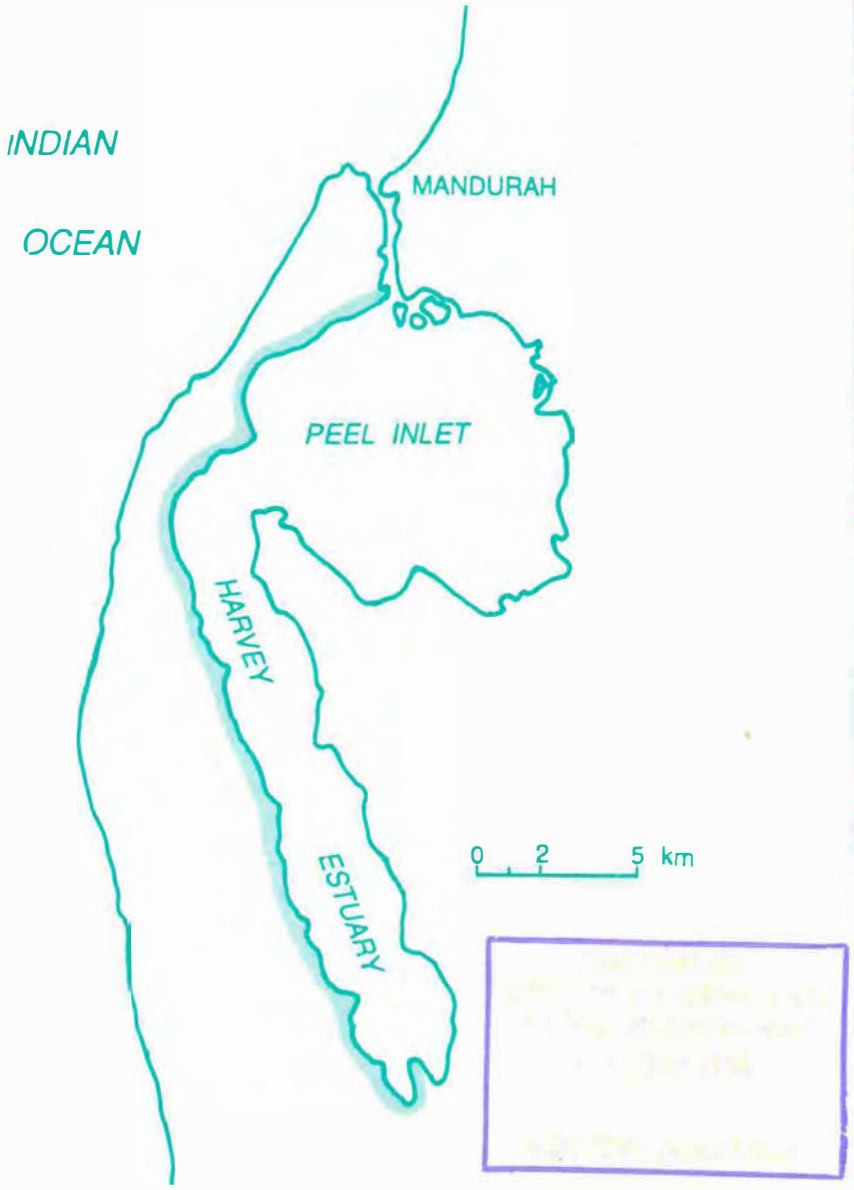
WESTERN FORESHORE OF THE PEEL-HARVEY ESTUARY

DRAFT MANAGEMENT PLAN



WATERWAYS COMMISSION

REPORT No. 30

February 1992

Western Foreshore Of The Peel - Harvey Estuary

Draft Management Plan

Prepared for The Peel Inlet Management Authority by the Waterways Commission

Compiled by Scott Woodcock

Waterways Commission
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Perth

Report N0 30
February 1992

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MINISTER'S FOREWORD

At the beginning of 1992 the Peel Inlet Management Authority released its Management Programme 1992, which will guide the Authority in its management of the waterway for the rest of the century.

The Management Programme identifies a range of issues of concern to people with an interest in the waterway and makes recommendations to deal with them. Several recommendations relate to the planning, management and use of the western foreshore. This area is of major concern to many people because it is under increasing pressure from a number of sources. The impending construction of the Dawesville Channel and expanding urbanisation of the district will result in increased public use of the foreshore. More detailed planning and better management are required to ensure that conservation values are protected and the community obtains the best recreational use of the area.

This draft plan identifies specific problems and makes recommendations about the need to create reserves and vest them in the appropriate authorities. It also makes recommendations about long term management.

The community is invited to consider this draft and make appropriate comments to assist PIMA in preparing the final plan. When implemented the Western Foreshore Management Plan will result in more effective conservation of the waterway margin and increased recreational opportunities for people.

Bob Pearce MLA

Minister for the Environment

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BACKGROUND

The western foreshore of the Peel - Harvey Estuary provides a major focus for recreation and tourism in the Mandurah region. Boat ramps and jetties enable access to the waterway for both amateur and professional fishing. Additionally, particular areas of the western margin are noted for their high conservation significance.

Presently, the western foreshore is experiencing considerable development pressure from the planned Dawesville Channel, encroaching residential and tourist developments and increasing recreational activity. Consequently, this plan was commissioned by the Peel Inlet Management Authority to develop recommendations to maintain the natural integrity of the landscape by providing a useful tool for the long term management of the Vacant Crown Land and reserves of the western foreshore of the Peel - Harvey Estuary.

In 1990 the Draft Peel Inlet Management Programme Review was prepared by the Waterways Commission. The purpose of the programme is to develop a general strategy for the entire Peel Inlet Management Area as well as to make specific planning recommendations for particular sites requiring attention. This study represents the first step in implementing the relevant recommendations of the Management Programme Review.

AIM

" To provide for the proper long term management of the water and Crown land adjoining the western margins of the Peel - Harvey Estuary between the Sticks Channel and Harvey River."

RECOMMENDATIONS

A diverse range of issues were addressed in preparing the management plan. Three primary objectives are defined in Chapter 3 to cover these issues. General Recommendations (Chapter 4) have been developed to achieve these objectives and to provide a framework for the Specific Recommendations. Chapter 5 contains the Specific Recommendations which enable the detailed implementation of the initial objectives.

OBJECTIVES

OBJECTIVE 1

Map all Crown land (reserves and Vacant Crown Land) to show reserve and private property boundaries, describing :

(a) existing geomorphological features as described by Seminiuk (1990);

(b) vegetation showing the location of trees (approximate light and dominant species), density of cover, main understorey species, presence of rush beds and weed species;

(c) the presence of open areas of water;

(d) the presence of sandy beaches;

(e) all human constructions including sealed and unsealed roads , tracks, bridges, causeways, parking areas, boat ramps (hard and soft), houses and sheds, filled land, parks and gardens, fences, log barriers and jetties on or near Crown land;

(f) waterway management problems including identified mosquito breeding areas, uncontrolled vehicular access points, erosion, fire hazards, weed infestations and unapproved developments.

OBJECTIVE 2

Prepare recommendations about future reserve purposes and vestings to cover all Crown land in the study area.

OBJECTIVE 3

Make recommendations about the future development and management of reserves.

(Plate 1: Erskine Wetland)
Conservation of significant wetlands is a priority in appropriately managing the western foreshore.

Recommendations

All General Recommendations are listed below in numerical order (1-25). The rationale behind these recommendations is discussed in Chapter 4. Chapter 5 lists the Specific Recommendations (S1-S75) in relation to their geographical locations. These have not been duplicated in this section due to the large number of recommendations presented and the need to consider them in conjunction with the relevant maps. The agencies responsible for implementation of the recommendations are shown in abbreviated form following each recommendation. These abbreviations are expanded in full in at the end of this document.

GENERAL RECOMMENDATIONS

CONSERVATION RESERVES

1. Vest areas of identified environmental significance in the NPNCA for appropriate management by CALM for the purpose of conservation of flora and fauna. (DOLA, NPNCA, CALM, LGA)

PROPOSED REGIONAL PARK

2. Implement recommendations 20 and 33 of the Peel Inlet Management Programme Review. Acquire foreshore reserves on freehold land and vest all Vacant Crown Land and unvested land in the appropriate authorities. Treat all foreshore reserves as a single regional park. (DOLA, NPNCA, CALM, LGA, WWC, PIMA)

ABORIGINAL, ARCHAEOLOGICAL AND ETHNOLOGICAL SITES

3. Refer all proposals to reserve, vest or develop Crown land or the foreshore to the Western Australia Museum for comment. (DPUD, PIMA, LGA)

EUROPEAN HISTORIC SITES

4. Implement recommendation 30 of the Peel Inlet Management Programme Review, so that, all sites of cultural and/or historical significnce are identified and protected under the Heritage of Western Australia Act 1990. (HCWA)

5. Develop appropriate historical sites as tourist attractions in a manner which does not conflict with the natural conservation or aesthetic value of the area. (WATC, HCWA, LGA)

PUBLIC ACCESS

6. Implement recommendation 51 of the Peel Inlet Management Programme Review. Encourage the provision and management of public access by establishing Public Access Precincts through the practice of reserving river foreshore land , promoting management plans which improve access and investigating the feasibility of entering into agreements with private landowners to gain the right of public access. Support the planning, construction and extension of dual use paths by LGAs in accordance with Dual Use Path Guidelines. Support the provision of foreshore facilities by LGAs to provide access for the disabled. (DPUD, CALM, PIMA, LGA)

7. Actively control public access to environmentally sensitive wetlands or conservation reserves by excluding vehicles and providing very limited pedestrian access ways. (PIMA, CALM, LGA)

FIRE MANAGEMENT

8. Prohibit the lighting of fires on the foreshore except in properly constructed fire places in accordance with Section 25 (1a), (1b) and (1c) of the Bush Fires Act (1954). (LGA, PIMA)

9. Develop a public education programme informing the people about the danger of fire in the area and the responsibilities of citizens in relation to the lighting of fires. (LGA, PIMA)

10. Develop roads, tracks, carparks and dual use paths as firebreaks and determine the appropriate location of firebreaks when locating such facilities. (PIMA, LGA)

11. Co- ordinate a fire fighting strategy between PIMA, City of Mandurah, CALM, SES and the Bush Fires Board. Provision will be made for training council staff in fire fighting techniques.(LGA, PIMA, CALM)

WEEDS

12. Remove weeds according to the priority assigned to those areas nominated in Table 3. (PIMA, LGA)

13. Identify areas of Bulrush (*Typha orientalis*) growth, monitor their progress and remove if expansion is noted. (PIMA)

FERAL ANIMALS

14. Develop a programme to eradicate feral animals. Particular attention should be directed at removing the fox and the introduced cat from environmentally sensitive wetlands. (CALM, PIMA)

TUART DIEBACK

15. Support scientific research into examining the cause of the Tuart dieback and develop measures by which to mitigate its effects. (PIMA, CALM)

16. Develop a Tuart revegetation programme for the entire western foreshore of the Peel - Harvey Estuary. Revegetate with Marri if Tuart planting becomes unviable due to continued extensive dieback attack.(PIMA, LGA, CALM)

UNAUTHORISED USE OF PUBLIC LAND

17. Seek to ensure that the boundaries between reserves and private properties are properly surveyed and clearly defined by road, dual use path, substantial fencing or signs. (DOLA, LGA, PIMA)

18. Consider the feasibility of preparing a lease agreement with landowners with freehold property abutting specific foreshore reserves vested in the Waterways Commission. (PIMA)

MOSQUITOES

19. Support a regional mosquito strategy which improves control methods and reduces environmental impact. (MCAC, CLAG, PIMA)

PROVISION OF FACILITIES

20. Support recommendation 46 of the Peel Inlet Management Programme Review to develop site design criteria and development guidelines for recreational nodes. (PIMA, DPUD, LGA)

21. Establish priority on development of recreation nodes based on :

(a) projected community demand

(b) environmental constraints and

(c) available funds. (LGA, PIMA)

22. Develop management plans for key recreational nodes to minimise the environmental impact and account for the provision of facilities based on projected demand. Required facilities may include:

- soft launching areas
- barbecues (preferably gas)
- toilets (connected to deep sewerage or approved alternative systems)
- tables and seating
- shelter (preferably natural)
- children play equipment
- fresh water supply
- rubbish disposal facilities
- vehicle and/or pedestrian access
- car parking
- beaches
- upgraded existing formal or soft launching areas with associated parking areas and
- nature interpretation facilities. (LGA, PIMA, CALM)

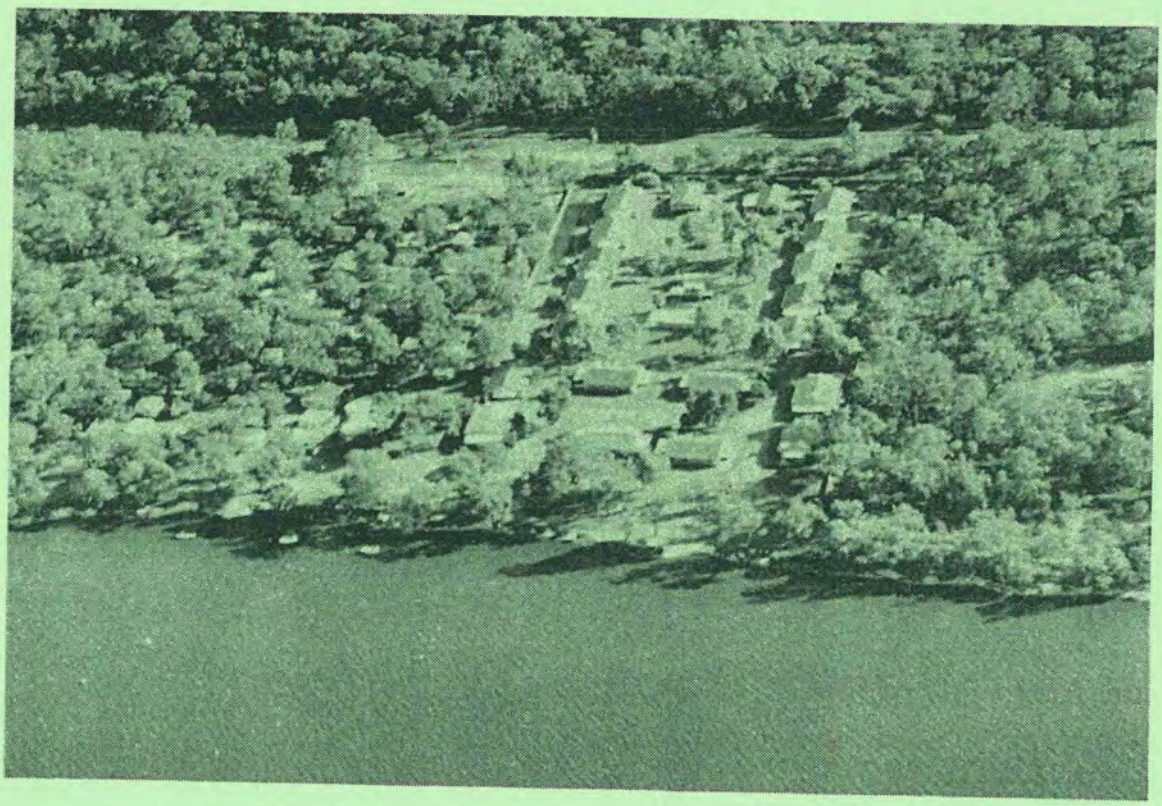
INTERPRETATION PROGRAMMES

23. Implement recommendations 11, 12 and 13 of the Peel Inlet Management Programme Review to raise the estuary's profile in the community. Techniques employed may include advertising in local newspapers of draft management plans, seeking advice from interested people and groups, educational packages, leaflets, displays and informative videos. (PIMA)

24. Examine the feasibility of constructing an interpretation centre in an area of representative estuarine environment to focus the community information programme. Include facilities such as walk trails, hides, signs and other interpretation tools.(CALM, PIMA, LGA)

NODULARIA WARNING

25. Develop a public information programme including press releases, pamphlets and signs to highlight the risk involved in ingesting water containing *Nodularia spumigena*. (HD, LGA, PIMA)



(Plate 2: Water's Edge Caravan Park)
The western foreshore contains various types of tourist accomodation.

