; (c) comparative research involving biosphere reserves with analogous ecological characteristics or similar ecological problems; (d) application of new technologies in such research; and (e) development and expansion of linkages for research and educational purposes.
- Action 21* In order to promote the restoration of degraded ecosystems, UNESCO should encourage governments to support research in this field and should develop a mechanism for the exchange and dissemination of information about relevant successful experiences in biosphere reserves.
- Action 26* In order to obtain the commitment of people who live in or adjacent to biosphere reserves, governments should ensure that these people are encouraged to participate in planning for the management of the area. Where possible, they should also participate in the scientific research, monitoring, and other activities taking place in the reserve. Furthermore, governments should encourage the setting up of mechanisms for consultation so that conflicts may be resolved and changing local perceptions may be reflected in the management of the reserve.

Policies

- * in conjunction with adjoining protected areas and in co-operation with other state agencies and the Commonwealth Government nominate the Murray River National Park as an extension of the Dangali Biosphere Reserve and rename it Bookmark Biosphere Reserve.
- * maintain the Murraylands Conservation Trust as a mechanism for involving the local community in decision making and for resolving resource allocation conflicts.
- * undertake at least the minimum set of activities required by the MAB Action Plan for Biosphere Reserves, i.e.
 - baseline inventories of flora and fauna

- . establish a procedure for monitoring key biological parameters
- . maintain an inventory of past and on-going research and relevant publications
- . establish a research program
- . establish a training and education program
- . prepare a management plan

Actions

- * through the Australian Nature Conservation Agency, liaise with Commonwealth agencies in the preparation of a nomination to include the Murray River National Park in the proposed Bookmark Biosphere Reserve
- * maintain the Murraylands Conservation Trust as the peak body for day to day decision making
- * undertake the research, inventory and monitoring program as outlined in this plan
- * provide appropriate training for park management staff, researchers and volunteers
- * provide public information and education materials and opportunities as outlined in this plan
- * seek community involvement in the drafting of a management plan for the Biosphere Reserve and forward such plan to the Man and Biosphere Program Executive.

KATARAPKO

(Including Rilli Island, Media Island and Kapunda Island)

1 KATARAPKO DESCRIPTION

1.1 Geology

The study area lies in the western portion of the Murray Basin, a sedimentary structure extending over approximately 260 000 square kilometres. The stratigraphy of the western basin is complex and variable and reflects changes in depositional environments over the area during several hundred million years.

The formation of the River Murray was preceded by the deposition of early Quaternary deposits. During glacial periods when sea-level was lowered by about 100 metres, the ancestral river deeply incised its bed and the present deep trench reached its final form approximately ten thousand years ago (South Australian state Planning Authority, 1978). The subsequent rise of sea level caused the river to deposit considerable thicknesses of alluvium which underlie the present floodplain.

The surface geology of Katarapko has been mapped broadly by Firman (1972) as two formations:

The Coonambidgal Formation comprises light grey alluvium of the River Murray system made up by fluviatile clays, silts and sands overlying the coarse grained riverine sand of the Monoman Formation. The Monoman Formation is a cut and fill sequence related to ancestral fluvial activity and is approximately 15 metres deep over the base of the river valley (Thomson 1975). The Coonambidgal Formation represents floodplain deposition of the more recent past and is at least 15 metres thick.

The Woorinen Formation consists of aeolian pale reddish brown quartz sand material with carbonate silt. In most places platy and nodular carbonate is present, and occasionally the Bunyip Sand, another aeolian deposit, is present as the veneer. At a more detailed level, areas mapped as the Woorinen Formation also include a mosaic of younger and older geological types (Potter et al. 1973).

1.2 Geomorphology

The Upper Murray area of South Australia consists of two broad geomorphological divisions (South Australian State Planning Authority, 1978). The Murray High Plains (the mallee surface) are those areas of low relief into which the river has cut its valley. This surface has been built up by fluvial and lacustrine deposits of Blanchetown Clay and other formations. The second division, the Murray Valley, is a Quaternary feature developed essentially in response to repeated glacioeustatic lowering of sea-level.

Katarapko contains elements of both divisions. More detailed geomorphological units were mapped for the River Murray area in South Australia by Thomson (1975) and for Katarapko Island by Caldwell Connell (1981). An outline of the units which are apparent in the reserve is given below. Apart from the mallee surface which has already been described, these geomorphological types are the result of fluvial activity, some having been reworked since their initial formation.

The area is characterised by the following features:

(a) Slip-off slopes

Slip-off slopes are the result of erosion processes as material moves into the river valley, typically on the inside bend of a meander and opposite an oversteepened and undercut slope where the outside bend meets the valley side.

(b) Terraces

There are several extensive terraces in the Upper Murray Valley representing the remnants of an older, higher floodplain which has been partly eroded and reworked by the modern river regime. The terrace has been largely covered by dunes derived from wind erosion of the mallee surface to the north. Between some dunes the original material of dark red fine-grained sandy clay is visible.

(c) Present floodplain formation

Fluvial erosion and deposition have created a micro relief of up to three metres on the modern floodplain. The geomorphic types within the present flooding regime include: exposed point bar deposits, levee deposits, swales (floodplain scour routes and channel remnants), surficial accretions, clay plugs and crevasse splays.

(d) Wetlands

Many wetland areas occur within the park. They have been formed by three major processes creating depressions which lie permanently or temporarily below the water-table: the abandonment of meanders which led to the isolation of Horseshoe Lagoon; erosion by localised surges of entering or receding floodwaters forming flood chutes; and uneven overbank deposition of sediment leading to back swamps between the levee and the edge of the valley or terrace.

1.3 Hydrology

The River Murray catchment upstream from Loxton covers an area of approximately 1 million square kilometres. Much of the catchment receives little rainfall, thus the flow regime before river regulation was strongly influenced by rainfall and snow melt in the high country of New South Wales and Victoria, which led to peak discharges typically in spring and summer (Caldwell Connell 1981). The reserve is well within the very large non-contributing sector (zero run-off) of the Murray catchment area and is also well downstream of the point of maximum discharge at about Yarrawonga, below which transmission losses are greater than accretions of runoff (Burton 1974). Before regulation of flow by dams and weirs, the typical seasonal flow regime was superimposed on irregular long-term changes in flow, since most of the catchment is arid country where rainfall is erratic. Some extremely low flows were experienced in the Upper Murray during droughts.

River regulations and massive diversions for irrigation and other uses have had significant effects on the flow regime in the Upper Murray. By 1974 the average annual flow reaching South Australia had been reduced to about 60 percent, the intensity and duration of high flows had also been reduced, while flows were increased during dry times (Johnson 1974). Regulation has also changed the seasonal pattern of flow, reducing discharge in winter and early spring, and increasing summer and autumn flows, particularly in the upper river reaches.

The hydrology of a portion of the reserve has been significantly altered by the construction of embankments in 1964 to form an evaporation basin in the southern portion of Katarapko Island (Figure 2). This basin receives saline irrigation water from the Loxton irrigation area which is stored until river flows are sufficient to absorb it without creating salinity problems downstream. Management of the basin has had the following three main effects on the area contained (Caldwell Connell 1981).

(a) Elevated water levels

Water flows into the basin throughout the year with peak inflows in the hotter months. Releases from the basin to the river are made during periods of high river flow and, providing salinity is favourable, continue until water levels on either side of the outlet are equal. Releases have usually been made during periods when the river is rising so that outflows have been limited. Since management of the basin began, an average water level 1.5 metres above the adjacent river level has been maintained.

(b) Reduced flooding frequency

Before 1964 the lagoons within the evaporation basin would have been flushed by river water on average in nine out of every ten years. The frequency of flushing and flooding of low-lying areas has been approximately halved since construction of the basin. The frequency with which other higher areas within the basin are flooded has also been reduced, but by a smaller proportion.

(c) Prolonged inundation

The period of inundation of the enclosed floodplain has been extended during and after floods due to the restricted outflow.

Outside the evaporation basin, much of the floodplain in the reserve is frequently flooded. About every two years floodwaters cover many low-lying areas including some lignum flats and the areas surrounding wetlands.

Information on groundwater in the reserve and the influence of the evaporation basin on levels and salinity has been summarised from Caldwell Connell (1981). The sedimentary alluvial strata underlying the reserve contain a number of discrete aquifer systems. Groundwater in the higher Pliocene sands aquifer and probably the lower Murray Group aquifer are in direct hydraulic continuity with the River Murray at Loxton. The depth and quality of groundwater below the floodplain in the reserve is therefore probably directly influenced by both systems. Other factors influencing natural groundwater levels below the floodplain are prevailing river levels, evapotranspiration, and local inputs from flooding and rain. During periods of low flow at Loxton, the natural water-table has been between 2 and 6 metres below the surface of the floodplain. Natural groundwater salinities below the floodplain are typically between 20,000 and 40,000 parts per million.

The overall effect of the evaporation basin on groundwater has been to raise the water-table within the basin by between 1 and 1.5 metres depending on the surface water levels maintained. Apart from surface flow water moves out of the lagoons by seepage of groundwater toward the river and Katarapko Creek and by evapotranspiration of groundwater. A survey in 1980 found that the water table is within 2 metres of the surface in some low-lying areas, a critical zone where salt accumulation can occur close to the surface due to capillary rise and evaporation of groundwater.

1.4 Soils

The soils of the reserve can be discussed in terms of four broad environments; the mallee surface, the terraces, the Slopes and the floodplain. Although there are no published soil surveys of the mallee areas of the reserve, the study of Potter et al. (1973) on the Loxton area is applicable. They recognised four types of land-form in the area; depressions, flats, rises and sandhills, and described a soil profile for each one. They described the soil of the general area as reddish sand grading to sandy-clay loam over lime, rubble and calcrete in the flats and rises; a deep layer of coarse reddish sand with moderate lime at depth on the hills while the depressions are more clayey, often rubble free and non-limy at the surface.

Alluvial terraces as defined by Thomson (1975) are defined as high terraces by Potter et al. (1973) who described the soils as consisting of more than 2 metres of reddish-grey clay which cracks when dry, often saline and cemented in the lower layers. The reddish colour is due to admixture of red, limy, wind-blown sand with the grey clay. This description is probably applicable to the terraces on the western side of Katarapko Creek. The grey surface material on the terrace to the west of the horseshoe lagoons suggest that aeolian influence was unimportant here. Thomson (1975) notes that deep aeolian sands have been deposited on some terraces which accounts for the dunes on the large terrace in the south-western corner of the reserve. It has been suggested that the dunes on the Katarapko Island terrace have been produced by reworking of levees and point bar deposits (Caldwell Connell 1981).

The soils of the present floodplain have been formed largely by the reworking of older alluvial deposits during stream processes, resulting in a complex horizontal and vertical distribution of soils ranging from heavy clays and fine silts to coarse gravels (Caldwell Connell 1981). Differences in texture and other parameters can be related to position relative to the river and to geomorphic history. Descriptions of floodplain soils in the Chowilla area are relevant to Katarapko (Caldwell Connell 1981). The levee deposits consist mainly of fine sand, silt and clay. Floodplain channel soils are deeper silty clays and younger soils of surficial accretions have a higher clay content. Variations in organic content reflect the degree of swamp formation (Thomson 1975).

1.5 Aboriginal Occupation

A large volume of information exists on the Aboriginal occupation of the Murray Valley. The following discussion is based on the studies of Buchan (undated, 1979) who has summarised most of the available information.

The Murray Valley originally supported a large Aboriginal population although its actual size at the time of European settlement is difficult to estimate because of the lack of consistent data on the area as a whole. However, the population along the river was noticeably more dense than elsewhere due to the concentration of resources and their fairly permanent nature. For most of the year the economy was sustained by the riverine environment although in the colder months there were minor shifts away from the river to exploit seasonally available resources. These probably did not involve long distances. Three types of Aboriginal groups were commonly seen in the early days of European settlement. Small groups of fewer than twenty people, usually men, often attached themselves to expedition parties and accompanied them for short distances, sometimes acting as guides. Also common were autonomous extended family groups consisting of a man, his wife or wives, their children and sometimes older relatives of the man. The family appears to have been the basic economic unit within which food gathering and cooking activities took place. When larger groups camped together, families shared the same fire and shelter and travelled together when on the move. A number of extended families collectively formed the tribe which shared a common language and moved within its own specific territory. On the New South Wales section of the Murray, tribes varied in size from eighty to one hundred and fifty people. Occasionally several tribes met, either to exploit abundant resources, for ceremonial purposes, or to exchange marriage partners or for defence purposes.

Food was plentiful along the Murray between spring and late autumn. It consisted largely of fish, game, vegetable foods and particularly in summer, shellfish. Possums were the most

commonly hunted land animal. Many other resources were obtained from the river valley including reeds and branches for spears, spear throwers, clubs and digging sticks, fibre or rushes for nets, animal skins for clothing, large pieces of wood for bowls, stone for grinding surfaces (rock for toolmaking was imported) and bark for winter huts, cooking shelters, canoes and shields.

Burial was the major method of disposal of the dead. Graves were usually about 1.2 metres deep and were usually located on sandhills or in mounds where digging was easy. The large population suggests that most or all of the sand dunes within the river valley would have been used for burials.

The extent of modification of the Murray Valley environment by Aborigines is difficult to assess. However, the major modifying agent would certainly have been fire which was used for opening up reed beds in spring to facilitate passage and to flush game and perhaps encourage new growth attractive to game in the western part of the basin. Accidental fires no doubt sometimes spread from cooking sites. Impacts on fauna populations remain conjectural.

The Aboriginal culture did not persist long after the intrusion of Europeans into the Murray Valley. Epidemic diseases decimated the population within a few years of European contact and settlement ultimately led to the loss of traditional land and disintegration of Aboriginal society.

The Loxton area was the country of the Erawirung, a relatively small tribe which occupied land on both sides of the Murray (Cooper 1972). The reserve contains Aboriginal graves and middens and shield and canoe trees. Many graves and middens have been reported by local residents and previous land holders from the dunes on Katarapko Creek. High floods, grazing and wind erosion, however, have obscured or obliterated many of those which existed when Europeans arrived in the area.

1.6 European Settlement

In 1838, only eight years after Sturt travelled down the River Murray on his exploratory tour, drovers brought cattle along the north bank of the Murray from Albury to Adelaide and opened it up as a stock route. The first land taken up in the Upper Murray was near Morgan between 1839 and 1841, three to five years after the first settlement in South Australia (Potter et al. 1973). Following this, the area south, east and west of the river was used for grazing under occupation licenses. In 1851 these Crown Lands were taken up as pastoral leases and remained as such until about 1870. About this time began the subdivision and disposal for agriculture of land to the west of the river, a process completed by 1889.

The use of the river as a major trading route began soon after 1840 when the South Australian Government offered a prize for the first two steamers with engines of more than "40 horsepower" to navigate between Goolwa at the mouth of the Murray and the junction with the Darling River (South Australian State Planning Authority 1978). In the 1880s, in the peak of the trade, there were several hundred steamers operating on the river and a larger number of barges. After 1900, however, the river trade was negligible, due to the introduction of a rail network, first in Victoria and New South Wales, and then in South Australia.

Irrigation development began on the Upper Murray at Renmark after 1887 but progressed slowly in the face of many difficulties. In 1894, to mitigate the effects of a severe depression, the Government established eleven village settlements at roughly 32 kilometre intervals between Murtho and Morgan. These co-operative associations, which were based on irrigated crops, also ran into problems. By the close of the nineteenth century irrigation on the Upper Murray had failed to produce the economic benefits which had been envisaged. In this century there has been a general growth and diversification in irrigation schemes, with spates of development between about 1908 and 1925 and following the second World War.

In 1968 further water allocations for irrigation were frozen and no new irrigation districts have since been approved.

In 1914 the Murray Waters Agreement between the Commonwealth and the three states concerned with the Murray laid down a program of locks and storage's to maintain water levels and a formula for water allocation including releases for the control of salinity. Six weirs and locks were built on the Murray between Blanchetown and the state border in the 1920s and 1930s

According to Casson and Hirst (1972), the land immediately opposite Loxton which now comprises Katarapko, once formed part of Pastoral Lease 91, a leasehold of 125 square kilometres which was issued to John Walker in July 1851. The western boundary of this holding ran north for eight kilometres in a straight line from the approximate present position of Pyap and then turned north-north-east toward the river. The adjoining leasehold to the west was Pastoral Lease 86 (375 square kilometres), taken up at the same date by John Chambers. Katarapko was therefore almost entirely contained within Walker's holding except perhaps for a narrow strip of floodplain on its western side fronting the river. Walker's leasehold was eventually taken over by Chambers and the present reserve was entirely contained within Chambers large Cobdogla station which became an important horse-run from which horses were supplied for John McDouall Stuart's inland explorations.

Lands department records show that parts of the present reserve were later held by Chambers under Pastoral Leases 1655 (1867-1888), 1655C (1870-1891) and 165 (1889-1891). In 1884 the horses on Cobdogla Station were sold and the run was converted to cattle raising. Shortly afterwards sheep became the main concern. A survey map drawn at about 1890 shows several features on the land now included within the reserve which were associated with its management as part of Cobdogla Station. Three horse-trap yards, one in the waist of the island, one beside the Splash, and one to the west of Katarapko Creek on the edge of the floodplain, were areas into which horses were run with the aid of long fences forming "wings" to guide the herds into the gates. A punt bridge across Katarapko Creek about three kilometres downstream from its junction with the Splash was used to move "small cattle" (sheep) across to the island and back. Katarapko Island was originally call Craggs Island and the creek Katarapko or Craggs Creek.

In 1891 most of the pastoral leases in the vicinity of the reserve expired and two years later the Hundreds of Moorook, Pyap, Bookpurnong and Gordon were proclaimed (Casson and Hirst 1972). Sections available under perpetual lease and later, right of purchase lease, were gazetted in 1894. However, Cobdogla Station remained in John Chambers' family until it was resumed by the Government in 1910. In 1894 a Lands Department letter to the solicitors of representatives of the late John Chambers indicated that occupation of land within the Great Pyap Bend of the river could continue at the cost of "fifteen shillings per square mile per year" until the whole or any portion was required for irrigation or other settlement. The conditions for this allowance were that the lessees would erect and keep in repair a vermin-proof fence from the River Murray near Springcart Gully, upstream of Berri, across to Overland Corner and that they would destroy all vermin on the land.

The Katarapko section of the station was maintained for a while after the remainder was closed, the last sheep being taken from there to be shorn at the sheds near Spectacle Lakes in 1971 (Woolmer 1973).

Katarapko Island and adjacent areas to the west of the Murray were proclaimed as the Hundred of Katarapko around 1922. The areas now within the park were subdivided and made available under Miscellaneous Lease in about 1931. The Bennett family were the original lessees of the northern half of Katarapko Island and used the area mainly for sheep grazing, although some cattle were run. During floods, stock were moved to another property. The Bennetts originally lived on the eastern bank of Katarapko Creek but moved to higher ground on the opposite side of the island after the 1956 flood.

The southern half of the island was leased by Jack Bland and later taken over by Leo Bennett. The Blands had no land on the western side of the creek but had a house there on the basis of an informal agreement with the lease holder. Stock in this area included about 120 cattle until the 1930s, after which the run was used for sheep. There were about 3 000 sheep on the holding during this period although numbers fluctuated as stock were bought and sold. Most were sold at Loxton, sheep being boated across the river to market while the cattle were swum across. During floods the sheep were agisted or shepherded in "the long paddock". Small sections on the western side of Katarapko Creek were held by a number of people in the decades before they were included in the reserve. Grazing was the only viable agricultural use of this land although attempts were also made at wheat growing.

Katarapko Island and adjacent areas were used for a variety of other activities in the first half of this century. Large volumes of timber were cut out of the sand dunes south of the mallee area once being covered in an open woodland of *Callitris preissii* until the pine was taken out for the building of workers' shacks in the early Barmera settlements. River Red Gum was also cut, mainly from the island and for a while there was a sawmill on the north-eastern section of the island which provided planks for the settlements. During World War II vast quantities of timber were cut from Katarapko Island and Section 89 by Italian Prisoners of War and Internees for use in the power station and pumping station at Berri. At least 2 000 tonnes of timber was cut for the Berri Power station alone. Timber cutters lived in camps in the Katarapko area and cut out large amounts of River Box posts for the nearby fruit-growing areas. The heavy use of the floodplain west of Katarapko Creek for timber cutting can be seen today by the large number of trees which have coppiced from cut trunks. A number of fishermen also lived in rough houses on the island from time to time, and among the more unusual residents were two German migrants who lived in an old steamboat on Katarapko Creek about one kilometre downstream from the waist of the island.

Historic remnants of European occupation occur at a number of sites within the park. The following are brief notes on five historic sites (HS) shown in Figure 2 .

HS 1: Lines of stones are the only remains of a stone hut which was built by the Cragg family who were the first permanent residents along the creek. The house was built from stone quarried from the hill behind the house.

About five members of the Cragg family were buried in a grave west of their house. The cause of their deaths is unknown.

The remains of an old ferry crossing that was used to ferry stock and supplies over to Katarapko Island can still be seen at this site. This ferry was used up until the 1940s.

HS2: Brick foundations, fencing, stock yards, an old sheep dip, floodbanks and poplar trees mark the location of an old home site occupied before the 1956 flood by the Bennett family who leased the northern and later the southern sections of the island for grazing.

HS3: The remains of a fence which was erected across the narrowest point of Katarapko Island is still evident, old sheep yards and the old shearing shed used by Jack Bland and later by Leo Bennett can still be seen.

HS4: A levee bank built for irrigation on the triangular terrace to the north. A large pepper tree stands beside the foundation of an old building.

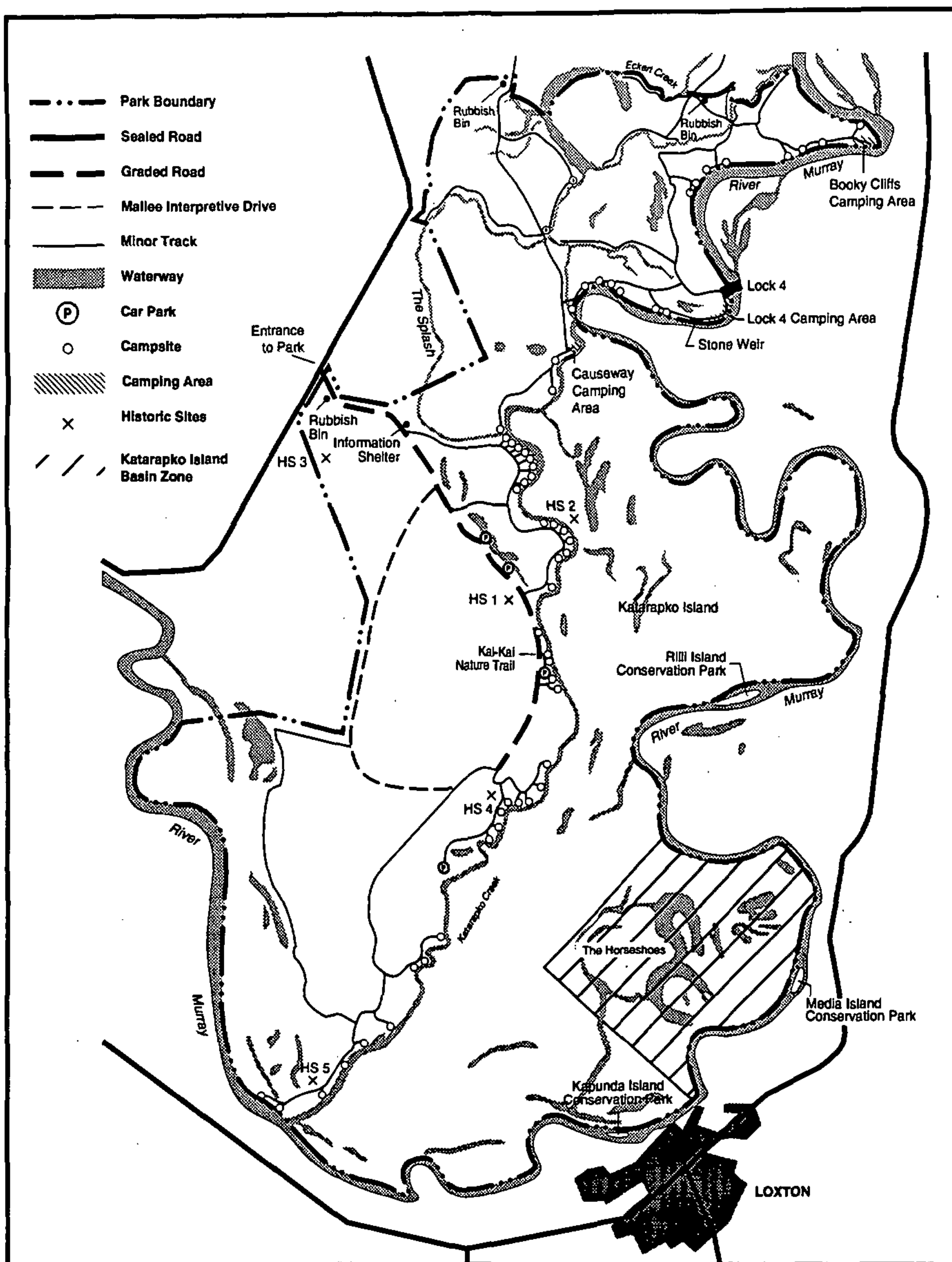


FIGURE 2

MURRAY RIVER NATIONAL PARK
Katarapko
Park Features and Visitor Facilities



0 kilometres 1 2 3

HS5: An old windmill and the remains of pump sheds and old irrigation equipment mark the 'remains of a market garden which was operated by Mr. Tupper who grew vegetables which he sold in Loxton. He also used to row Jack Bland's children daily to and from Loxton where they attended school. The remains of a punt which was towed upstream and sank opposite Tupper's pump can still be seen on the river bank.

1.7 Vegetation

There are three broad vegetation associations in the Upper Murray area of South Australia (Specht 1972; South Australian state Planning Authority 1978). On the highland through which the river valley is incised is an open scrub dominated by the mallees' *Eucalyptus socialis*, *E. gracilis* and *E. dumosa*. On old alluvial terraces along the western side of the valley from below Renmark to a point about ten kilometres downstream of the border is a low shrubland with *Atriplex vesicaria* and *Maireana sedifolia*, and on the present floodplain is a "river swamp association" consisting mainly of *E. camaldulensis* open woodland, *E. largiflorens* open woodland and *Muehlenbeckia cunninghamii*. Within these broad groups there are many minor vegetation types or communities which occur in response to local variations in "climate, soils, topography, hydrology and other factors".

Prior to the initial preparation of this plan, the knowledge of vegetation in the reserve was fragmentary and insufficient as a basis for management. During preparation of the draft plan twenty vegetation community types were identified by consultant Bob Pressey. Areas of each community type are listed in Table 1.

The distribution of communities above the floodplain is influenced mainly by soil type which is strongly associated with topography. On the mallee surface generally, the composition of dunes and the geological types exposed in the intervening swales are mainly responsible for variations in vegetation. In the higher areas of the floodplain there are also soils derived from abandoned alluvial terraces and recent aeolian deposition on ground level which determines the frequency and duration of flooding. However, variations on this pattern are also imposed by soil texture, salinity, drainage and possibly other factors.

Table 1: Vegetation Communities (Katarapko)

	Area of Reserve (Hectare)	(Percent)
(a) <i>Eucalyptus camaldulensis</i> woodland	543	5.9
(b) <i>E. largiflorens</i> woodland-low woodland	2,454	26.8
(c) <i>E. oleosa</i> - <i>E. cyanophylla</i> - <i>E. gracilis</i> open scrub	865	9.6
(d) <i>Dodonaea viscosa</i> open scrub	206	2.2
(e) Unstable-regenerating dunes	103	1.1
(f) <i>Muehlenbeckia florulenta</i> closed heath-low open shrubland	2,503	27.4
(g) <i>Chenopodium nitrariaceum</i> low shrubland	21	0.2
(h) <i>Typha domingensis</i> closed herbland	46	0.5
(i) Riparian complex	Not Mapped	
(j) <i>Atriplex</i> low shrubland - <i>Pachycornia triandra</i> - <i>Disphyma crassifolium</i> herbland	71	0.8
(k) <i>Bromus rubens</i> grassland	702	7.7
(l) <i>Eragrostis-Sporobolus mitchellii</i> grassland	1,134	12.5
(m) <i>Cressa cretica</i> herbland	42	0.5
(n) <i>Maireana pyramidata</i> low shrubland	29	0.3
(o) <i>Cyperus arenarius</i> - <i>C. gymnocaulos</i> closed sedgeland	21	0.2
(p) <i>Halosarcia-Suaeda australis</i> herbland	50	0.5
(q) <i>Heliotropium supinum</i> herbland	41	0.4
(r) Semi-permanent open water	121	1.3
(s) Temporary open water	146	1.6
(t) Ephemeral open water	50	0.5
	<hr/> 9,148	<hr/> 100.0

Each of the plan communities is described below

- (a) *Eucalyptus camaldulensis* woodland

E. camaldulensis (river red gum) is the only eucalypt in this community and grows up to 25 metres high, the only other tree being *Acacia stenophylla*. The understorey is generally sparse but with occasional thickets of *Muehlenbeckia florulenta* (lignum) and *Phragmites australis*. The introduced *Xanthium californicum* (California burr) and *Cuscuta* Sp. form dense low cover in places. Otherwise the ground cover consists of a variety of herbs, grasses and sedges, principally *Alternanthera nodiflora*, *Pseudoraphis spinescens*, *Solanum nigrum*, *Wahlenbergia* and unidentified Compositae. Internal variation in the abundance and diversity of the understorey and ground cover is related to differences in micro relief. Sedges, *Xanthium orientale*, *Muehlenbeckia florulenta* and other species are more common in swales behind the main levee.

The largest and densest areas of this community are on recent point bar deposits on the River Murray and on levees adjacent to the river and Katarapko Creek. *Eucalyptus camaldulensis* also surrounds wetlands and floodplain in the south-west corner of the reserve, usually a single line. According to Caldwell Connell (1981) this distribution is largely determined by the inability of *E. camaldulensis* to establish successfully in the predominantly heavy floodplain soils and by the effect of groundwater level on their survival. The critical depth of the water-table for this species appears to be about 1.5 metres. A decline of trees has been observed in areas where the water-table is closer to the surface than this limit, while healthy growth occurs where the water-table lies between 1.5 and 2 metres depth. Regular annual flooding has been found to be necessary for optimal growth (Dexter 1967, 1978).

(b) *Eucalyptus largiflorens* woodland-low woodland

E. largiflorens (river box) is generally 8 to 10 metres high but occasionally reaches 20 metres. *Muehlenbeckia florulenta* and *Eremophila divaricata* are common in the understorey, and the ground cover consists mainly of *Alternanthera nodiflora*, *Calocephalus* sp., *Cressa cretica*, *Enchylaena tomentosa*, *Epaltes cunninghamii*, *Sclerolaena* Sp. and various grasses.