1. Introduction

1.1 Aim of The Management Plan

The aim of the Management Plan is " To provide for the proper long term management of the water and Crown land adjoining the western margins of the Peel - Harvey Estuary between the Sticks Channel and Harvey River."

This plan was commissioned by the Peel Inlet Management Authority due to the increased development pressure being placed upon the western foreshore. The study will develop recommendations to maintain and enhance the natural integrity of the Vacant Crown Land and reserves, whilst providing public access. As such, the report will replace the previous ad hoc management with a consistent holistic approach to the reserves and the waterway to be included in a future Regional Park.

1.2 Background

In 1990 the Draft Peel Inlet Management Programme Review was prepared by the Waterways Commission. The purpose of the programme is to develop a general strategy for the management of the entire Peel Inlet Management Area as well as to make specific planning recommendations for particular sites requiring attention.

This study will represent the first step in implementing general recommendations 23 and 34 to 40 of the Management Programme Review. Particular consideration will be directed toward addressing area recommendations A20, A23, A24, A28, A29, A30, A31, A32, A33, A35, A37, A40, A53, A54, A58, A59, A60, A61, A63, A64, A65, A66, A67, A68, A70, A71, A72, A73, A74, A75, A76, A78, A79, A81 and A85 (WWC, 1990).

1.3 Development Pressure

As previously mentioned, the Peel Inlet western foreshore is under considerable development pressure. Dawesville Channel excavations are due to commence in 1993, to construct a channel which is expected to improve the flushing of the estuary (Kinhill 1988).

Residential and tourist development proposals other than those associated with the Dawesville Channel include the Estuary Gardens Development at Falcon and associated dredging of Cox Bay and spoil disposal activities (LeProvost Environmental Consultants, 1990b).

These major constructions as well as infill lot subdivisions along the western foreshore highlight the need to implement this study, to provide a useful tool for the long term management of the Vacant Crown Land and reserves of the Peel- Harvey Inlet.

1.4 Public Consultation

Preparation of this Management Plan was advertised in the *Mandurah Mail* on the 24 October, the *Coastal District Times* on the 26, and the *Mandurah Telegraph* on the 29 October 1991. The advertisement described the aim and method of the study and called for written submissions.

Furthermore, a pamphlet drop was made to all residents with freehold land located between Old Coast Road and the high water mark of the Estuary. The pamphlet outlined the study's intentions and invited comments.

A summary of the submissions is contained in Appendix 2.

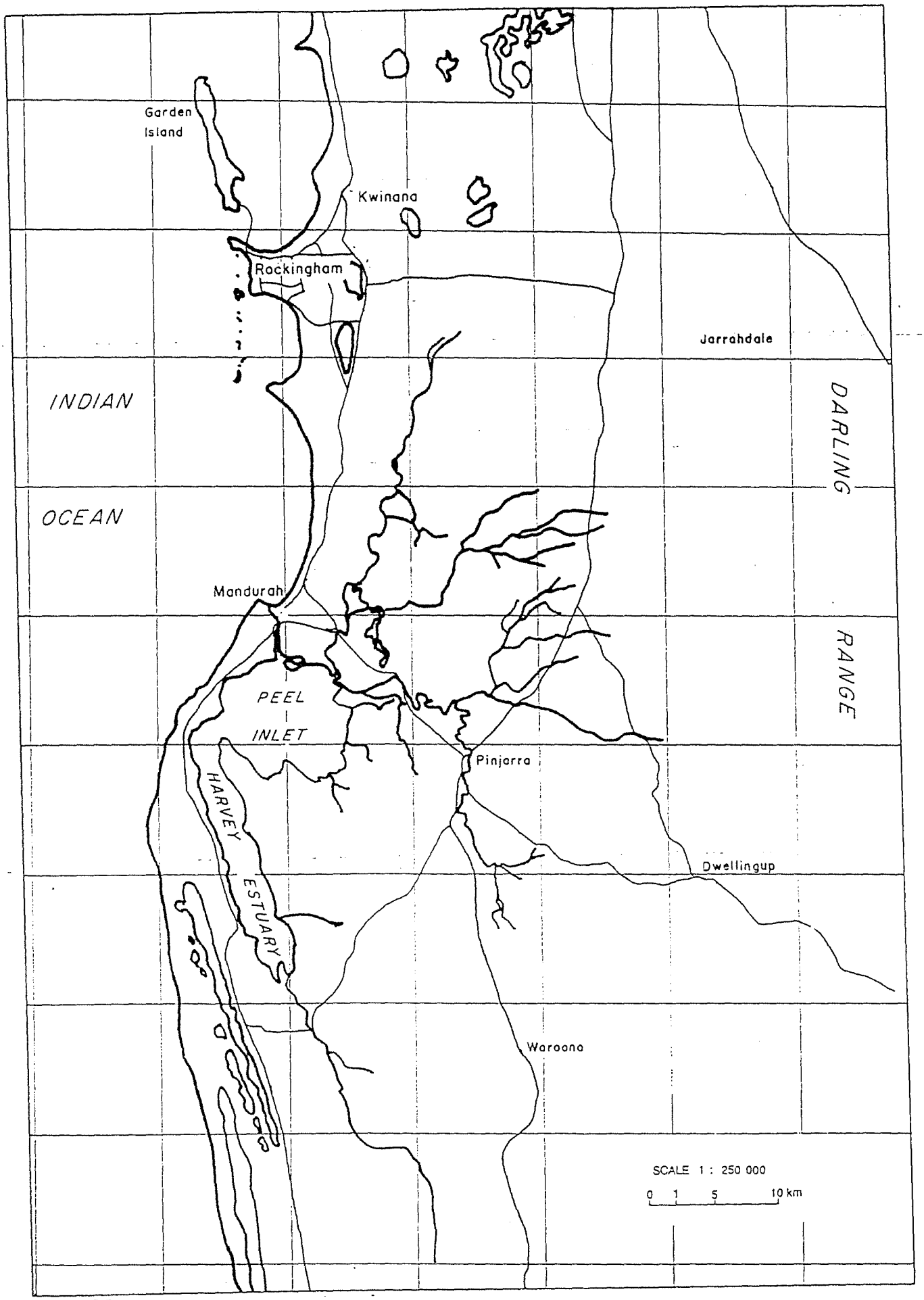

Garden
Island
Kwinana
Rockingham
Jarrahdale
INDIAN
OCEAN
DARLING
RANGE
Mandurah
PEEL
INLET
HARVEY
ESTUARY
Pinjarra
Dwellingup
Waroona
SCALE 1 : 250 000
0 1 5 10 km

FIGURE 1

2 Study Area

2.1 Location

The western foreshore study area is located between 32 ^{0} 33' 30" and 32 ^{0} 46' 30" south and 115 ^{0} 42' 50" and 115 ^{0} 42' 50" east. The site is located 75 kilometres by road south of Perth. (Fig 1)

The northern boundary of the study area is defined by the Mandurah Estuary Traffic Bridge and the southern by the Harvey River Delta. The width of the foreshore Crown land varies considerably between 5 metres off Estuary Road and up to 750 metres south of Island Point.

2.2 Geology

The soil associations of the region are described in detail by Churchward H M and Mc Carthur W M (1980) in the "Atlas of Natural Resources Darling System Western Australia". Those that apply specifically to the study area are described by Hesp and Wells (1989) and include the following (see Fig 2)

Vasse Estuarine and Lagoonal System

V1 - Saline, very low intertidal flats consisting of unconsolidated estuarine alluvium and lagoonal deposits. Quite susceptible to wave erosion.

V2 - A low intertidal flat similar to V1 with both supporting communities of samphire marsh.

V3 - A supratidal flat containing some qualities of V1 and V2. Tends to support *Melaleuca* communities.

V4 - Low level storm beach ridges and terraces with a low susceptibility to erosion.

V6 - Upper level sand terraces with deep grey or bleached brown siliceous sand of slopes between 1 and 3 %.

Spearwood Dune and Plain System

S16 - Deep siliceous yellow - brown sand dune ridges with a susceptibility to erosion.

S1d - Moderately deep yellow- brown sands with a susceptibility to wind erosion. Have moderate to steep slopes of 15- 25%.

S2a - Dune foreslopes of moderately deep yellow - brown sands.

S4a - A very gently sloping sand plain with deep pale Spearwood sands.

S4b - Similar to S4a but a shallow to moderate soil containing minor limestone rock outcrops.

(Hesp & Wells, 1989)

The geological formations which the soil associations overlie are illustrated in Fig 3. They include the Quaternary deposits of

1)Tamala Limestone which is closely associated with the Spearwood Soil Association.

2) Leached quartz sand with some limestone and the.

3) Wetland deposits, swamp, estuarine, lagoonal.

(Biggs Leech, Wilde, 1980).

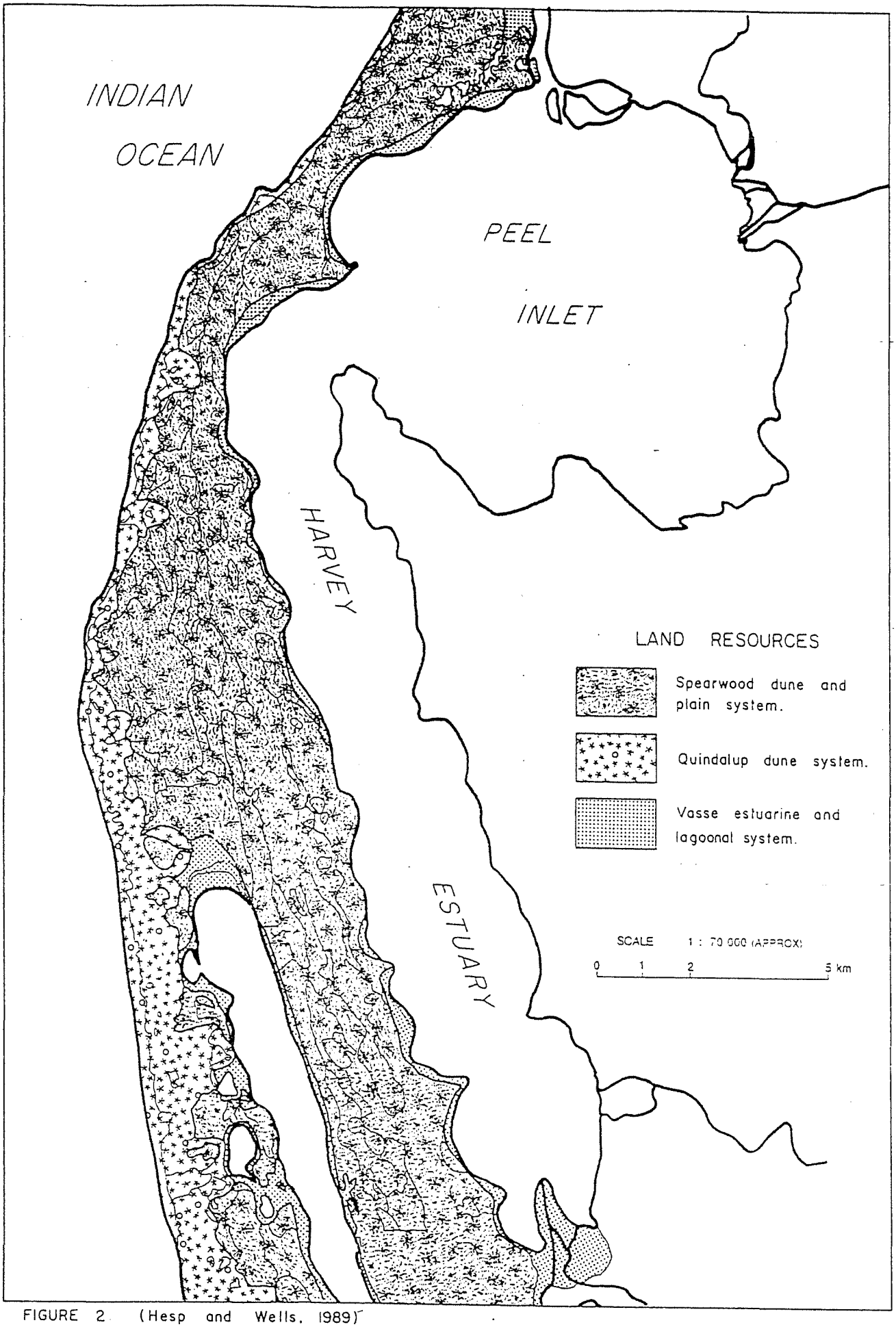


FIGURE 2 (Hesp and Wells, 1989)

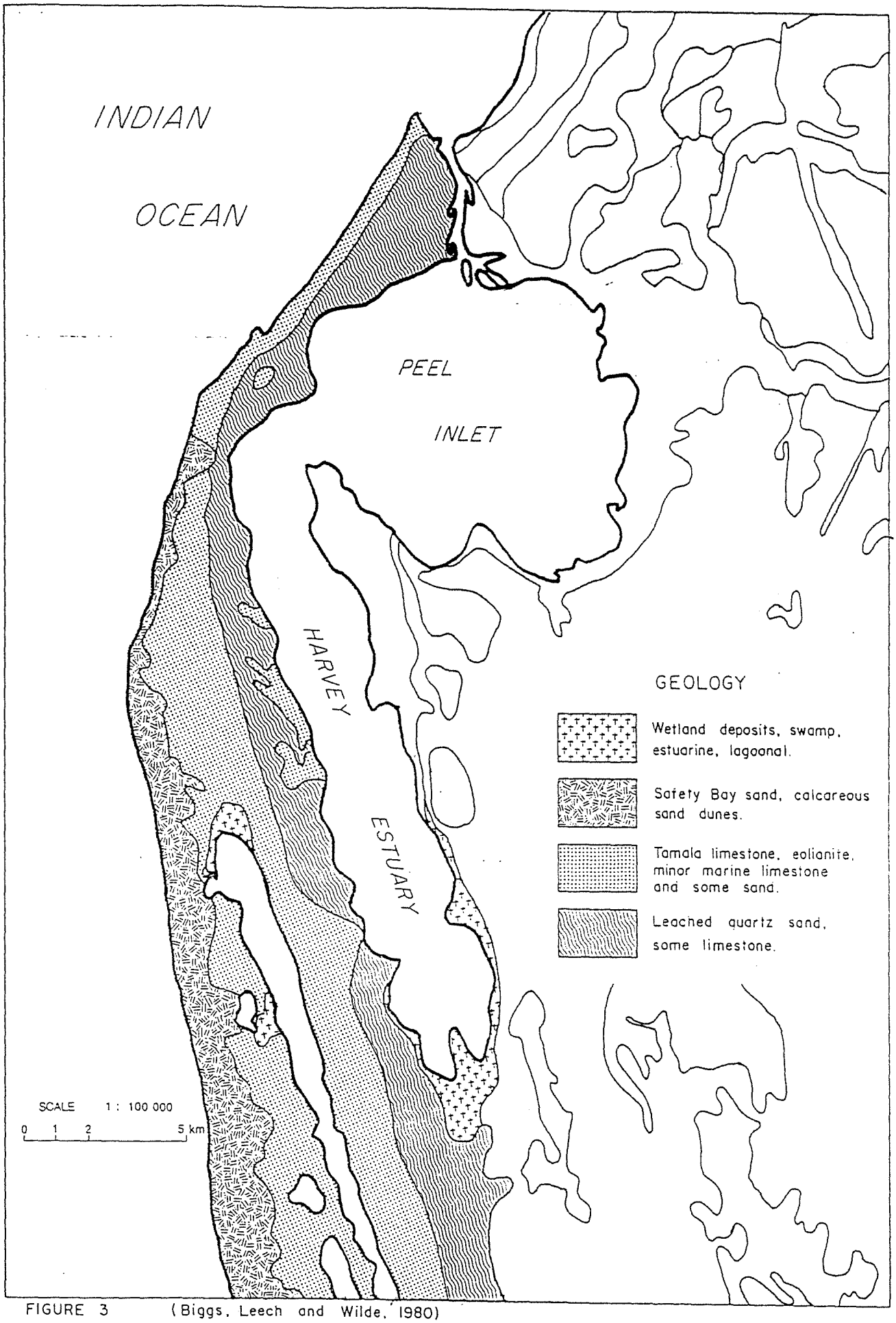


FIGURE 3 (Biggs, Leech and Wilde, 1980)

2.3 Climate

2.3.1 Rainfall

The Peel - Harvey western foreshore is located in a Mediterranean type climate with hot dry conditions in summer and cool wet winters (Seddon, 1972). Rainfall is moderate with an annual mean of 884 mm which falls mainly between May and October(Relf, 1991). (See Table 1.) Consequently, the Harvey Estuary becomes flushed with fresh water from the fluvial discharge of the Harvey River in winter and a saltwater wedge is driven down from the north in summer. The rainfall in winter also results in the waterlogging of estuarine peripheral flats.

2.3.2 Winds

Winds in the summer and autumn are predominantly from the east to south - east in the morning, often resulting in the algae being pushed onshore on the western foreshore of the Peel Inlet(LeProvost Env. Con., 1990a). In winter the winds blow mainly from the north - east in the morning and less frequent stronger winds may blow from the south - west to north - west. Spring winds are a combination of summer, autumn and winter patterns (LeProvost Env. Con., 1990a) (see Fig 4).

The often strong south - west sea breeze has a considerable effect on recreation in causing a decline in numbers using the foreshore once the wind arrives, due to the exposed nature of the estuary's periphery. In addition, it reduces the ability of small power boats to navigate due to the choppy waters and therefore focuses more demand on boat ramps as the wind speed increases (Chalmers & Thurlow, 1988).

2.3.3 Greenhouse Implications

Future climatic changes have been forecast from the impact of the "Greenhouse Effect". It is predicted that the average annual temperatures in southern Australia may be 4 - 5 ^{0}C higher than at present and the south - west will probably have less rainfall.

In terms of foreshore management , the implications for vegetation must be taken into consideration, with more salt tolerant varieties becoming predominant and a movement toward the xeric end of the continuum possibly will be experienced. Furthermore, the width of the foreshore should also be developed to account for predicted sea level rises and higher rates of erosion from increased storm frequency. Sea level rises would not only reduce foreshore width by inundation but the associated rise in groundwater would affect drainage and effluent disposal by reducing the depth of soil available to filter nutrients and pathogens (WWC, 1990).

2.4 Vegetation

Five major plant communities have been identified along the western foreshore of the Peel - Harvey Estuary. These have been categorised according to the Semeniuk (1990) classification as :

(a) Beach Ridge Complex

(b) Elongate Fluvial Delta Complex

(c) Erosional Sandy Shore

(d) Spit - Lagoon Complex

(e) Tidal Shoal

The extent of each complex is illustrated in the maps associated with the Specific Recommendations in Chapter 5 of the Management Plan.

Mandurah Rainfall

	RAINFALL (mm)	NO RAINY DAYS	RAINFALL(mm)	NO RAINY DAYS	AV. RAINFALL	AV. NO RAINY DAYS
MONTH	19 89		19 90		1889- 1990	
Jan	24	5	22	6	10	2
Feb	35	6	13	5	13	3
mar	4	1	55	10	19	4
Apr	62	6	89	16	46	8
May	192	10	95	14	128	14
Jun	107	12	92	12	191	18
Jul	251	20	164	19	176	19
Aug	88	14	103	20	126	17
Sep	72	16	99	15	88	14
Oct	105	21	50	12	53	11
Nov	6	3	20	8	22	6
Dec	7	4	5	3	12	3
Annual Total	953	118	807	140	884	119

Table 1

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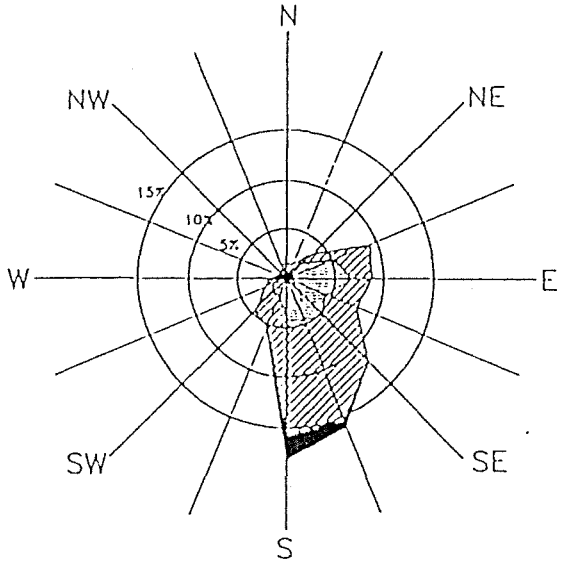
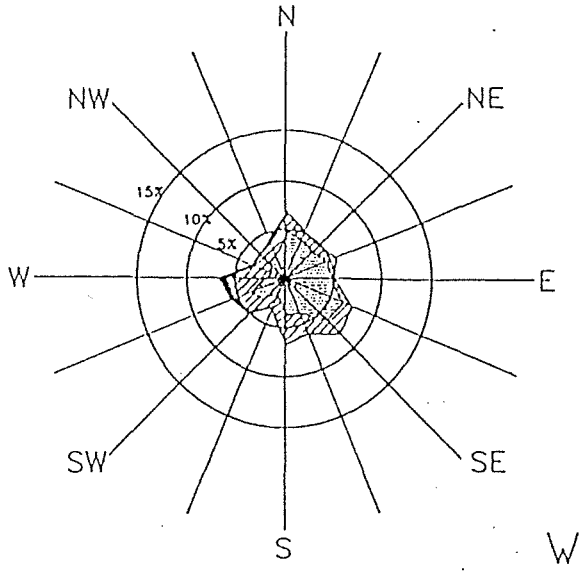
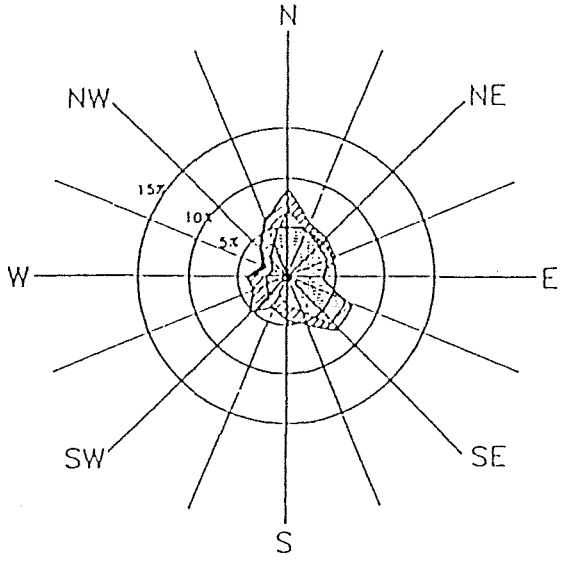


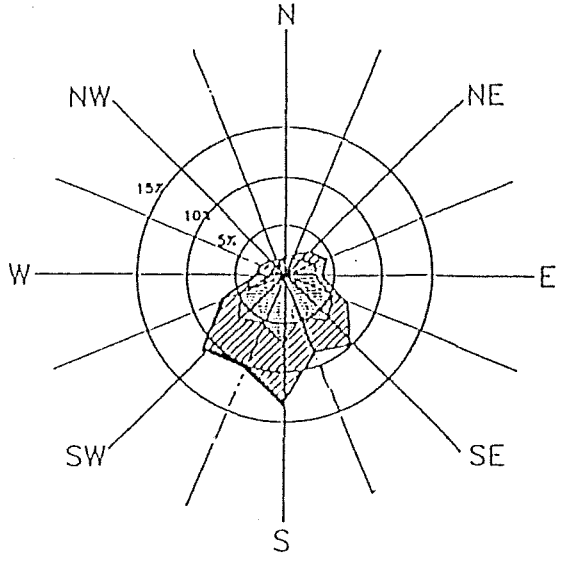
SUMMER WINDS



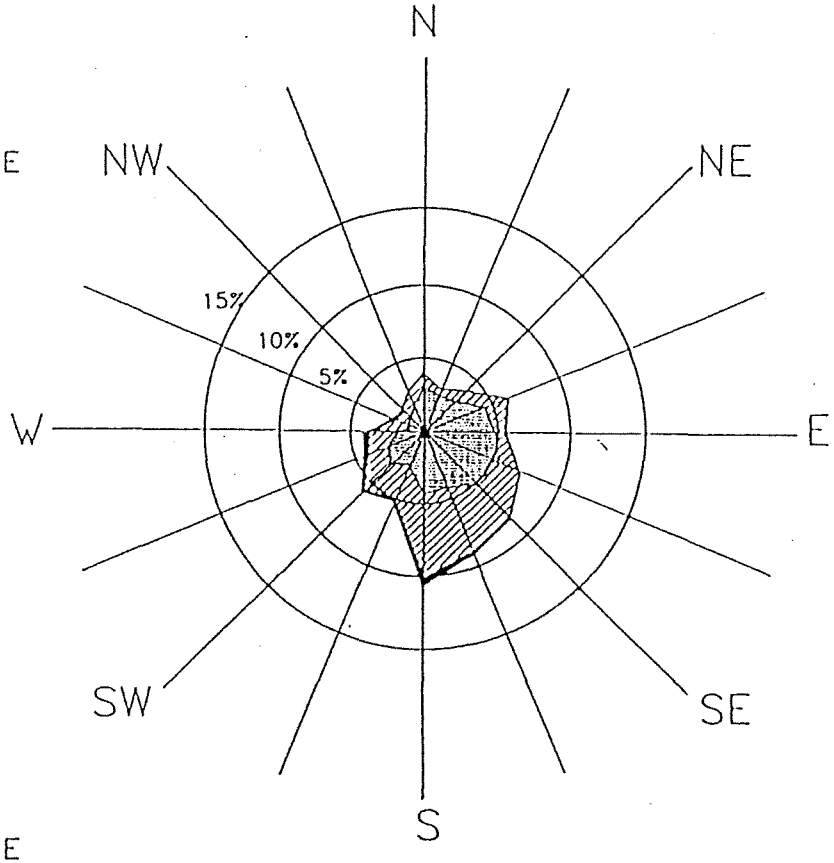
AUTUMN WINDS



WINTER WINDS



SPRING WINDS



WINDS FOR THE WHOLE YEAR
AUGUST 1986 TO SEPTEMBER 1987
MEASURED AT PORT MANDURAH

0 – 4 Km/h
4 – 8 Km/h
> 8 Km/h

PORT MANDURAH WIND ROSES

FIGURE 4

(LeProvost Env. Con. 1990b)

2.4.1 Vegetation Condition

The condition of the foreshore vegetation varies considerably along the length of the study area. Whilst a great proportion of the western foreshore is subject to weed infestation by species such as Buffalo Grass (*Stenotaphrum secundatum*) and Kikuya (*Pennisetum cladestenum*), there exist only isolated growths of Bulrush (*Typha orientalis*) which may be easily managed through regular monitoring and subsequent removal if expansion is noted.

Quite a number of mature healthy paperbark stands and their associated sedge understorey exist along the western periphery of the estuary, at sites such as Erskine, Park Ridge and Warrangup Spring. These are truly representative of the complex and accordingly worthy of preservation.

Similarly, mature stands of tall closed and open Tuart (*Eucalyptus gomphocephala*) are represented inland. They contribute a significant recreation and aesthetic value to the region.