This community occupies the highest parts of the floodplain marking the maximum heights of successive floods. It occurs on levees and abandoned point bar deposits, the fringes of old alluvial terraces and the edges of sandhills. In some areas, for example, to the west of Katarapko Creek, it occurs as a narrow band extending into sand deposits for a short distance.

(c) *Eucalyptus oleosa*-*E. cyanophylla*-*E. gracilis* open scrub

On the older aelian sand dunes which form the highest areas of the reserve, an open scrub or mallee dominated by three eucalypts grows up to 6 metres but generally 4 to 5 metres high. *E. oleosa* and *E. cyanophylla* are the commonest canopy species, although *E. gracilis* may be locally more abundant on the heavier swale soils as is the case in the Calperum area to the north (South Australian Department of Lands 1982). This community covers several topography types each with distinctive red soils (otter et al. 1973). In this part of the Upper Murray *E. cyanophylla* appears to be associated with the exposure of calcrete beneath the dunes (South Australian Department of Lands 1982).

There are no tall shrubs and the ground cover is dominated by several grasses.

(d) *Dodonaea viscosa* open scrub

Areas of *D. viscosa* (hop bush) generally occur on low flats between tracts of mallee on relatively heavy soils with exposed calcrete. Sparse eucalypts occur as emergents, and several other shrubs are interspersed with the hop bush, including *Acacia nyssophylla*, *Xorophyllum* *aphyllus*, *Alectryon oleifolius* and *Myoporum platycarpum*. Ground cover consists mainly of *Enchylaena tomentosa* and grasses.

(e) Unstable - regenerating dunes

To the south of the mallee is an extensive area of recent aeolian sand overlying an old river terrace. In many places overgrazing by stock and rabbits has removed the vegetative cover and exposed patches of bare sand, many of which are being stabilised by regrowth. Dunes with sparse vegetation also occur in the floodplain area, including a large area to the west of the evaporation basin which has been tentatively described as the product of reworking of old levees and point bar deposits rather than of aeolian processes (Caldwell Connell 1981). This may account for the paler colour of some dunes on the floodplain.

Areas included in this unit vary from bare sand to dunes which have recently stabilised by grasses, herbs, hop bush and other shrubs. While the regeneration of sand dune vegetation on the floodplain is hampered by persistent rabbit populations, stabilisation has been rapid in the western areas where intensive rabbit control has been carried out.

(f) *Muehlenbeckia florulenta* closed heath-low open shrubland

The density, height and vigour of lignum varies greatly over the floodplain in response to ground level and other factors. It is generally about two metres high and forms impenetrable stands in relatively low-lying, poorly drained areas with fine sediments. Its lower limit is set, however, by the persistence of standing water. Its inability to colonise ephemeral and temporary wetlands and its decline in parts of the evaporation basin indicate that long-term inundation excludes it from the lowest parts of the floodplain. In higher areas where it merges with grassland and woodland it becomes stunted and sparse.

Herbs and grasses commonly associated with lignum are *Agrostis avenacea*, *Alternanthera nodiflora*, *Atriplex lindleyi*, *Heliotropium supinum*, *Phyla nodiflora* and *Sporobolus mitchelli*.

(g) *Chenopodium nitrariaceum* low shrubland

This community occurs in small areas near the eastern bank of Katarapko Creek at a relatively high elevation just below river box woodland and on soils which are heavier and greyer than those which are typical of lignum areas. *C. nitrariaceum* (nitre goosefoot) is generally 1.5 to 2 metres high and is interspersed with occasional lignum and a few stunted river red gums. Associated herbs and grasses include *Calocephalus* sp., *Cressa cretica*, *Compositae* and *Sporobolus mitchelli*.

(h) *Typha domingensis* closed herbland

Lying in the north-western corner of the northern extension of the park is an extensive, dense stand of *T. domingensis* (bulrush), generally about two metres high. The unit also includes some dense patches of *Phragmites australis* and areas of temporary open water and sedgeland. Much of the bulrush in higher areas has died back, probably because of recent dry summers. The only other areas where bulrush occurs in the reserve in appreciable stands are in a narrow fringe around Horseshoe Lagoon and near the inlet to the evaporation basin on Katarapko Island, suggesting that the permanence of the water supply is an important factor in its distribution. The large area of bulrush in the northern extension may be maintained by persistent seepage of water from the adjacent highland which would be enhanced by irrigation of nearby orchards. Notably, this is the only part of the floodplain which is close to irrigated areas.

(i) Riparian complex (not mapped)

"Riparian" areas are here defined as sections of the bank of the River Murray and Katarapko Creek within two metres vertically of the waters edge. This zone is typified by levee soils which are a mixture of fine sand, silt and clay. Its lower sections are close to a relatively stable water-table while the higher parts are alternately flooded and desiccated. The zone includes some river red gum and lignum but is dominated by *Phragmites australis*, *Cyperus arenarius* and *Paspalum distichum*, which are typical of areas with a reliable water supply. A variety of herbs and grasses also occur which are typical of the floodplain in general. Hydrophytes occur mainly on gently sloping clay banks on the inside of slight bends in the river and included *Myriophyllum* sp., *Ludwigia peploides* and *Valisneria spiralis*.

(j) *Atriplex* low shrubland-*Pachycornia triandra*-*Disphyma*, *crassifolium* herbland.

The extent of intermixing of these vegetation types makes map-separation impractical. They occur above flood level on the heavy grey soils of the high alluvial terrace on the western edge of the evaporation basin and in smaller areas further west beside Katarapko Creek. The vegetation ranges from *Atriplex* shrubs generally up to 1.5 metres high over scattered *Disphyma crassifolium* (round-leafed pigface), to a dense cover of both *Pachycornia triandra* up to 40 centimetres high, and round-leafed pigface covering large areas without shrubs.

Species of *Atriplex* were not distinguished but probably include both *A. nummularia* and *A. vesicaria* which were recorded from a similar environment in the Calperum area (South Australian Department of Lands, 1982). At that site *A. nummularia* is most common in depressions where water collects. Potter et al. (1973) found *A. nummularia* to be typical of high terraces on the Upper Murray. A few shrubs of *Eremophila divaricata* are scattered through this unit and *Sclerolaena decurrens*, *Senecio* sp. and various grasses are common.

(k) *Bromus rubens* grassland

A grassland of *B. rubens* with small scattered shrubs of *Salsola kali* extends over the recent aeolian dunes which cover an old alluvial terrace, a part of which is exposed to the east and supports a low shrubland of *Maireana pramidata*. There are extensive areas of grassland without shrubs and occasional dense patches of *S. kali*. A variety of tall shrubs and trees grow sparsely through this unit including *Acacia ligulata*, *A. oswaldii*, *Callitris preissii*, *Exocarpos strictus*, *Hakea leucoptera* and *Alectryon oleifolius*. Most of the native pine (*Callitris Preissii*) in this area was cut out earlier in the century, but the large number of stumps indicate that this species would originally have formed an open woodland over the grassland. An old survey map of the area (circa 1890) describes the area as "broken sand hills covered with pines and bushes".

This community also occurs in treeless patches within the mallee and on the slip-off slope at the eastern edge of the highland. The underlying clayey terrace material is exposed in places, sometimes forming swampy flats.

(l) *Eragrostis-Sporobolus mitchelli* grassland

Floodplain grassland occurs extensively in the reserve both as a discrete unit and intermixed with other vegetation types. Both dominants are usually intermixed, but *Eragrostis* (*E. australasica* according to Caldwell Connell 1981) is denser and more common at higher levels, often forming a complete cover, while *S. mitchelli* predominates at lower levels extending through and below lignum where *Eragrostis* is usually absent. The bulk of the floodplain grassland in the reserve occurs at a higher level than lignum. This community includes a variety of herbs and shrubs among the most common being *Alternanthera nodiflora*, *Atriplex* Sps., *Calotis scapigera*, *Sclerolaena muricata* and *Wilsonia humilis*.

(m) *Cressa cretica* herbland

Cressa cretica is the dominant species in this community consisting of low herbs generally less than 10 centimetres high. Other common species are *Maireana sclerolaenoides* and *Wilsonia humilis*. On the higher points the density of these herbs is relatively low, and succulent herbs, possibly *Halosarcia*, occur.

This unit has a limited occurrence in the reserve, one of the largest areas being on an abandoned meander scroll on the eastern side of Katarapko Island. The zonation of communities is very pronounced here and this community occurs immediately above a dense zone of *Eragrostis* which, in turn, is above lignum. The absence of this community type in similar situations in other parts of the reserve, even though most of the species occur in other communities, suggest that specific conditions of soil texture or other factors are necessary for its development and for the absence of blackbox and other species which grow above grassland elsewhere.

(n) *Maireana pyramidata* low shrubland

This community occurs in a single discrete area on the western side of Katarapko Creek on a triangular remnant alluvial terrace with heavy red soils. The dominant species, *Pyrata* (blackbush), grows up to 60 to 70 centimetres high over a ground cover including *Bromus rubens*, *Brachycome ciliaris*, *Sclerolaena decurrens*, *Silene* Sp. and *Trisetum pumilum*. A few hop bush and river box are scattered over the terrace.

This community and the preceding one occupy an environment which is unusual in the reserve and the northern extension, lying above the present flooding regime but on much heavier soils that are typical of the highland areas on the reserve's western side. Each contains species which occur in highland or floodplain environments and a few, for example *Sclerolaena decurrens*, were found only on these high terraces. In the Calperum area, Blackbush was found on clay flats interspersed through the sand dunes, as well as on the high alluvial terrace (South Australian Department of Lands, 1982).

(o) *Cyperus arenarius* C. *gymnocaulos* closed sedgeland

Mixed stands up to 50 centimetres high of both dominant species occur in an area to the south of the *Typha* closed herbland on the western edge of the extension. Some die-back of *C. arenarius* was evident here in April 1982 possibly because of a lowered water-table. Again, reliable water supply from seepage may be an important factor in the distribution of these species.

The unit varies from closed stands of either dominant to open stands over *Paspalum distichum*, *Sporobolus mitchelli* and shallow open water.

(p) *Halosarcia-Suadea australis* herbland

Both species form a complex mosaic over the reserve area with *S. australis*, up to 50 centimetres tall, more common at lower levels and extending into shallow water on the western edge, and *Halosarcia*, up to 25 centimetres tall, densest at high levels. Other herbs include *Wilsonia humilis* which is uncommon but widely distributed, and *Atriplex leptocarpa* and *A. lindleyi* occurring on high points. This community occurs only in the northern extension. It is intermediate in level between lignum and bulrush in lower areas, and grassland above. The absence of this community elsewhere in the survey area and the fact that grassland does not extend down to the lignum here as it does elsewhere suggests that high salinity may play a part in its occurrence. Both dominant plants are commonly associated with coastal salt marshes.

(q) *Heliotropium supinum* herbland

Heliotropium supinum and *Sporobolus mitchellii* are the predominant species in this vegetation type, the former species being by far the most abundant. Other common species are *Alternanthera nodiflora* and *Centipeda cunninghamii*. This unit occurs at very low levels on the floodplain. On the western edge of the extension it is below the adjacent lignum. As the major species also occur commonly through areas of lignum, this type may be the product of clearing and grazing of lignum or may reflect significant differences in soil and flooding regime.

(r) Semi-permanent open water

These areas are mainly old meanders of the River Murray which have not been infilled because their isolation has been relatively recent in geomorphological terms. They are fairly deep, up to three metres, but generally about two metres. They support a dense littoral flora dominated by *Typha domingensis*, *Phragmites australis*, *Paspalum distichum* and *Cyperus arenarius*. Hydrophytes are generally absent in Horseshoe Lagoon in the evaporation basin but probably occur in the deep wetland in the northern extension.

A small wetland at the south-west corner of Katarapko Island is mapped as semi-permanent because, while shallow, it is directly connected to the River Murray. *Azolla filiculoides*, *Ludwigia peploides* and *Vallisneria sp.* occur here.

(s) Temporary open water

Two criteria have been used to identify temporary open water. First, they contained water when inspected in April 1982. Second, they are usually connected to the river of Katarapko Creek by minor creeks or flood chutes so that they are refilled by rises in river level which are insufficient to cover most of the floodplain. These areas are mainly between 1 and 1.5 metres deep when full. They support most species recorded (below) for ephemeral open water. In addition, other species are present which require more frequent inundation than occurs in ephemeral open water, for example, *Cyperus gymnocaulos* and *Rumex crystallinus*.

These depressions have no direct connections to the river or Katarapko Creek and be refilled only when floodwaters overtop the levees. Their shallowness, generally up to 50 centimetres, and height above the water-table lead to a relatively rapid drying after floods. All were dry when mapped by R. Pressey in April 1982.

The vegetation is highly variable and depends on the timing of drying out relative to seed dispersal by floodplain plants. In areas which remain dry for some time *Cressa cretica*, *sporobolus mitchellii* and other plants typical of the higher alluvium may occur. Plants dependent on moist conditions, for example, *Polygonum plebeium*, occur in areas which had not completely dried out.

Katarapko Island evaporation basin

Since operation of the evaporation basin on Katarapko Island began in 1964, a marked decline in the condition of floodplain vegetation, particularly river red gums, has led to controversy and to two studies which assessed the changes in plant communities and identified the factors involved. The following information is summarised from the most recent of these (Caldwell Connell 1981).

The Caldwell Connell study described a progressive decline in the condition of river red gum and blackbox inside the evaporation basin over the same period in which no changes were apparent in stands outside the basin. Lignum was also affected, extensive stands in low-lying areas being killed by about 1980, although plants at higher levels showed increased vigour.

One of the conclusions of the study was that: "The pattern and time sequence of the decline of trees in the evaporation basin is consistent with the primary cause being changes in the hydrological regime of the island arising from operation of the evaporation basin".

The death of the river red gums at low elevations was attributed to drowning after a significant rise in average water level in the lagoon system. The subsequent decline of trees at elevations which are normally above the water level in the basin appeared to be caused by localised elevation of the water-table. Although highly saline groundwater imposes increased stress on trees which are affected by other factors, the higher ground water salinity in the basin was not considered to be a major cause of decline.

No hydrophytes were found in Horseshoe Lagoon although many submerged species are typical of billabongs on the Murray floodplain. Several factors could be implicated, including the large populations of European carp, high turbidity due to nutrient inputs in irrigation water resulting in algal blooms, and the relatively high salinity of irrigation drainage. The latter could be significant since at least four common billabong water plants have salinity limits below the prevailing levels in the basin.

The 800 hectare evaporation basin covers approximately 8.7 percent of the reserve area, and although its adverse effects are concentrated only in restricted low-lying parts, some important floodplain communities are affected. The desirability of an altered management regime for the basin has been discussed by Caldwell Connell (1981) and an alternative approach outlined. This approach should permit at least a partial recovery of the affected communities, and close monitoring of flora and fauna in the future will allow refinement of management techniques within the constraints imposed by water quality criteria in the River Murray.

1.8 Fauna

The fauna of the Riverland is well known from museum collection records, scientific research and observations by naturalists over many years. Much of this information can be extrapolated directly to Katarapko. Additional faunal observations have been made in the course of development of this management plan.

(a) Mammals

A survey by Marlow (1958) of the marsupials of New South Wales and subsequent general work by CSIRO have shown that timbered hills and mountains still retain a high diversity of mammals, while many species have become extinct or are very uncommon on the inland plains and woodlands, including most of the Murray-Darling Basin. This also applies to the Upper Murray of South Australia where the present mammal fauna is only a remnant of the fauna which existed prior to European settlement. According to Frith (1971), although the platypus still survives in many streams and the echidna in the scrubs, the mammal fauna of the plains is virtually gone. Of the thirty-two non-flying mammals recorded during the Blandowski Expedition of 1856-1857 north-east from Mildura (Wakefield 1966a), twenty-two species are now extinct, one is rare, one very uncommon and only eight are still common (Frith 1974). Many of the extinct species once occurred in South Australia. Frith notes that all the species which have disappeared are small ground-living mammals which depend on coarse grass and other low growth for shelter and forage. This implies that the destruction of habitat by stock was the main cause for the decline, although clearing, burning and the introduction of rabbits and new predators no doubt had a significant effect.

In recent years twenty mammal species have been recorded in the Riverland (Table II). Of these, eight are introduced species. Because of the wide range of habitats available in Katarapko it is expected that most of the species on this list occur there.

Table II: Mammals Recorded in the Riverland

* Indicates species recorded in Katarapko .	
* Short-beaked echidna	<i>Tachyglossus aculeatus</i>
* Common brushtail possum	<i>Trichosurus vulpecula</i>
* Feathertail glider	<i>Acrobaters pygmaeus</i>
* Western grey kangaroo	<i>Macropus fuliginosus</i>
* Red kangaroo	<i>Macropus rufus</i>
Goulds wattled bat	<i>Chalinolobus gouldii</i>
White-striped mastiff-bat	<i>Tadarida australis</i>
Yellow-bellied sheath-tailed bat	<i>Taphozous flaviventris</i>
Lesser long-eared bat	<i>Nyctophilus geoffroyi</i>
* Water rat	<i>Hydromys chrysogaster</i>
Fat-tailed dunnart	<i>Sminthopsis crassicaudata</i>
Common dunnart	<i>Sminthopsis murina</i>
Introduced Species	
Black rat	<i>Rattus rattus</i>
* House mouse	<i>Mus musculus</i>
* Fox	<i>Vulpes vulpes</i>
* Cat	<i>Felis catus</i>
* Pig	<i>Sus scrota</i>
* Goat	<i>Capra hircus</i>
* Brown hare	<i>Lepus capensis</i>
* European rabbit	<i>Oryctolagus cuniculus</i>

(b) Birds

Two hundred and fifty five species of birds have been recorded in the Riverland of South Australia. According to Frith (1974) there is little difference between the present avifauna of the Murray Valley and the avifauna which existed before European settlement. A few species have been introduced (seven for the South Australian Riverland) and one, the Magpie Goose, has virtually disappeared, although individuals still return as vagrants. However, when the abundance of certain species is considered, the changes have been dramatic. Hunting, clearing and the introduction of predators has seriously altered the status of many species, particularly some of the larger birds (for example the Australian Bustard) and ground-dwelling species such as the Plains-wanderer and the Bush Thick-Knee.

Katarapko includes a small part of the vast Murray Darling floodplain system which is the source of most of the waterfowl (Frith 1967) and other water birds bred in southern Australia. As well as valuable breeding habitat, the floodplain provides an enormous expanse of feeding, roosting and drought refuge areas in the form of lakes, billabongs and swamps. Waterbirds have generally been adversely affected in the South Australian section of the Murray by the following factors: engineering works which drain wetlands and reduce the frequency and duration of floods which are a stimulus to breeding; the use of low-lying areas as evaporation basins; and the introduction of the European carp which consumes aquatic plants and invertebrates and increases the turbidity of waterways. Despite these unfavourable trends, much valuable wetland habitat remains in the Riverland of South Australia, including billabongs and swamps within the Katarapko reserve.

A total of 147 bird species or 58 per cent of the Riverland avifauna has been recorded within the reserve. This is a high percentage relative to other faunal groups and can be attributed to the ease of observing birds and to the interest shown by local ornithologists and Department of Environment and Natural Resources staff in collecting records over many years. Most of the species not recorded in the reserve occur irregularly and/or in very small numbers in the Riverland.

Others are unlikely to be recorded, even with further intensive sampling, because of the lack of suitable habitat in the reserve.

The reserve includes a significant proportion of the reserved riverine woodland in the South Australian Murray Valley and is therefore of particular importance to the conservation of a number of species identified by Reid and Vincent (1979) as being highly dependent upon this habitat. These include the Peaceful Dove, Sulphur-crested Cockatoo, Sacred Kingfisher, Little Friarbird, Striped Honeyeater, Regent Parrot, Yellow Rosella, Blue-faced Honeyeater and Pied Butcherbird. The last four species are particularly associated with river red gums.

According to Caldwell Connell (1981) the extensive areas of healthy lignum make Katarapko Island exceptional as habitat for waterbirds. Elsewhere in the Riverland much of the lignum is grazed and cleared. This study also suggested that the evaporation basin may be important as a drought refuge and post-breeding area because of the stands of lignum and bulrush (*Typha*) beside permanent water. Several wetlands in the reserve, particularly the lagoon system within the evaporation basin, are important for the breeding of waterbirds. Most nesting of waterfowl in the Riverland is from July/August to February/March, the length of the breeding season being determined by the timing and duration of flooding. Even without flooding there is normally some small-scale breeding. Breeding of the Maned Duck and Australian Shelduck is more closely associated with day-length than fluctuating water levels and so takes place regardless of flooding.

The floodplain between the Katarapko evaporation basin and Loch Luna is a valuable area for colony breeding birds. Horseshoe Lagoon on Katarapko Island is an important breeding site for Darters. The Darters usually breed there in early spring if no flooding occurs, and a second nesting may take place in a flood year. A survey of Horseshoe Lagoon in January 1982 (M.J. Harper, SA DENR unpublished) gave the following information on waterbird breeding:

- * Two Darter nests in the north-eastern corner of the south lagoon in dead river red gums. A further six nests on the north lagoon in dead river red gums.
- * Thirty Little Black Cormorant nests in live river red gums along the bank of the south lagoon.
- * Twelve Yellow-billed Spoonbill nests on the eastern bank of the south lagoon in live river red gums.

Since construction of the evaporation basin and the decline of river red gums fringing the waterways the value of Horseshoe Lagoon for breeding has declined. In the Macquarie Marshes (New South Wales), live river red gums were used for breeding by eleven colonially-nesting birds during the major flood of May-December 1978 (A.K. Morris, N.S.W. National Parks and Wildlife Service pers. comm.). Only the Darters used dead gums as well as live ones. Although much further work is needed to establish the optimal breeding habitats of waterbirds in the Murray-Darling system, this information suggests that the die-back of gums in the evaporation basin, most severe on the lagoon margin, could have been accompanied by a reduction in the frequency and duration of lowered water levels relative to the original situation which has probably affected the productivity of wetland within the basin. A number of Australian studies (for example, Frith 1967; Braithwaite 1975) have shown that periodic drying of littoral areas is necessary for the breakdown of organic matter to useable forms, for optimal germination of marginal plants, and for other changes which can stimulate breeding and produce rich invertebrate and plant communities.

One of the favourable effects of the evaporation basin may be an increase in the food supply due to nutrient enrichment. In the southern part of Horseshoe Lagoon, high populations of many species occur, apparently in response to organic industrial inputs, although the lagoon appears to have reached or exceeded its assimilative capacity (Caldwell connell 1981). Horseshoe Lagoon and its associated wetlands support a moderate diversity of waterbirds despite the adverse effects of operations in the basin. Field observations suggest that this diversity may be decreasing now that the lagoon does not flood. Apart from breeding areas described above, important aspects of habitat in Horseshoe Lagoon include; the stands of *Typha* which are important for Baillon's Crake, Spotless Crake and several other species, and an area of dead gums at the eastern end of the south part of

Horseshoe Lagoon which is used by four species of cormorants for roosting (Caldwell Connell 1981).

Although the net effect of the evaporation basin upon waterbird populations has been adverse, the remaining values of wetlands within the basin, and the significant areas of wetlands elsewhere on the island and to the west of Katarapko Creek with a natural water regime, make the reserve an important area for waterbird conservation in the Murray Valley of South Australia. Further, there is potential for this value to be enhanced with appropriate management of the evaporation basin (see 3.10: Alien Tenures).

(c) Reptiles

The reptile fauna of the Riverland appears to have remained relatively stable despite changes caused by European settlement, although the distribution and abundance of many species have been reduced. Some reptiles are absent or very uncommon in grazed areas while retaining a foothold in refuges of natural or near-natural vegetation. Both cats and foxes are known to take a toll of reptiles, particularly in droughts when rabbit populations are low. Foxes, in particular, have had a serious impact on tortoise populations. Thompson (undated) found that predation on tortoise eggs in the Murray system of South Australia is of the order of 94 percent and considered that the main predator was the fox. Of the sixty-eight species of reptiles reported from the Riverland, only three have been recorded from Katarapko to date. However, this is likely to be a reflection of the lack of specific investigation and the secretive habits and low population densities of many species rather than the lack of suitable habitat. The diversity of habitats in the reserve is such that the majority of species in the region should occur there.

(d) Frogs

Nine species of frogs are known to occur in the Riverland although only three have so far been recorded from Katarapko. They are the eastern banjo frog (*Limnodynastes dumerilii*), spotted grass frog (*L. tasmaniensis*) and *Ranidella parinsignifera*.

(e) Fish

Twenty-one species of fish have been recorded in the Berri-Loxton area. The fish of the Upper Murray have also been subject to adverse influences since European settlement. There have been obvious declines in the distribution and abundance of most native fish species over the past century due to interactions with introduced species and to various environmental changes (Walker 1981b). Lake (1975) lists a number of adverse influences on the fish in the Murray-Darling system including the removal of snags, altered flood regime, release of cool water from dams, siltation, and inputs of chemicals and nutrients. Of the fish in the Riverland he lists the golden perch, Murray cod and freshwater catfish as species with considerably reduced range and abundance.

In Katarapko Creek the main recreational species are golden perch, red fin and yabbies.

The wetlands within the Katarapko contain some valuable fish habitat, which includes holes up to 10 metres deep, snags formed by fallen trees, and steep clay banks. The flood prone areas of The Splash is possibly an excellent fish breeding area.

1.9 Recreation

(a) Origin of visitors

The Riverland area caters for a significant proportion of travellers in South Australia. Data compiled by the South Australian Department of Tourism (1981) showed that during 1979/80, when all-purpose travel was considered, 9.2 percent of visits to all South Australian regions were made to the Riverland. When only holiday travel has considered, this figure rose to 13.1 percent. During 1981/82, 84.1 percent of visits to the Riverland were made by people living in the State and 10.2 percent of all within State visits were made to the Riverland (South Australian Department of Tourism, undated).

Overall, the main source of all travel groups to the Riverland in the first half of 1979 was Adelaide (49.5 percent), with about 14 percent from other areas in South Australia (South Australian Department of Tourism 1980). When groups are considered whose final destination is the Riverland, these figures rise to 65.6 percent and 16.6 percent respectively.

More recent figures (Tourism South Australia, 1988) suggest that numbers of visitors to the Riverland are continuing to increase even though the proportion of domestic travellers to the region has decreased slightly. Eighty five percent of Australian domestic visits to the Riverland were from people of South Australian origin whilst 15 percent were from interstate.

International tourists are a minor proportion of total visitors to South Australia (4 percent in 1986/87) but this group has displayed substantial growth in recent years.

Of significance to Katarapko is the finding by the South Australian Department of Tourism (1981) that camping outside caravan parks in the Riverland was a major type of accommodation (15.3 percent of nights). Tourist authorities in the Upper Murray believe that the various types of natural reserves in the area are playing an increasing role in tourism and that they are largely an untapped resource. Katarapko is one of five or six very popular natural camping areas on the river from Loxton upstream to the border.

(b) Visitor Attitudes and Activities

Important factors guiding the management of a reserve are the characteristics, activities and opinions of visitors, since a major aim of the reserve system is to cater for the general public as well as to conserve, natural and historic features. This information may be obtained from visitor interviews or questionnaires as well as other sources. The amount of data gained so far from Katarapko is not great but is sufficient to describe current visitors in general terms and to identify their views on management options. A summary is outlined below:

Visitor characteristics

- * heaviest use of the park is over Easter when there are usually 250-300 campers.
- * other busy periods are the New Year and October long-weekend.
- * over 50 percent of visitors are aged under thirty years.
- * family groups are most common (approximately 45 percent), followed by mixed sex (30-10 percent) and all male (15-25 percent) groups.

- * origins of groups have been : Riverland (30-40 percent) South Australian city (25-60 percent), interstate (0-30 percent). Almost all groups came to the reserve by car. The proportion of visitors from the Riverland is much higher during weekdays and on normal weekends. People from the Berri-Loxton area predominate at these times.

Activities

- * most common recreational activities are; fishing (50 percent of visitors), relaxation (35 percent), water sports (10 percent), picnicking and bushwalking (5-10 percent).
- * tents are the most common camping mode (60-80 percent of groups) although caravans, campervans and other specialised vehicles are growing in popularity. A significant proportion (approximately 8-10 percent) of campers camp in the open.
- * regardless of camping mode, the vast majority of groups (95 percent) have a fire for both cooking and relaxation.
- * the locations of regular camp sites have been mapped. Most camping takes place along the three kilometres of bank downstream from the junction with The Splash. The next heaviest concentration is between the lower junction of the creek with the River Murray and a point about four kilometres upstream. Camp sites tend to be widely separated between these zones. This distribution seems to reflect the ease of access to the creek bank, the ease with which boats can be launched and landed and the distribution of open, level areas suitable for camping.

Views on management

- * past visitor surveys and public responses to the draft of this plan released for public comment in 1984 indicate that the great majority of people are opposed to any "improvements". The majority of both local visitors and those from other parts of the State value the area in its undeveloped state.
- * minor facilities sometimes considered to be acceptable include fireplaces and toilets as well as improved boat launching facilities.
- * despite past resistance from park users, it has been considered that some regulation of camping is essential to ensure the continued quality of the recreation experience. As a result, some 40 campsites have been identified along the Katarapko Creek and the network of superfluous tracks on the Katarapko floodplain has been rationalised. Public reaction to these rationalisations of campsites and tracks has been positive and a marked improvement in amenity values has resulted.

1.10 References

The following list includes references cited in this management plan:

Braithwaite, L.W. (1975). - Managing Waterfowl in Australia. Proceedings of the Ecological Society of Australia. 8:107-128.

Buchan, R. (undated). - "The Aborigines of New South Wales: Murray People." (NWS National Parks and Wildlife Service: Sydney).

Buchan, R. (1979). - Aborigines Along the Murray. Forest and Timber 15:15-18.

Burton, J.;R. (1974). - Hydrology of the Basin. In: "The Murray Waters: Man, Nature and a River System." (Eds. H.J. Frith and G. Sawyer) (Angus and Robertson: Sydney).

Caldwell Connell Engineers Pty. Ltd. (1981). - Katarapko Island Evaporation Basin Environmental Study. Draft. Prepared for South Australian Engineering and Water Supply Department.

Casson, H.R. and Hirst, W.R.C. (1972). "Loxton District and Town." (Hawthorn Press: Melbourne).

Cooper, H.M. (1972). - Aboriginals of the Loxton Area In: "Loxton: District and Town". (M.R. Casson and W.R.C. Hirst) (Hawthorn Press: Melbourne).

Dexter, B. (1979). - To Flood or Not to Flood: That is The Red Gum Question. Forest and Timber. 15:5-8.

Firman, J.B. (1972). - Renmark, South Australia, Explanatory Notes 1:250,000 Geological Series. Sheet :SI/54-10 International Index. South Australian Department of Mines. Geological Survey South Australia.

Frith, H.J. (1967). - "Waterfowl in Australia." (Angus and Robertson: Sydney).

Frith, H.J. (1974). - Wildlife. In: "The Murray Waters, Man, Nature and a River System." (Eds. H.J. Frith and G. Sawyer) (Angus and Robertson: Sydney).