Of considerable importance are the expanses of samphire marsh that may be observed at many sites along the foreshore. Such highly productive ecosystems are valuable in controlling erosion, providing an organic nutrient source for the detrital estuarine food chains and as a habitat to birds and insects (Adam , 1981); (McMillan ,1985). They also provide a buffer between nutrient sources like septic tanks and domestic gardens and the estuary. As an ecosystem that is now considered a rarity around Perth, there are particular sites within the study area that require urgent conservation measures. These include Chimney Spit and the Erskine Wetlands.

2.4.2 Tuart Dieback

The western foreshore contains a generally healthy expanse of Tuart. Its eastern boundary is typically located between 20 and 100 metres inland from the estuary. The community is commonly associated with the Spearwood Soil Formation, with the substrate often containing limestone outcrops.

However, a large number of individual trees appeared to be exhibiting the symptoms of some form of dieback. Plate 3 illustrates the browning of the leaves whilst Plate describes the total defoliation of an individual and its subsequent death.

The appearance of the affected Tuarts' foliage resembles that of the Flooded Gum (*Eucalyptus rudis*) which was also noted to be suffering from heavy insect attack in spring 1991. Yet, the Flooded Gum soon becomes green again with vigorous summer growth (Powell, 1990). This was not evident in respect to the Tuart, with the extent of mortality within the population suggesting deterioration over a number of years.

Research is currently being conducted by Murdoch University and ALCOA to determine the exact cause of mortality (Chilcott, 1991). A list of the possible agents is outlined in Appendix 3.

(Plate 3)

Many Tuarts are exhibiting symptoms of a form of dieback.

2.5 Fauna

Reports on the varieties and number of animals on and around the estuary include the comprehensive Kirke (1986) study of the "Conservation Value of Three Foreshore Areas of the Peel Inlet - Harvey Estuary", in which two sites relevant to this Management Plan are examined.

Other useful reference material is in studies such as the Biggs (1977) report of the C50 System 6 Area, bird recordings by Lane (1977) and current Western Australian Museum records.

2.5.1 Birds

The wetland's intrinsic value as a highly productive biological system is often illustrated by reference to the great diversity and number of birds that utilise the shallow waters and the mudflats. The Peel - Harvey Estuary is possibly the most important estuary in South - Western Australia for the conservation of waterbirds (Biggs, 1977). More than 75 species have been recorded (Lane, 1977).

A majority of the birds identified are waterfowl and wader species such as the Coot, Grey Teal, Red- necked Stint, Banded Stilt and Hoary - headed Grebe. The aforementioned have been numbered at more than 10 000 individuals. (Lane, 1977)

The Harvey Estuary generally contains a greater number of individual birds than the Peel (up to 45% of the total) (Kirke, 1986). In late summer the Harvey River Delta is of particular importance, with thousands of ducks utilising the banks (Biggs, 1977), whereas the Peel tidal delta region is noted for supporting significant numbers of bird species that are rare or uncommon elsewhere in south - western Australia (Kirke, 1986). These include the White - winged Tern, Ruff, Eastern Curlew and Little Egret (Kirke, 1986).

Furthermore, the estuary is known to support the largest Pelican (*Pelcanus conspicillatus*) population of any estuary of south - western Australia. It has been estimated that up to 60% of the total individuals in the south -west of Western Australian gather on the Peel and Harvey waters. The Peel Inlet is also the site of the only known breeding colony of Pelicans south of Shark Bay (Biggs, 1977).

At least two Osprey (*Pandion haliaetus*) were observed during the preparation of this report. Nests were sighted at two locations (a) 1.5 km north of Island Point (b) 600 m west of Chimney Spit.

2.5.2 Reptiles and Amphibians

Significant reptile species most relevant to the western foreshore include the Black - Lined Skink, listed as rare with a restricted distribution. Although not officially recorded, this is thought to exist in the Erskine Wetlands (Kirke, 1986).

Of amphibians, the Western Australian Museum(1985) has recorded three species of frogs from the Peel tidal region which include the Moaning Frog (*Heleioporous eyrei*), Western Banjo Frog (*Lymnodynastes dorsalis*) and Gunther's Toadlet (*Pseudophryne guentheri*). From the Harvey Estuary only the Slender Tree Frog (*Litoria adelaidenis*) and the Western Tree Frog (*Litoria Moorei*) have been noted.

2.5.3 Mammals

A substantial population of Western Grey Kangaroos (*Macopus fuliginosus*) is known to exist around the Erskine Wetland area. (Chester, 1986). Two were observed during field work for the Management Plan.

Other mammals include the Short - nosed Bandicoot (*Isoodon obesulus*), the native cat (*Dasyurus geoffroii*), Brush Wallaby (*Macropus irma*), Brush - tailed Possum (*Trichosurus vupecula*), South - western Pygmy Possum (*Cercartetus concinnus*) and the Southern Bush Rat (*Rattus fuscipes*). Two species of bats are known to inhabit the foreshore area, those being the Gould's Wattle Bat (*Chalinolobus gouldii*) and *Eptesicus regulus*. (Kirke, 1986).

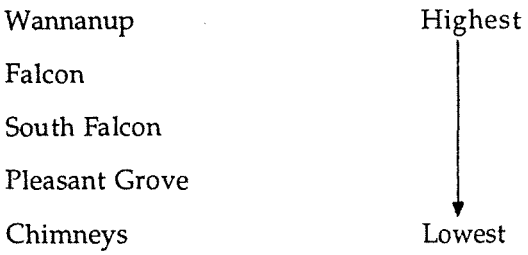
2.5.4 Feral Animals

Discussion with residents along the western foreshore also revealed the existence of a number of feral cats (*Felis cattus*) and the European Fox (*Vulpes Vulpes*). Many species of native mammal have had their distributions severely reduced by such predators. "Competition between native and introduced species for food and / or territory often leads to drastic reductions, and sometimes complete exhaustion of native species populations" (Cavana, 1986).

2.6 Mosquitoes

A major waterway management problem that has achieved a high public profile over the years, has been the effect of mosquitoes on the residents of the region. In the summer of 1988-89 an epidemic of polyarthritis, caused by Ross River Virus, was recorded. One of the principal vectors (carriers) of the virus is the mosquito, *Aedes camptorhynchus*. This species is considered to be the dominant variety of mosquito in the Peel region and accordingly is of significant concern to the relevant authorities and the residents around the Peel - Harvey Estuary (Chester and Klemm, 1990).

The major mosquito breeding areas are listed below in descending order of "Breeding Intensity".



(Chester and Klemm, 1990)

The specific locations of the above sites are illustrated in Chapter 5.

The waterway management problem has two dimensions. One relates to the intrinsic nature of the population control method, whilst the second is less easily monitored and concerns the more insidious effects of the mosquito control strategy on the broader ecosystem. In effect, the danger exists that short term eradication methods may lead to possibly greater mosquito populations and their associated problems in the future.

In 1984 the Mosquito Control Review Committee was established by the Waterways Commission to respond to nuisance and potential health problems caused by mosquitoes. This, with State Government financial involvement, has led to the establishment of research programmes aimed at achieving an integrated mosquito control programme for the long term control of the vector and ultimately that of the Ross River Virus.

A research programme currently is being conducted within the study area by Jane Lachford of Murdoch University under the supervision of Professor Arthur McComb ,Dr Jenny Davis and the Mosquito Control Advisory Committee. It aims to examine the effectiveness of a non - chemical mosquito control method and to assess the environmental impact of the technique employed (Lachford, 1991). The research programme is outlined in Appendix 4.

2.7 Heritage And Cultural Sites

2.7.1 Aboriginal, Archaeological and Ethnological Sites

An Aboriginal site survey was commissioned by LeProvost Semeniuk and Chalmer for the Mandurah Quay CER. It concluded that there were no archaeological sites located in the survey area (LeProvost Env. Con., 1990a). There have been no other intensive ethnographic surveys conducted in the study area. However, it is predicted that the western foreshore contains a significant number of unrecorded Aboriginal sites. For example, Warrangup Spring and Island Point are known to have been Aboriginal camping grounds (Bodney, O'Connor, Quartermaine, 1989).

2.7.2 European Historic Sites

There are no historic sites within the study area listed or registered with National Trust of WA (Macey, 1991).

2.8 Land Ownership

A majority of the land comprising the western foreshore of the Peel - Harvey Estuary is held in public ownership. A substantial proportion is Vacant Crown Land, with the remainder reserved in accordance with the Land Act 1933 and vested in the authorities outlined in Table 2.

Table. 2

Vesting Authority	Purpose
City Of Mandurah	Recreation / Other
Waterways Commission / PIMA	Recreation / Waterways and Foreshore Protection
NPNCA (*CALM)	Nature Conservation Reserve

* managed by

Freehold property abutting the waterway presently exists at the site of the proposed Mandurah Quay Development off Sticks Channel. A foreshore reserve is currently being acquired by DOLA as a condition of subdivision for nature conservation and recreation purposes. It is expected that the foreshore consisting of the Erskine Wetlands and Chimney Spit will be actively managed by CALM.

Similarly, it is proposed that a section of land located behind the Pleasant Grove estate off Ward Point will be acquired for recreation. It should be incorporated into Reserve 37706 for recreation and foreshore management purposes (WWC, 1990).

In some locations there is freehold property with titles extending to the high water mark. Most is located south of Estuary Road, with nine locations being recorded.

Only two private properties east of Estuary Road have titles extending to the waterway. These include Lot 2 next to Allandale House and Location 41 approximately 1.35 kilometres to the south.

Publicly owned land currently vested in the NPNCA for conservation of flora and fauna includes Nature Reserve A23756 located below Island Point and extending to the southern boundary of the study.

3 Methodology

To achieve the aforementioned aim, a series of objectives has been developed. The objectives outline the broad methodology that this study will employ to obtain the baseline data. The objectives also provide a framework for the types of recommendations that the study has produced to enable effective management of the western foreshore reserves of the Peel - Harvey Estuary.

3.1 Objectives

OBJECTIVE 1

Map all Crown land (reserves and Vacant Crown Land) to show reserve and private property boundaries, describing :

(a) existing geomorphological features as described by Seminiuk (1990);

(b) vegetation showing the location of trees (approximate light and dominant species), density of cover, main understorey species, presence of rush beds and weed species;

(c) the presence of open areas of water;

(d) the presence of sandy beaches;

(e) all human constructions including sealed and unsealed roads, tracks, bridges, causeways, parking areas, boat ramps (hard and soft), houses and sheds, filled land, parks and gardens, fences, log barriers and jetties on or near Crown land;

(f) waterway management problems including identified mosquito breeding areas, uncontrolled vehicular access points, erosion, fire hazards, weed infestations and unapproved developments.

OBJECTIVE 2

Prepare recommendations about future reserve purposes and vestings to cover all Crown land in the study area.

OBJECTIVE 3

Make recommendations about the future development and management of reserves.

3.2 Vision Of The Future

The implementation of the aims and recommendations of this Management Plan will enable effective management of the western foreshore of the Peel - Harvey Estuary. This action is the first stage in a three part initiative to develop management plans for all Crown land abutting the waterway.

The second management plan will be created for the northern foreshore (rivers region) and the third will ensure that the eastern foreshore is properly maintained. Ultimately, these plans will be utilized to create a management framework for all Crown foreshore reserves for their final incorporation into a Regional Park, a concept recommended by the EPA Conservation Through Reserves Committee, System 6 (DCE, 1983).

(Plate 4: Erskine Wetland - Dead Paperbark)
A structure plan is to be created to manage the Erskine Wetland.

4 General Recommendations

4.2 Conservation and Environmental Protection

NEED FOR ACTION

Recreational and residential development is creating considerable conflict along the western foreshore by compromising the processes of the natural environment. This includes the clearing and drainage of foreshore areas, residential development near the estuary and intensive recreational use of the waterway resulting in the crowding of foreshore reserves. Furthermore, introduced feral animals compete with and displace native species. There is a need to conserve the waterway margin. This is most effectively achieved by reserving land in a manner which enables appropriate management.

4.2.1 Conservation Reserves

NEED FOR ACTION

Conservation reserves are areas of land which have been reserved for the preservation of flora and fauna. Presently, only one conservation reserve exists in the study area. Reserve 23756 is located at the Harvey River Delta and is exceptional for its value as a regionally important wetland. All conservation reserves are vested in the NPNCA.

The area identified within the EPA Conservation Through Reserves Committee System 6 Recommendations known as Chimney Spit is currently being vested in the NPNCA to be managed by CALM. The Erskine wetland is also presently being considered for inclusion in a Conservation Park.

It is important to identify and provide appropriate protection to other areas of environmental significance by vesting them in the NPNCA for CALM to manage accordingly.

RECOMMENDATIONS

1. Vest areas of identified environmental significance in the NPNCA for appropriate management by CALM for the purpose of conservation of flora and fauna. (DOLA, NPNCA, CALM, LGA)

4.2.2 Proposed Regional Park

NEED FOR ACTION

In 1989, the Minister for Conservation and Land Management, Environment and Waterways, acting on the recommendations of the Peel - Harvey Conservation and Development Committee (PHCDC), agreed to establish a Regional Park based on the Peel - Harvey Estuary. This report must therefore regard the western foreshore as part of a broader system and subsequently plan for its future inclusion in the proposed estuarine reserve. This involves identifying the various areas of Vacant Crown Land, unvested reserves and portions of freehold land for vesting in the appropriate authorities. In addition, rationalisation of present reserve boundaries must be undertaken to enable more economical management of the land.

RECOMMENDATIONS

2. Implement recommendations 20 and 33 of the Peel Inlet Management Programme Review. Acquire foreshore reserves on freehold land and vest all Vacant Crown Land and unvested land in the appropriate authorities. Treat all foreshore reserves as a single regional park. (DOLA, NPNCA, CALM, LGA, WWC, PIMA)

4.3 Heritage And Cultural Sites

4.3.1 Aboriginal, Archaeological And Ethnological Sites

NEED FOR ACTION

The western foreshore of the Peel - Harvey Estuary contains a large number of archaeological and ethnological sites which reflect the historical and spiritual importance of the area to the Aboriginal people and are of heritage value to all Australians. Furthermore, such sites are protected under the Aboriginal Heritage Act (1972 - 80) which requires any proposal involving physical disturbance of the ground to be referred to the WA Museum.

RECOMMENDATIONS

3. Refer all proposals to reserve, vest or develop Crown land or the foreshore to the Western Australia Museum for comment. (DPUD, PIMA, LGA)

4.3.2 European Historic Sites

NEED FOR ACTION

A few buildings along the western periphery of the estuary may be of sufficient age and character to be listed or registered with the National Trust of WA. It is essential that any building of significance should be brought to the attention of the Trust for subsequent appraisal. Registered sites are included in the National Estate Register and are protected under the Australian Heritage Commission Act (1975).

RECOMMENDATIONS

4. Implement recommendation 30 of the Peel Inlet Management Programme Review. Such that, all sites of cultural and/or historical significance are identified and protected under the Heritage of Western Australia Act 1990. (HCWA)

5. Develop appropriate historical sites as tourist attractions in a manner which does not conflict with the natural conservation or aesthetic value of the area. (WATC, HCWA, LGA)

4.4 Public Access

NEED FOR ACTION

At particular locations along the western foreshore, access to the waterway is restricted by the presence of freehold land with titles extending to the highwater mark. In other locations there is no formalised access through private land abutting foreshore Vacant Crown Land or reserves. As the population grows the demand for access will increase. Consequently, paths and roads need to be developed to channel access to areas that are designated for recreation, to provide for the demand and reduce conflict with private property owners.

Unlimited public access is not always desirable and it may be necessary to limit it in environmentally sensitive areas. If the public is to enter these reserves, access must be carefully managed to avoid conflict between human and conservation interests.

RECOMMENDATIONS

6. Implement recommendation 51 of the Peel Inlet Management Programme Review. Encourage the provision and management of public access by establishing Public Access Precincts through the practice of reserving river foreshore land , promoting management plans which improve access and investigating the feasibility of entering into agreements with private land owners to gain the right of public access. Support the planning, construction and extension of dual use paths by LGAs in accordance with Dual Use Path Guidelines. Support the provision of foreshore facilities by LGAs to provide access for the disabled. (DPUD, CALM, PIMA, LGA)

7. Actively control public access to environmentally sensitive wetlands or conservation reserves by excluding vehicles and providing very limited pedestrian access ways. (PIMA, CALM, LGA)

4.5 Management Difficulties

4.5.1 Fire Management

NEED FOR ACTION

The combination of dense often dry forest litter, hot summers and heavy recreation use on the estuary's foreshore may create a fire risk. A bush fire would not only threaten residents but also the foreshore vegetation which provides habitat for fauna, bank stabilisation and protection against erosion, and is a valuable landscape asset.

Increasing recreational demand and the growing number of recreational vehicles make it difficult to exclude people from remote areas of bushland. In addition, it may not be desirable to construct extensive firebreaks and undertake frequent hazard reduction burning in environmentally sensitive areas. These factors can make fire management difficult.

Fire protection activities must be undertaken in consultation with the Bush Fires Board.

RECOMMENDATIONS

8. Prohibit the lighting of fires on the foreshore except in properly constructed fire places in accordance with Section 25 (1a), (1b) and (1c) of the Bush Fires Act (1954). (LGA, PIMA)

9. Develop a public education programme informing the people about the danger of fire in the area and the responsibilities of citizens in relation to the lighting of fires. (LGA, PIMA)

10. Develop roads, tracks, carparks and dual use paths as firebreaks and determine the appropriate location of firebreaks when locating such facilities. (PIMA, LGA)

11. Co- ordinate a fire fighting strategy between PIMA, City of Mandurah, CALM, SES and the Bush Fires Board. Provision will be made for training council staff in fire fighting techniques.(LGA, PIMA, CALM)

4.5.2 Weeds

NEED FOR ACTION

Weeds present a management problem as removal often leads to greater disturbance of the native vegetation and soil, which promotes more weeds.

Much of the fringing vegetation on the western foreshore is infested with exotic plants. Of particular concern are Buffalo grass (*Stenotaphrum secundatum*), kikuya grass (*Pennisetum cladestenum*) and Watsonia (*Watsonia bulbillifera*). In addition, Bulrush (*Typha orientalis*) may cause difficulty where freshwater inflows have been increased.

The Waterways Commission is undertaking research to develop weed control methods which do not have an unacceptable environmental impact.

RECOMMENDATIONS

12. Remove weeds according to the priority assigned to those areas nominated in Table 3. (PIMA, LGA)

13. Identify areas of Bulrush (*Typha orientalis*) growth, monitor their progress and remove if expansion is noted. (PIMA)

4.5.3 Feral Animals

NEED FOR ACTION

Feral animals are known to prey on and compete with native species. In addition, they disturb the breeding sites of many native animals. Of particular concern is the introduced cat (*Felis cattus*) and the fox (*Vulpes vulpes*). Their presence in an often geographically restricted habitat such as the estuary's periphery can lead to a drastic reduction or elimination of native populations in certain areas.

RECOMMENDATIONS

14. Develop a programme to eradicate feral animals. Particular attention should be directed at removing the fox and the introduced cat from environmentally sensitive wetlands. (CALM, PIMA)

4.5.4 Tuart Dieback

NEED FOR ACTION

A proportion of individual trees within the Tuart forest community appear to be exhibiting symptoms of some form of dieback. This is resulting in a reduction in the number of healthy stands and therefore in the quality of habitat for the inhabitants of the western foreshore. Such a loss is of considerable concern both from an ecological and aesthetic perspective and requires immediate action.

RECOMMENDATIONS

15. Support scientific research into examining the cause of the Tuart dieback and develop measures by which to mitigate its effects. (PIMA, CALM)

16. Develop a Tuart revegetation programme for the entire western foreshore of the Peel - Harvey Estuary. Revegetate with Marri if Tuart planting becomes unviable due to continued extensive dieback attack.(PIMA, LGA, CALM)

4.5.5 Unauthorised Use Of Public Land

NEED FOR ACTION

Clearing and development of foreshore reserves and Vacant Crown Land by landowners with freehold title abutting the public land presents a major management concern. Clearing of rush beds and other peripheral vegetation removes habitat, promotes erosion and creates a visual alienation of the foreshore. Activities such as filling, construction of illegal structures such as sheds and jetties and launching areas for use by adjoining landowners can have similar effects.

Areas of foreshore reserves which have been altered without approval should be rehabilitated by removing fill and revegetation. If this is not practical the area should be made available for public use by improving and encouraging access.

The use of dual use paths and fences to highlight boundaries may offer a partial solution but with private licensed jetties existing on public land the demarcation may still remain in question. A combination of the aforementioned and appropriate liaison with residents may prove to be more effective.

RECOMMENDATIONS

17. Seek to ensure that the boundaries between reserves and private properties are properly surveyed and clearly defined by road, dual use path, substantial fencing or signs. (DOLA, LGA, PIMA)

18. Consider the feasibility of preparing a lease agreement with landowners with freehold property abutting specific foreshore reserves vested in the Waterways Commission. (PIMA)

4.6 Mosquitoes

NEED FOR ACTION

Mosquitoes create considerable nuisance to visitors and residents of the Peel - Harvey locality. In addition, they are considered to be the primary carrier (vector) of the Ross River Virus.

The control of the mosquitoes is principally a health issue, yet as the insect is an intrinsic part of the estuarine environment and the effects of eradication often have further effects on the broader ecosystem, the issue requires addressing within this wider management context.

In 1985,in a detailed study of larval breeding and adult biting activities of mosquitoes in the Mandurah region, Wright (1988) concluded that the most significant mosquito breeding sites were located on tidal saltmarsh habitats around the margins of the Peel Inlet.

An outbreak of Ross River fever in 1988 led to Government approval of a special funding grant to control mosquito nuisance in the Peel Inlet.

The Interim Strategy for Mosquito Control in the Peel Inlet and Leschenault Estuary Regions, developed as a result of the Government grant, relies on commitment from both local and State governments (Government of Western Australia, 1989). The Strategy details monitoring breeding sites, larvicide control and aerial application.

In addition, studies on bird breeeding and feeding on the Inlet were conducted (Ninox Wildlife Cons., 1990). This information is being used to develop more effective and environmentally sensitive mosquito control techniques.

A Mosquito Control Task Force (MCTF) with representation from appropriate State and local authorities, was formed in November 1989 to review the control programme initiated under the Interim Strategy and to assess the need for continuing State Government involvement in mosquito control. On the basis of the Task Force's recommendations the Government has decided that ongoing financial involvement in this area is essential. Guidelines have been formulated whereby cost sharing with LGAs for mosquito control will be implemented. This is outlined in the Regional Strategy.

RECOMMENDATIONS

19. Support a regional mosquito strategy which improves control methods and reduces environmental impact. (MCAC, CLAG, PIMA)

4.7 Provision Of Facilities

NEED FOR ACTION

Increased demand on recreation areas will result in a proportionate increase in facilities. Recreation nodes should therefore be planned and landscaped to accommodate both passive and active pursuits including:

- soft launching areas
- barbecues (preferably gas)
- toilets (connected to deep sewerage or approved alternative systems)
- tables and seating
- shelter (preferably natural)
- children play equipment
- fresh water supply
- rubbish disposal facilities
- vehicle and/or pedestrian access
- car parking
- beaches
- upgraded existing formal or soft launching areas with associated parking areas and
- nature interpretation facilities

All artificial structures should be constructed to minimise the visual impact upon the foreshore and be planned to scale according to projected demand.

RECOMMENDATIONS

20. Support recommendation 46 of the Peel Inlet Management Programme Review to develop site design criteria and development guidelines for recreational nodes. (PIMA, DPUD, LGA)

21. Establish priority on development of recreation nodes based on :

(a) projected community demand

(b) environmental constraints and

(c) available funds. (LGA, PIMA)

22. Develop management plans for key recreational nodes to minimise the environmental impact and account for the provision of facilities based on projected demand. Required facilities may include:

- soft launching areas

- barbecues (preferably gas)

- toilets (connected to deep sewerage or approved alternative systems)

- tables and seating

- shelter (preferably natural)

- children play equipment

- fresh water supply

- rubbish disposal facilities

- vehicle and/or pedestrian access

- car parking

- beaches

- upgraded existing formal or soft launching areas with associated parking areas and

- nature interpretation facilities. (LGA, PIMA, CALM)

4.8 Education

4.8.1 Interpretation Programmes

NEED FOR ACTION

To ensure public co - operation in protecting and managing the foreshore of the Peel - Harvey Estuary requires that the community be given a greater insight into the nature, complexity and importance of the estuarine environment. It is essential that a public information system be developed to highlight the problems of inappropriate development, improper use, pollution,and environmental degradation whilst focusing on the public's role in addressing such issues. Finally, by creating a mechanism to increase community input, solutions may be achieved that satisfy both development and conservation interests.

Due to the varied nature and size of the estuary, the public may have problems in identifying with the waterway. To overcome such difficulties in community perception, the concentration of interpretation facilities to focus visitors' attention on a representative section of the estuary is necessary. This may include the construction of walk trails, hides, signs and ultimately an interpretation centre. The western foreshore provides one of the only remaining sites to develop the aforementioned educational area.

RECOMMENDATIONS

23. Implement recommendations 11, 12 and 13 of the Peel Inlet Management Programme Review to raise the estuary's profile in the community. Techniques employed may include advertising in local newspapers of draft management plans, seeking advice from interested people and groups, educational packages, leaflets, displays and informative videos. (PIMA)

24. Examine the feasibility of constructing an interpretation centre in an area of representative estuarine environment to focus the community information programme. Include facilities such as walk trails, hides, signs and other interpretation tools.(CALM, PIMA, LGA)

4.8.2 Nodularia Warning

NEED FOR ACTION

Blooms of the micro-algae *Nodularia spumigena* often occur in late spring ,lasting approximately 6 weeks. The blue- green algae is toxic if ingested and therefore care should be taken to minimise contact with the water during that period.

The community is aware of the visual nature of the bloom and the smell it creates as it decays but there is a need to inform the public of the toxic nature of the species.

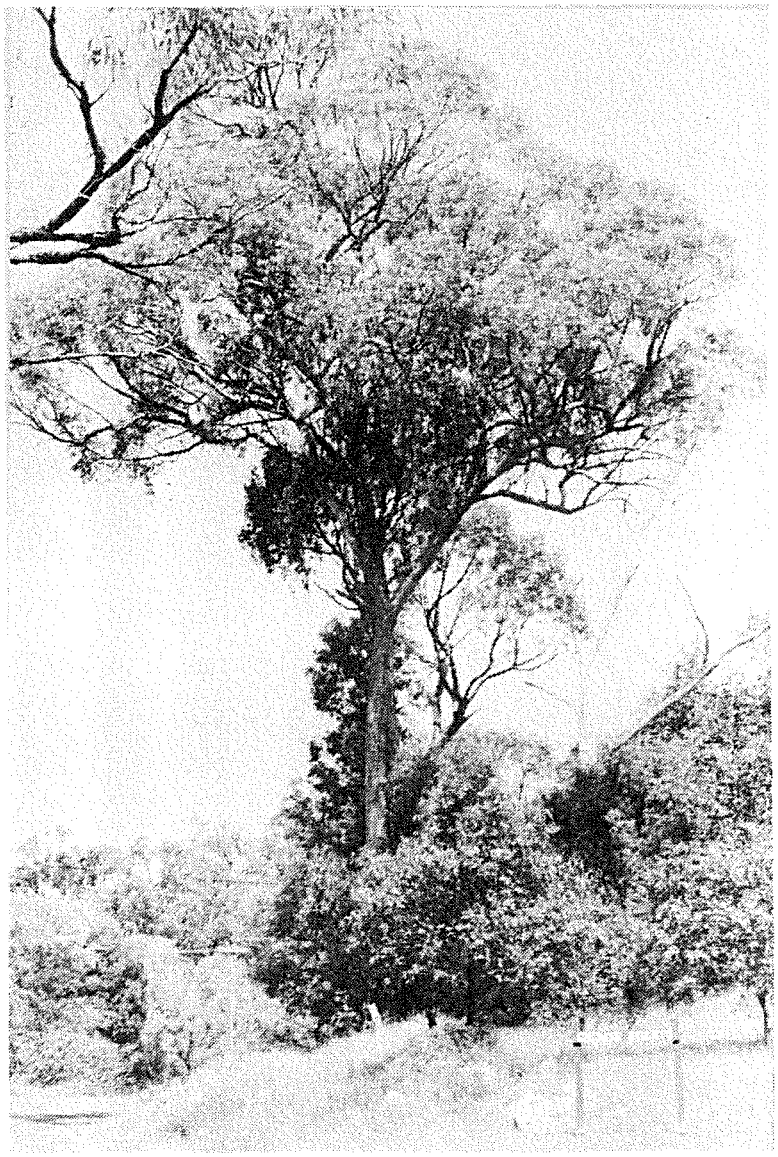
RECOMMENDATIONS

25. Develop a public information programme including press releases, pamphlets and signs to highlight the risk involved in ingesting water containing *Nodularia spumigena*. (HD, LGA, PIMA)