Johnson, K.E. (1974). - The Role of the River Murray Commission. In: "The Murray Waters: Man, Nature and a River System." (Eds. H.J. Frith and G. Sawyer) (Angus and Robertson).

Lake, J.S. (1975). - Fish of the Murray River. In: "The Book of the Murray." (Eds G.V. Lawrence and G.K.I. Smith) (Rigby: Adelaide).

Marlow, B.J. (1958). - A Survey of the Marsupials of New South Wales. CSIRO Wildlife Research. 3:71-114.

Potter, J., Wetherby, K.G. and Chittleborogh, D.J. (1973). - A Description of the Land in County Albert, County Alfred and Part of County Eyre, South Australia. South Australian Department of Agriculture, Soil and Conservation Branch LD1.

Reid, N. and Vincent, D.J. (1979). - Report of an ornithological Survey of South Australian National, conservation and Recreation Parks and s, with Comments on the Adequacy of Bird Conservation in south Australia. South Australian Ornithologist Association.

South Australian Department of Lands (1982). - Calperum Management Study. Draft. Land Resource Management Division.

South Australian Department of Tourism (undated). - Tourist Research Information: Summary of South Australian Tourism Statistics, 1980/81.

South Australian Department of tourism (undated). - Papers presented at the Riverland Visitor Survey Seminar held in Berri, 30 April 1980.

South Australian Department of Tourism (1980). - Tourism Research Information: Riverland Visitor Survey, January-June 1979.

South Australian Department of Tourism (1981). - Tourism Research Information: Domestic Travel in South Australia, April 1979 - March 1980.

South Australian State Planning Authority (1978). - Murray Valley Planning Study. The River Murray in South Australia: a Resource Under Pressure.

Tourism South Australia (1988). - S.A. Tourism Statistics 1986/87.

Specht, R.L.O. (1972). - "The vegetation of South Australia." (Government Printer: Adelaide).

Thompson, M.B. (undated). - Fox Predation on the Eggs of Tortoises in South Australia. Report for the National Parks and Wildlife Reserves Advisory Committee.

Thompson, R.M. (1975). - Geomorphology of the Murray Valley in South Australia. MA thesis, University of Adelaide.

Wakefield, N.A. (1966a) - Mammals of the Blandowski Expedition to North-western Victoria 1956-57. Proceedings of the Royal Society of Victoria. 79:371:391.

Walker, K. (1981b) - Effects of Weirs on the Environment of the Lower River Murray. South Australian Fisheries Industry Council. 5:26-29.

Woolmer, G. (1973) - "The Barmera Story." (Barmera Golden Jubilee Committee: Barmera).

2 KATARAPKO MANAGEMENT OBJECTIVES

The following objectives for the management of Katarapko are designed to serve as a rigorous guide to the uses and developments permitted in the area. All reserve management should be within the constraints of these objectives.

2.1 Zoning

Katarapko serves a number of functions, some of which are in conflict or may lead to conflict as visitor use continues to grow. Management of the reserve should aim to conserve natural areas representative of the Riverland area, to cater for an increasing recreational use, to promote interpretation and education. Parts of the reserve therefore need to be zoned for the most appropriate use so that all aims can be achieved with a minimum of conflict.

To indicate the geographical pattern of use and management which satisfies the management objectives for the reserve and to protect areas of high conservation significance and provide a range of recreation opportunities.

2.2 Native Flora

The preservation of plant communities representative of the Riverland of South Australia is a major function of Katarapko. Management toward this end is particularly significant since the area contains a large proportion of the conserved floodplain plant communities along the River Murray in South Australia and because vegetation on high ground within the reserve is easily disturbed. Management should therefore aim to preserve the diversity of plant communities and species, to minimise the impacts of other uses on vegetation, and to promote the re-establishment of plant communities as near as possible to their condition before European settlement.

To manage native flora within the park as far as possible in a condition approximating that which existed before European settlement.

2.3 Native Fauna

The Murray Valley has a distinctive fauna, much of which is still intact although fragmented because of European settlement. Katarapko contains a sample of this fauna which needs to be carefully assessed and considered in future management. Much of this can be achieved by properly managing plant communities, although some animals may have more specific requirements. Consideration should also be given to the pre-European fauna of the area and to the re-introduction of species where appropriate.

To manage native fauna within the park as far as possible in a condition approximating that which existed before European settlement.

2.4 Plant and Vertebrate Pests

Deliberate and accidental introduction of alien plants into the reserve during more than 130 years of European land-use have altered the natural plant communities and affected the integrity of the area as a conservation unit. In addition there are a number of declared plant pests in the Riverland which could invade under certain circumstances. Introduced animals, particularly the rabbit, have had significant adverse effects on the vegetation while others pose a threat to native fauna. Management of the reserve toward a state as close as possible to that which existed before European settlement therefore requires the control of alien species, particularly those which are proclaimed pests under the Animal and Plant Control Act, 1986.

To control plant and vertebrate pests within the reserve and, where possible, limit the extension of and reduce populations of other introduced species.

2.5 Fire

Other than nuisance call outs resulting from arson attempts there have been few problems posed by fire damage or control in the reserve. However, with increasing recreational use and the regeneration of plant communities, the risk of wild-fire needs to be minimised, and methods of control and management defined.

To ensure that measures compatible with the purposes of the reserve are taken to prevent the outbreak and spread of unplanned fires within the reserve.

To ensure that when unplanned fires do occur they are controlled as soon as possible.

2.6 Aboriginal and Historic Resources

The relics of European settlement in the park provide an important source of information on the areas history. All European relics should therefore be researched and documented and those of particular historic or educational significance should be preserved. Prior to dedication, many of the Aboriginal sites which had existed when the land was opened up for grazing had disappeared due to high floods, erosion and the removal of relics. There has been no systematic description of those which remain. The first priority of management of these relics must therefore be identification and assessment followed by the necessary steps to preserve or describe any of significance.

To investigate and document relics of Aboriginal and European occupation of the reserve and to preserve any relics of significance.

To involve the Riverland Aboriginal community in the protection and management of Aboriginal relics.

2.7 Facilities for Visitors

Recreational demand both from local residents and from tourist use of areas along the upper reaches of the River Murray has increased significantly over the past decade. The region is seen by many people to have considerable potential for further tourist and recreational usage. This is particularly true of the Katarapko reserve.

So as to adequately cater for increasing visitor numbers and at the same time ensure protection of the environment, the provision of well sited, basic facilities is required. The placement of such facilities will need to consider the linear pattern of visitor use of the reserve.

To provide for a range of quality recreational experiences which are consistent with reducing impact on the riverine environment while enabling visitor enjoyment and appreciation of that environment.

To design and carry out education and information programs so as to increase public knowledge of the reserves' natural and historic features and to influence patterns of visitor use and minimise conflict with other park values.

2.8 Roads and Tracks

Many years of unmanaged access prior to reservation of the floodplain areas of the reserve resulted in a highly complex and largely unnecessary track network. Many of these tracks were actually or potentially damaging to the reserve because they caused erosion, increased fire risk by allowing access to fire-prone areas away from camp sites and also helped to spread litter and weeds. The need to rationalise this network was recognised in the draft of the management plan and has since been undertaken.

To ensure that an effective and efficient system of roads and tracks is maintained.

2.9 Alien Tenures

Within many South Australian reserves there are areas which, for various reasons, are occupied or controlled by other instrumentalities. In general it is desirable to have all management under a single authority or, where this is impossible, to carefully co-ordinate other management to avoid compromising the objectives of the reserve. Two management issues in Katarapko can be grouped under this broad heading. The first of these is dredging of the river with deposition of soil on Katarapko Island. The second impact concerns the Katarapko Evaporation Basin, the future management of which is crucial to the recovery of damaged plant and animal communities within the lagoon system it encloses.

To monitor the effect of modifications to natural values of the reserve caused by dredging in the River Murray and to respond to such monitoring programs by seeking appropriate modifications to work programs of other management agencies.

To enhance the wetland habitat value of the Katarapko Evaporation Basin in conjunction with its management as a salinity control structure.

2.10 Research and Monitoring

Management techniques and objectives cannot be regarded as inflexible. They need to be dynamic and to accommodate the changing needs of users, natural communities, and increasing knowledge of the natural systems within reserves. Many aspects of Katarapko need to be studied more closely and changes monitored so that management can react appropriately.

To undertake research and monitoring programs to provide information critical for park management purposes.

To foster further research on the reserve's flora, fauna and geomorphic features.

3 KATARAPKO MANAGEMENT PROGRAM

3.1 Zoning

To indicate the geographical pattern of use and management which satisfies the management objectives for the reserve and to protect areas of high conservation significance and provide a range of recreation opportunities.

Natural boundaries within the Park have been used to delineate four zones (figure 3), each of which has particular management requirements and is significant for achieving the management objectives.

Floodplain Conservation Zone

This zone incorporates the whole of Katarapko Island comprising 4,087 hectares or 44.6, percent of the reserve area, only a small part of which (the alluvial terrace west of Horseshoe Lagoon) is above the present flooding regime. The zone also includes the adjacent Rilli Island, Media Island and Kapunda Island Conservation Parks.

These areas are completely surrounded by either Katarapko Creek or the River Murray which protects them from access by terrestrial vehicles and other human influences. With the exception of the evaporation role of the basin and the artificial manipulation of water levels, they therefore provide a natural area where biological processes continue largely unaffected by external influences. As Katarapko Island contains a wide range of plant communities and faunal habitats, some of which are not present in other parts of the reserve and are unusual in the context of the Upper Murray as a whole, the continuation of a conservation function for this area is highly desirable. Consequently, vehicular access across Katarapko Island will be restricted to authorised service vehicles only.

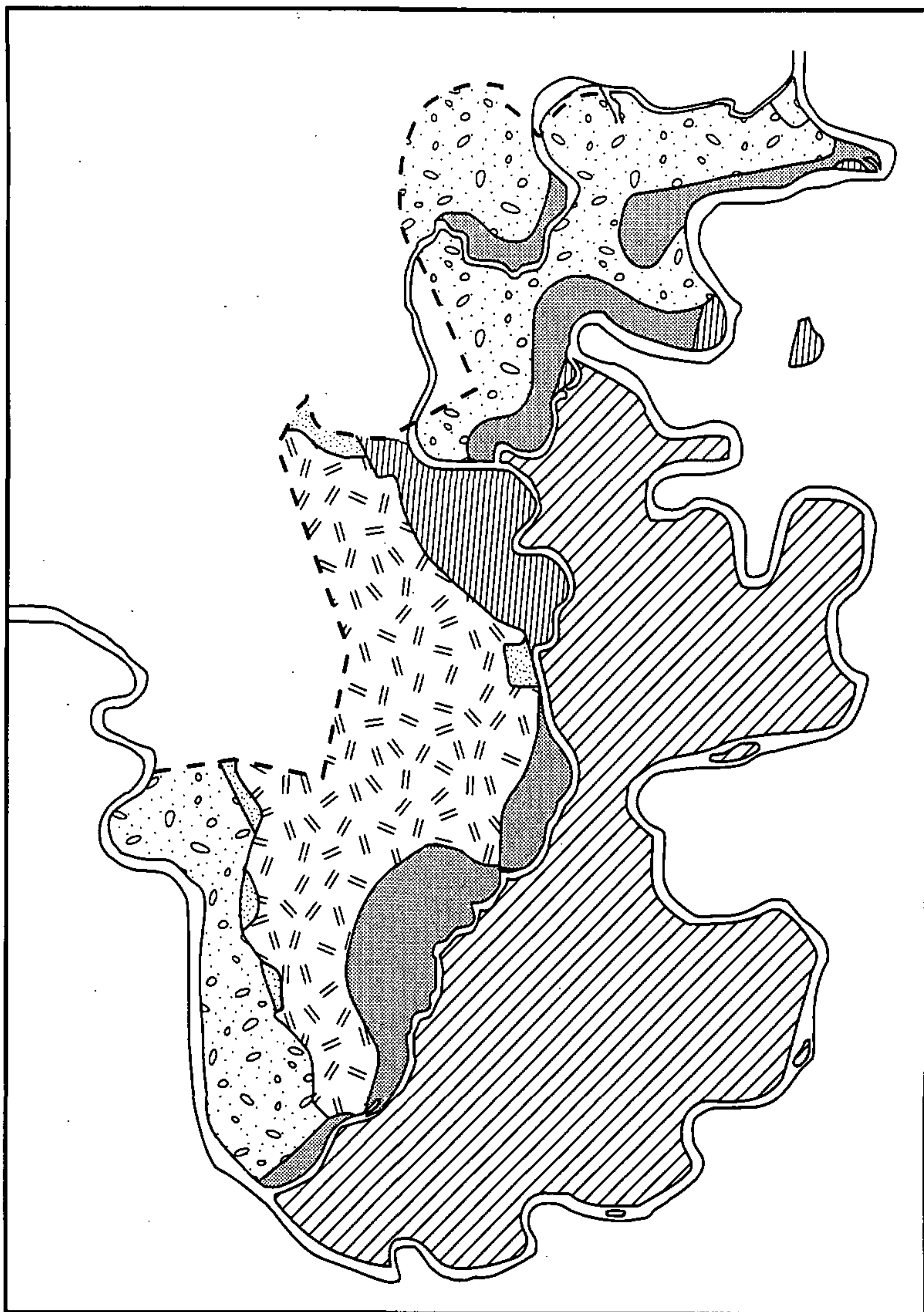
Although the Floodplain Conservation Zone covers areas which have been altered by management of the evaporation basin, future management of irrigation water should result in restoration of the plant communities to a near-natural condition (see section 3.10 on Alien Tenures).

Highland Conservation Zone

Apart from small areas included within the Highland Use Zone, all high ground within the reserve will be managed as a conservation area with limited vehicular access. The proposed road system (see section on Roads and Tracks) will allow visitors to view a representative range of habitats while preventing further damage to vegetation. Particularly sensitive areas are the triangular alluvial terrace adjacent to Katarapko Creek which is badly eroded, and the large area of sandhills over an extensive alluvial terrace south of the mallee area (figure 3). Access to highland areas not covered by roads will be allowed by pedestrians.

Floodplain Use Zone

The Floodplain Use Zone incorporates all remaining areas of floodplain excluding the Conservation Zone. Vehicular access within this zone will be allowed only on the tracks which are retained after rationalisation of the road and track system. No vehicular access will be allowed after flooding and heavy rain because of the serious damage caused to the wet clay tracks.



 Floodplain : Conservation

 Highland : Conservation

 Floodplain: High use

 Highland : Use

 Floodplain: Moderate use

 Floodplain: Low use

0 km 2 4





FIGURE 3

**MURRAY RIVER NATIONAL PARK
Katarapko
Zoning**

The following two levels of use are envisaged for specific areas within this zone (figure 3)

(a) High-use area

The area of the Floodplain Use Zone at the western entrance of the reserve designated for high use receives regular use by campers and day visitors. This area has served as a recreation and camping area for many years. It will continue to be managed so as to allow a high level of informal camping while minimising environmental impact. Provision of minor facilities in this area may be necessary to achieve this.

(b) Low-use areas

Because of their nearly natural condition and range of habitats, the areas of floodplain between the Highland Use Zone and the River Murray and sections of floodplain in the north of the park will remain available for camping but facilities will not be provided and vehicle-based camping will not be encouraged. Instead, these areas will emphasise activities such as nature study, bushwalking and bird watching. Public vehicle tracks in these areas will be limited to those required to allow through traffic.

Highland Use Zone

One area of highland has been zoned for use to allow for the provision of visitor facilities above flood level. Should camping pressure on the floodplain increase to the extent that toilet facilities become necessary, small additional sections of highland may need to be rezoned for use to allow the establishment of the required facilities on high ground.

3.2 Native Flora

To manage native flora within the reserve as far as possible in a condition approximating that which existed before European settlement.

The management of native flora is closely tied to the implementation of other management objectives discussed in this plan and is therefore covered under other relevant headings. The most important management requirements for the maintenance and restoration of plant communities are the control of vertebrate and plant pests, wild fires and appropriate zoning of the reserve. Significant regeneration of most plant communities has been observed since stock were removed from the various sections after the reserve was established. The effective control of rabbit populations, particularly on the large dune area west of Katarapko Creek, is the next most important step in the restoration of vegetation followed by weed control and prevention of vehicular access to delicate environments.

Wildfires within the river red gum woodland area of the reserve can have devastating affects. For example large old trees, because of their usually hollow nature are easily destroyed by fire. These trees have major conservation and aesthetic value and should be protected.

Monitoring of vegetation responses to revised management of the evaporation basin (see section 3.11) will help to define the optimal water regime in this area and encourage regeneration of plant communities.

The regeneration of several plant species will be given special attention. For example hop bush (*Dodonaea viscosa*) which occurs within the reserve in a large, self-maintaining population, will be encouraged to grow on bare sand dunes because of its value in stabilising these areas.

Numbers of other species including bullock bush (*Alectryon oleifolius*), native pine (*Calitris Preissii*) and silver needle-bush (*Hakea leucomyxa*) have been severely depleted through grazing by stock and rabbits, and in the case of native pine, by timber cutting. Individuals of these species are now widely spaced and seed reserves apparently exhausted so that natural regeneration is very slow. Monitoring of these species when rabbit populations have been effectively controlled will indicate the necessary management measures required. Such measures may include importing seed from other areas and creating conditions suitable for germination by burning or preparation of the soil surface in an active revegetation program.

3.3 Native Fauna

To manage native fauna within the reserve as far as possible in a condition approximating that which existed before European settlement.

Achievement of this management objective will principally be through restoration and maintenance of plant communities (see section 3.2 on Native Flora) and through the control of introduced predators (see section 3.4 on Plant and Vertebrate Pests).

Public comment on the draft of this management plan expressed concerns relating to circumstances of a number of species or groups of fauna. These concerns included:

- (a) the need to protect aquatic organisms inhabiting billabongs, creeks and backwaters from excessive visitor use such as power boating.
- (b) the impact of recreational net fishing on native fish populations within the Katarapko Creek during the breeding season.
- (c) the population structure of the Murray tortoise *Emydura macquarii* being skewed towards old individuals because of fox predation on eggs.

During the period of this plan DENR will investigate the nature of these and future concerns and will implement specific management action if required. Survey work on fox predation of tortoise eggs was commenced during 1988/89.

Additional information will also be gathered to assess the fauna of the reserve in the context of the Riverland and to determine whether reintroduction of some species is feasible. Such data will also indicate whether further reserves are necessary in the region to maintain the existing patterns of migration and dispersal of fauna.

3.4 Plant and Vertebrate Pests

To control plant and vertebrate pests within the reserve and where possible, limit the extension of and reduce populations of other introduced species.

Introduced Plants

The Department has a commitment to the ongoing control of introduced plants which is influenced by the priorities of the Pest Plant Control Board. Outbreaks of weeds are usually treated with an initial intensive effort followed by routine maintenance to prevent re-establishment. Control methods include chipping or cutting and swabbing with herbicide for the less abundant species and spraying for large infestations. Of the 80 or so proclaimed pest plants under the jurisdiction of the Riverland Pest Plant Control Board, thirty-one have been recorded in the Riverland area and, of these, eleven have been recorded growing within Katarapko.

California burr (*xanthium californicum*) is one of the more serious pest plant problems occurring within the reserves.

This species commonly occurs in areas of river red gum, and may form a complete cover particularly in swales behind levees along the banks of the River Murray. Some of the most extensive infestations within the reserve are on Katarapko Island.

The extensive outbreaks of this plant after floods, and the continual recolonisation from areas upstream, make complete control within the reserve impractical. Instead, efforts will be concentrated on areas zoned for public access, particularly camping areas. Chipping, spot-spraying and slashing will be carried out to enhance the appearance and comfort of these areas for campers.

Of the other pest plants within the reserve, only golden dodder (*Cuscuta* sp.) presents a similar problem to California burr. This plant is common in some areas of river red gum and is concentrated on Katarapko Island.

Recently extensive trials have been carried out on Katarapko Island to examine ways of controlling dodder using chemicals which will not adversely affect native flora. Future dodder control programs will consider the results of these trials.

Other problem pest plant species occurring within the reserve include African boxthorn (*Lycium ferocissimum*), African daisy (*Senecio Pterophorus*) and boneseed (*Chrysanthemoides monilifera*). These species will gradually be eliminated from the reserve by ongoing spraying, cutting and swabbing. Small infestations of prickly pear (*Opuntia* sp.) and Olives (*Olea europaea*) will be eradicated as quickly as possible because of their present limited distribution and their potential for expansion into established native vegetation. Control of other scheduled pest plants occurring in the reserve may be undertaken after considering the requirements of the Animal and Plant Control Act, 1986 for the schedule on which the plant is listed and the economic and environmental impact of the species on the reserve and on surrounding land.

Willows (*Salix* Spp.), occur on Katarapko Island and the adjoining island conservation parks. To date, their presence has had little impact on the park environment, making control unnecessary. However, as willows are recognised as a species that can invade creeklines, their occurrence in the reserve will be monitored and control measures instigated if necessary.

Introduced Animals

(a) Rabbits

As in many other South Australian reserves, rabbits are by far the most abundant and serious animal pest in Katarapko, causing severe damage to vegetation through feeding and burrowing. Some of the effects of rabbit infestation within the reserve, which are most apparent in the dune area of the west of Katarapko Creek, are the encouragement of weed-growth through heavy selective grazing of the more palatable species, prevention of regeneration of some native plants and instability of the dunes because of depleted cover (leading to destruction of some Aboriginal sites). In 1981 the worst affected part of the reserve contained about 600 warrens within 400 hectares.

In the 1979/1980 financial year, a program of systematic rabbit control was begun in the highland area west of the creek. This program had a marked success in initiating regeneration of plant communities. Control involved three main stages: poisoning with 1080 poisoned oats; destruction of warrens, usually by ripping; and fumigation of inaccessible warrens. Experience has shown that such control is most effective when rabbit numbers are lowest and during the non-breeding period (when they are not underground with young). In Katarapko these conditions usually apply between January and March.

Unfortunately, the control program has also demonstrated that the complete elimination of rabbits from the reserves is impractical. Even after poisoning and destruction of warrens some rabbits remain, many living and even breeding on the surface in areas such as beneath lignum bushes. Populations quickly build up as soon as control programs are completed.

Because of these remnant populations there will be a continuing need to maintain a rabbit control

program until such time as an effective biological control agent is introduced. The Department will consequently conduct, at least, a control program to reduce rabbit numbers. In addition selected areas may be fenced with rabbit proof fence to further assist regeneration mechanisms or protect important features such as Aboriginal midden sites.

(b) Other vertebrate pests

No assessment has been made of the number of hares, foxes and cats in the reserve, but populations of each are probably low and the numbers of foxes are known to decline after rabbit poisoning. On-going control will continue by fencing and trapping or shooting by rangers.

Irregular sightings of feral pigs have been reported. Although it is considered that pigs will not become a major pest in the Riverland (as they have in other areas of Australia), there is the possibility that they may cause localised problems. Consequently due to the extensive areas of habitat on the reserve which is suited to pigs, every effort will be made to eradicate all animals sighted. Monitoring of pig activity will also be of high priority.

3.5 Fire

To ensure that measures compatible with the purposes of the reserve are taken to prevent the outbreak and spread of unplanned fires within the reserve.

To ensure that when unplanned fires do occur they are controlled as soon as possible.

In terms of risk of ignition and spread of fire by natural causes, Katarapko can be regarded as a low fire risk. The risk of unplanned fires occurring in the reserve is, however, much greater in areas accessible to the public, particularly those areas used for camping. The main preventive measure to avoid fire spreading from camping areas is to ban the use of open fires during the hotter months. This practice will be continued.

Although the reserve is not totally covered under any council fire restriction the Department will normally relate the reserve fire ban period to that set by the Berri District Council unless unusual circumstances dictate otherwise.

Fire is unlikely to spread into or from adjoining areas. Katarapko Island and the island conservation parks are obviously well protected from fire, and the area west of Katarapko Creek is bordered by the River Murray. There are vehicle tracks along either side of the Gerard Reserve boundary, and the dual carriageway entrance road.

The northern area of the reserve is insulated from fires by a perimeter of orchards, wetlands, samphire flats and creeks. Fire control and suppression will be facilitated by the proposed track network (see section 3.8 on Access) and the terrain is such that fire fighting equipment can readily be taken to most sections of the mainland part of the reserve.

The risk of fire on Katarapko Island is low and in the unlikely event of an outbreak, vehicles and equipment can be taken over the weir at the northern end. A boat, equipped with a fire pump and hoses, will be retained within the Region for fire suppression in areas close to navigable waterways.

3.6 Aboriginal and Historic Resources

To investigate and document relics of Aboriginal and European occupation of the reserve and to preserve any relics of significance.

To involve the Riverland Aboriginal community in the protection and management of Aboriginal relics.

Relics of early European settlement are now limited, (see Section 1.6 - European Settlement). Many of the more recent items are simply accumulations associated with shack sites and are not worthy of conservation. These sites will be progressively tidied up. The old stockyards (see Figure 2, "HS2") however, will be retained and used in park interpretation. Before removal of any relics occurs, all remnants of European settlement will be mapped, described and researched with the help of previous land-holders and others so that the details of the reserve's history are not lost.

Many Aboriginal relics have also been lost or damaged through erosion and other disturbances. The Service will seek to ensure that remaining important sites are stabilised and that further deterioration is prevented. The history and location of Aboriginal sites within the reserve is known mainly by local Aboriginal residents and previous land holders. This knowledge will be used in conjunction with a systematic survey of the reserve to document Aboriginal sites. Further assistance will then be sought from the local Aboriginal community to determine priorities for the conservation of cultural sites and requirements for future management.

Management practices developed for the preservation and management of Aboriginal sites and European heritage resources will be consistent with the Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (The Burra Charter).

3.7 Facilities for Visitors

To provide for a range of quality recreational experiences which are consistent with reducing impact on the riverine environment while enabling visitors enjoyment and appreciation of that environment.

To design and carry out education and information programs so as to increase public knowledge of the reserve's natural and historic features, and to influence patterns of visitor use and minimise conflict with other park values.

Camping

The location and condition of camp sites within the reserve has developed through many years of unregulated use rather than through deliberate management. As the great majority of visitors are opposed to any modification of these camping areas (see Section 1.9 - Recreation), the management of the reserve will aim to alter them as little as possible while seeking to prevent excessive damage to vegetation and degradation of camp sites due to over-use.

Those parts of the reserve zoned for Floodplain Use have the capacity to support expansion of camping in selected locations. Nevertheless extension of camping areas is not necessary at the present time as existing campsites satisfy demand. Any future expansion of camping opportunities will be in the Floodplain Use or Highland Use Zones. Within these zones a certain amount of alteration to plant communities due to trampling, clearing and collection of firewood has occurred. This degradation will be monitored and, if necessary, areas rested from camping activity. Nevertheless, a degree of alteration will be tolerated in use zones, bearing in mind the large floodplain and highland areas zoned for conservation.

Alternative sources of firewood will be investigated.

The designation of camp sites by the placement of numbered posts is necessary to identify sites and stop random site proliferation. At present 38 designated nodal campsites have been identified on the western side of Katarapko Creek and a further 17 nodal campsites plus three

campgrounds have been established between Eckert and Katarapko Creek (figure 2). To help visitors dispose of litter, rubbish depots have been placed at the reserve's three main entrances (see figure 2). these depots will be regularly serviced.

After flooding, Nankeen Night Herons sometimes nest in river red gum saplings close to designated camping areas. This situation will be monitored and if necessary nearby camping areas will be closed during the breeding season.

Toilets

These may be seen as undesirable by some visitors but will be necessary to prevent pollution and health problems during peak periods in high use areas. Suitably designed and placed they have minimal effect on the natural setting. Toilets should be established at both campgrounds and at the junction of The Splash and Katarapko Creek.

Boat Access

Powered and unpowered watercraft will be permitted to enter and use the water at any point along the waterways of the reserve, provided environmental disturbance does not become excessive. Current South Australian legislation relating to the use of watercraft will apply in the reserve. During the period of this plan DENR will also investigate the suggestion that there be additional speed limits on boats, moving through the waterways of the reserve. Any further restrictions on boating activities (over and above those already applying under the South Australian Boating Act) will be advertised in the South Australian Gazette and subsequently enforced.

The two natural boat ramps on the western side of the Katarapko Creek (see figure 2) will be maintained.

Information

Information on the reserve and its management will be provided in the following forms:

- * small information facilities near the two main entrances (see figure 2) to provide an outlet for information materials and displays of the reserve's natural attributes.
- * a general previsit introductory brochure about the reserve available from all Departmental headquarters.
- * interpretative walks and an interpretative drive explaining the natural features of the reserve.
- * various signs to facilitate directional and regulatory information.

Litter Collection

Litter Collection bins at the three major park entrances will be serviced regularly.

3.8 Roads and Tracks

To ensure that an effective and efficient system of roads and tracks is maintained.

A rationalisation of the track network within the high use area of the Floodplain Use Zone, west of Katarapko Creek, was completed in 1986 with the area between Eckert and Katarapko Creeks completed in 1993. As demonstrated by the road rationalisation, any future road network design will aim to reduce erosion and minimise the disturbance of plant communities while satisfying the following criteria:

- * access will be retained to suitable camping areas and lengths of bank appropriate for launching and landing of boats.
- * where possible, camping nodes will be accessed by way of a spur track leading off a through road thereby minimising disturbance caused by through traffic.
- * where possible, access to camping nodes will be designed so that specific areas can be temporarily closed off to allow regeneration of vegetation.
- * a limited number of circular drives leading from through roads will be provided at suitable locations to facilitate access to camp sites by caravans.
- * a road system will be designed which allows public vehicular access to samples of all habitats present in the use zones and facilitates smooth traffic flow. New tracks may be introduced where required.
- * roads and tracks will cater for a range of visitor uses including access to interpretative facilities, sightseeing from cars, nature study and other recreational activities.
- * additional access roads may be maintained specifically for park management and fire control purposes.
- * the Engineering and Water Supply Department retain a right of access to roads across section 1958 to Lock 4 and to the Katarapko Creek weir crossing.

To protect the fragile road network on the floodplain from vehicle traffic after heavy rain or flooding, the condition of the road network will be monitored, and if the District Ranger considers that damage to roads and tracks will be excessive, the roads will be closed to vehicles until sufficiently dry.

3.9 Alien Tenures

To monitor the effect of modifications to natural values of the reserve caused by dredging in the River Murray and to respond to such monitoring programs by seeking appropriate modifications to work programs of other management agencies.

To enhance the wetland habitat value of the Katarapko Evaporation Basin in conjunction with its management as a salinity control structure

The present major uses of the Katarapko reserve for non-park purposes are the deposition of dredge spoil on the eastern side of Katarapko Island, and the use of the evaporation basin (figure 2) for storage of irrigation water. Both activities are controlled by the Engineering and Water Supply Department.

Dredging

Dredging of sand from the river has been carried out near the upstream ends of Rilli and Media Islands to maintain a navigable channel which is threatened by continual movement of sediment from upstream. The nature of the problem is such that it will again be necessary in future years.

The general affect of dredging on the reserve is to deposit beds of sand (at present less than one hectare each) in an essentially clay habitat, suggesting that some vegetation changes are likely. Guidelines have been developed by DENR concerning the location of spoil deposits and the maximum depth of sand. Where possible the dredge spoil will be deposited into the main stream of the river or elsewhere outside the park. If the spoil is to be deposited onto Katarapko Island DENR will continue to liaise with the Engineering and Water Supply Department to ensure dredged material does not impact on important wildlife habitats.

DENR has initiated monitoring of the depth and distribution of spoil deposits and changes to vegetation. This monitoring will be continued so that the extent and severity of impacts can be assessed. These are not entirely predictable at the moment because the effect of floods on dispersal of the material is not known. If it is found that the effects of the operations significantly affect the integrity of the plant communities on the eastern part of the island, then DENR will request the Engineering and Water Supply Department to investigate alternative methods of disposal.

Evaporation Basin

In 1964 the Engineering and Water Supply Department constructed a series of levee banks on Katarapko Island to form an 800 hectare evaporation basin for disposal of irrigation water from the Loxton Irrigation Area. The basin encompasses several floodplain habitat types (figure 3) including lignum flats, grassland, riverine woodland, temporary wetlands and Horseshoe Lagoon, the only semi-permanent wetland within the reserve. The effects of operation of the basin on flora and fauna have been outlined in Part 1 of this plan. In response to controversy over the impact of the evaporation basin, particularly the decline of river red gums, studies were commissioned to assess the ecological changes within the basin and to suggest measures for mitigation.

The Caldwell Connell (1981) study confirmed that the major factors responsible for the decline of vegetation in the basin were prolonged flooding of low-lying areas and elevation of the water-table and salinity of groundwater. These in turn were produced by the mode of operation of the basin which maintained high water-levels within the basin, increased the salinity of the wetland system, and reduced the frequency of flooding within the basin.

In the light of these findings three options for the management of the basin were identified:

- (a) Continuation of existing operation (Option 1) This would involve no alteration of the previous management regime but assumed that discharge of organic trade wastes into the basin from Loxton would be terminated. A long term mean water level of about EL 11.3 metres would be maintained, about 1.5 metres higher than the Lock 3 pool level, and real salinities would be in the range of 3,500 to 500 parts per million.

The general impacts of this option would include a continuation of the river red gum die-back, with reduced potential for regeneration in lower areas and continued impacts on, and relocation of other vegetation types.

- (b) Cessation of discharge to the basin (Option 2) Under this management all irrigation water would be conveyed to the Noora Evaporation Basin and the system of levee banks on Katarapko Island could be breached to allow a reversion to the pre-1964 flooding regime. The feasibility of this option, however, was influenced by its high economic cost, estimated at 12.4 million in November 1980, against which ecological benefits are unlikely to be seen as significant.

This option would result in the lowering of water-levels and salinities in the lagoon system and return to the regional groundwater regime and normal flooding frequency. Healthy vegetation associations would eventually reappear in low-lying areas, and river red gums between the lagoons and river could show increased vigour as seepage flows of highly saline groundwater cease. The lagoon system would become shallower and more natural aquatic communities would develop.

- (c) Revised management of the basin (Option 3): This option proposed a new management regime which would effectively make the area a holding basin. Drainage water would only be discharged into the basin when it could not be safely discharged to the river and controlled discharges would be made from the basin into the river whenever high water flows permitted. It was estimated that at least 50 percent of the irrigation drainage water could be diverted to the River Murray instead of the basin for 73 per cent of the time. This management would have allowed the basin to be flushed with river water for at least a two week period in every year between 1964 and 1979. Flushing actually occurred in only six of these years. Under this management option there would be a mean operating water level of approximately EL 10.5 metres within the basin. This would be 0.8 metres lower than the mean water-level under previous management but still 0.7 metres higher than Lock 3 pool-level. The resultant lower water table in the basin would allow the re-establishment of river red gums and other vegetation types in most of the areas where they originally occurred. The diversity of the aquatic biota would be increased and avifaunal habitat would generally be enhanced from the existing situation.

The evaporation basin occupies approximately nine per cent of Katarapko. Its adverse effects on flora and fauna are restricted to the less extensive low lying areas around Horseshoe Lagoon and associated wetlands. While DENR is concerned about these impacts, the problems of optimal management of the basin are influenced by factors such as water quality in the River Murray and the economic feasibility of alternative schemes which are beyond the scope of the Service alone to consider.

In 1984, after consultation by all authorities involved, Option 1 was accepted. It was anticipated that this option would achieve partial restoration of natural habitats while avoiding the large economic costs of an alternative disposal system.

Within the constraints imposed by the revised management scheme, DENR in consultation with the Engineering and Water Supply Department will develop detailed guide-lines for water-level manipulations so that the natural values of the wetland system within the basin can be optimised. A quantitative long term monitoring program of the wetlands will be established and programs for rehabilitation of the wetlands will be initiated. Through discussions with the Engineering and Water Supply Department, DENR will seek to enhance wetland habitats. This may be achieved by varying lagoon levels and flushing regimes. Periodic wetting and drying of part or all of the wetlands may be undertaken. If feasible, inlet and outlet structures will be modified to facilitate the control of carp.

3.10 Research and Monitoring

To undertake research and monitoring programs to provide information critical for park management purposes.

To foster further survey and research on the reserves flora, fauna and geomorphic features.

Although the need for further information on the reserve has been discussed previously in relation to various aspects of management, the following are the areas and issues on which ongoing research and monitoring will be concentrated.

Visitor surveys

Further standardised visitor surveys will be carried out to assist in defining user requirements and responses to management actions. Surveys will cover both holiday and non-holiday periods and will investigate the reaction of visitors to hunting on Katarapko Island.

Visitor information

An information program for the reserve will be researched and developed with emphasis on the natural history of the area (See Part 4.7 above)

European History

Further research into the European history of the reserve will be encouraged, particularly the documentation of local knowledge of past European occupation of the area now reserved.

Aboriginal History

In conjunction with the local Aboriginal community, Aboriginal sites within the reserve will be investigated, documented and priorities for their management determined.

E & W.S. Department Activities

The effects of dredged spoil deposition and management of the evaporation basin will be monitored, particularly in terms of changes in plant communities, waterbird numbers and waterbird breeding.

Ecological Survey and Research

The assistance of naturalist groups, tertiary institutions and others will be sought to expand the information base on flora, fauna and geomorphic features of the reserve. Priority will be given to wetland research.

Community Liaison

DENR will maintain close community involvement in management of the reserve through both informal and formal processes. A Murraylands Consultative Committee comprising representatives of local interest groups and individuals with specialised knowledge will be continued, providing a forum for discussion between Murraylands Regional staff, the community and the Minister. The Aboriginal community will be involved in park management decisions through the continuation of the Districts Aboriginal Working Party which comprises representatives from the Gerry Mason Centre the Gerard Reserve Council and staff of the Murraylands Region of the Department of Environment and Natural Resources.

4 KATARAPKO MANAGEMENT ACTIONS

Throughout this plan various general and specific objectives of management practices are listed. These are designed to identify the direction of future management of the planning area. Actual progress in implementing the various management proposals will be determined by the level of management resources available and the extent of other responsibilities in the Murraylands Region.

Constraints on DENR may not permit the rapid achievement of any or every objective identified in this plan. To ensure that the most important of the management functions are met in an orderly fashion from the limited resources available, the relative priorities of the various management operations are summarised below. DENR will monitor progress in achieving the various objectives of the plan and will maintain an updated list of management priorities.

PROJECT	PRIORITY	DURATION	PAGE
Native Flora			
Survey of species distribution and abundance.	Moderate	Continuing	26
Encourage regeneration of depleted vegetation types	Moderate	Long	26
Implement revegetation program	Moderate	Long	26
Native Fauna			
Survey of species distribution and abundance.	Moderate	Continuing	27
Monitor rare and threatened species.	Moderate	Long	27
Plant and Vertebrate Pests			
Control of pest plant species	High	Continuing	27
Control rabbits	High	Continuing	28
Monitor and, if possible, eradicate pigs	High	Continuing	29
Fire			
Maintain boundary and designated internal tracks for fire control	High	Continuing	29
Control all unplanned fires	High	Continuing	29
Aboriginal and Historic Resources			
Research and document Aboriginal and European historic sites	Moderate	Short	30
Stabilise disturbed sites	High	Short	30
Facilities for Visitors			
Designate additional campsites	Moderate	Short	30
Construct required toilets	Moderate	Short	31

Maintain natural boat ramps	Moderate	Continuing	31
Maintain information facilities at road entrances	High	Continuing	31
Signposting	High	Short	31
Produce a reserve introductory brochure	High	Short	31
Design and develop interpretative walks and an interpretative drive	Moderate	Short	31
Litter collection	High	Continuing	31
Roads and Tracks			
Complete the rationalisation of the track network	High	Medium	32
Allow Engineering and Water Supply Department right of access to installations	High	Continuing	32
Monitor the condition of the floodplain road network and if necessary close to vehicular access	High	Continuing	32
Alien Tenures			
Monitor the effects of deposition of dredge spoil	High	Continuing	33
Monitor the effects of the revised management scheme of the Evaporation Basin	High	Continuing	33
Manipulate water levels in the Katarapko Evaporation Basin so as to enhance its value as waterfowl habitat	High	Continuing	33
Further Research and Monitoring			
Develop standardised survey techniques for assessing visitor numbers and attitudes. Carry out these surveys at regular intervals	Moderate	Continuing	35
Develop and implement a comprehensive information and interpretation program	Moderate	Continuing	35
Foster accumulation of fundamental data on the reserves flora, fauna and geomorphic features	Moderate	Continuing	35

LYRUP FLATS

1 LYRUP FLATS DESCRIPTION

1.1 Landform and Soils

Laut et al. (1977) place Lyrup Flats in the Renmark Environmental Association of the Upper Murray lands Environmental Region of the Murray Mallee Province. The main feature of the landscape in this Association is the incised ancestral floodplain of the Murray River with a variety of fluvial landforms including discontinuous levees, oxbows, back swamps, lakes and low terraces. Many of these wetlands are seasonally inundated although the overall effect of river regulation has been to maintain river levels higher than their natural summer depth but with a substantially reduced frequency of winter flooding.

Deep, grey, self-mulching, cracking clay soils occur in the low-lying, river terraces. Much of the surrounding region has largely been cleared for town-site development and for grazing and irrigation purposes. To the north there are two large pastoral properties "Calperum" and "Chowilla" both of which contain extensive areas of floodplain. The latter has recently been the subject of a detailed public consultation and planning exercise and, as a result, a considerable volume of natural resource information is available (see National Environmental Consultancy, 1987, NCSSA, 1990 and Murray-Darling Basin Commission, 1991).

1.2 Vegetation













A vegetation map showing the major plant communities at Lyrup Flats is shown in Figure 4. Nicholson and Carter (1992) have provided descriptions of each of these mapping units as outlined below.

1.2.1 Red Gum Woodland

This association occurs immediately adjacent to the river and associated wetlands and occupies low lying areas that are frequently flooded. Associated soils are typically a mixture of fine sand, silt and clay. *Eucalyptus camaldulensis* (river red gum) is the dominant species with *Acacia stenophylla* (coobah) occasionally co-existing on the landward margin of the association. The sparse understorey is dominated by *Muehlenbeckia florulenta* (lignum), *Cyperus gymnocaulos*, *Cynodon dactylon*, *Paspalum* spp. and *Alternanthera nodiflora*. *Phragmites australis* can be found growing in dense patches on the banks of the river.

1.2.2 Red Gum/River Box/River Coobah Woodland

This association occurs on the floodplain and can be found at slightly higher elevations than the red gum woodland. *E. camaldulensis* occurs closest to the water and grades to a mix of *Eucalyptus largiflorens* (River Box) and *A. stenophylla* further inland. *M. florulenta* is the dominant understorey species with *Atriplex lindleyi*, *Eremophila divaricata*, *Atriplex suberecta* and grass species co-existing. The condition of this vegetation type varies significantly with health generally declining with distance from the river. Soils range from fine sands and silts to floodplain clays.

-  *Eucalyptus camaldulensis* Woodland
Cyperus gymnocaulos Sedgeland
-  *Eucalyptus camaldulensis*-*E. largiflorens*-*Acacia stenophylla* Woodland
Muehlenbeckia floruenta Shrubland
-  *Eucalyptus largiflorens*-*Acacia stenophylla* Woodland
Muehlenbeckia floruenta Shrubland
Cyperus gymnocaulos Sedgeland
-  *Eucalyptus largiflorens* Woodland
Atriplex rhagodioides Shrubland
-  *Dodonaea viscosa* spp. *angustata*-*Callitris prelatii* Woodland
-  *Muehlenbeckia floruenta*-*Chenopod* Shrubland
-  *Atriplex* spp. Shrubland
Cynodon dactylon Grassland
-  *Helioscira* spp.-*Atriplex* spp. Shrubland
-  Scald
-  Wetland
-  River Murray
-  Out of Study Area

• Photo Point

— 1956 Flood Level

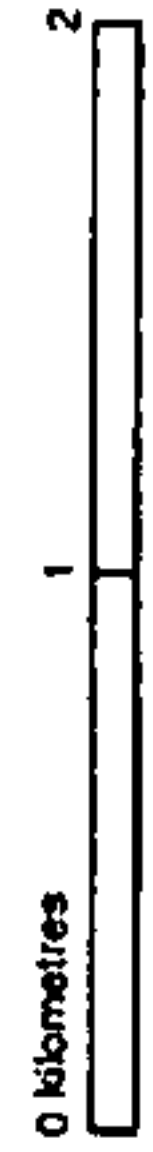
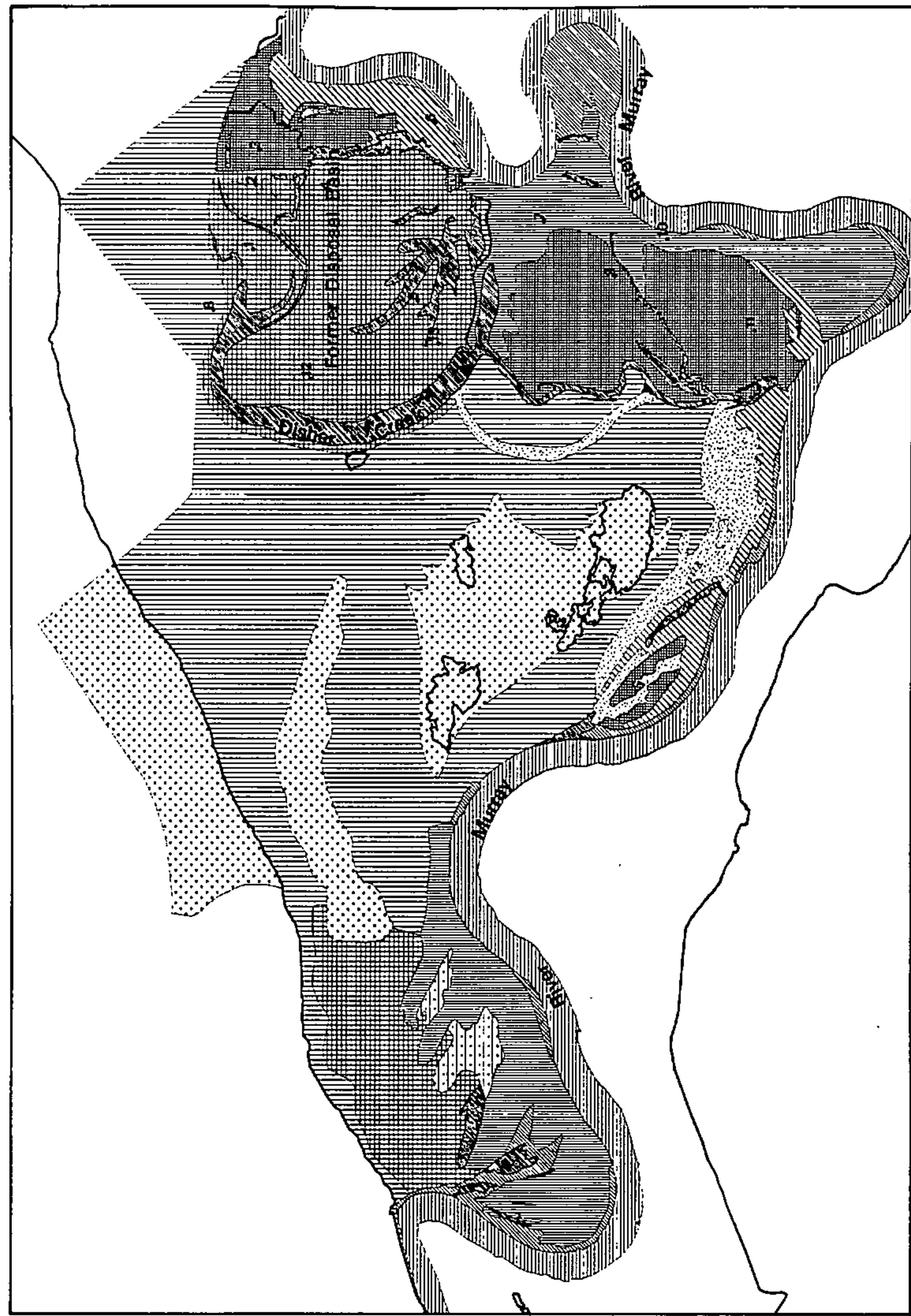


FIGURE 4

MURRAY RIVER NATIONAL PARK
Lyrup Flats
Existing Vegetation



1.2.3 River Box/River Coobah/Lignum Woodland

Characterised by *E. largiflorens* and *A. stenophylla*, this association occurs on the high floodplain which is subject to infrequent flooding. *E. largiflorens* generally marks the outermost boundary of the association, representing successive flood events. *M. florulenta* is the dominant understorey species with *Atriplex lindleyi*, *Eremophila divaricata*, *Atriplex suberecta* and grass species also occurring. The lignum sometimes forms dense thickets, particularly in areas that are low lying and intermittently flooded. Lignum typically fades out as ground elevation rises and is excluded from lower areas by permanently waterlogged soils. At higher elevations the understorey is dominated by *Atriplex* and *Maireana* species. Soils vary from grey floodplain clays in low lying areas to sandy loams at higher elevations.

1.2.4 Degraded Red Gum/River Box/River Coobah Woodland

Once a healthy community, this vegetation, which is found predominantly on saline grey clays on the low floodplain, contains trees which have died as a result of artificially high water levels, increased soil salinities and river regulation. The dead trees are remnants of the pre-regulation forests. The present vegetation is characterised by *Halosarcia* species, *Atriplex lindleyi*, *A. semibaccata*, *A. rhagodioides*, *Sclerolaena tricuspus* and *M. florulenta*.

1.2.5 River Box Woodland

River box woodland occurs on the high floodplain and generally represents successive flood events with the outermost trees indicating the 1956 flood level.

Tree cover is sparse with an understorey dominated by *Atriplex* species. Where the soil is highly saline, samphire species and *Disphyma crassifolium* dominate the understorey. Depending on their elevation, soils range from red sandy loams to grey sandy clay.

The health and vegetative structure of the trees varies enormously across the floodplain. In some areas they are stunted and have adopted a mallee habit which Margules et al. (1990), suggests "is due to the combination of the coppicing effect caused by cutting, and dry soils caused by the low flooding frequency". Local opinion suggests that the multi-stemmed growth habit is a result of coppicing after cutting whilst stunted growth is due to high soil salinity. The latter factor is probably also responsible for the large number of dead and stressed trees over much of the high floodplain.

Scattered pockets of river box regeneration can be found in areas where rabbit activity is low.

1.2.6 Hopbush/Native Pine Woodland

This association can be found on a large sandy rise adjacent to the high floodplain. The dominant species is *Dodonaea viscosa* var. *angustissima*, an unpalatable species commonly considered by graziers to be a "woody weed". According to Margules et al. (1990), *D. viscosa* is able to out-compete the original dominant tree species and invade the sandy rises as a result of overgrazing and soil erosion.

Calitris preissii occurs as scattered individuals throughout the association. This species was once prolific throughout the Murray Mallee but grazing pressure from sheep and rabbits is now a common barrier to effective regeneration. The Lyrup Flats area is no exception.

Other species in this community include *Casuarina cristata*, *Alectryon oleifolius* and *Pittosporum phylliraeoides*.

1.2.7 *Lignum*

This species varies from being clustered and impenetrable to quite sparse. It is generally found on low lying, poorly drained and saline soils within the former evaporation basin. In many areas the plants are dead having been drowned by previously high water levels. Increasing soil salinity is placing many other individuals under additional stress. In areas where the soil is relatively sandy and therefore not highly saline lignum can be found growing in association with saltbush species including *Atriplex lindleyi*, *A. semibaccata* and *A. rhagodioides*. Where the soil is saline, associated plants include samphire species such as *Halosarcia indica*, *H. pergranulata* and *Disphyma crassifolium*.

1.2.8 *Lignum/Chenopods*

This association is found in the southern part of the old evaporation basin. Soils range from grey cracking clays to coarse sands and silts. Vegetation is variously dominated by *M. florulenta* and *Halosarcia* species depending on soil type and drainage. The vegetation is either stressed or dead due to high soil salinities and water-logging associated with the former evaporation basin. *E. camaldulensis* and *E. largiflorens* occur along creek lines. Ground-cover species include *A. lindleyi*, *Pachycornia triandra*, *Einadia nutans* and *Alternanthera nodiflora*. *E. camaldulensis* regeneration is occurring on a series of low ridges in the southern section of the evaporation basin.

1.2.9 *Samphire*

This association is found adjacent to the embankment at the northern end of the evaporation basin on low-lying, poorly drained saline clays. Construction of the embankment has restricted natural water flows and resulted in increased soil salinities and consequent domination by salt tolerant plants such as samphires. Species present include *Halosarcia indica*, *H. pergranulata*, *Disphyma crassifolium*, *Pachycornia triandra*, *Heliotropium curassavicum* and sedge species.

1.2.10 *Atriplex/Grassland*

This association occurs on the floodplain at a higher elevation than associations characterised by lignum. It consists of a number of grass species including *Paspalum distichum* and *Cynodon dactylon* and *Atriplex* species including *A. lindleyi*, *A. rhagodioides* and *A. nummularia*. Scalds are common and in places the soil is badly eroded and compacted. Soils consist of grey silty clay loams.

1.3 Native Animals

There is little published information available on the fauna of Lyrup Flats although it is known to have a resident population of western grey kangaroos and a diverse avifauna. Bird species commonly observed in the area include White-faced Heron, Yellow-billed Spoonbill, Little Pied Cormorant, Grey Teal, Black Swan, Whistling Kite, Yellow Rosella, Red-rumped Parrot and Noisy Miner. Mammals include kangaroos, brush-tailed possums, several species of bats and water rats.

Aquatic fauna collected by Thompson (1986) include European Carp (*Cyprinus carpio*), mosquito fish (*Gambusia holbrookei*), Mitchellian Freshwater Hardyheads (*Craterocephalus strecumuscarum*), Western Carp Gudgeons (*Hypseleotris klunzingeri*), Big-headed Gudgeons (*Philypnodon grandiceps*), Australian Smelt (*Retropinna semoni*), prawns (*Paratya australiensis*), corixids (*Agraptocorixa* sp.) and ostracods. Chironomids, various copepods, corixids, cladocerans, notonectids and *Macrobrachium* prawns have also been recorded by Lloyd et al., 1984)

1.4 Wetlands

Thompson (1986) and Pressey (1986) have undertaken surveys along the River Murray. Pressey identified and mapped all wetlands greater than one hectare on the river floodplain and Thompson surveyed all the wetlands identified by Pressey that occur in South Australia. Four of the 220 South Australian River Murray wetlands identified occur in the Lyrup area. Thompson and Pressey also reviewed the conservation status of the wetlands and made management recommendations. An important observation was that changes in the hydrological management of the wetlands would improve habitat value and productivity. Both studies suggested that hydrological management should aim to reinstate flushing regimes approaching those that existed prior to river regulation.

Thompson considered that the Disher Creek Basin was of only low conservation value because of the degraded nature of its vegetation and high salinity levels. However when combined with other wetlands in the Lyrup area this rating was elevated to "high", because together they form a series of wetlands from permanent to temporary, thus providing a diverse habitat that is valuable to water birds and also provides drought refuge for fish and other aquatic species.

In its report entitled "Enhancing Wetlands" the South Australian River Murray Wetlands Working Party reviewed the data presented by Thompson and Pressey and examined opportunities in South Australia for improvement in wetland habitat through hydrological management

The Working Party considered a number of options (SA River Murray Wetlands Working Party, 1989) and, after considering social, economic and environmental impacts, concluded that the most acceptable method was to manipulate water levels within individual wetlands rather than in entire reaches via lock and weir management. Many of the works recommended in the 1989 report have now been implemented and a monitoring program established.

Since publication of the Working Party report in 1989, a further investigation has been carried out that has evaluated the potential for water level manipulations within entire reaches by lowering and/or raising upper pool levels at the locks and weirs (Ohlmeyer, 1991). This report has recommended that the Lock 8 - Lock 9 reach, due to its relative isolation from irrigators and river users, could be raised and lowered on a trial basis.

The Disher Creek Basin was one of four wetlands given highest priority for manipulation by the SA River Murray Wetlands Working Party. Criteria for such selection were:

- * it had an existing control structure that would be less expensive to modify than installing a new one
- * it was located on Crown Land so modification would be less constrained by possible impacts on private users
- * its hydrological regime was already substantially man altered
- * it was highly degraded and therefore had high priority for rehabilitation
- * it was modified as a disposal basin in 1983 when the Noora Drainage Disposal Scheme came into operation and has since operated as a balancing storage for drainage water before it is pumped to Noora (see section 2.4.1).

A comprehensive wetland management program was commenced in 1990 based upon recommendations made by the South Australian River Murray Wetlands Working Party. The program consisted of three separate components (Nicholson and Carter, 1992):

- (a) hydrological management involving a series of construction works to increase the frequency of flushing
- (b) rehabilitation of riparian vegetation involving on-ground trials, community involvement and the development of riparian vegetation management guidelines

- (c) a wetland monitoring program evaluating the impacts of the new flushing regimes on wetland flora and fauna.

As a result of these management actions Disher Creek Basin is now considered to be of high conservation value as waterbird habitat and warrants special protective measures.

1.5 Hydrological Management

Following the acquisition of Disher Creek from Calperum Station in 1964 (see history section - 1.10) a long earth embankment was constructed which isolated the creek from the main river and inlet creeks. The area subsequently served as an evaporation basin until the Noora Drainage Disposal Scheme was commissioned in 1983.

A drainage outfall channel is located at the northern end of the basin while at the southern end there is an old concrete spillway and a newer, low level regulator. The concrete spillway is approximately 26 metres wide and has a sill level of EL 15.19. The outlet regulator consists of a single 750 mm pipe and sluice gate with an invert level of 12.5 m. The surrounding embankments are constructed to EL 16.40 m. River pool level is 13.20 m.

During the 1981 high river, which peaked at 107 800 ML/day, the northern portion of the embankment near the outfall channel was breached. The breach was deliberately retained and has since acted effectively as a lower level inlet.

Prior to 1981 the Disher Creek Evaporation Basin was flooded when flows reached 105 000 ML/day, or approximately once every twelve years. Since the embankment was breached and the inlet effectively lowered, the basin has flooded at flows of 40 000 ML/day or approximately once every two to three years.

In 1983, the commencement of the Noora Drainage Disposal Scheme enabled water to be pumped from Disher Creek to Noora and Disher Creek has since functioned as a balancing storage for drainage water before it is pumped to Noora. Water is consequently now held at much lower levels than previously and, outside flood events, water is maintained in the creek at pool level (13.20 m) so as not to induce saline groundwater flows to the river.

In 1990 a series of construction works were carried out to improve flushing through the basin.

To increase the frequency of flushing flows the old 1981 breach was formalised and rock protection provided. The breached section was established at EL 14.40 m which allows flows through the basin to commence when river flows reach 38 000 ML/day. The sill is approximately 18 metres long and rock protection extends the full width of the sill and 3 metres either side of the end slopes. The banks of two other watercourses into the evaporation basin were lowered to EL 15.1 and EL 15.0 respectively to increase flushing during river flows in excess of 52 000 ML/day.

To cope with the increased flows a new 15 m long, rock protected outlet spillway was constructed at EL 14.00 m, between the low level regulator and the high level spillway.

The high river that peaked at 113 000 ML/day in October 1990 flooded the entire basin and dislodged much of the rock protection on the low level spillway. The rock protection has since been reinstated.

1.6 Pest Plants and Animals

Common proclaimed pest plant species which occur at Lyrup Flats include Californian burr (*Xanthium californicum*) and Bathurst burr (*Xanthium spinosum*). Both are found along watercourse margins and are sometimes parasitised by dodder (*Cuscuta epithymum*), a species of major economic concern which also parasitises small commercial crops such as clovers. An annual spraying program for dodder is undertaken by the Plant and Animal Control Board along river margins downstream of Renmark.

Until recently, African boxthorn (*Lycium ferocissimum*) and prickly pear (*Opuntia* sp.) trees were scattered through the area. A spraying program for the control of boxthorn was carried out in 1991-92 and during the same period prickly pears were physically removed. Follow up will be required to prevent re-establishment.

Willow trees (*Salix* sp.) are scattered along the river frontage and major watercourses.

Because of the extent of inundation in flood periods, problems associated with vertebrate pests are comparatively minor. Rabbits are the most serious threat with foxes, nomadic hares and occasional feral pigs usually present in relatively low numbers.

An assessment of rabbit numbers was undertaken in June 1990 (Nicholson and Carter, 1992). The highest density of warrens was recorded in the north east of Lyrup Flats adjacent to the high floodplain in an area of some 100 hectares bordered by the Renmark Country Club, the Sturt Highway and Spring Cart Gully Road. A number of warrens were also recorded in dune areas on the high floodplain but the remainder of the floodplain was relatively free of warrens due to the unsuitability of the clay soils for warren excavation.

In floodplain areas dense stands of lignum provide refuge for rabbits and, according to Nicholson and Carter, at times their numbers can be high. Frequent flooding of such areas does tend to keep numbers down and also provides the ideal time for rabbit control programs as rabbits are forced from their floodplain refuge to higher ground. Such a program was undertaken in the Disher Creek Basin area during the 113 000 ML/day flood of November 1990 and effectively removed all rabbits from this area.

A rabbit control program over the remainder of the planning area involving baiting with 1080 poisoned oats, warren fumigation and warren destruction has been continuing since February 1991. A survey conducted in December 1991 showed that rabbit numbers were low over the entire area but indicated that follow up by warren fumigation and destruction would be an ongoing requirement.

Through cooperation with adjoining landholders, complimentary control programs have also been undertaken on adjoining lands. Labouring assistance has been provided through community work orders under the direction of Pest Plant and Animal Control Board officers.