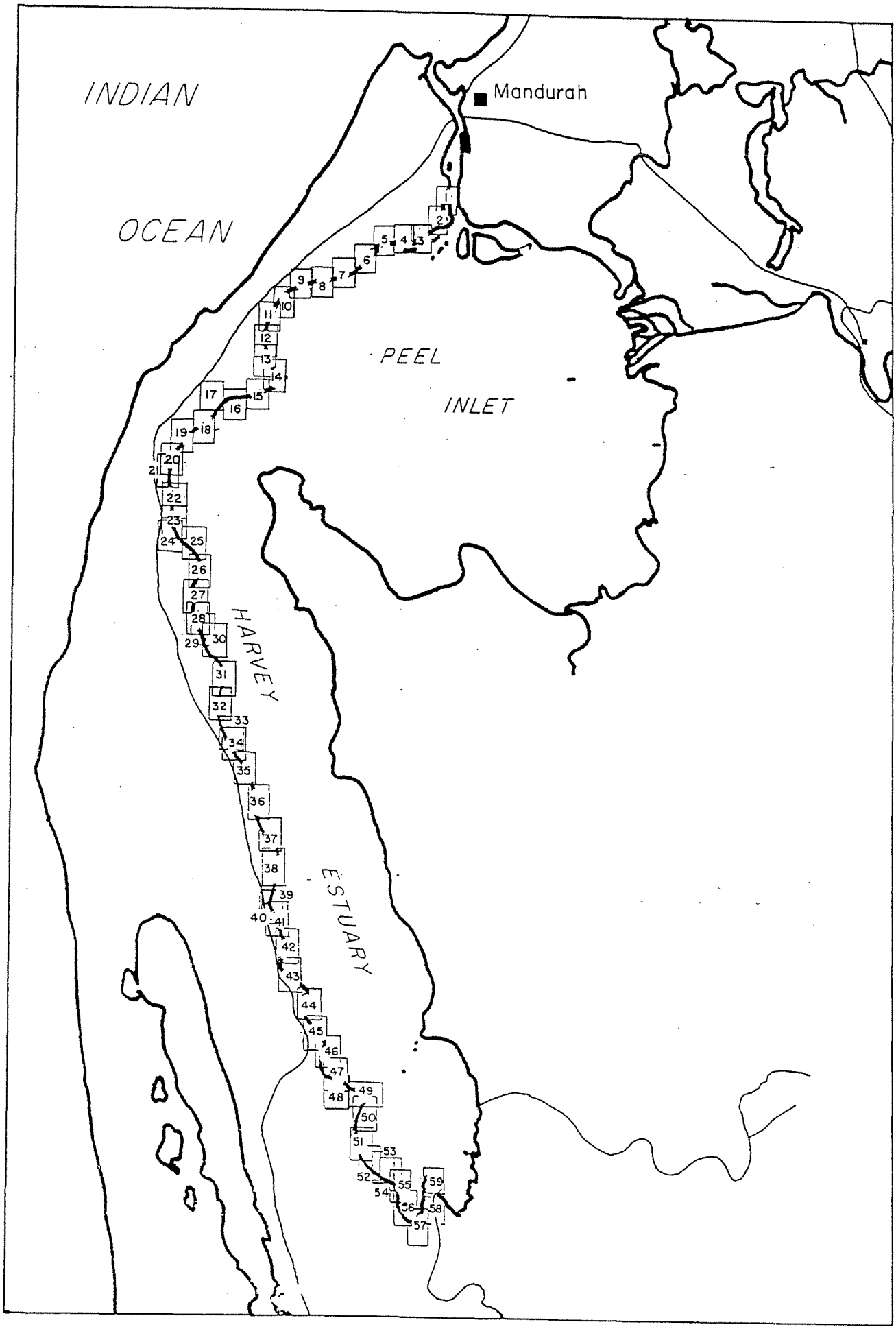
(Plate 5: Estuary Road Narrow Foreshore)
Estuary Road highlights current inadequate provision of foreshore reserves along the western foreshore.

(Plate 6: Sheep On Foreshore)
Unrestricted foreshore access can result in foreshore degradation.

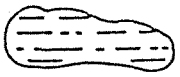
5 Specific Recommendations

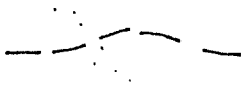


(Plate 7: Healthy Tuart)
The Tuart, a geographically restricted species is common along the western foreshore of the Harvey Estuary.


INDIAN
OCEAN
Mandurah
PEEL
INLET
HARVEY
ESTUARY

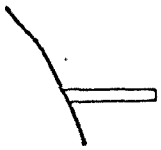
LEGEND

Artificial Wetland/Lake 

Bathymetric Line (0.5m) 

Building Envelope 

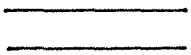
Gate 

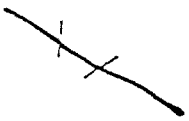
Jetty 

Priority Survey Area 

Proposed Dredging 

Proposed Weed Removal Area 

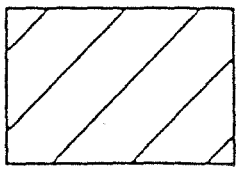
Road 

Soft Launching Area 

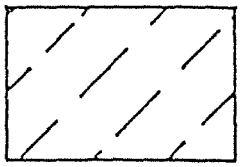
Stone Walling 

Track 

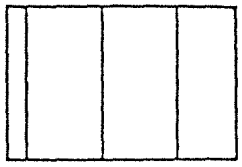
SEMENIUK VEGETATION CLASSIFICATION



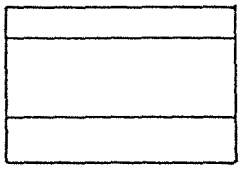
TIDAL SHOAL



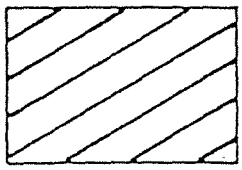
SPIT LAGOON COMPLEX



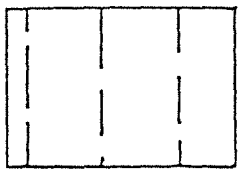
BEACH RIDGE COMPLEX



EROSIONAL SANDY SHORE

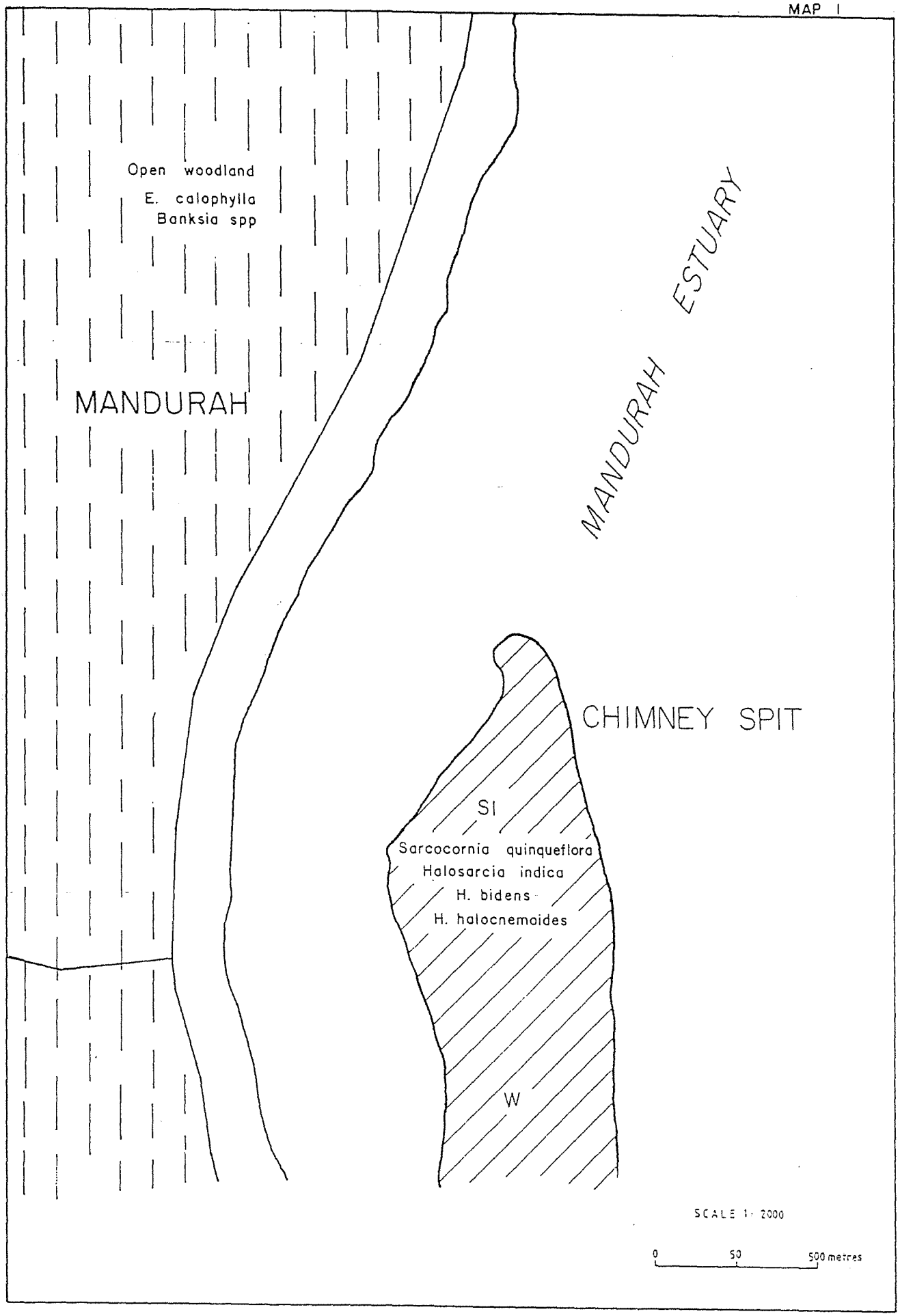


TUART COMPLEX



MARRI COMPLEX

S1 Develop a management plan for Chimney Spit. To be conserved recognising System 6 significance. (CALM)


MAP 1
Open woodland
E. calophylla
Banksia spp
MANDURAH
MANDURAH ESTUARY
CHIMNEY SPIT
SI
Sarcocornia quinqueflora
Halosarcia indica
H. bidens
H. halocnemoides
W
SCALE 1: 2000
0
50
500 metres

S2 Construct a barrier to prevent vehicles gaining access to Chimney Spit. Design to include the creation of a channel, to be dredged and maintained regularly by the developer. (CALM , Dev)

S3 Rehabilitate 4WD track areas by restricting access, filling wheel ruts and allowing the samphire and other natural vegetation to re - establish itself. Consider possibility of creating a walking trail. (CALM)

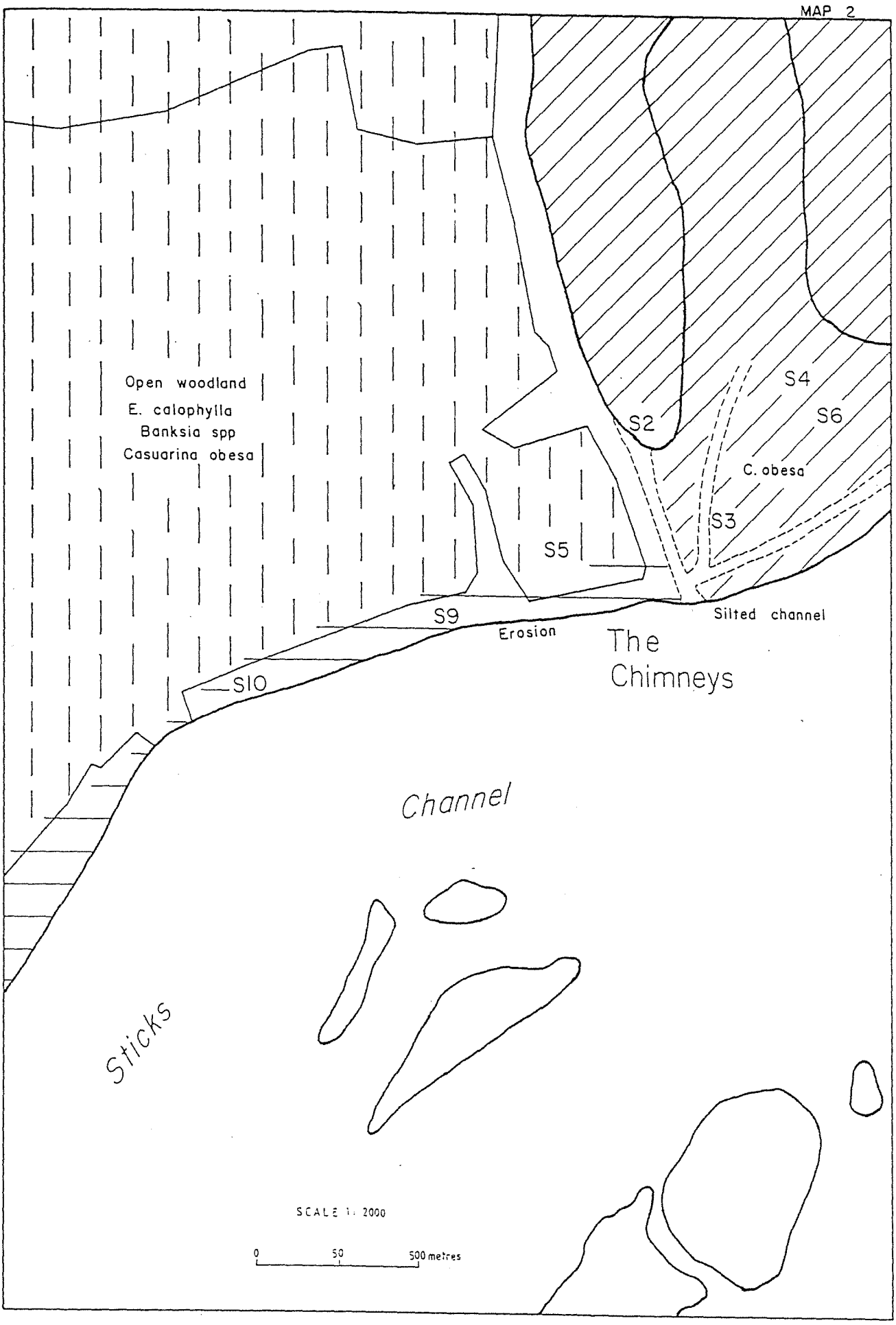
S4 Establish an interpretation programme to provide information about the value of samphire as a highly productive wetland and relate its importance to the Peel - Harvey Estuary. This would include signs, walking trails and a pamhlet. (CALM)

S5 Direct lighting from the proposed hotel and other development away from Chimney Spit. (Dev)