1.7 Degradation

Prior to 1983, water was retained in the Disher Creek Basin at artificially high levels, virtually inundating all land enclosed by the embankments and resulting in widespread waterlogging and vegetation death. As a result Thompson (1986), assigned the wetland a low conservation value and recommended that future management should be reviewed following investigations of possible hydrological changes.

Inside the former evaporation basin, dead river box trees and lignum dominate the landscape, although a few river box trees still survive on slightly higher ground and appear to be quite healthy. Dead river red gums line the banks of the basin and smaller creeks. The soil has become highly salinized through evaporation of the saline drainage water and, in April 1991, Nicholson and Carter (1992), recorded salinities of 45 000 EC. Even though the evaporation basin function was modified in 1983 and water levels have since been dropped significantly, the soil remains salinized and the dominant plant species are now samphires and lignum with saltbush present on higher ground.

Historic evidence (Nicholson and Carter, 1992) suggests that lignum was the dominant vegetation of the site prior to the establishment of the area as a basin for drainage water. The remains of lignum can still be seen inside the basin today, mostly as dead stumps. The present contrast in vegetation either side of the embankment in the vicinity of the drainage outfall channel is further evidence that this was the case.

Vegetation health has also been affected outside the evaporation basin (see Figures 4 & 5). River red gum and black box woodland adjacent to the River Murray on the eastern edge of Disher Creek exhibit signs of stress in the form of canopy die-back. Also, on the high floodplain to the west of the basin there is an area of some 400 hectares of river box woodland in which the trees are either dead or highly stressed. This die-back has been attributed to the establishment of a groundwater mound underneath the evaporation basin and local elevation of groundwater. The combination of low elevation, fine textured soils, infrequent flooding and elevated saline water tables has thus pushed the black box trees beyond their tolerance limits. A series of piezometers has been established to monitor water table depth and salinity levels.

It may be concluded that soil and groundwater salinity levels on the high floodplain are generally above the tolerance levels of the dominant tree species and that this situation is likely to persist until salt is flushed from the soil profile. The principal agent to achieve flushing is local rainfall.

Away from the salt affected Disher Creek Basin the creeks and river banks are in reasonable condition. The effects of past clearing and stock grazing are particularly evident in elevated hopbush and native pine covered areas to the north. Destruction of regeneration by rabbits has been a continuing problem but presently seems to be contained.

During the period June 1990 to June 1992 some 2000 river red gum and river box trees were planted along watercourse margins as part of the "Riparian Vegetation Rehabilitation Project" (Nicholson and Carter, 1992) which was funded by the Murray-Darling Basin Commission's Natural Resources Management Strategy.

In addition to undertaking works in other areas this project also involved the establishment of a 250 x 150 metre enclosure in the northern section of Lyrup Flats above the 1956 flood level. Some 700 trees and shrubs were planted in this area (primarily *Calitris preissii* with *Acacia* species, including *A. oswaldii*, *A. brachybotrya*

The Woods and Forests Department has also undertaken some experimental direct seeding programs in the western portion of the area and have had some success in establishing *Pittosporum phylliraeoides*, *Calitris preissii*, saltbush and blackbush in scrapes.

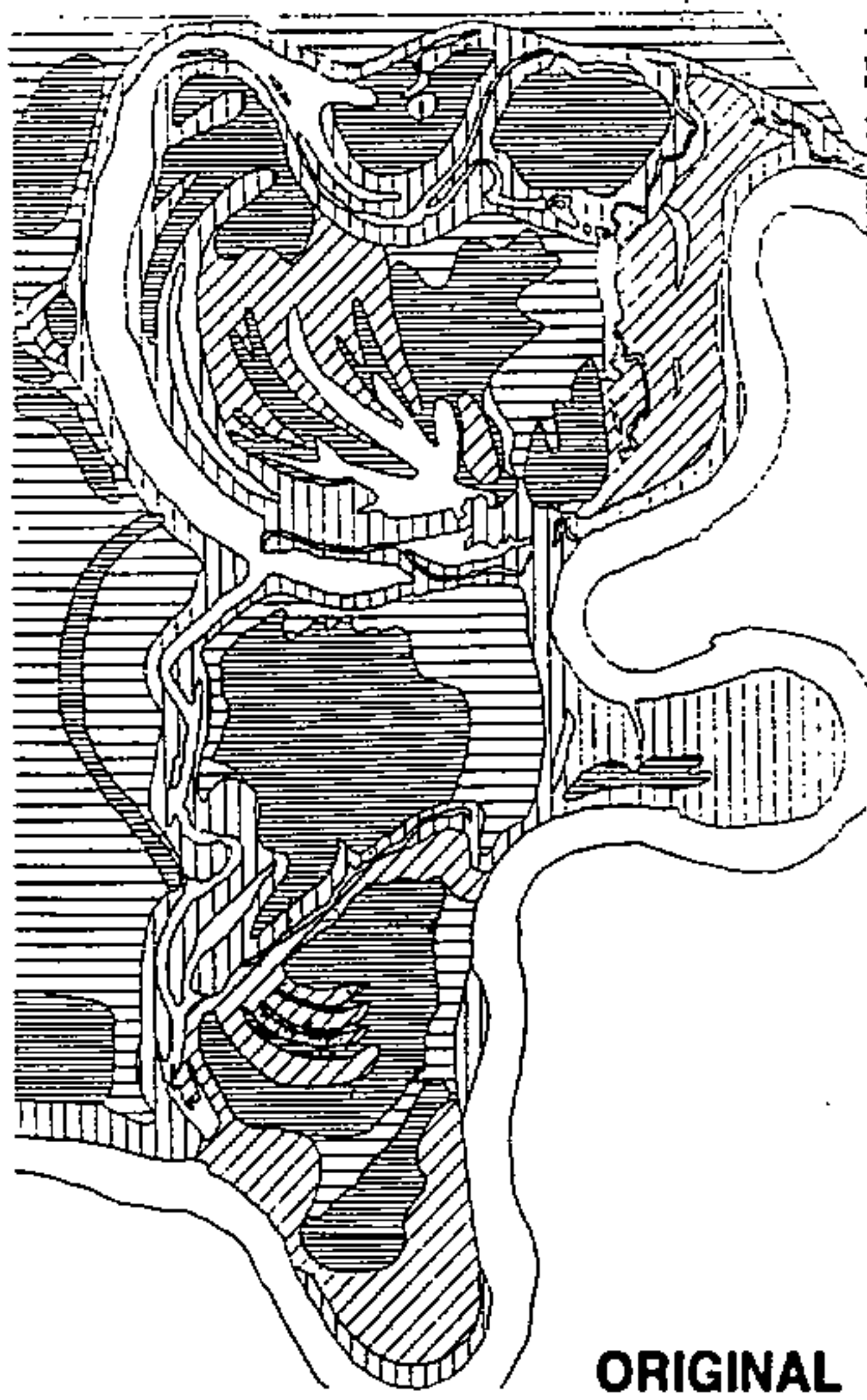
Near river frontage, areas show moderate to severe levels of degradation as a result of many years of unmanaged recreational use. Track proliferation has resulted from access by camper's and other vehicles and uncontrolled camping and other activities on the rivers edge has contributed to vegetation clearance, erosion and littering.

1.8 Wildfire

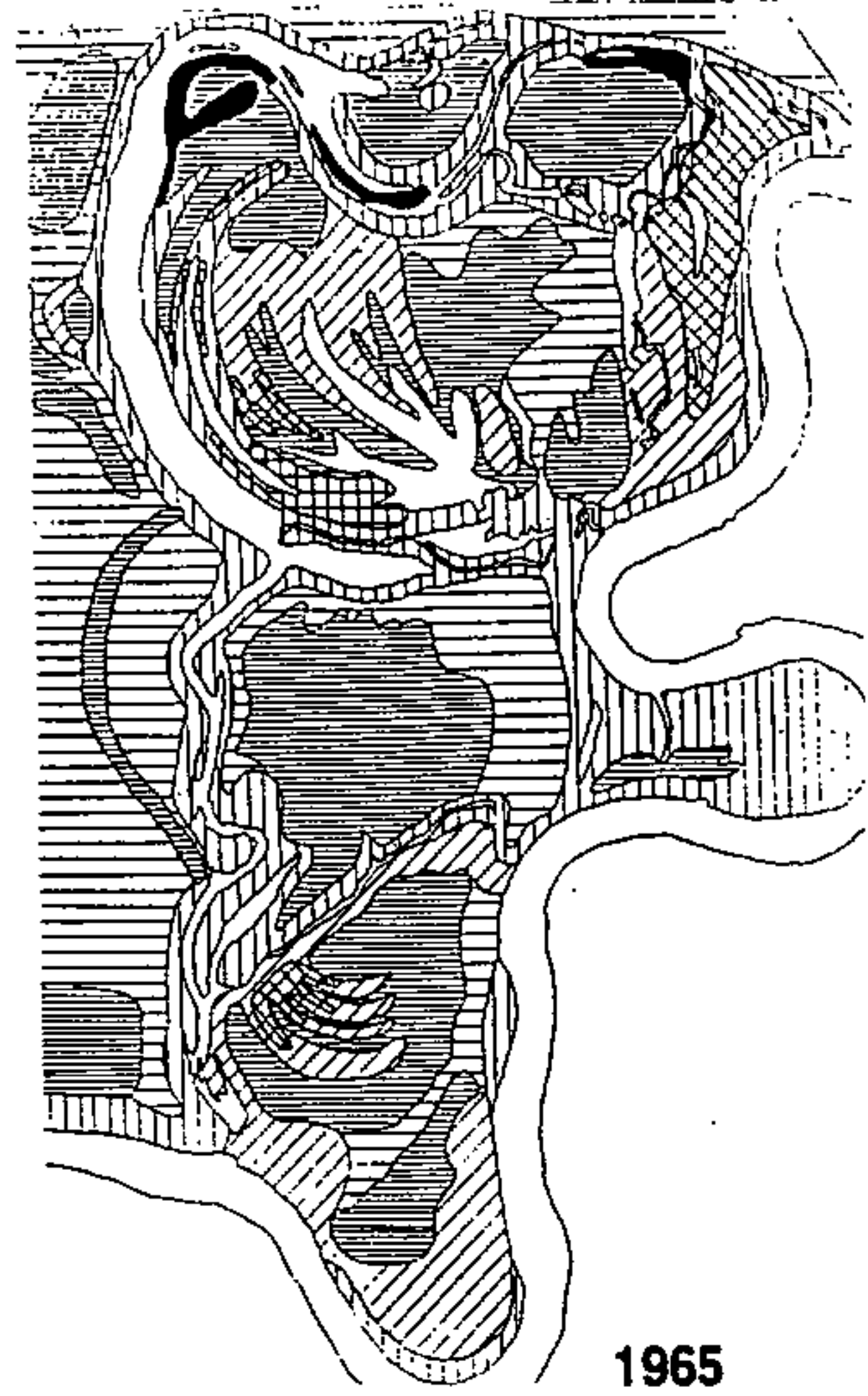
There are no records of major wildfires occurring in the area. Years of significant fire hazard occur after major floods have subsided or when grasses proliferate after above average rainfalls. The presence of large water-bodies and moderate fuel loads mean that the risk of serious fire is low. However the risk of low intensity wildfires from visitor activities (such as camp-fires) is significant and requires that reasonable precautions be taken to minimise the risk of fire spread. The concentration of public use along the bank of the River Murray also means that there is limited availability of wood for camp-fires in this vicinity. Away from the river bank there are extensive areas of standing dead timber where former forests have been killed by elevated water levels.

1.9 Access and Recreational Values

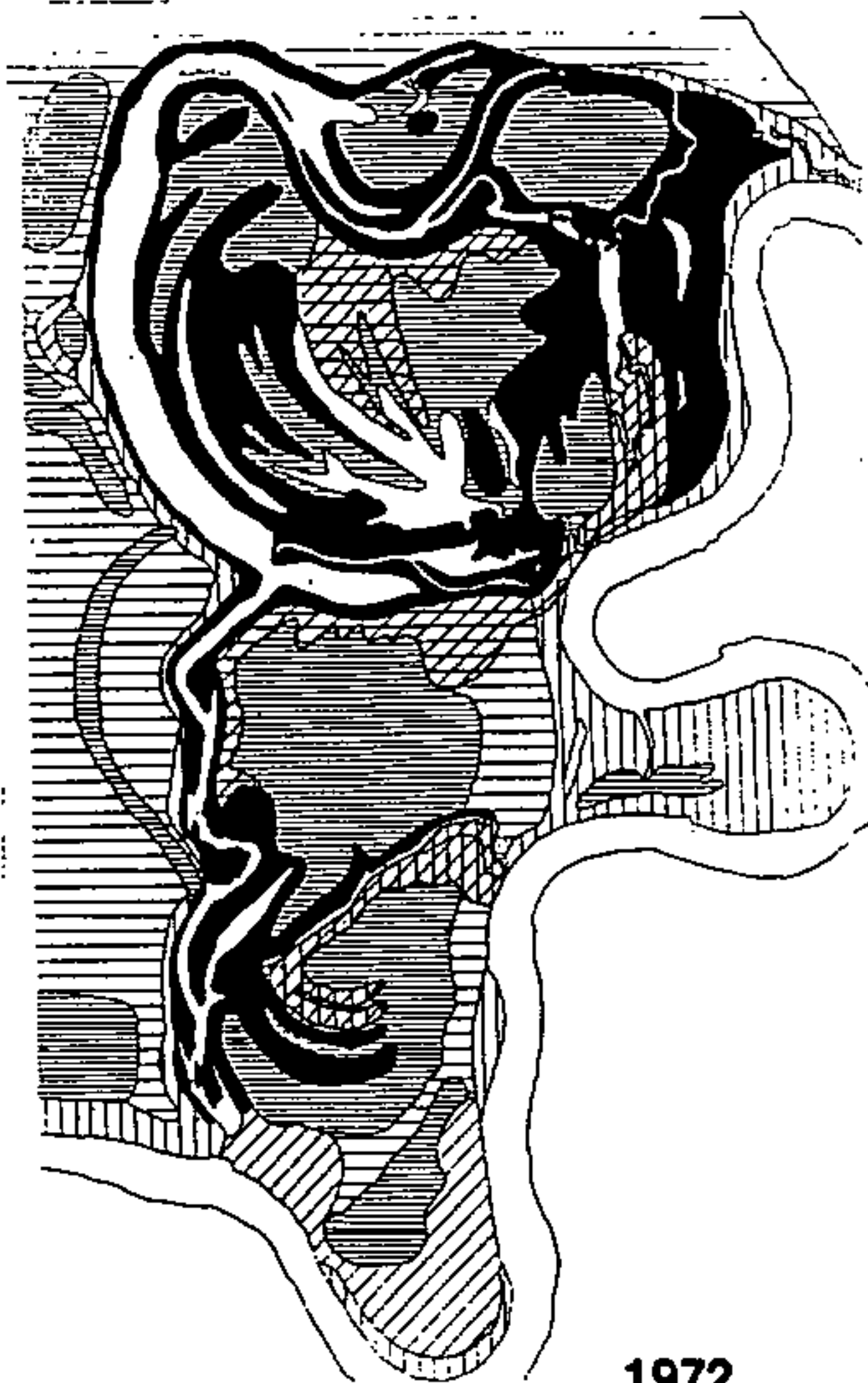
There are several access routes to and through Lyrup Flats (Figure 6). A sealed road links the Sturt Highway to the Lyrup Ferry and provides good all-weather access to the western margin. The Old Lyrup Road, a gravel road from the Sturt Highway, passes through the centre section of Lyrup Flats before joining the Lyrup Ferry Road at the ferry site. A grant of easement has been issued by the Minister of Lands to formally provide access between this road and Section 1272 (Out of Hundreds, Renmark) where the old Calperum Homestead is located (see Section 2.4.3).



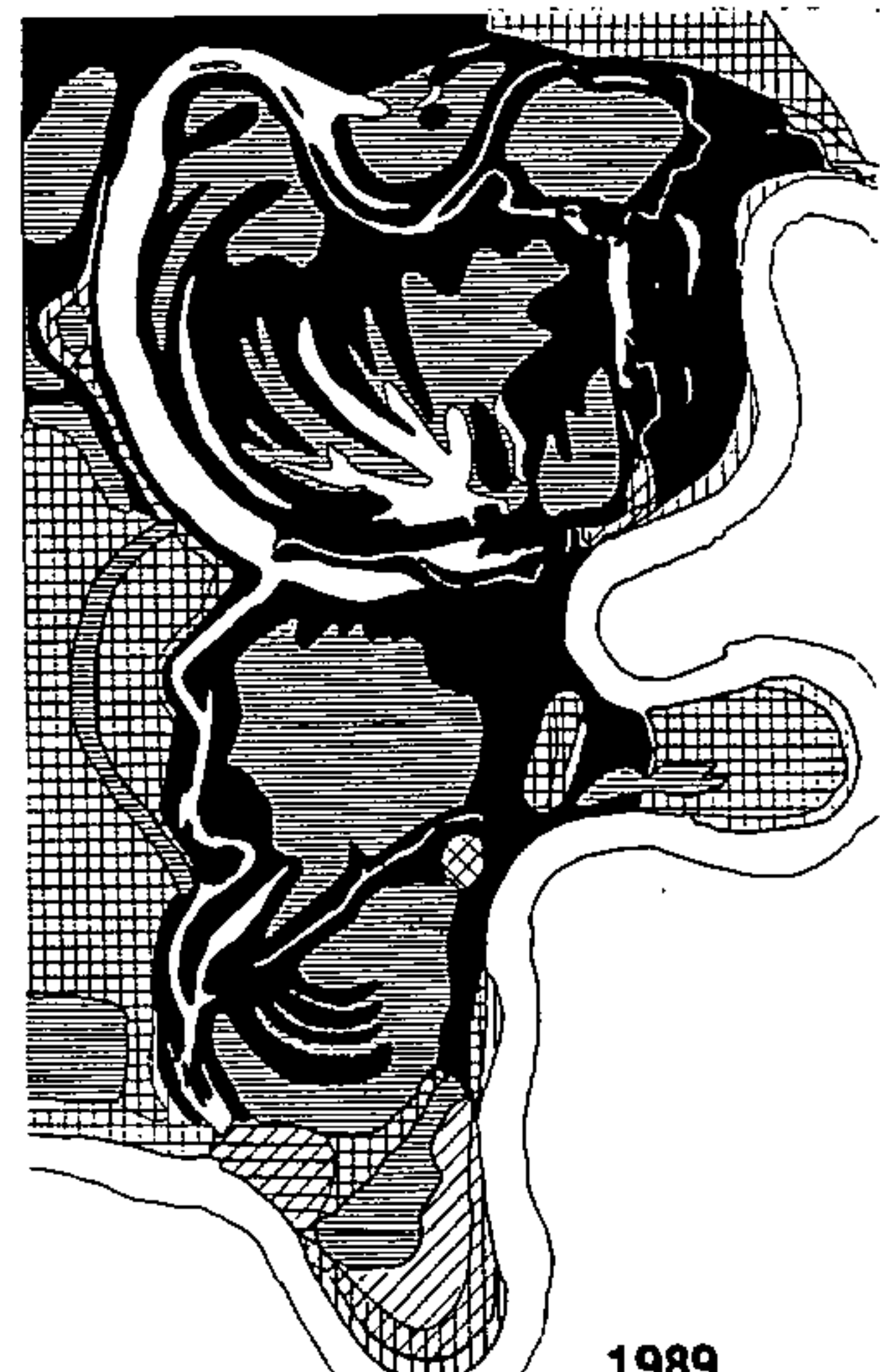
ORIGINAL



1965



1972



1989

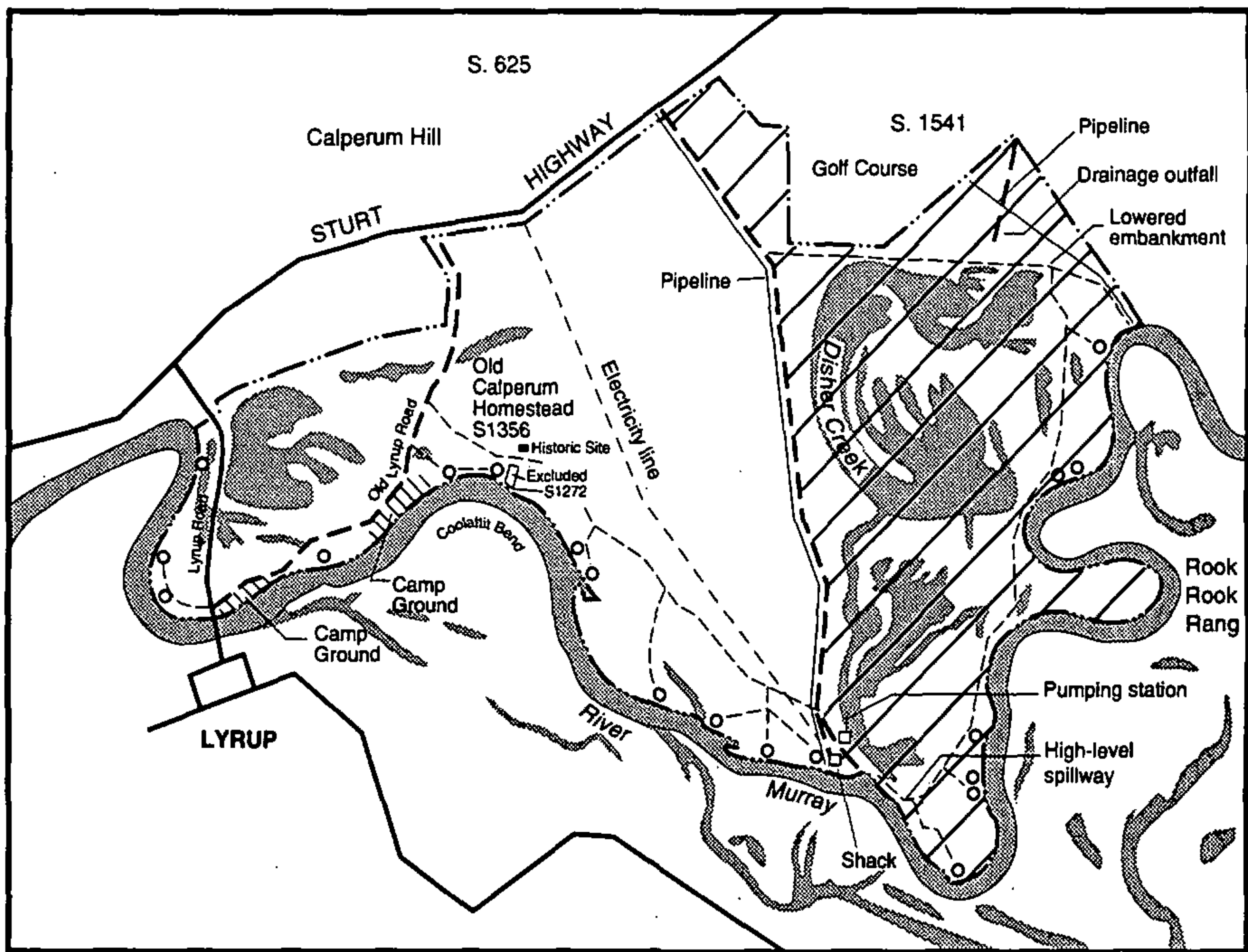


FIGURE 5

MURRAY RIVER NATIONAL PARK

Lyrup Flats

Vegetation Decline (after Nicolson and Carter, 1992)



- Park Boundary
- Sealed Road
- - - Access Road – All Weather
- - - Track – Dry Weather
- ▨ Waterway
- ▨▨▨ Campground
- Campsite
- ▨▨▨ Disher Creek Drainage Basin Zone

0 kilometres 1 2



FIGURE 6

MURRAY RIVER NATIONAL PARK
Lyrup Flats
Park Features and Visitor Facilities

Another gravel road leaves the Sturt Highway at Calperum Hill, passes through the eastern section of Lyrup Flats, and provides access to water management installations at the Disher Creek Basin. In addition to these formed roads there are numerous other vehicular tracks which provide cross linkages between made roads. Many run parallel, serve no useful purpose and, logically, their number should be rationalised.

There is good boating access along the River Murray to almost all river frontage areas.

1.10 History

Department of Lands records show that the area surrounding Renmark was originally held under Pastoral Lease No. 95 by A.B. Cator from 1 July, 1851. A portion of this lease was taken by William Finke from 1 July, 1859 and subsequently divided into two properties named "Bookmark" and "Chowilla". The present study area was located in the former although, according to Grosvenor (1979), a complicating factor regarding times and places is that the ultimate Calperum station, in addition to having been changed in name from Bookmark, is made up of eight original pastoral leases.

In 1867, a Mr John Chambers took over the Bookmark and Chowilla properties and in the 1870's the leases were transferred to the Robertson brothers.

In 1887 land was acquired from Bookmark Station by the Commissioner of Crown Lands for the establishment of the Renmark Irrigation Trust by the Chaffey Brothers (Department of Lands, 1984). The *Chaffey Brothers' Irrigation Works Act, 1887* gave the legal right to develop 200 000 acres (80 000 Ha) of land from Spring Cart Gully to the border for irrigation purposes.

In 1897 the Robertson Brothers dissolved their partnership. Robert stayed on the Chowilla lease, John took over Bookmark, renaming it Calperum and William moved to Queensland. The Disher Creek area subsequently became part of the Calperum Pastoral Lease.

In 1964 the Renmark Irrigation Trust acquired Disher Creek from Calperum to accept drainage water from the Chaffey and Renmark irrigation districts. The land surrounding the drainage basin (or "evaporation" basin as it was then known) remained part of the Calperum Pastoral Lease until 1979 when 7500 hectares between Renmark and Berri was acquired by the Department of Lands.

1.11 Hunting

In recent years little duck hunting has occurred in the Lyrup Flats area due to the closure of the Disher Creek Basin for this purpose by the Renmark irrigation Trust.

Also, under the provisions of the *National Parks and Wildlife Act, 1972* recreational duck hunting is not permitted in National Parks and therefore precludes a resumption of this activity in the National Park area.

2 LYRUP FLATS MANAGEMENT PROGRAM

Policies for the management of Lyrup Flats which are summarised below are guided by:

- (a) Government policy
- (b) the *National Parks and Wildlife Act, 1972* and Regulations
- (c) National Parks and Wildlife Service (SA) policies, and
- (d) community attitudes and expectations

Because of the proximity of Lyrup Flats to the towns of Berri, Lyrup and Renmark and its high value as a local recreational and tourism resource, particular emphasis has been given to the expectations and desires of local residents.

2.1 Natural Resources

2.1.1 Native Flora

Policies

- * diversity of habitat will be maintained
- * aquatic and wetland habitats will be protected and enhanced where feasible by prolongation of natural floods
- * sensitive and important plant communities will be accorded special protection measures
- * management will ensure visitor activities do not cause unacceptable degradation of habitat
- * degraded areas will be progressively rehabilitated
- * long term trends in vegetation condition will be monitored

Actions

- * encourage fundamental survey and mapping of the biological resources of Lyrup Flats to provide a data base to assist future decision making.
- * identify high conservation value areas where there is conflict between recreational use and protection of the resource
- * encourage prolongation of flooding and increased flooding frequency by controlled releases of water from Lake Victoria and other upstream catchments when water storage volumes and river flow rates permit.
- * encourage investigation of habitat requirements for the maintenance of native fauna populations.
- * continue revegetation schemes as resources permit
- * encourage community interest groups to be involved in vegetation rehabilitation programs
- * annually photograph and record vegetation condition at permanent monitoring points

2.1.2 Pest Plants

Policies

- * control proclaimed pest plants which constitute a threat to downstream agricultural activities or which are of substantial nuisance value in popular recreational areas
- * abide by the Pest Plant and Animal Control Board's Policy for control of golden dodder
- * replacement of weed species by re-establishment of native vegetation will be the preferred method of weed control where practical

- * willow trees to be progressively controlled by poisoning and/or physical removal. Individual trees which play an important role in providing shade or stabilising erosion-prone banks may be deliberately retained
- * in general, local species and seed sources will be used in revegetation programs, however, in salt affected areas, salt tolerant species from other areas may be introduced

Actions

- * spray or slash burrs (*Xanthium* spp.) in popular recreation areas
- * control outbreaks of Golden Dodder in accordance with the Pest Plant and Animal Control Board's policy which is to contain this species by spraying along river frontages and roadsides
- * continue boxthorn and prickly pear eradication program
- * progressively remove willow trees

2.1.3 Native Animals

Policies

- * protect resident native species

Actions

- * control, and where practical eradicate, feral predators such as foxes and cats (see section 2.1.4.)
- * inform park visitors of fauna habitat requirements and encourage appropriate behaviour and movements

2.1.4 Introduced Animals

Policies

- * control, and if practicable eradicate, vertebrate pests including rabbits, foxes, cats and pigs

Actions

- * continue rabbit control program, emphasising control when river levels are high
- * where practicable eradicate feral predators

2.1.5 Rehabilitation

Policies

- * manage the Disher Creek Basin to optimise habitat values whilst retaining its role as a drainage water balancing storage for the Noora Drainage Basin (see section 2.4.1)
- * where practical, rehabilitate salt affected areas
- * recognise that the hydrological regime of the river has permanently changed and attempt to re-establish vegetation best suited to the present circumstances
- * through the River Murray Wetlands Committee investigate opportunities for minor earthworks which provide significant local enhancement of wetlands
- * revegetation effort to involve rabbit and weed control programs and direct seeding and planting of local species and to concentrate on the slopes and highlands which fringe the floodplain area
- * manage recreational use to ensure that impacts are minimised

Actions

- * support increasing the frequency and efficiency of flooding of the Disher Creek Basin by controlled releases of water from upstream storages
- * manage sluice gates and water control structures to optimise frequency of flooding
- * undertake active vegetation regeneration programs
- * consider the practicability of additional and/or lowered openings under Lyrup Road to increase the frequency and effectiveness of flooding of the wetland located along its eastern edge
- * liaise with relevant road construction authorities with a view to reopening dissecting creeks (which were blocked by the construction of the Old Lyrup Road) by placement of pipes and culverts under the road
- * encourage and support the involvement of voluntary community groups in revegetation projects
- * rest popular camping and mooring sites which are being over-used

2.2 Cultural Resources

2.2.1 Aboriginal

Policies

- * sites and objects of archaeological value or of significance to Aboriginal people will be protected
- * management of Aboriginal sites or objects will have regard to the views of Aboriginal people who have an affiliation with the area

Actions

- * encourage research for the inventory, analysis and assessment of sites or objects of archaeological or historic significance
- * ensure any development sites are surveyed before disturbance occurs
- * middens or other relics which have become exposed through land degradation processes to receive priority in rehabilitation programs
- * liaise with Aboriginal people regarding management of sites or objects of significance found in the park

2.2.2 European

Policies

- * sites and objects of historical significance will be protected

Actions

- * solid remnants of obsolete drainage structures will be retained and interpreted as part of the overall picture of River Murray regulation and salinity management
- * relics of pastoral occupation of Lyrup Flats such as old stockyards and fence-lines will be individually assessed as to their historical value. Those which merit retention will be tidied up by the removal of loose wire and other debris and interpreted. Others will be removed. Structures which warrant retention include the old shearing shed, yards and grave located to the north of the old Calperum Homestead

2.3 Visitors

2.3.1 Access

Policies

- * minimal restriction on movement and mooring of boats in river frontage areas
- * all boating activities to be in accordance with the *South Australian Boating Act*,

1974 and Regulations

- * vehicular (terrestrial) access on Lyrup Flats to be restricted to designated vehicular tracks (Figure 6) or for management purposes
- * the vehicular access track which follows the power-line through Lyrup Flats from its north western corner to the Disher Creek Pumping Station to be closed to general public access
- * appropriate use will be encouraged and the interpretation role of Lyrup Flats maximised by the identification of a preferred vehicular and pedestrian access network
- * houseboat mooring and/or vehicle camping sites may be managed by
 - (a) temporary closure of areas being over-used
 - (b) creation of additional sites by judicious trimming of reeds and other obstacles
- * all boating on the Disher Creek will be prohibited except under permit

Actions

- * identify a suitable route for a self-guided drive through Lyrup Flats to features of interest and produce an accompanying brochure and sign system
- * establish a system of walking tracks to features of interest
- * if appropriate, issue permits for boating on Disher Creek evaporation basin
- * map houseboat mooring sites and bank condition
- * identify areas to be spelled and rehabilitated
- * invoke the SA Boating Act and Regulations over all waters within the Park by publishing a notice in the SA Government Gazette

2.3.2 *Camping and Picnicking*

Policies

- * encourage picnicking and camping activities
- * within the campground and nodal camping areas (Figure 6) provide basic facilities such as fireplaces, toilets and small boat launching ramps
- * foster a "campground host" scheme to assist in on-site supervision of the camping area
- * maintain a central depot for collection of litter
- * siting of facilities to have regard to:
 - (a) the protection of the natural values of the park;
 - (b) existing camping patterns; and
 - (c) the perceived need for provision of facilities

Actions

- * establish a defined camping ground as indicated in Figure 6
- * construct facilities in the nodal camping area
- * monitor levels of use and impacts and when necessary erect temporary signs and barrier to allow resting and recovery of over-used camping sites

2.3.3 *Fishing and Yabbying*

Policies

- * no restrictions on recreational fishing other than those under Fisheries Act and Regulations

Actions

- * invoke the Fisheries Act and Regulations over the whole of the Park by publishing a

- * notice in the SA Government Gazette
- * ensure compliance with Fisheries Act and Regulations.