S6 Eradicate foxes and other introduced predators that gain access to Chimney Spit. (CALM)

S9 Control erosion along foreshore of the Mandurah Quay development in accordance with EPA Bulletin 488. (Dev)

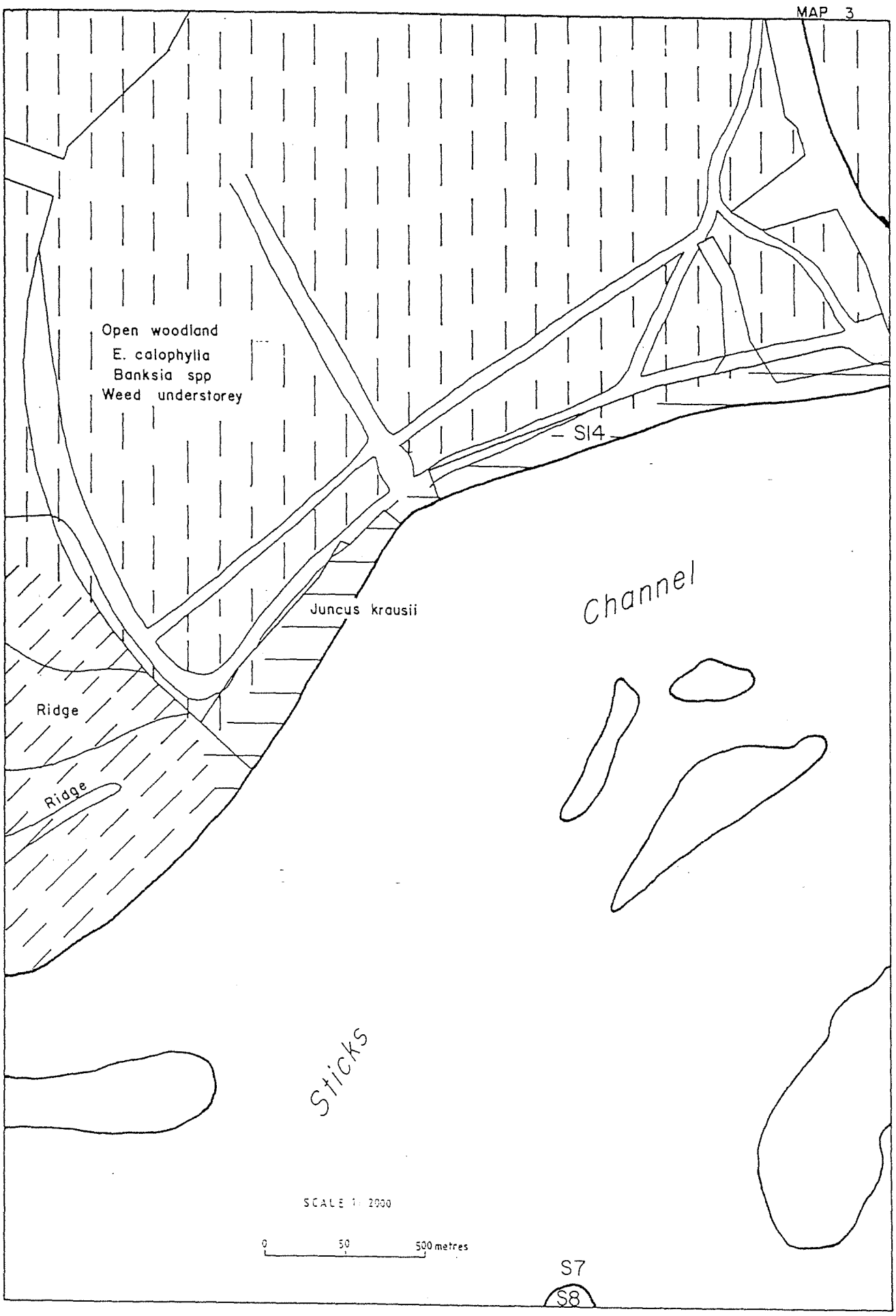
S10 Reserve Lot 2 and Lot 3 for recreation purposes. Preferably to be vested in the City of Mandurah with limited management involvement from CALM and PIMA. (DOLA, CM, CALM)


MAP 2
Open woodland
E. calophylla
Banksia spp
Casuarina obesa
S2
S4
S6
C. obesa
S3
S5
S9
Erosion
Silted channel
The Chimneys
S10
Channel
Sticks
SCALE 1: 2000
0
50
500 metres

S7 Reserve Boundary Island according to its value for conservation of fauna and potential for passive recreation and education. Preferably to be vested in NPNCA to be managed by CALM.

S8 Consolidate sands of Boundary Island by developing a vegetation enrichment programme. Options include utilizing confiscated fishing nets for covering harvested algae to create a humus. Conduct enrichment planting with Juncus krausii and appropriate sand dune shrubs. Complete revegetation using sheoak (*Casuarina obesa*) and paperbarks (*Melaleuca spp.*) (PIMA, DMH, DF)

S14 Construct dual use path along Mandurah Quay Development foreshore. (Dev)

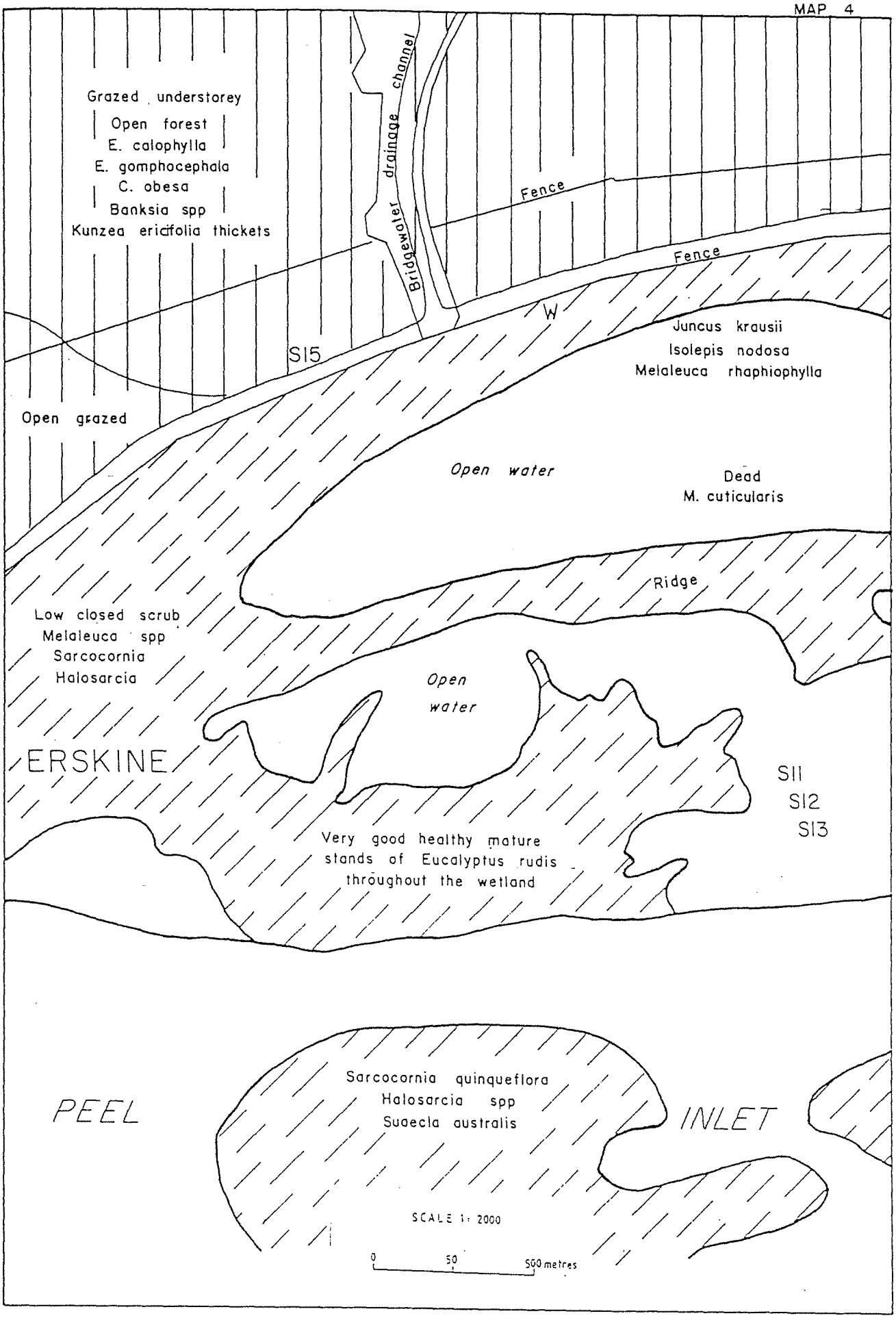

MAP 3
Open woodland
E. calophylla
Banksia spp
Weed understorey
S14
Juncus krausii
Channel
Ridge
Ridge
Sticks
SCALE 1: 2000
0
50
500 metres
S7
S8

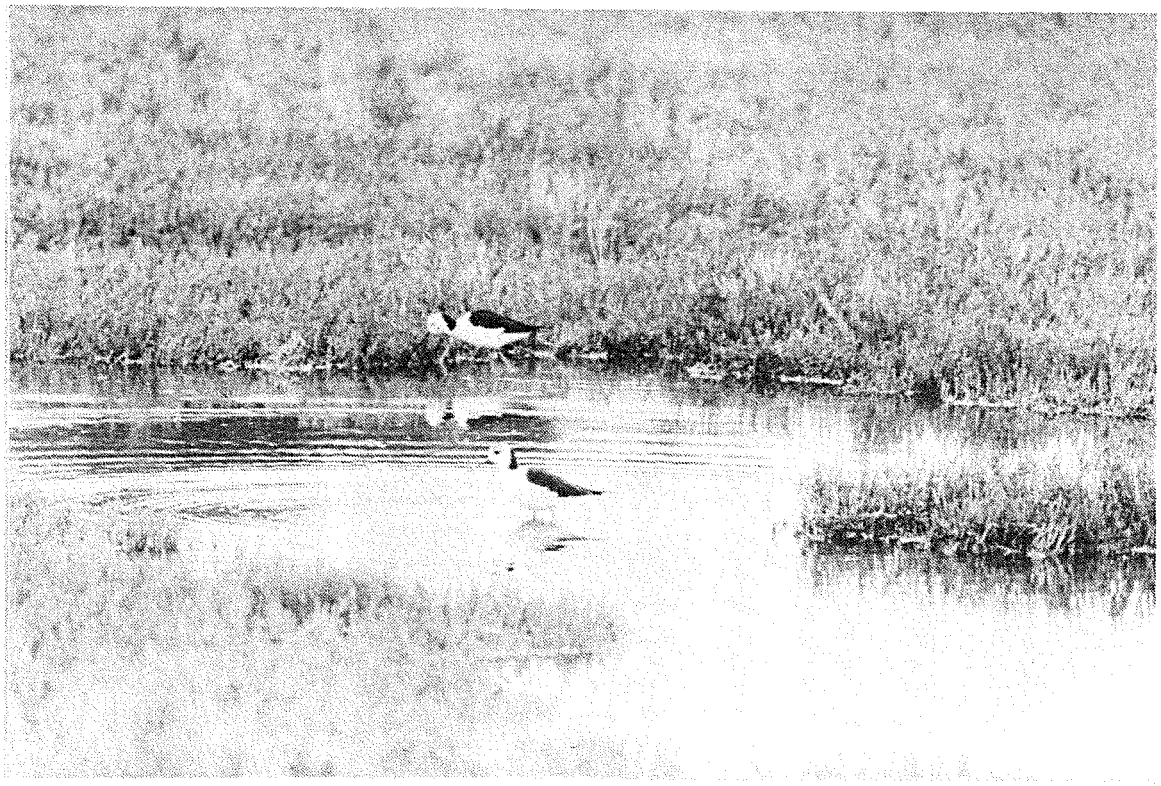
S11 Lot 6, and Pt Lot 5 to be given for vesting in the NPNCA as a condition of subdivision. (DOLA, Dev, NPNCA, CALM)

S12 Amalgamate Mandurah Quay foreshore vested in NPNCA into one reserve known as the Erskine Conservation Park. CALM to produce Master Development Plan to manage Erskine Wetlands and Chimney Spit for the purpose of recreation and conservation of flora and fauna. (CALM)

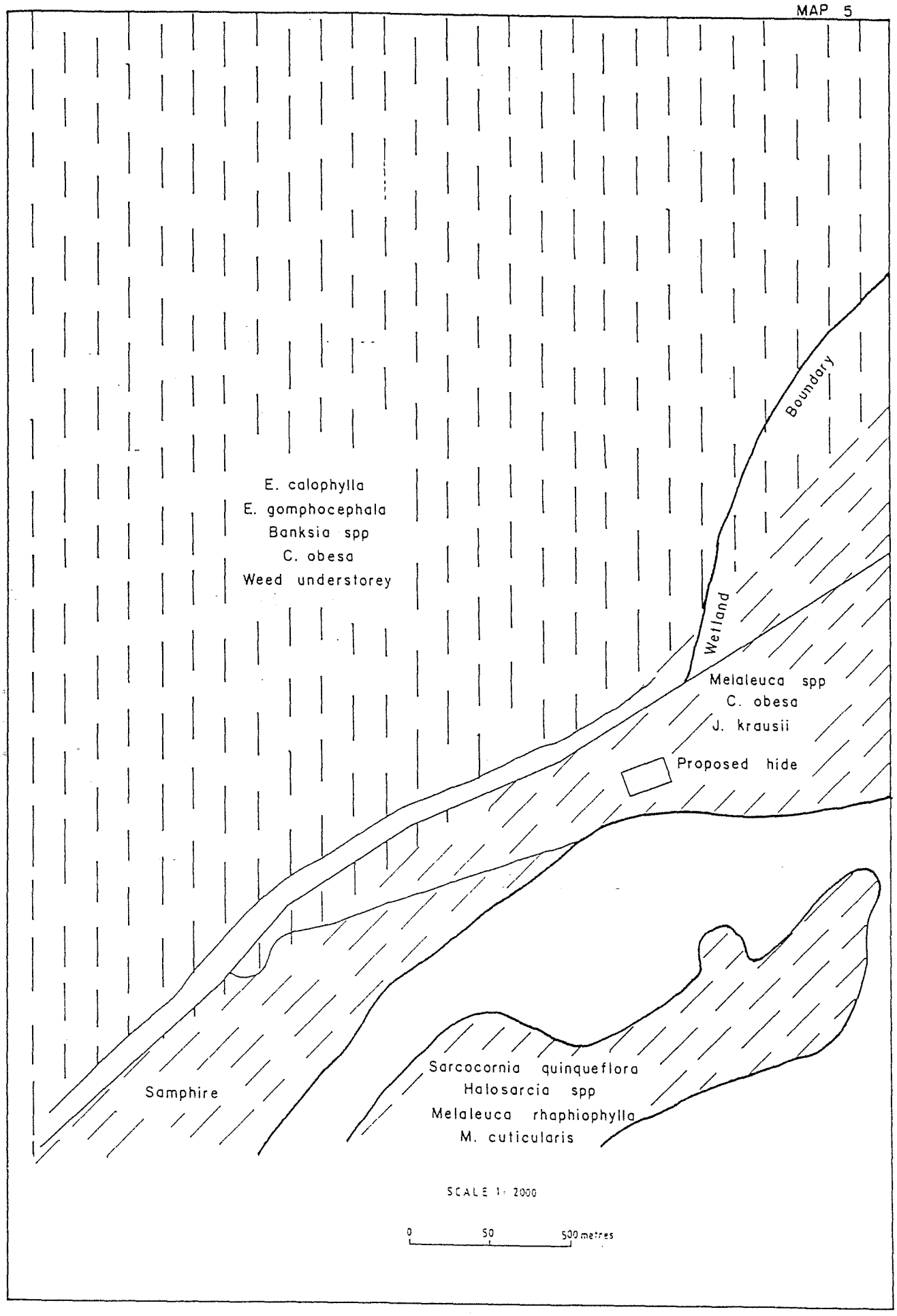
S13 Implement the recommendations of the "Proposal For The Management Of The Erskine (Sticks) Wetland Area". (CALM, PIMA)