2.3.4 Fires

Policies

- * fire protection to be in accordance with the S.A. N.P. & W.S. Fire Management and Protection Manual (1988) and the Park Fire Protection Plan.
- * outside of fire ban periods allow camp-fires.
- * camp-fires should only occur in identified areas
- * the use of gas cooking fires will be encouraged
- * visitors should be encouraged to bring wood for camp-fires into the park and not collect it from the local area

Actions

- * ensure fire bans correspond to those of Berri and Renmark Councils
- * prepare a Fire Protection Plan for Murray River National Park
- * provide fireplaces in popular camping areas

2.3.5 Visitor Facilities

Policies

- * except in the Nodal Camping Area and along the route of the guided drive (see Section 2.3.1) facilities will be minimal, consistent with the semi-natural, undeveloped character of the area
- * pedestrian access routes may be identified with track markers and interpretive signs
- * basic facilities to be provided in the camping areas may include information and interpretation signs, fireplaces, toilets and small boat launching ramps

Actions

- * provide basic facilities and information within the camping areas and along the Guided Drive
- * produce an accompanying "Map and Notes" for the Guided Drive
- * seek sponsorship/advertising from local businesses for "Map and Notes" and for special facilities

2.3.6 Walking Trails

Policies

- * walking within the park will be encouraged

Actions

- * identify and construct or mark a simple system of short walkways to features of particular interest

2.3.7 Litter

Policies

- * visitors will be expected to package their own rubbish and either take it away with them to dispose of off-site or place it in the bulk collection bin provided
- * a low impact camping philosophy to be promoted

Actions

- * low impact camping philosophy to be promulgated through information materials and other media
- * periodic clean up campaigns to be undertaken, ideally involving user groups and organisations such as KESAB, River Murray Boat Owners Association and Riverwatch

2.3.8 Dogs

Policies

- * while visitor numbers remain low and users continue to act responsibly in controlling their pets, dogs will be permitted at Lyrup Flats provided they are kept on a leash or within a vehicle

Actions

- * Lyrup Flats to be designated as a "dog zone" and an appropriate announcement made in the *Government Gazette*
- * levels of use and behaviour of dogs will be monitored to ensure they do not present a significant threat to wildlife or present unreasonable inconvenience to other park users

2.4 Other Interests

2.4.1 Disher Creek Disposal Basin

Explanation

The Renmark Irrigation Trust acquired Disher Creek from Calperum Station in 1964 for the purposes of drainage water disposal. It was subsequently proclaimed a drainage reserve and over the next 25 years a number of earth embankments and regulating structures were established. The Disher Creek Basin stage of the Noora Drainage Disposal Scheme was commissioned in 1983. This enabled drainage water to be pumped from Disher Creek to the Noora Basin for disposal. Disher Creek has since functioned as a balancing storage for drainage water before it is pumped to Noora. Water is consequently now held at much lower levels than previously and provides scope to revegetate areas degraded as a result of elevated water tables.

Prior to the establishment of Murray River National Park in 1991 a management agreement ("The Disher Creek Basin Operating Agreement") was negotiated with the Engineering and Water Supply Department. This agreement identifies the Disher Creek Basin Zone (Figure 6) which is defined as:

the area of land comprised in the Disher Creek Basin Zone being the former Drainage Reserve situated in Section 269 Out of Hundreds (Renmark), together with the access road situated in Sections 1268 and 477 and Allotment "A" Deposited Plan 23939 linking the Sturt Highway and the Disher Creek Pumping Station and the drainage outfall channel situated in Section 479.

This zone is jointly managed by the Department of Environment and Natural Resources and the Engineering & Water Supply Department for the conservation and rehabilitation of the natural resources in the area and for the operation of the Disher Creek Basin. This joint management recognises the commitment of the Government to the conservation, rehabilitation and sound management of the land and surface and groundwater resources of the Murray River National Park whilst ensuring that the area be managed with one accord whilst continuing to fulfil its function as a balancing storage for the Noora Drainage Basin Statement of Intent.

Policies

- * in managing the Disher Creek Basin Zone both the Department of Environment and Natural Resources and the Engineering and Water Supply Department will endeavour to conserve and rehabilitate the zone's land and surface and groundwater resources
- * E&WS will maintain the Disher Creek Basin as a balancing storage for the Noora Disposal Basin
- * E&WS will continue the operation, maintenance, construction and replacement of all facilities and works associated with the Disher Creek Basin
- * E&WS will have free and unrestricted use of the zone for the operation of the basin and for the construction, maintenance and replacement of the facilities and works associated with it
- * E&WS will have right of access at all times for necessary inspection, maintenance and construction
- * all buildings, structures, improvements and facilities existing and constructed within the zone by E&WS for the Disher Creek Basin will be the property of E&WS
- * in the event of E&WS wishing to withdraw from the use of all or part of the zone, that Department may remove any of its buildings, structures, improvements and facilities
- * should the DENR wish to retain any such items on withdrawal by E&WS, appropriate compensation will be negotiated
- * E&WS will not be held liable for, nor obliged to mitigate or remedy any effect upon the environment caused by the operation of the Disher Creek Basin
- * in the event of any disputation between the Director NPWS and the Chief Executive E&WS the Minister for Environment and Natural Resources will seek advice from the Murray-Darling Basin Commission

Actions

- * E&WS will generally maintain basin water levels at or below river levels, i.e. the basin will be used as a balancing storage for the Noora Drainage Disposal Scheme
- * E&WS will maintain the required embankments, the inlet structures, a pumping main and the following three outlet structures:
 - (a) a low level 750mm pipe with sluice gate
 - (b) a low level rock-protected spillway which facilitates flushing flows through the basin when River Murray flows exceed 38 000 ML/day
 - (c) a high level concrete stop log structure
- * DENR will liaise with the Electricity Trust of South Australia to ensure that an electric power supply route is available across the park to the Disher Creek Basin Pumping Station
- * E&WS will maintain all access tracks to facilities and works in the Disher Creek Basin Zone

2.4.2 Mining and Petroleum Exploration

Explanation

The proclamation which established Lyrup Flats as part of Murray River National Park (*The South Australian Government Gazette*, 20 June 1991) provided for the continuation of existing rights of entry, prospecting, exploration and mining under the *Mining Act, 1971* and *Petroleum Act 1940* over the area. In addition to the Minister of Mines and Energy's approval, approval must also be sought from the Minister for Environment and Natural Resources for approving the acquisition of further rights for such purposes.

The proclamation further specified the following conditions:

- (a) *at least three months before commencing any drilling or excavation, any vegetation clearance, the making of any road, track or airstrip or the construction of any building or other structure, the person must notify the Minister for Environment and Natural Resources and the Minister for Mines and Energy of the proposed work and must supply each Minister with such information relating to the proposed work as that Minister may require;*
- (b) *the person, in carrying out any work referred to in paragraph (a)-*
 - (i) *must comply with such directions as the Minister for Environment and Natural Resources may give in writing in relation-*
 - (A) *to carrying out the work in a manner that minimises damage to the land or the environment or to vegetation or wildlife on the land;*
 - (B) *to preserving objects, structures or sites of historic, scientific or cultural interest;*
 - or
 - (C) *to rehabilitate the land upon the completion of the work;*
 - and
 - (ii) *if the work is being carried out in pursuance of a right of entry, prospecting, exploration or mining acquired after the making of this proclamation must comply with such directions as the Minister for Environment and Natural Resources or the Minister for Mines and Energy may give in writing in relation to prohibiting or restricting access to any specified area that the Minister believes would suffer significant detriment as a result of carrying out the work;*
- (c) *if a plan of management is in operation under section 38 of the National Parks and Wildlife Act 1972 in respect of the Murray River National Park, the person must have regard to the provisions of the plan of management;*
- (d) *the person, in addition to complying with any directions given under paragraph (b)-*
 - (i) *must take such steps as are reasonably necessary to ensure that objects, structures and sites of historic, scientific or cultural interest, features of scientific or scenic interest and any wildlife on the lands are not unduly affected by the exercise of those rights;*
 - (ii) *must take reasonable steps to minimise damage to vegetation;*
 - (iii) *must maintain all work areas in a clean and tidy condition;*
 - and
 - (iv) *must, upon the completion of any work, obliterate or remove all roads, tracks, airstrips, buildings or other structures (other than a road, track, airstrip, building or structure designated by the Minister for Environment and Natural Resources and the Minister for Mines and Energy as suitable for retention) used exclusively for the purposes of that work.*

Policies

- * **State government policy, as outlined in the Proclamation by the Governor will be followed**

Actions

- * **all mining applications or notifications received by the Minister for Environment and Natural Resources will be referred to the Department of Environment and Natural Resources for comment. The Minister will consider these comments in drafting any directions for the carrying out of the proposed works.**
- * **the Department of Environment and Natural Resources and the Department of Mines and Energy will jointly assess mining applications and will:**
 - (a) **take into consideration any known important features, artefacts or flora, and fauna that should be avoided and**
 - (b) **consider possible park management benefits of retaining any roads, tracks or structures created and forward appropriate recommendations to the Minister**
- * **the Department of Environment and Natural Resources and the Department of Mines and Energy will jointly monitor compliance with the Gazetted requirements for mining**

2.4.3 Old Calperum Homestead

Explanation

- * The old Calperum Homestead situated on Section 1256, Out of Hundreds, Renmark, is presently held under Miscellaneous Lease by W.J. & E.J. Jeffree and is excluded from the Murray River National Park. The Miscellaneous Lease was for 20 years and expires on 1 July 2000. Rights of access to the Jeffrees and their agents, servants, workmen and invitees is secured by a Grant of Easement over portion of Section 1267.

The Jeffree's also hold an Annual Licence over the narrow parcel of land between the homestead and the River Murray (Section 1272) which is excluded from the park but which is, for practical purposes, part of the Jeffree's holding and which provides them with access to the river from which they obtain their water supply.

The possibility of "freeholding" the homestead and S.1256 is being considered by the lessees and the Department of Lands subject to listing of the building on the State Heritage Register.

Policies

- * Heritage Listing of the old Calperum Homestead is supported
- * reasonable effort should be made to provide privacy to the occupants of dwellings which are completely surrounded by parks
- * further alienation of river frontage areas should be avoided

Actions

- * while Calperum Homestead remains in its present tenure, to protect the privacy of the residents, Section 1272 and the easement to S.1256 across S.1267 will be considered to form part of the land holding of S.1256 and will not be available for general public access
- * to prevent long term alienation of river frontage, in the event of S.1256 becoming freehold the Department of Environment and Natural Resources will further consider public access provisions to S.1272 and the term of the present Annual Licence over it which allows for the pump and pipeline to the river. In this event:
 - (a) a term lease will be granted to the owners of S.1256 to secure their access to water
 - (b) provision will be made to secure long term public access to the river frontage
- * in the event of the present twenty year lease running its full term and/or the present lessees indicating that they wish to quit the premises, the tenure arrangements of S.1256 should be re examined

2.4.4 Shack Site

Explanation

Section 750, Out of Hundreds, Renmark (Figure 6) is registered by Department of Environment and Natural Resources as a shack site and is excluded from the National Park area.

Policies

- * under the terms of the present Government Shack Policy this shack is classified as one with "life tenure" i.e. the existing licensee may retain the use of the site for the rest of their life, but may not transfer their interest in the site to a third party

Actions

- * compliance with shack licence conditions will be monitored
- * upon surrender of the shack licence the structure should be removed and the land incorporated into the National Park area

2.4.5 Commercial Fishing

Explanation

Responsibility for control of commercial fishing in South Australia rests with the Minister of Fisheries and his Department. On 13 August 1991, the Minister of Fisheries approved arrangements for commercial fishing in backwaters of the River Murray. These arrangements allow licence holders to take certain fish from specified backwaters which include backwaters on National Parks and Wildlife Act reserves and on private property.

Notwithstanding commercial fishing control by the Department of Fisheries, licence holders are required to comply with the *National Parks and Wildlife Act, 1972* and Regulations and to obtain permission of the Minister for Environment and Natural Resources if they wish to fish backwaters that form part of a National Parks and Wildlife Act reserve.

In recent years European carp have been commercially harvested from the Disher Creek Basin and it is anticipated that demand for this activity will continue.

Areas which are backwaters at normal river levels have their surface waters linked with the River Murray during periods of flood. Under present Fisheries Regulations the flooded area is then considered to be part of the river itself and thus commercial fishers are allowed access.

Policies

- * in view of the limited potential for commercial fishing in the Lyrup Flats area, the substantial local recreational fishing demand and the high conservation value of the wetland complex, Department of Environment and Natural Resources will not support applications for commercial fishing in the Lyrup Flats backwaters except for the harvesting of European carp from the Disher Creek Basin
- * established Fisheries policy allowing commercial fishers access to floodplain wetlands during periods of flood will be continued

Actions

- * subject to relevant conditions, permit commercial harvesting of carp from Disher Creek Basin
- * to meet National Parks and Wildlife Act requirements for Ministerial approval for commercial fishing activities, publish an appropriate notice in the SA Government Gazette

2.4.6 Quarries

Explanation

Two large quarries which were previously used for gaining road construction materials are located in Section 478 in the northern, highland section of Lyrup Flats bordering the Sturt Highway.

Policies

- * the quarries are no longer used and should be landscaped and rehabilitated

- * rehabilitation works may involve approval for the further removal of limited quantities of quarry aggregate

Actions

- * negotiate with Highways Department and local District Councils with a view to rehabilitating quarries
- * seek the involvement of local environmental groups in landscaping and revegetation works

2.4.7 Pumps and Pipelines

Explanation

In addition to the pump and pipeline servicing the old Calperum Homestead (see 4.4.3), three further pumps and pipelines, servicing adjoining areas, are located within the planning area. One crosses sections 477 and 1268 and serves Section 625 held by R & F Quarry Supplies Ltd. while the other two are located on sections 966 and 479 and provide water to the Renmark Golf Club and to Section 1541 held by P. J. Freeman.

Policies

- * the existing pumps and pipelines were in existence prior to park establishment and service important community and commercial operations and should be licensed to continue to serve these functions

Actions

- * prepare formal licence agreements which clarify the rights and responsibilities of the licensees including their right to undertake reasonable upgrading of infrastructure

2.5 Fencing

Explanation

Lyrup Flats is bordered on its eastern, western and southern boundaries by the River Murray. With the exception of a boundary fence around S.1265 (Calperum Homestead) and temporary fences around rehabilitation areas, there is no requirement for fencing on these boundaries or for internal fencing.

To prevent stock and pest animals moving onto Lyrup Flats and to clearly indicate the park boundary it is desirable that a good quality boundary fence be constructed along the entire length of the northern boundary.

Policies

- * park boundaries which adjoin private and public lands should be fenced

Actions

- * construct a new boundary fence along entire northern boundary of the Lyrup Flats area
- * contribute towards maintenance of fences which adjoin private property

2.6 Research, Inventory and Monitoring

Explanation

Research is a function which assists in understanding the resources of reserves, their use and management. It is also a legitimate intrinsic use to further scientific knowledge.

Policies

- * all research will be subject to National Parks and Wildlife Service policy and procedures for granting of scientific permits, the conduct of research and the forwarding of results to the Department of Environment and Natural Resources
- * approval to conduct research will normally be routine if:
 - (a) it has potential to facilitate better management, and
 - (b) it does not conflict the natural and cultural features and visitor use of the area.

Actions

- * encourage research which has potential to facilitate better management

3 LYRUP FLATS MANAGEMENT ACTIONS

The actions required to implement the management proposals outlined in Section 2 are summarised below. The ranking indicates the relative priority of projects and whether they are of a short term, moderate term or continuing nature.

PROJECT	PRIORITY	DURATION	PAGE
Native Flora			
Survey and map biological resources	High	Moderate	46
Identify high conservation areas	High	Short	46
Encourage flood frequency and duration	High	Ongoing	46
Investigate habitat requirements of native fauna	Moderate	Moderate	46
Continue revegetation schemes	Moderate	Ongoing	46
Encourage community groups in revegetation schemes	High	Ongoing	46
Establish vegetation monitoring points	High	Short	46
Pest Plants			
Spray burrs in popular recreation areas	High	Ongoing	47
Control golden dodder	High	Ongoing	47
Continue boxthorn and prickly pear eradication	High	Moderate	47
Progressively remove willows	Moderate	Moderate	47
Native Animals			
Control cats and foxes	Moderate	Ongoing	47
Educate visitors re fauna habitat requirements	High	Short	47
Introduced Animals			
Continue rabbit control	High	Ongoing	47
Control feral predators	Moderate	Ongoing	47
Rehabilitation			
Support increase flooding of Disher Creek	High	Ongoing	48
Optimise frequency of flooding	High	Ongoing	48
Undertake revegetation program	Moderate	Moderate	48
Increase Lyrup Road floodways capacity	Moderate	Short	48
Re-open dissecting creek along Old Lyrup Road	Moderate	Short	48

Encourage Volunteers in revegetation projects	Moderate	Moderate	48
Rest over-used camping/mooring sites	Moderate	Short	48
Aboriginal Cultural Resources			
Encourage site research	High	Moderate	48
Survey development sites	High	Short	48
Rehabilitate exposed sites	High	Short	48
Liaise with Aboriginal people	High	Ongoing	48
European Cultural Resources			
Retain obsolete drainage structures	Moderate	Short	48
Retain relics of pastoral occupation	Moderate	Short	48
Visitor Access			
Develop a self-guided drive	Moderate	Short	49
Establish walking tracks	Moderate	Moderate	49
Issue permits for boating on Disher Creek	High	Ongoing	49
Identify areas to be rehabilitated	High	Moderate	49
Invoke the S.A. Boating Act and Regulations	High	Short	49
Camping and Picnicking			
Establish campgrounds	High	Short	49
Establish nodal camping areas	High	Short	49
Monitor visitor impacts	Moderate	Ongoing	49
Fishing and Yabbying			
Invoke Fisheries Act and Regulations	High	Short	50
Ensure compliance of legislation	High	Ongoing	50
Fires			
Fire bans to correspond to local Government	High	Short	50
Prepare Fire Protection Plan	Moderate	Short	50
Provide fire-places in camping areas	Moderate	Short	50
Visitor Facilities			
Provide basic facilities and information	Moderate	Moderate	50
Produce interpretative information	Moderate	Short	50

Seek sponsorship for interpretative information	Moderate	Short	50
Walking Trails			
Establish walking trails	Moderate	Moderate	50
Litter			
Promote low impact camping philosophy	Moderate	Ongoing	51
Encourage clean up campaigns	High	Ongoing	51
Dogs			
Designated as "dog zone"	High	Short	51
Monitor dog behaviour	High	Ongoing	51
Disher Creek Disposal Basin			
EWS will manage basin water level	High	Ongoing	52
EWS will maintain structures	High	Ongoing	52
Maintain electric power supply	High	Ongoing	52
EWS will maintain access tracks to structures	High	Ongoing	52
Mining and Petroleum Exploration			
Applications will be referred to DENR for comment	High	Ongoing	53
DENR and DME will jointly assess application	High	Short	53
DENR and DME will jointly monitor compliance	High	Moderate	53
Old Calperum Homestead			
Protect privacy of residents	High	Ongoing	54
Prevent alienation of river frontage	High	Short	54
Tenure should be re-examined when lease runs out	Moderate	Short	54
Shack Site			
Monitor compliance of licence conditions	High	Ongoing	55
Upon surrender of licence incorporate into Park	Moderate	Short	55
Commercial Fishing			
Permit commercial harvesting of carp from Dishers Creek	High	Short	55
Invoke Fisheries Act and Regulations	High	Short	55

Quarries

Rehabilitate quarries	Moderate	Moderate	56
Involve local environment groups in rehabilitation	Moderate	Short	56

Pumps and Pipelines

Prepare formal licence agreements	High	Short	56
-----------------------------------	------	-------	----

Fencing

Construct new northern boundary fence	Moderate	Short	56
---------------------------------------	----------	-------	----

Research, Inventory and Monitoring

Encourage research	Moderate	Ongoing	57
--------------------	----------	---------	----

SELECT BIBLIOGRAPHY

- Aston HI 1973 Aquatic Plants of Australia, Melb. Uni. Press, Melbourne.
- Black JM 1963-1978 Flora of South Australia, V1-4, Govt. Printer, Adelaide.
- Briggs SV 1981 "Freshwater Wetlands" in Grove (Ed) Australian Vegetation, Cambridge University Press, Cambridge.
- Condon HT 1969 A Handlist of the Birds of South Australia, 3rd edition, SA Ornithological Assoc., Adelaide.
- Davies RLP 1982 The Conservation of Major Plant Associations in South Australia, Conservation Council of SA, Adelaide.
- Delroy LB Creation of Waterfowl Habitat in South Australia, Department of Environment & Planning internal report, reference DE GR2/950/00.
- Department of Lands 1984 Summary - Management Study - Disher Creek - Border, The Government of South Australia.
- Frith HI 1967 Waterfowl in Australia, Angus and Robertson, Sydney.
- Grosvenor GA 1979 Red Mud to Green Oasis, Raphael Arts Pty. Ltd.
- International Waterfowl Research Bureau 1976 Proceedings: International Conference on Conservation of Wetlands and Waterfowl, Heiligenhafen, Germany, 2-6 Dec, 1974 IWRB Slimbridge, England.
- Jessup JP (ed) 1983 A list of the Vascular Plants of South Australia, Adelaide Botanic Gardens and Department for Environment and Planning, Adelaide.
- Keast A 1959 "The Reptiles of Australia", in Keast et al. (eds) Biogeography and Ecology in Australia, Uitgeverij, Dr W Junk, Den Haag.
- Laut P, Heyligers PC, Keig G, Löffler E, Margules, Scott RM & Sullivan ME 1977 Environments of South Australia - Province 2, Murray Mallee, CSIRO Division of Land Use Research, Canberra.
- Lloyd L, Moller, J & Balla S 1984 Berri Evaporation Basin Study, Department of Zoology, University of Adelaide.
- Ludbrook NH 1980 A Guide to the Geology and Mineral Resources Of South Australia, Dept. of Mines and Energy, Adelaide.
- Mackay N & Eastburn D (Eds.) The Murray, Murray-Darling Basin Commission, Canberra, 1990.
- Margules and Partners Pty. Ltd., P. & J. Smith Ecological Consultants, Department of Conservation Forests and Lands Victoria 1990 River Murray Riparian Vegetation Study, Murray-Darling Basin Commission.
- Nicholson C. & Carter J (1992) "Disher Creek Basin Area", unpublished report on Murray-Darling Basin Ministerial Council Natural Resources Management Strategy project "Riparian Vegetation Rehabilitation", SA Department for Environment and Planning internal report, 1992.
- O'Driscoll EPD 1960 "The Hydrology of the Murray Basin Province in South Australia", Geol. Survey South Aust. Bull. 35.

Ohlmeyer RG 1991 Report on Implications of Manipulating Water Levels in the River Murray Between Lock 1 and 10. Murray-Darling Basin Natural Resources Management Strategy.

Pizzey G 1980 A Field Guide to the Birds of Australia, Collins, Sydney.

Pressey RL 1986 Wetlands of the River Murray Below Lake Hume, River Murray Commission Environmental Report 86/1.

Reid N & Vincent DJ 1979 Report on an Ornithological Survey of South Australian National, Conservation and Recreation Parks and Game Reserves with Comments on the adequacy of Bird Conservation in South Australia, SA Ornithological Assoc., Adelaide.

Robinson F & York B 1977 The Black Resistance, Widescope, Camberwell.

Scott TD, Glover DJM & Southcott RV 1974 The Marine and Freshwater Fishes of South Australia, Govt. Printer, Adelaide.

South Australian Department of Tourism 1984 Domestic Travel in South Australia - Characteristics by Region, SA Department of Tourism, Adelaide.

South Australian River Murray Wetlands Working Party 1989 Enhancing Wetlands, Engineering and Water Supply Department report 1439/88.

Specht RL 1972 The Vegetation of South Australia, Govt Printer, Adelaide.

Thompson MB 1983 "Murray River Tortoise, *Emydura chelodina* Populations: the Effect of Egg Predation by the Red Fox *Vulpes vulpes*" Aust. Wildlife Res. 10(2).

Thompson MB 1986 River Murray Wetlands, their Characteristics, Significance and Management, Department of Environment and Planning and Nature Conservation Society of South Australia, Adelaide.

Tindale MB 1974 Aboriginal Tribes of Australia, Aust. Nat. Uni. Press, Canberra.

Tyler MJ 1978 Amphibians of South Australia, Govt. Printer, Adelaide.

Watts CHS & Aslin HJ 1981 The Rodents of Australia, Angus & Robertson, London.

BULYONG ISLAND

1 BULYONG ISLAND DESCRIPTION

1.1 Landform and Soils

Laut et al. (1977) place Bulyong Island in the Renmark Environmental Association of the Upper Murray lands Environmental Region of the Murray Mallee Province. The main feature of the landscape in this Association is the incised ancestral floodplain of the Murray River with a variety of fluvial landforms including discontinuous levees, oxbows, back swamps, lakes and low terraces. Many of these wetlands are seasonally inundated although the overall effect of river regulation has been to maintain river levels higher than their natural summer depth but with a substantially reduced frequency of winter flooding.

Deep, grey, self-mulching, cracking clay soils occur in the low-lying, river terraces. Much of the surrounding region to the south has largely been cleared for the Town of Renmark and for grazing and irrigation purposes. To the north there are two large pastoral properties "Calperum" and "Chowilla" both of which contain extensive areas of floodplain. The latter has recently been the subject of a detailed public consultation and planning exercise and, as a result, a considerable volume of natural resource information is available (see National Environmental Consultancy, 1987, NCSSA, 1990 and Murray-Darling Basin Commission, 1991).

1.2 Vegetation

A vegetation map showing major plant communities on the island has been prepared by Carter & Nicholson (unpublished) and is reproduced in Figure 7. Carter & Nicholson have also examined an historic sequence of aerial photographs of the area, documented vegetation decline attributable to elevated river levels (Figure 8), conducted a tree planting and rabbit eradication program and established a series of permanent photographic monitoring points. The following vegetation descriptions have been provided by them.

The major plant communities on the island are:

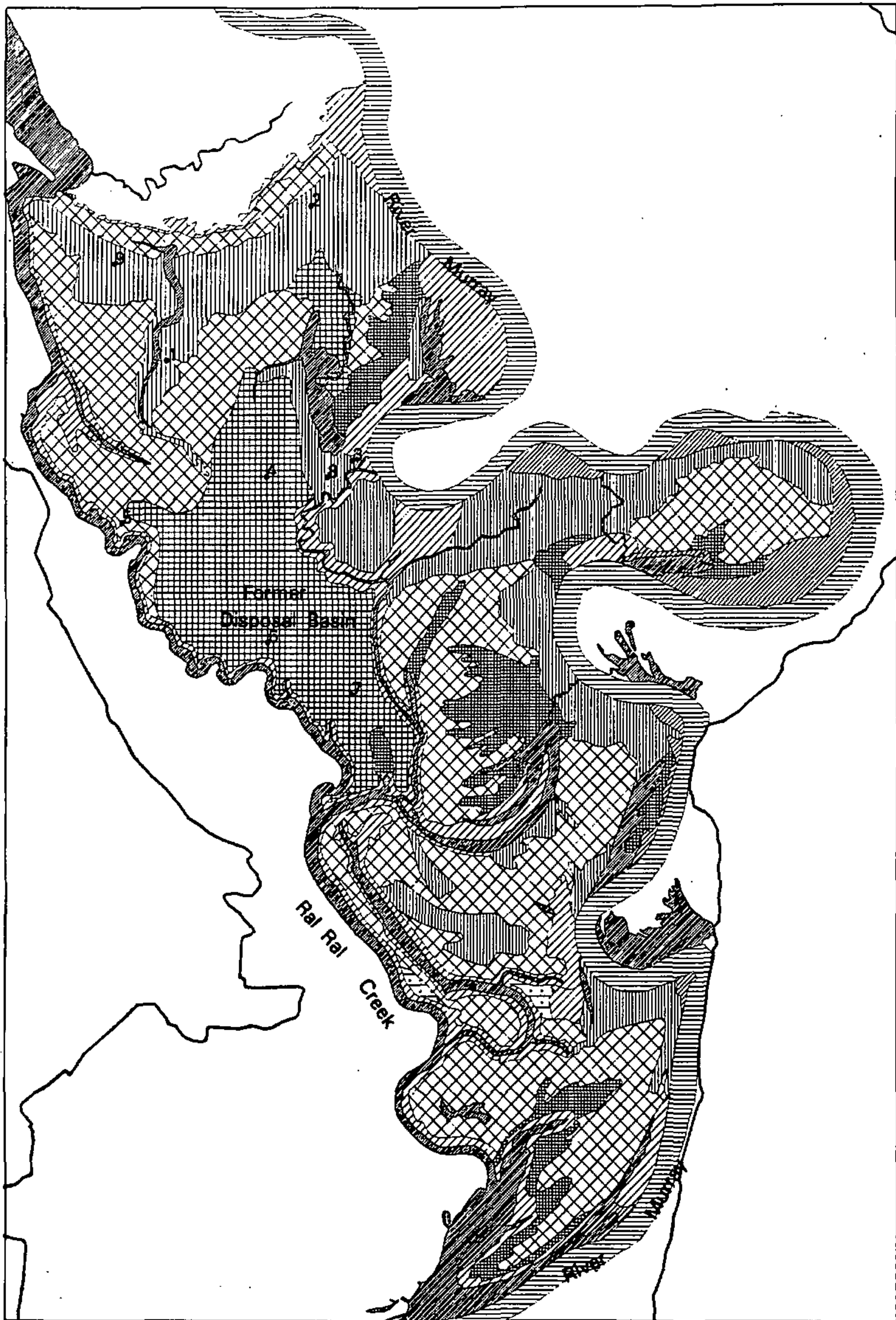
1.2.1 Red Gum woodland







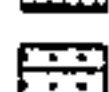




Found immediately adjacent to the river and occupying low lying areas which are frequently flooded this association is typified by soils that are a mixture of fine sand, silt and clay. *Eucalyptus camaldulensis* is the dominant tree species. *Acacia stenophylla* occurs occasionally on the landward margin. The understorey is sparse and includes *Muehlenbeckia florulenta*, *Cyperus gymnocaulos*, *Cynodon dactylon*, *Paspalum* spp. and *Alternanthera nodiflora*. *Phragmites australis* can be found growing in dense patches on the river bank. Regeneration of *E. camaldulensis* is patchy.

At many locations along the river this association has been affected adversely by the impacts of river regulation. Permanently raised water levels around locks and weirs have caused many of the trees to drown and others to become stressed.

1.2.2 Red Gum/River Box/River Coobah Woodland

This association is also found adjacent to the river on the low floodplain, but at slightly higher elevations than the *E. camaldulensis* woodland/*C. gymnocaulos* sedgeland. *Eucalyptus camaldulensis* occurs closest to the water, grading to a mix of *E. largiflorens* and *A. stenophylla* further inland. *Muehlenbeckia florulenta* is the dominant understorey species. The density of this species varies according to soil type and topography and, in places, forms dense thickets. Where this occurs, regeneration of *Eucalyptus camaldulensis* and *E. largiflorens* is evident, apparently because seedlings have had protection from grazing. Other associated species include *C. gymnocaulus*, *Enchylaena tomentosa*, *Sclerolaena tricuspidis* and annual grasses.



-  *Eucalyptus camaldulensis* Woodland
Cyperus gymnocarpus Sedge/land
-  *Eucalyptus camaldulensis*-*E. largiflorens*-
Acacia stanophylla Woodland
Muehlenbeckia floruenta Shrubland
-  *Eucalyptus largiflorens*-*Acacia stanophylla* Woodland
Muehlenbeckia floruenta Shrubland
Cyperus gymnocarpus Sedge/land
-  *Eucalyptus largiflorens* Woodland
Diophrys crassifolium Shrubland
-  *Muehlenbeckia floruenta*-*Chenopod* Shrubland
-  *Chenopod* Shrubland
-  *Halosarcia* spp.-*Atriplex* spp. Shrubland
-  Scald
-  Wetland
-  River Murray
-  Out of Study Area

• Photo Point

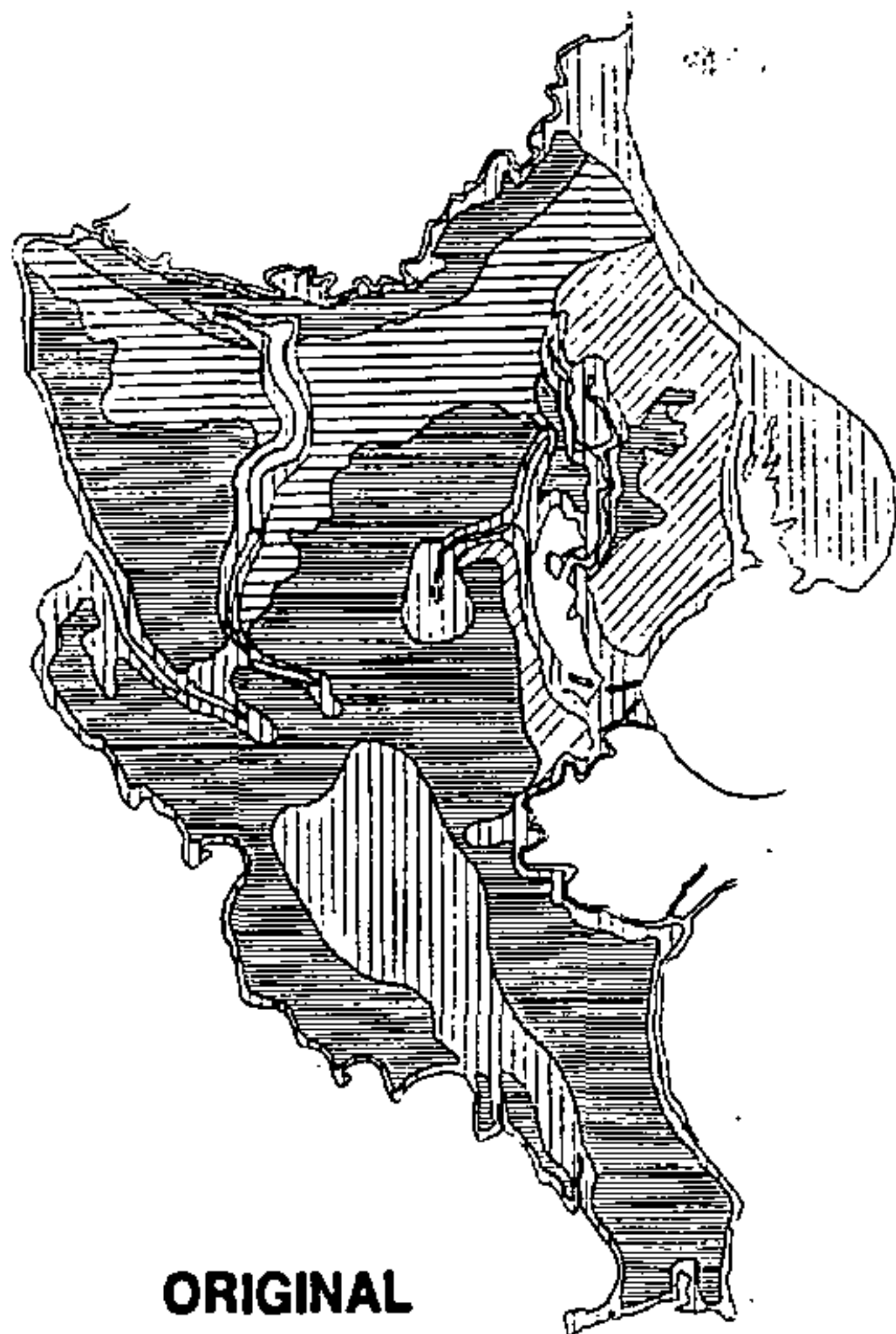
— 1956 Flood Level

0 1 2
kilometres

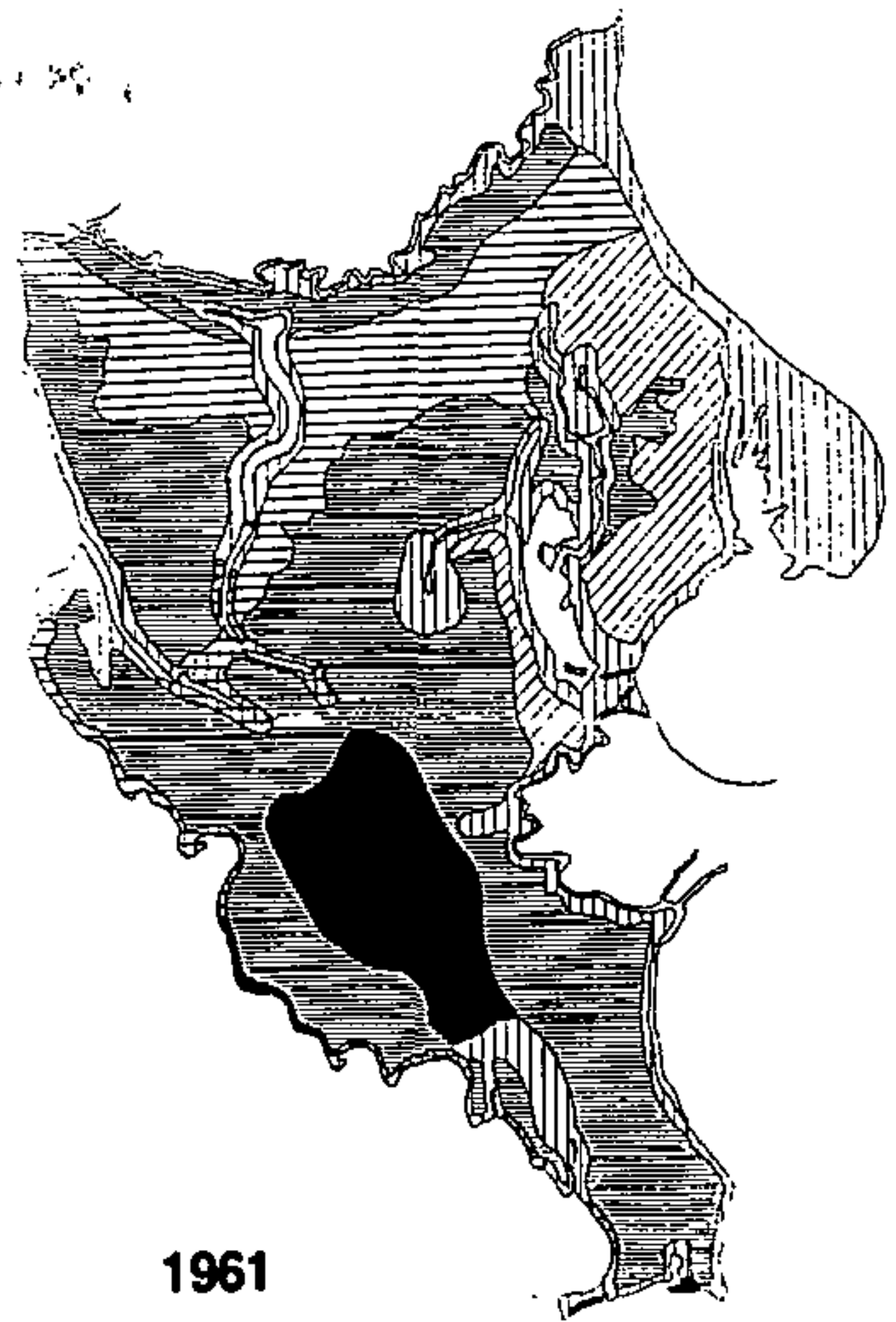


FIGURE 7

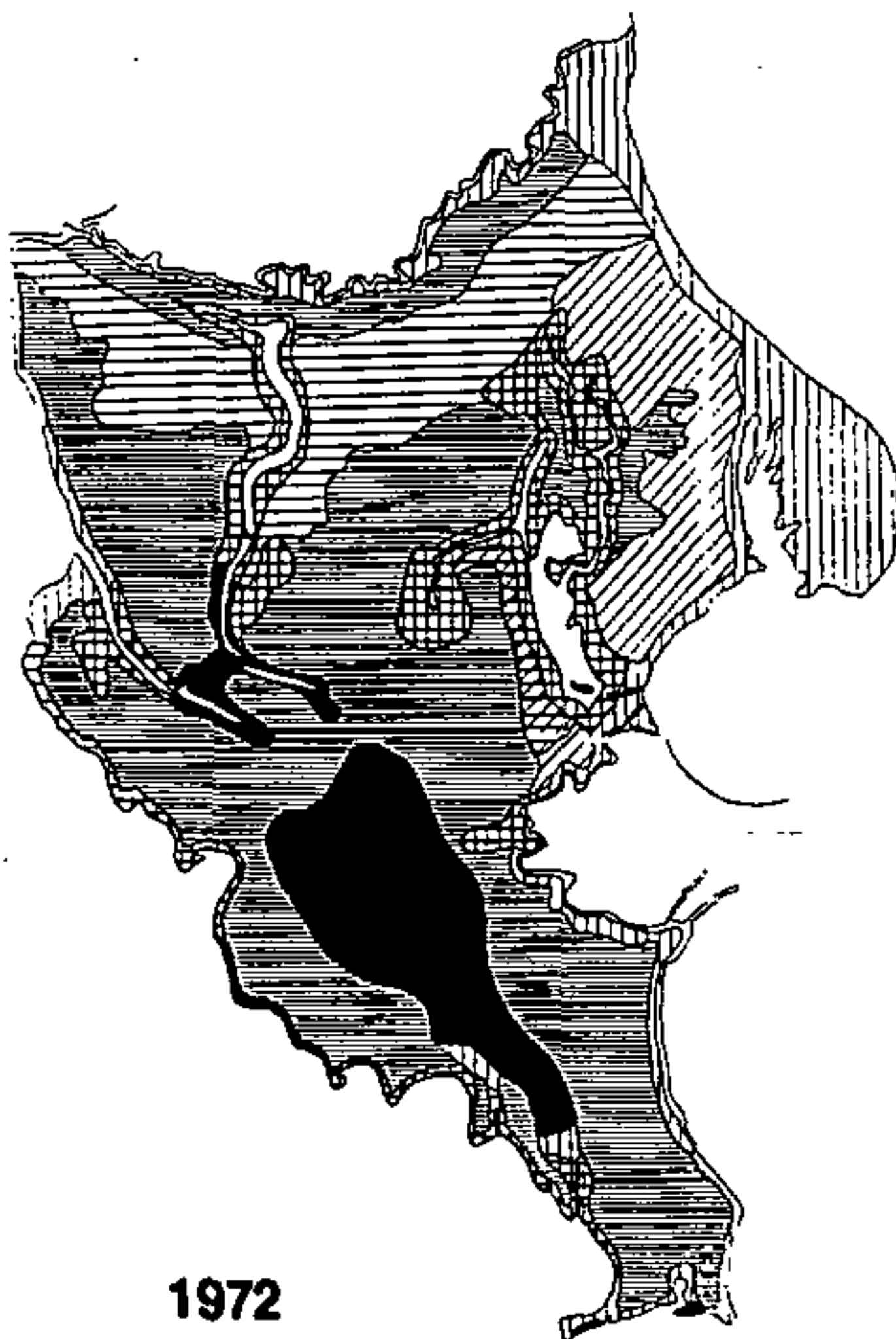
**MURRAY RIVER NATIONAL PARK
Bulyong Island
Existing Vegetation**



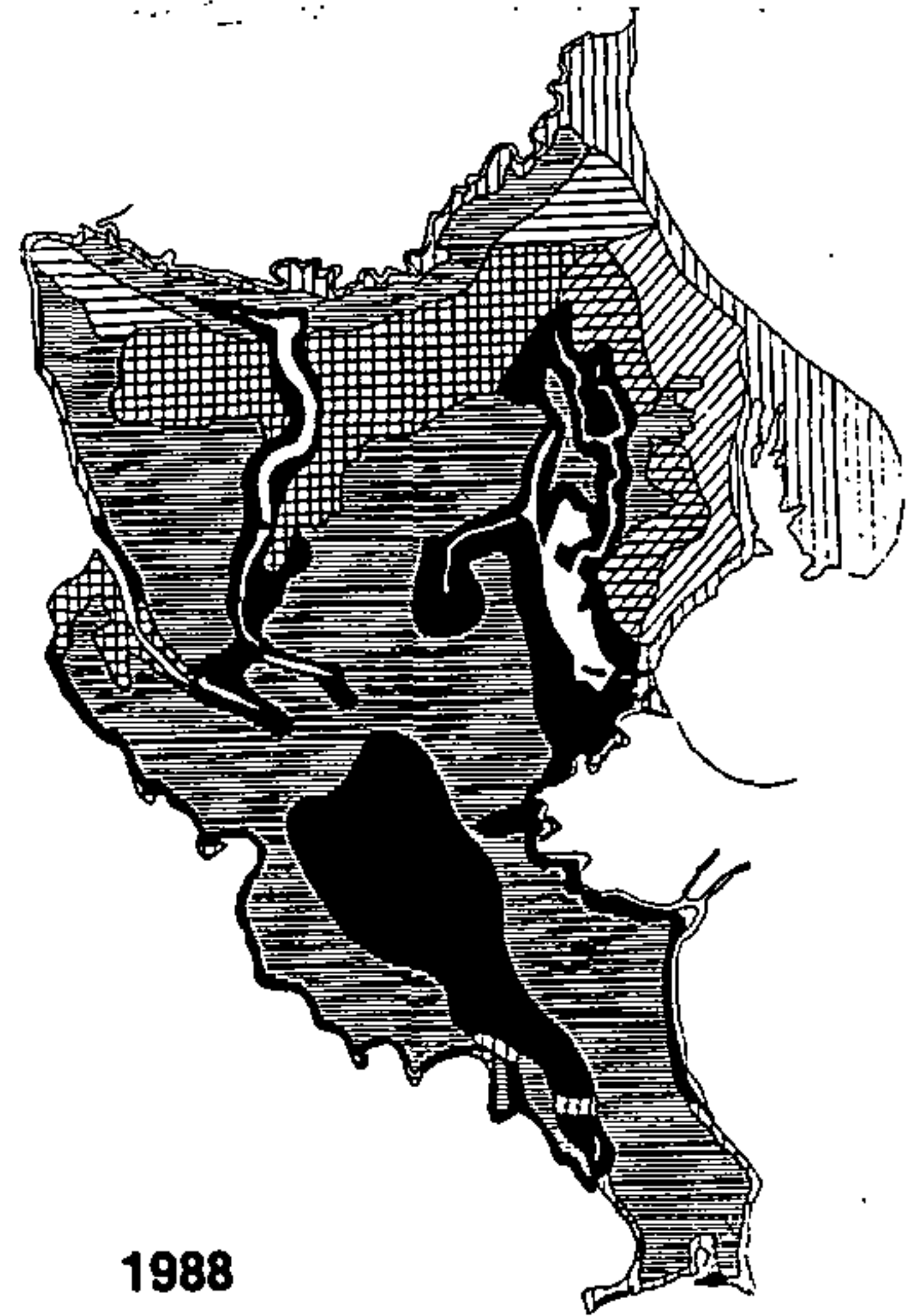
ORIGINAL



1961



1972



1988

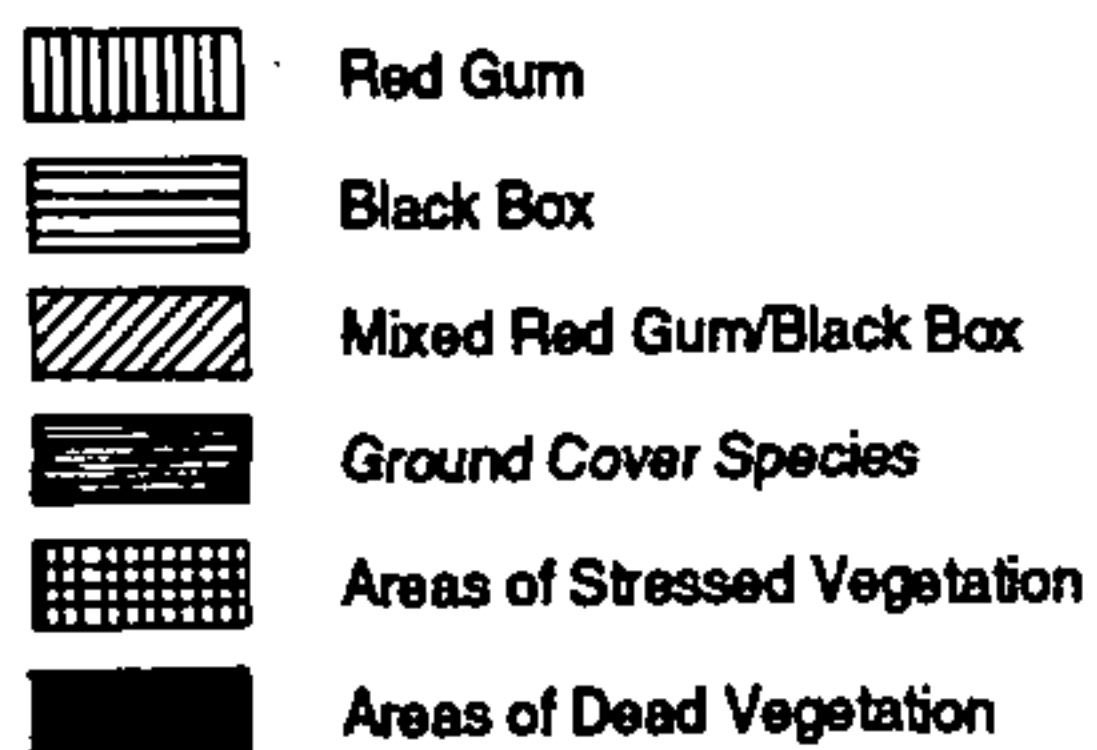


FIGURE 8

MURRAY RIVER NATIONAL PARK
Bulyong Island
Vegetation Decline (after Nicolson and Carter, 1992)

The health of this vegetation varies significantly, with decline in health generally related to distance from the river. Soils vary from fine sands and silts to heavy floodplain clays.

1.2.3 River Box/River Coobah/Lignum Woodland

Eucalyptus largiflorens is the major tree species of this association which is found on more elevated portions of the floodplain which, historically, flooded less frequently. *A. stenophylla* and *M. florulenta* are subdominant.

Eucalyptus largiflorens generally marks the outermost boundary of this association and delineates extreme flood events. The understorey is dominated by *A. lindleyi*, *A. semibaccata*, *E. tomentosa*, *C. gymnocaulos*, *Paspalum distichum* and *S. tricuspidis*. Soils range from grey floodplain clays in the lower lying areas to sandy loams at higher elevations.

Eucalypt regeneration occurs in areas where *M. florulenta* is dense and seedling have been protected from grazing.

1.2.4 River Box Woodland

This association is found in the northern sections of Bulyong Island and consists of *Eucalyptus largiflorens* with a dense ground cover of *Disphyma crassifolium*. The trees are stunted and adopt the mallee appearance that indicates extreme soil dryness. This is apparently due to the reduced incidence of flooding since river regulation. The presence of dense patches of *D. crassifolium* reflects relatively high soil salinities while other infrequently occurring species include *Halosarcia pergranulata*, *H. indica* and *Atriplex rhagodioides*.

1.2.5 Lignum/Chenopods

The soils of this association, which generally occupies low lying areas of floodplain, are generally highly saline, heavy floodplain clays.

The density of *M. florulenta* varies considerably; it is usually quite dense in areas that are particularly low lying and poorly drained but becomes sparse in more elevated, drier areas.

The distribution of chenopod species also varies according to drainage and soil salinity. *Atriplex lindleyi*, *A. semibaccata*, *E. tomentosa*, *S. tricuspidis* and *A. nodiflora* tend to occur in the less saline areas while *Halosarcia pergranulata*, *H. indica*, *C. cretica* and *S. australis* occur in more saline, low lying areas.

1.2.6 Samphire

This association occurs in the former disposal basin and is dominated by *Halosarcia* and *Atriplex* species. Soil salinity is the primary determinant of species distribution with samphire species such as *H. indica* and *H. pergranulata* occurring in low lying saline areas and *Atriplex* species including *A. rhagodioides* and *A. lindleyi* on more elevated areas.

The former floodplain (*Eucalyptus camaldulensis* woodland) community that used to occur in the area was severely affected by water logging when the river was first regulated. Impoundment of drainage disposal water between 1967 and 1990 (see History section) compounded the problem and caused severe soil salinisation in some areas. Alterations to control structures since 1990 mean that flows of 50 000 ML/day are now required to flood the area. While floods of this magnitude are of high quality water which may flush some of the accumulated salt from the surface soil and enable limited recovery of salt sensitive vegetation, the high water tables resulting from river regulation will continue to be a barrier to re-establishment of extensive *Eucalyptus camaldulensis* communities.

1.2.7 *Chenopod shrubland*

Chenopod shrubs are widespread across Bulyong Island on higher parts of the floodplain. Dominant species in relatively well drained soils include *Atriplex rhagodioides*, *A. lindleyi* and *A. vesicaria* while Halosarcia species, including *H. indica* and *H. pergranulata* are predominant in lower lying saline areas.

1.3 Native Animals

There is little published information available on the fauna of Bulyong island although it is known to have a resident population of western grey kangaroos and a diverse avifauna, particularly waterbirds and species typically found in riparian vegetation in the region. Species reported include Emus, Pelicans, Sacred Kingfishers, Regent Parrots and White-breasted Sea-eagles. Mammals include kangaroos, brush-tailed possums, several species of bats, and water rats.

Long-necked tortoises (*Chelodina longicollis*) occur in Ral Ral Creek and nest along its banks and several species of frog including the eastern banjo frog and spotted grass frog may be heard. Some of the more obvious reptile species include bearded dragons, water dragons, shingleback lizards, lace monitors, brown snakes and tiger snakes.

1.4 Wetlands

The Ral Ral Widewaters on the north-western boundary of Bulyong Island is considered by Thompson (1986) to be of moderate conservation value and typical of the creek banks along the upper Murray in South Australia being long and narrow in shape with extensive areas of bank. The banks themselves, and the fringing vegetation associated with them, provide substrata important to many aquatic animals. The banks are stabilised by the roots of trees, mostly red gums (*Eucalyptus camaldulensis*), which also provides diversity to the bank habitat. Much of the water's edge is vegetated with bulrush (*Typha* sp.) and there are ribbon weed (*Vallisneria spiralis* and *Potamogeton* species) in the water. Adjacent flats in less frequently flooded areas contain river box (*Eucalyptus largiflorens*), coobah (*Acacia stenophylla*) and lignum (*Muehlenbeckia florulenta*). Thompson suggests that many species of fish probably occur in the creek and bony bream (*Nematalosa erebi*), Australian smelt (*Retropinna semoni*) and European carp (*Cyprinus carpio*) were collected by him as well as prawns (*Paratya australiensis*), calanoid copepods, cladocerans (*Moina* sp.) and larvae of chironomids and damselflies (Lestidae).

1.5 Pest Plants and Animals

Proclaimed pest plant species Californian burr (*Xanthium californicum*) and Bathurst burr (*Xanthium spinosum*) commonly occur along watercourse margins and are sometimes parasitised by dodder (*Cuscuta epithymum*) a species of major economic concern which also parasitises small commercial crops such as clovers.

Mud dock (*Rumex bidens*) is a native plant which periodically blooms in confined water ways, restricting water flows and boating access. Major control programs are not warranted.

Because of the extent of inundation in flood periods there are few problems associated with vertebrate pests. Rabbits, foxes and feral pigs all occur but are usually in low numbers. Opportunistic control measures during high rivers (flows in excess of 100 000 ML/day) is likely to be sufficient to maintain these species at very low levels.

1.6 Degradation

Away from the creek and river banks, and particularly in the vicinity of the former Bulyong Island Evaporation Basin, much of the area is severely degraded (see Figure 8) and presently of low conservation value (SA River Murray Wetlands Working Party Report, 1988). In some areas the soil is salinized to the point that only a few scattered samphire bushes survive and

many river red gums have been drowned.

1.7 Wildfire

There are no records of significant wildfires occurring on the island. Years of significant fire hazard occur after major floods have subsided of when grasses proliferate after above average rainfalls. However, the presence of numerous watercourses, bare soil and light fuel loads mean that the risk of serious fire is minimal. The risk of wildfires from visitor activities (such as camp-fires) is significant particularly in the reed beds along the waters edge after the spring subsidence in water level. However, because highland fuel loads are usually low and there are substantial natural fire breaks, the risk of fire spread is not great. The low fuel loads also means that there is limited availability of wood for camp-fires as well as for small ground dwelling animals and micro-fauna.

1.8 Access and Recreational Values

There is no convenient form of public vehicular access to the island. However because of its proximity to Renmark the sparse vegetation on the island and the high frequency of boat ownership in the region there remains a potential threat from uncontrolled use by trail bikes should such use become prevalent.

Access to the northern section of Bulyong Island is physically possible via Calperum Station and an embankment over Ral Ral Creek south of Lake Woolpolool. Again, access is barred by Nelbuck Creek which flows from the southern part of Woolenook bend on the River Murray to the southern end of Ral Ral Wide Waters.

Whirlpool Corner, the western bank of Woolenook Bend, and smaller bends between these two, are popular mooring points for houseboat users, particularly for private vessels emanating from Renmark.

The creek system is very popular for a range of aquatic activities including boating, fishing, yabbing and canoeing.

Several "dinghy derbys", involving high speed navigation through the creek system within and around the island have been conducted. These events attract up to 50 boats and also foster numerous pre-event practice sessions by competitors. There are no formal walking tracks and while pedestrian use away from the creek is limited there have been a number of orienteering and similar events held on the island.

1.9 History

Department of Lands records show that from 1 July, 1851 the area surrounding Renmark was held under Pastoral Lease No. 95 by A.B. Cator. A portion of this lease was taken by William Finke in July 1859 and subsequently divided into two properties named "Bookmark" and "Chowilla". The present study area was located in the former although, according to Grosvenor (1979), a complicating factor regarding times and places is that the ultimate Calperum station, in addition to having been changed in name from Bookmark, was made of eight original pastoral leases.

In 1867, a Mr John Chambers took over the Bookmark and Chowilla properties and in the 1870's the leases were transferred to the Robertson Brothers (Grosvenor, 1979). In 1887 land was acquired from Bookmark Station by the Commissioner of Crown Lands for the establishment of the Renmark Irrigation Trust by the Chaffey Brothers (Department of Lands, 1984). The *Chaffey Brothers' Irrigation Works Act, 1887* gave the legal right to develop 200 000 acres (80 000 Ha) of land from Spring Cart Gully to the border for irrigation purposes.

In 1897 the Robertson Brothers dissolved their partnership. Robert stayed on the Chowilla lease, John took over Bookmark, renaming it Calperum and William moved to Queensland.

Throughout these land transactions the southern portion of Bulyong Island (Section 199)

remained a commonage under the control of the Minister of Lands.

At the end of World War I Bulyong Island was leased by the RSL as part of its returned soldier repatriation program. It was apparently used primarily for agisting horses while they were not being used for agricultural work.

In the mid-1960s the Renmark Irrigation Trust entered into negotiations with the RSL to obtain the northern portion of the Island for use as an evaporation basin. The RSL acceded to these moves and subsequently took possession of 280 hectares of land from Calperum Station.

By October 1967 a series of embankments and an inlet/outlet structure had been established and the area began to receive drainage water from the Renmark and Chaffey Irrigation areas. The following year Section 374 Ral Ral Division, Chaffey Irrigation Area was proclaimed as a Drainage Reserve.

Although there were some areas of degraded vegetation within the boundaries of the basin area prior to its construction, the commissioning of the basin led to the death of large areas of vegetation. Initially these deaths were caused by drowning and were confined to the basin area itself (Figure 8). Subsequently, elevated water tables and salinity levels led to an extension of the basin's sphere of influence and widespread changes to vegetation composition, most noticeably deaths of large areas of river red gums.

After the completion of the Noora Drainage Disposal Scheme in 1983, until the completion of diversion works in 1990, the basin continued to receive excess drainage water. The flood of 1989 breached the basin embankment and, on 6 April 1990, the Engineering and Water Supply Department, on behalf of the River Murray Wetlands Management Committee, removed further sections of the embankment so that the basin lost its holding capacity. It is now flooded only by fresh water flows, approximately one in every two years, when River Murray flows to South Australia exceed 35 000 ML/day.

In 1991 the Bulyong Island Drainage Basin was resumed and, on 20 June 1991, the island was established as part of the Murray River National Park

1.10 Hunting

Historically, Bulyong Island has provided an alternative, easily accessible area for duck hunting. Numbers of individuals using the island for this activity were not great.

Under the provisions of the *National Parks and Wildlife Act, 1972* recreational duck hunting is not permitted in National Parks and this activity therefore legally terminated upon park establishment in 1991.

2 BULYONG ISLAND MANAGEMENT PROGRAM

Policies for the management of Bulyong Island which are summarised below are guided by:

- (a) the Articles of the Convention on Wetlands of International Importance especially as Waterfowl Habitat
- (b) Government policy
- (c) the *National Parks and Wildlife Act, 1972* and Regulations
- (d) the desires and expectations of the Corporation of the town of Renmark
- (e) National Parks and Wildlife Service (SA) policies,
and
- (f) community attitudes and expectations

Because of the proximity of Bulyong Island to the town of Renmark and its high value as a local recreational and tourism resource, particular emphasis has been given to the expectations and desires of local residents.

A need has also been identified to clarify nomenclature of the various islands in the Bulyong Island area. The convention adopted in this report and that which is to be recommended to the Geographical Names Board is for each island to be named after the dissecting creek immediately to its north i.e. the islands from north to south (Figure 9) would be Renney, Nelbuck, Bulyong and Kylie. Because Longwang Creek no longer flows between the River Murray and Ral Ral Creek, the name Longwang Island will no longer be used.

The present name attached to "Kylie" Creek is apparently not acknowledged by the Geographical Names Board. The Geographical Names Board should be approached to recognise "Kylie" Creek.

2.1 Natural Resources

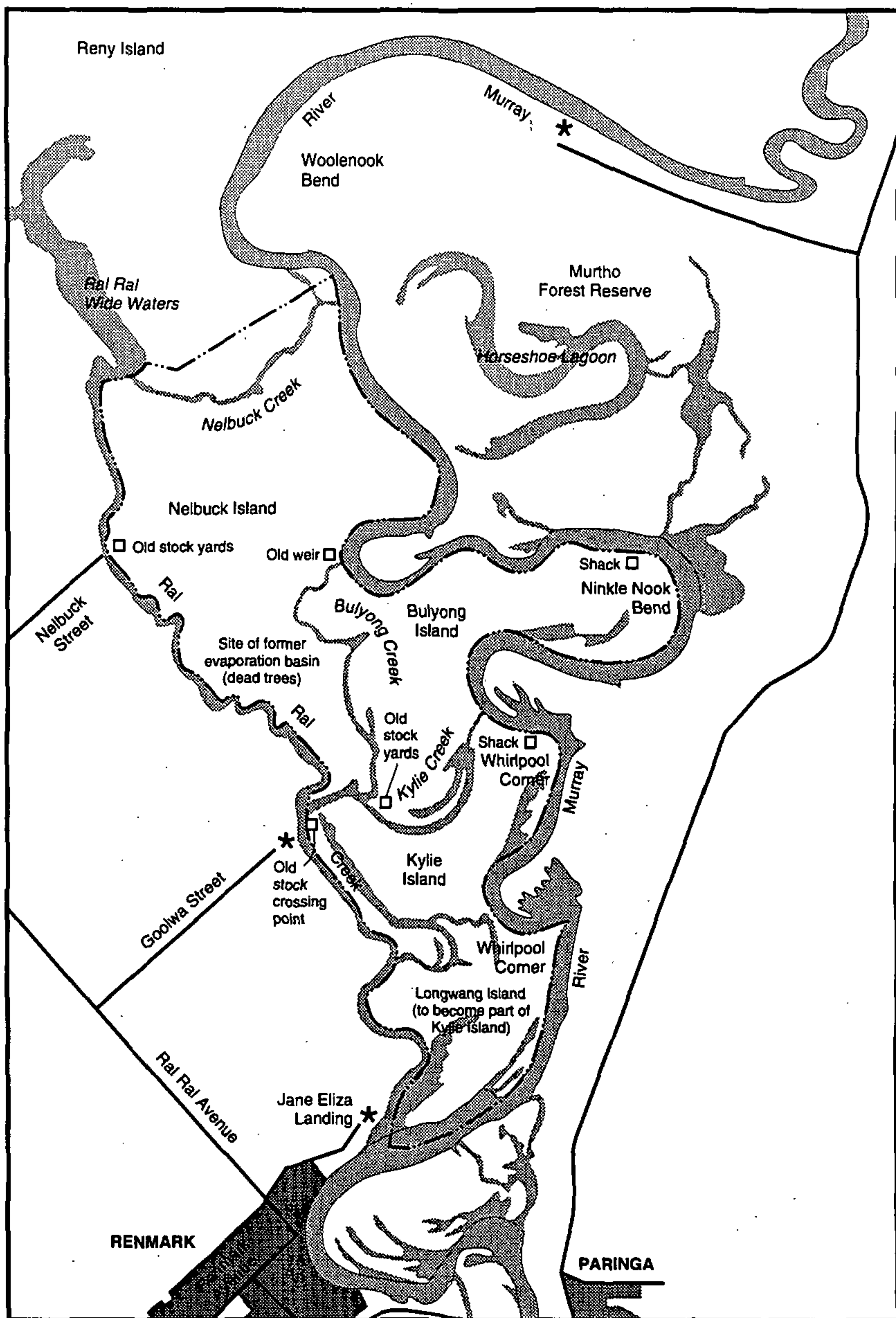
2.1.1 Native Flora

Policies

- * diversity of habitat will be maintained
- * aquatic and wetland habitats will be protected and enhanced where feasible by prolongation of natural floods
- * sensitive and important plant communities will be accorded special protection measures
- * management will ensure visitor activities do not cause unacceptable degradation of habitat
- * degraded areas will be progressively rehabilitated
- * long term trends in vegetation condition will be monitored

Actions

- * encourage fundamental survey and mapping of the biological resources of Bulyong Island to provide a database to assist future decision making.
- * identify high conservation value areas along major watercourses where there is a conflict between recreational use and protection of the resource
- * encourage prolonged flooding and increased flooding frequency by controlled releases of water from Lake Victoria and other upstream catchments when water storage volumes and river flow rates permit,
- * encourage investigation of habitat requirements for the maintenance of native fauna populations
- * provide protection to riverfront trees which are being ring-barked by mooring ropes
- * continue revegetation schemes as resources permit
- * encourage community interest groups to be involved in rehabilitation and tree planting programs
- * annually photograph and record vegetation condition at permanent monitoring



- Park Boundary
- Sealed Road
- ▨ Waterway
- ★ Boat Ramp

0 kilometres 1 2



FIGURE 9

MURRAY RIVER NATIONAL PARK
Bulyong Island
Park Features and Visitor Facilities

points

2.1.2 Pest Plants

Policies

- * control proclaimed pest plants which constitute a threat to downstream agricultural activities or which are of substantial nuisance value in popular recreational areas
- * abide by the Pest Plant and Animal Control Board's policy for control of golden dodder
- * replacement of weed species by re-establishment of native vegetation will be the preferred method of weed control where practical
- * willow trees to be progressively controlled by poisoning and/or physical removal. Individual trees which play an important role in providing shade or stabilising erosion-prone banks may be deliberately retained.
- * in general, local species and seed sources will be used in revegetation programs, however, in salt affected areas, salt tolerant species from other areas may be introduced

Actions

- * spray burrs (*Xanthium* spp.) in popular visitor areas
- * control golden dodder in accordance with Pest Plant and Animal Control Board's policy
- * eradicate outbreaks of dodder and any other primary (Schedule 1) pest plants whenever discovered
- * encourage and assist with current willow destruction program being undertaken by Mr Jack Seekamp under a Murray-Darling Basin Commission Natural Resources Management project

2.1.3 Native Animals

Policies

- * protect resident native species
- * investigate potential for re-introductions of native species which naturally occurred in the area

Actions

- * where practicable eradicate feral predators

2.1.4 Introduced Animals

Policies

- * control, and if practicable eradicate, vertebrate pests including rabbits, cats, foxes and pigs
- * utilise the expertise of recognised hunting groups in feral animal control programs

Actions

- * carry out opportunistic shooting of rabbits when river levels are high
- * if rabbit numbers increase significantly, lay rabbit baits in conjunction with warren ripping programs on elevated areas during periods of high river.

- * negotiate agreements with hunter organisations to allow shooting of feral species on selected days on a needs basis
- * where practicable eradicate feral predators

2.1.5 Rehabilitation

Policies

- * as salt conditions permit, progressively rehabilitate salt affected areas, in particular the site of the former Bulyong Island Evaporation Basin
- * recognise that the hydrological regime of the river has permanently changed and attempt to re-establish vegetation best suited to the present circumstances
- * involve the local community in revegetation projects
- * manage recreational use to ensure that impacts are minimised

Actions

- * support increasing the frequency and effectiveness of flushing through controlled releases of water from upstream storages so as to assist flushing (desalinisation) of the site of the old evaporation basin
- * along flushed creek banks and in other areas where salt conditions permit, undertake active revegetation programs using locally occurring species
- * encourage and support the involvement of voluntary community groups in revegetation projects
- * undertake appropriate actions to minimise impacts of recreational use

2.1.6 Wetland of International Importance

Policies

- * management of Bulyong Island will recognise its status as part of a "listed" wetland under the Convention on Wetlands of International Importance Especially as Waterfowl habitat

Actions

- * as required under Article 4 of the Convention:
 - (a) research and exchange of data on the Bulyong Island wetland and its flora and fauna will be encouraged
 - (b) management of the Bulyong Island wetland will aim to increase waterfowl populations
 - (c) opportunities will be provided for training of personnel "in fields of wetland research, management and wardening"

2.2 Cultural Resources

2.2.1 Aboriginal

Policies

- * sites and objects of archaeological value or of significance to Aboriginal people will be protected
- * management of Aboriginal sites or objects will have regard to the views of Aboriginal people who have an affiliation with the area

Actions

- * encourage research for the inventory, analysis and assessment of sites or objects of archaeological or historic significance
- * ensure development sites are surveyed before disturbance occurs
- * liaise with Aboriginal people regarding management of sites or objects of significance found on the island

2.2.2 European

Policies

- * sites and objects of historical significance will be protected

Actions

- * solid remnants of the former Bulyong Island Evaporation Basin such as old weirs and levee banks will be retained and interpreted as part of the overall picture of River Murray regulation and salinity management
- * relics of pastoral occupation of the island such as old stockyards, bridges and fence-lines will be individually assessed as to the historical value. Those which merit retention will be tidied up by the removal of loose wire and other debris and interpreted. Others will be removed. Structures which warrant retention include:
 - (a) the old stockyards near the junction of "Kylie's" and Bulyong creek
 - (b) the old stock loading ramp opposite Goolwa Street
 - (c) the old stockyards opposite Nelbuck Street

2.3 Visitors

2.3.1 Access

Policies

- * unless there are pressing reasons to do otherwise, navigation along all water bodies within Bulyong Island will be unrestricted
- * similarly there will be minimal restriction on movement and mooring of boats along river banks
- * all boating activities to be in accordance with the *South Australian Boating Act, 1974* and Regulations
- * vehicular (terrestrial) access on Bulyong Island will be for management purposes or by permit only
- * pedestrian access on the island will be encouraged
- * to maintain the natural character of the area signposting will be kept to a minimum and restricted to boundary markers, interpretation signs at significant features of public interest and to hazard warning signs

Actions

- * monitor boating activities with regard to:
 - (a) safety of park visitors
 - (b) environmental impacts
- * invoke the SA Boating Act and Regulations over all waters within Murray River National Park by publishing a notice in the SA Government Gazette.
- * enforce Boating Act and Regulations
- * provide hazard warning signs where required such as at entrances to confined meandering watercourses like Bulyong Creek

- * liaise with organisers of special events such as "Dinghy Derbies" to ensure courses are set which avoid sensitive areas and that impacts from associated activities are minimised

2.3.2 *Camping and Picnicking*

Policies

- * allow picnicking and camping activities

Actions

- * monitor levels of use and impacts

2.3.3 *Fishing and Yabbying*

Policies

- * no restrictions other than those under Fisheries Act and Regulations

Actions

- * invoke the Fisheries Act and Regulations over the park by publishing a notice in the SA Government Gazette.
- * ensure compliance with Fisheries Act and Regulations.

2.3.4 *Fires*

Policies

- * fire protection to be in accordance with the S.A. N.P. & W.S. Fire Management and Protection Manual (1988) and the Park Fire Protection Plan.
- * outside of fire ban periods allow camp-fires.
- * camp-fires should only occur in identified areas.
- * the use of gas cooking fires will be encouraged
- * visitors should be encouraged to bring wood for camp-fires into the park and not collect it from the local area.

Actions

- * ensure fire bans correspond to those of Renmark Corporation
- * DENR to prepare a Fire Protection Plan for Murray River National Park

2.3.5 *Visitor Facilities*

Policies

- * limited internal pedestrian access
- * signs
- * map and notes

Actions

- * seek sponsorship/advertising from local businesses for map and notes

2.3.6 Walking Trails

Policies

- * encouraged

Actions

- * identify a simple system of walkways to features of particular interest
- * prepare signage system and accompanying map and notes

2.3.7 Information and Education

Policies

- * to maintain the natural character of the area, on-site information signs will be kept to a minimum
- * simple information signs may be erected to demarcate park boundaries and to interpret features of particular interest
- * a printed information guide to be available for boaters and canoeists

Actions

- * in conjunction with the Department of Recreation and Sport, adjoining land-holders and local interest groups revise, update and reprint the *Ral Ral Creek Canoe Guide* (No. 2) as a general purpose park brochure.
- * in addition, a simple, low-cost park interpretation leaflet to be prepared

2.3.8 Litter

Policies

- * litter bins not to be provided on the Island
- * visitors will be expected to package rubbish and take away with them to dispose of off-site
- * a low impact camping philosophy to be promoted

Actions

- * low impact camping philosophy to be promulgated through information materials and other media
- * periodic clean up campaigns to be undertaken, ideally involving user groups and organisations such as KESAB, River Murray Boat Owners Association and Riverwatch

2.3.9 Dogs

Policies

- * while visitor numbers remain low and users continue to act responsibly in controlling their pets, dogs will be permitted on the island and internal watercourses provided they are kept on a leash or within vessels

Actions

- * Bulyong Island to be designated as a "dog zone" and an appropriate announcement made in the Government Gazette
- * levels of use and behaviour of dogs will be monitored to ensure they do not present a significant threat to wildlife

2.4 Other Interests

2.4.1 Drainage Basin

Explanation

Much of Section 374, in the northern part of Bulyong Island served as an evaporation basin between 1968 and 1989. Noora Drainage Basin is now the alternative site for disposal of saline drainage water from Renmark Irrigation District and Chaffey Irrigation Area.

Since 1989 the Engineering and Water Supply Department, on behalf of the River Murray Wetlands Committee, has undertaken substantial earthworks to enhance the flushing characteristics of the area. Relics of some regulation structures still remain.

The drainage basin was resumed in 1991 prior to park establishment and the Engineering and Water Supply Department has advised that it has no further use for the area.

Policies

- * remaining relics of control structures will be retained and interpreted as part of the Islands history
- * as flushing gradually decreases the soil salt load of the area affected regeneration of native vegetation will occur

Actions

- * revegetation techniques may be applied to facilitate recovery

2.4.2 Mining and Petroleum Exploration

Explanation

The proclamation which established Bulyong Island as part of Murray River National Park (*The South Australian Government Gazette*, 20 June 1991) provided for the continuation of existing rights of entry, prospecting, exploration and mining under the *Mining Act, 1971 and Petroleum Act 1940* over Bulyong Island. In addition to the Minister of Mines and Energy's approval, approval must also be sought from the Minister for Environment and Natural Resources for approving the acquisition of further rights for such purposes.

The proclamation further specified the following conditions:

- (a) *at least three months before commencing any drilling or excavation, any vegetation clearance, the making of any road, track or airstrip or the construction of any building or other structure, the person must notify the Minister for Environment and Natural Resources and the Minister for Mines and Energy of the proposed work and must supply each Minister with such information relating to the proposed work as that Minister may require;*
- (b) *the person, in carrying out any work referred to in paragraph (a)-*
 - (i) *must comply with such directions as the Minister for Environment and Natural Resources may give in writing in relation-*
 - (A) *to carrying out the work in a manner that minimises damage to the land or the environment or to vegetation or wildlife on the land;*
 - (B) *to preserving objects, structures or sites of historic, scientific or cultural interest;*
 - or
 - (C) *to rehabilitate the land upon the completion of the work;*
 - and
 - (ii) *if the work is being carried out in pursuance of a right of entry, prospecting, exploration or mining acquired after the making of this proclamation must comply with such directions as the Minister for Environment and Natural Resources or the Minister for Mines and Energy may give in writing in relation to prohibiting or restricting*

access to any specified area that the Minister believes would suffer significant detriment as a result of carrying out the work;

- (c) *if a plan of management is in operation under section 38 of the National Parks and Wildlife Act 1972 in respect of the Murray River National Park, the person must have regard to the provisions of the plan of management;*
- (d) *the person, in addition to complying with any directions given under paragraph (b)-*
 - (i) *must take such steps as are reasonably necessary to ensure that objects, structures and sites of historic, scientific or cultural interest, features of scientific or scenic interest and any wildlife on the lands are not unduly affected by the exercise of those rights;*
 - (ii) *must take reasonable steps to minimise damage to vegetation;*
 - (iii) *must maintain all work areas in a clean and tidy condition;*
 - and*
 - (iv) *must, upon the completion of any work, obliterate or remove all roads, tracks, airstrips, buildings or other structures (other than a road, track, airstrip, building or structure designated by the Minister for Environment and Natural Resources and the Minister for Mines and Energy as suitable for retention) used exclusively for the purposes of that work.*

Policies

- * State government policy, as outlined in the Proclamation by the Governor will be followed

Actions

- * all mining applications or notifications received by the Minister for Environment and Natural Resources will be referred to the Department of Environment and Natural Resources and the Corporation of Renmark for information and comment. The Minister will consider these comments in drafting any directions for the carrying out of the proposed works.
- * the Department of Environment and Natural Resources and the Department of Mines and Energy will jointly assess mining applications and will:
 - (a) take into consideration any known important features, artefacts or flora and fauna that should be avoided and
 - (b) consider possible park management benefits of retaining any roads, tracks or structures created and forward appropriate recommendations to the Minister
- * the Department of Environment and Natural Resources and the Department of Mines and Energy will jointly monitor compliance with the Gazetted requirements for mining

2.4.3 Shack Sites

Explanation

Sections 409 and 410, Chaffey Irrigation area (Figure 9) are registered by the Department of Lands as shack sites and are excluded from the National Park area.

Policies

- * under the terms of the present Government Shack Policy both sites have "life tenure" i.e. the existing licensees may retain the use of the site for the rest of their life, but may not transfer their interest in the site to a third party.

Actions

- * compliance with shack licence conditions will be monitored
- * upon surrender of each of the shack licences all structures are to be removed and the land incorporated into the National Park area.

2.4.4 Commercial Fishing

Explanation

Responsibility for control of commercial fishing in South Australia rests with the Minister of Fisheries and his Department. On 13 August 1991, the Minister of Fisheries approved arrangements for commercial fishing in backwaters of the River Murray. These arrangements allow licence holders to take certain fish from specified backwaters which include backwaters on National Parks and Wildlife Act reserves and on private property. Commercial fishing in Ral Ral Creek and Bulyong Creeks is currently prohibited.

Notwithstanding commercial fishing control by the Department of Fisheries, licence holders are required to comply with the *National Parks and Wildlife Act, 1972* and Regulations and to obtain permission of the Minister for Environment and Natural Resources if they wish to fish backwaters that form part of a NPW Act reserve.

There is currently an inconsistency in defining areas that can be fished. Areas which are backwaters at normal river levels have their surface waters linked with the River Murray during periods of flood. Under present Fisheries Regulations the flooded area is then considered to be part of the river itself and thus commercial fishers are allowed access.

Policies

- * in accordance with Department of Fisheries regulations and policy on commercial fishing in River Murray backwaters, commercial licence holders will be authorised to take non-native fish (except redfin) and bony bream from backwaters within the Park. The following areas of Bulyong Island will be excluded from that policy:
 - (a) Bulyong Creek
 - in consultation with the Department of Fisheries, commercial fishers and users,
 - (c) any other areas of high conservation and/or recreation value in which the Minister for Environment and Natural Resources believes commercial fishing should be excluded.
- * additional conditions, over and above Department of Fisheries regulations, may be imposed by the Minister for Environment and Natural Resources to enhance management arrangements.

Actions

- * assess working arrangements of all commercial fishers licensed to operate in the Park and notify licensees of any additional conditions necessary
- * monitor commercial fishing activities in all waters of Murray River National Park
- * liaise with Department of Fisheries, commercial fishers and users to consider the identification of additional areas to be excluded from commercial fishing
- * liaise with Department of Fisheries, commercial fishers and users to reconsider present policy allowing access to backwaters during periods of high river level

2.5 Research, Inventory and Monitoring

Explanation

Research is a function which assists in understanding the resources of reserves, their use and management. It is also a legitimate intrinsic use to further scientific knowledge.

Policies

- * all research will be subject to Department of Environment and Natural Resources policy and procedures for granting of scientific permits, the conduct of research and the forwarding of results to DENR.
- * approval to conduct research will normally be routine if:
 - (a) it has potential to facilitate better management, and
 - (b) it does not conflict the natural and cultural features and visitor use of the area.

Actions

- * encourage research which has potential to facilitate better management

3 BULYONG ISLAND MANAGEMENT ACTIONS

The actions required to implement the management proposals outlined in Section 2 are summarised below. The ranking indicates the relative priority of projects and whether they are of a short term, moderate term or continuing nature.

PROJECT	PRIORITY	DURATION	PAGE
Native Flora			
Survey and map biological resources	High	Moderate	69
Identify high conservation areas	High	Short	69
Encourage flood frequency and duration	High	Ongoing	69
Investigate habitat requirements of native fauna	Moderate	Moderate	69
Protect trees from ring-barking by mooring ropes	High	Short	69
Continue revegetation schemes	Moderate	Ongoing	69
Encourage community groups in revegetation schemes	High	Ongoing	69
Establish vegetation monitoring points	High	Short	69
Pest Plants			
Spray burrs in popular recreation areas	High	Ongoing	70
Control golden dodder in accordance with PPACB Policy	High	Ongoing	70
Eradicate primary pest plants	High	Moderate	70
Encourage and assist willow destruction program	High	Moderate	70
Native Animals			
Where practical eradicate feral predators	Moderate	Ongoing	70
Introduced Animals			
Control rabbits during floods	High	Short	70
Utilise hunting organisation to control feral animals	Moderate	Ongoing	70
Where practical eradicate feral predators	Moderate	Ongoing	71
Rehabilitation			
Support increase flooding of Evaporation Basin area	High	Ongoing	71
Undertake active revegetation program	Moderate	Ongoing	71

Encourage volunteers in revegetation projects	Moderate	Moderate	71
Minimise impacts of recreation use	High	Ongoing	71
Wetland of International Importance			
Implement requirements under Article 4 of the Convention	Moderate	Moderate	71
Aboriginal Cultural Resources			
Encourage site research	High	Moderate	72
Survey development sites	High	Short	72
Liaise with Aboriginal people	High	Ongoing	72
European Cultural Resources			
Retain obsolete drainage structures	Moderate	Short	72
Retain relics of pastoral occupation	Moderate	Short	72
Visitor Access			
Monitor boating activities	Moderate	Ongoing	72
Invoke Boating Act and Regulations	High	Short	72
Enforce Boating Act and Regulations	High	Ongoing	72
Provide boat hazard warning signs	High	Short	72
Liaise with Dinghy Derby organisers	High	Ongoing	73
Camping and Picnicking			
Monitor levels of use and impact	Moderate	Ongoing	73
Fishing and Yabbing			
Invoke Fisheries Act and Regulations	High	Short	73
Ensure compliance of legislation	High	Ongoing	73
Fires			
Fire bans to correspond to Renmark Corporation	High	Short	73
Prepare Fire Protection Plan	Moderate	Short	73
Visitor Facilities			
Seek sponsorship for education material	Moderate	Short	73
Walking Trails			
Identify a walking track system	Moderate	Short	74
Prepare accompanying education material	Moderate	Short	74

Information and Education

Revise Ral Ral Creek Canoe Guide	Moderate	Short	74
Develop Park interpretation leaflet	High	Short	74

Litter

Promote low impact camping philosophy	Moderate	Ongoing	74
Encourage clean up campaigns	High	Ongoing	74

Dogs

Designated as "dog zone"	High	Short	74
Monitor dog behaviour	High	Ongoing	74

Drainage Basin

To facilitate recovery, active revegetation may occur	Moderate	Moderate	75
-------------------------------------------------------	----------	----------	----

Mining and Petroleum Exploration

Applications will be referred to DENR and Renmark Corporation for comment	High	Ongoing	76
DENR and DME will jointly assess application	High	Short	76
DENR and DME will jointly monitor compliance	High	Moderate	76

Shack Site

Monitor compliance of licence conditions	High	Ongoing	76
Upon surrender of licence incorporate into Park	Moderate	Short	76

Commercial Fishing

Assess working arrangements of commercial fishers	High	Short	77
Monitor commercial fishing activities	Moderate	Ongoing	77
Consider excluding additional areas from commercial fishing	Moderate	Short	77
Reconsider backwater fishing policy	Moderate	Short	77

Research, Inventory and Monitoring

Encourage research	Moderate	Ongoing	78
--------------------	----------	---------	----

SELECT BIBLIOGRAPHY

- Aston HI 1973 Aquatic Plants of Australia, Melb. Uni. Press, Melbourne.
- Black JM 1963-1978 Flora of South Australia, V1-4, Govt. Printer, Adelaide.
- Briggs SV 1981 "Freshwater Wetlands" in Grove (Ed) Australian Vegetation, Cambridge University Press, Cambridge.
- Carter J & Nicholson C. (1992) Report of Murray-Darling Basin Commission Natural Resources Management Strategy project "Riparian Vegetation Rehabilitation", SA Department of Environment and Planning.
- Condon HT 1969 A Handlist of the Birds of South Australia, 3rd edition, SA Ornithological Assoc., Adelaide.
- Davies RLP 1982 The Conservation of Major Plant Associations in South Australia, Conservation Council of SA, Adelaide.
- Delroy LB "Creation of Waterfowl Habitat in South Australia", internal report DEP reference DE GR2/950/00.
- Department of Lands 1984 Summary - Management Study - Disher Creek - Border, The Government of South Australia.
- Frith HJ 1967 Waterfowl in Australia, Angus and Robertson, Sydney.
- Grosvenor GA 1979 Red Mud to Green Oasis, Raphael Arts Pty. Ltd.
- International Waterfowl Research Bureau 1976 Proceedings: International Conference on Conservation of Wetlands and Waterfowl, Heiligenhafen, Germany, 2-6 Dec, 1974 IWRB Slimbridge, England.
- Jessup JP (ed) 1983 A list of the Vascular Plants of South Australia, Adelaide Botanic Gardens and Department of Environment and Planning, Adelaide.
- Keast A 1959 "The Reptiles of Australia", in Keast et al. (eds) Biogeography and Ecology in Australia, Uitgeverij, Dr W Junk, Den Haag.
- Laut P, Heyligers PC, Keig G, Loffler E, Margules, Scott RM & Sullivan ME 1977 Environments of South Australia - Province 2, Murray Mallee, CSIRO Division of Land Use Research, Canberra.
- Ludbrook NH 1980 A Guide to the Geology and Mineral Resources Of South Australia, Dept. of Mines and Energy, Adelaide.
- Mackay N & Eastburn D (Eds.) The Murray, Murray-Darling Basin Commission, Canberra, 1990.
- Margules and Partners Pty. Ltd., P. & J. Smith Ecological Consultants, Department of Conservation Forests and Lands Victoria 1990 River Murray Riparian Vegetation Study, Murray-Darling Basin Commission.
- O'Driscoll EPD 1960 "The Hydrology of the Murray Basin Province in South Australia", Geol. Survey South Aust. Bull. 35.
- Ohlmeyer RG 1991 Report on Implications of Manipulating Water Levels in the River Murray Between Lock 1 and 10, Murray-Darling Basin Natural Resources Management Strategy.

- Pizzey G 1980 A Field Guide to the Birds of Australia, Collins, Sydney.
- Pressey RL 1986 Wetlands of the River Murray Below Lake Hume, River Murray Commission Environmental Report 86/1.
- Reid N & Vincent DJ 1979 Report on an Ornithological Survey of South Australian National, Conservation and Recreation Parks and Game Reserves with Comments on the adequacy of Bird Conservation in South Australia, SA Ornithological Assoc., Adelaide.
- Robinson F & York B 1977 The Black Resistance, Widescope, Camberwell.
- Scott TD, Glover DJM & Southcott RV 1974 The Marine and Freshwater Fishes of South Australia, Govt. Printer, Adelaide.
- South Australian Department of Tourism 1984 Domestic Travel in South Australia - Characteristics by Region, SA Department of Tourism, Adelaide.
- South Australian River Murray Wetlands Working Party 1989 Enhancing Wetlands, Engineering and Water Supply Department report 1439/88.
- Specht RL 1972 The Vegetation of South Australia, Govt Printer, Adelaide.
- Thompson MB 1983 "Murray River Tortoise, *Emydura chelodina* Populations: the Effect of Egg Predation by the Red Fox *Vulpes vulpes*" Aust. Wildlife Res. 10(2).
- Thompson MB 1986 River Murray Wetlands, their Characteristics, Significance and Management, Department of Environment and Planning and Nature Conservation Society of South Australia, Adelaide.
- Tindale MB 1974 Aboriginal Tribes of Australia, Aust. Nat. Uni. Press, Canberra.
- Tyler MJ 1978 Amphibians of South Australia, Govt. Printer, Adelaide.
- Watts CHS & Aslin HJ 1981 The Rodents of Australia, Angus & Robertson, London.