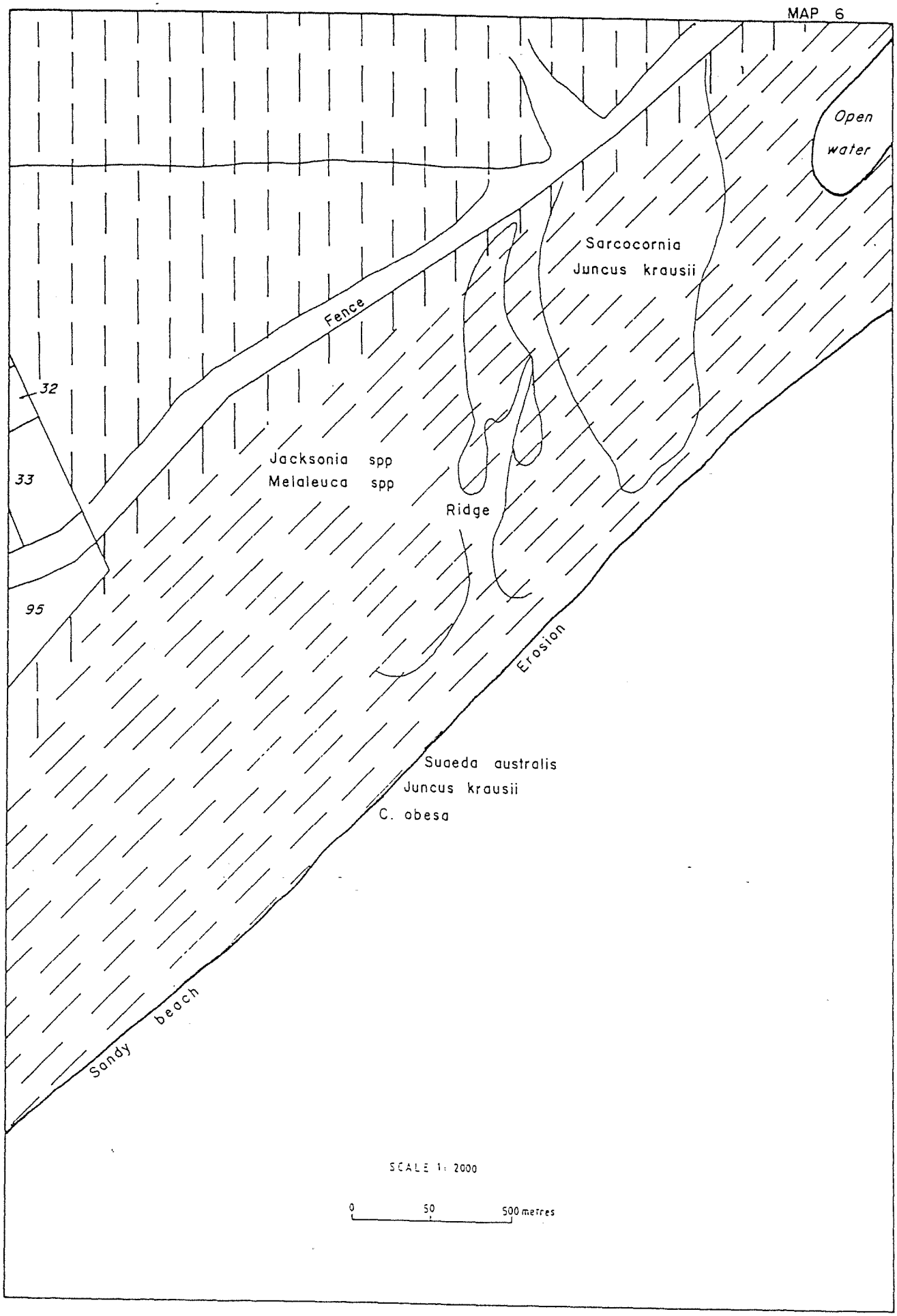
S15 Develop an interpretive trail through the Erskine Wetland using National Heritage grant. (WWC, PIMA, CALM)


MAP 4
Grazed understorey
Open forest
E. calophylla
E. gomphocephala
C. obesa
Banksia spp
Kunzea ericifolia thickets
Bridgewater drainage channel
Fence
Fence
W
S15
Juncus krausii
Isolepis nodosa
Melaleuca rhaphiophylla
Open grazed
Open water
Dead
M. cuticularis
Ridge
Low closed scrub
Melaleuca spp
Sarcocornia
Halosarcia
Open water
ERSKINE
S11
S12
S13
Very good healthy mature stands of Eucalyptus rudis throughout the wetland
PEEL
INLET
Sarcocornia quinqueflora
Halosarcia spp
Suaeda australis
SCALE 1: 2000
0
50
500 metres

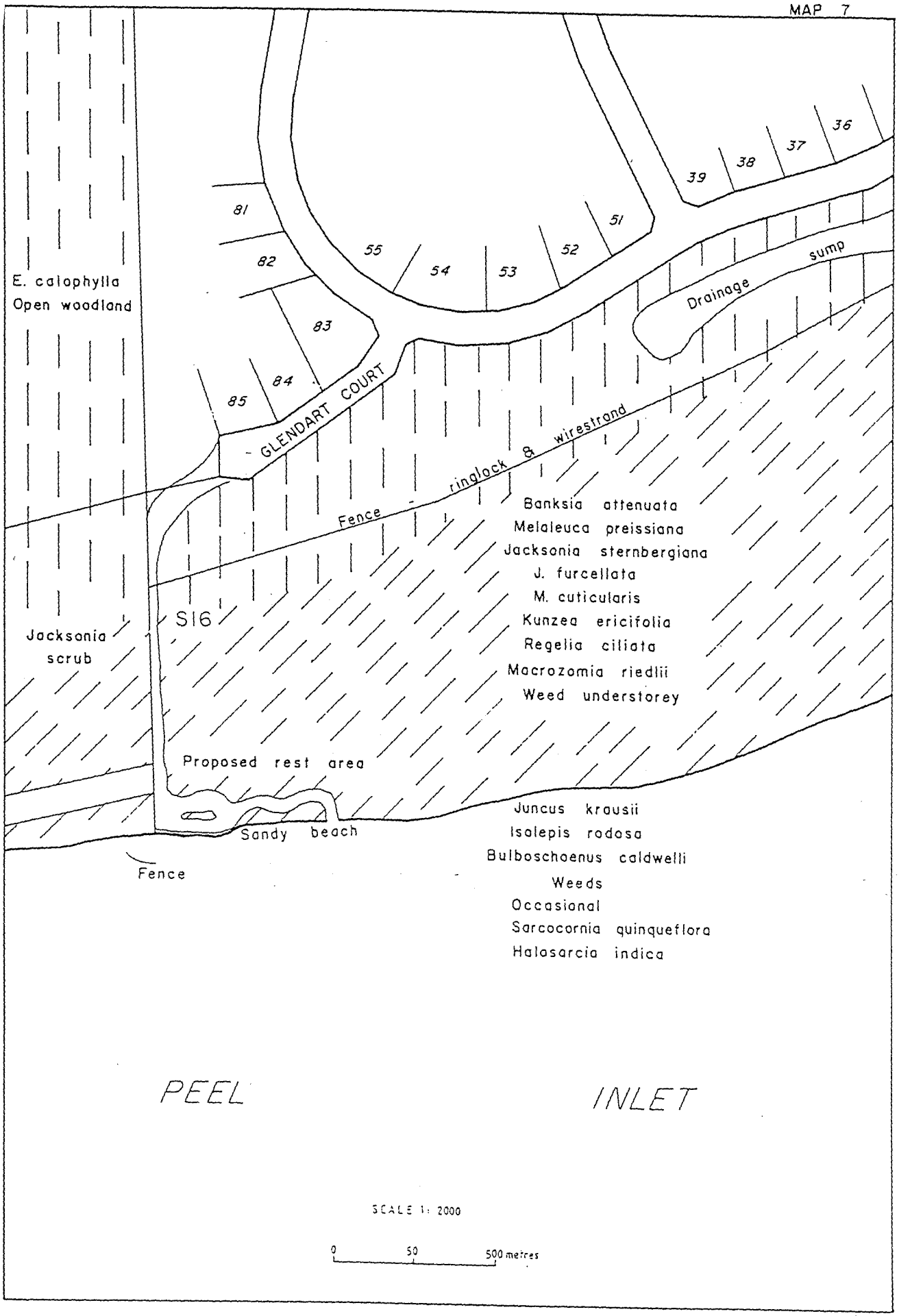


(Plate 8: Samphire And Wading Birds)
Samphire marsh provides excellent feeding grounds for wading birds.


MAP 5
E. calophylla
E. gomphocephala
Banksia spp
C. obesa
Weed understorey
Boundary
Wetland
Melaleuca spp
C. obesa
J. krausii
Proposed hide
Samphire
Sarcocornia quinqueflora
Halosarcia spp
Melaleuca rhaphiophylla
M. cuticularis
SCALE 1: 2000
0
50
500 metres

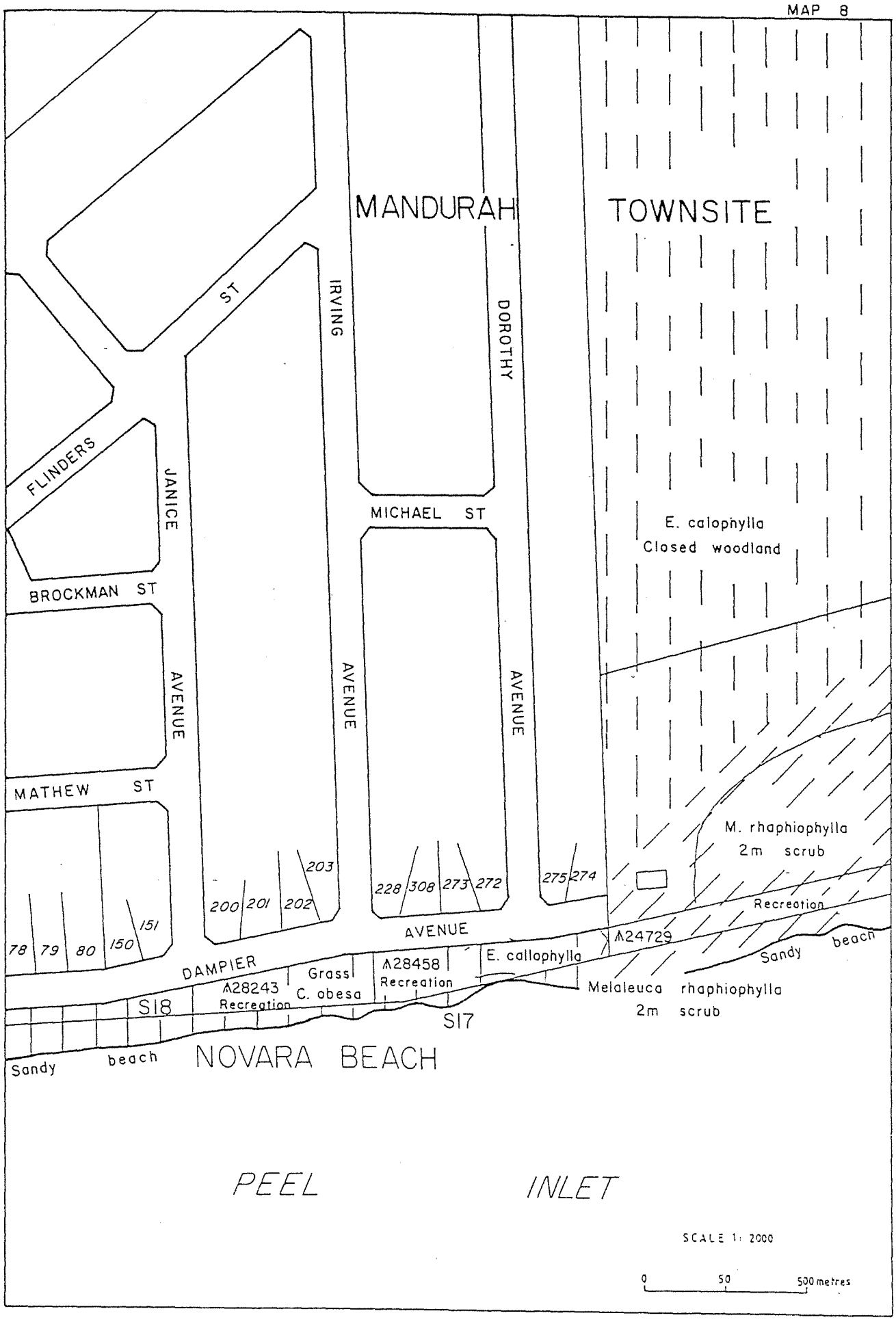

MAP 6
Open water
Sarcocornia
Juncus krausii
Fence
32
33
95
Jacksonia spp
Melaleuca spp
Ridge
Erosion
Suaeda australis
Juncus krausii
C. obesa
Sandy beach
SCALE 1: 2000
0
50
500 metres

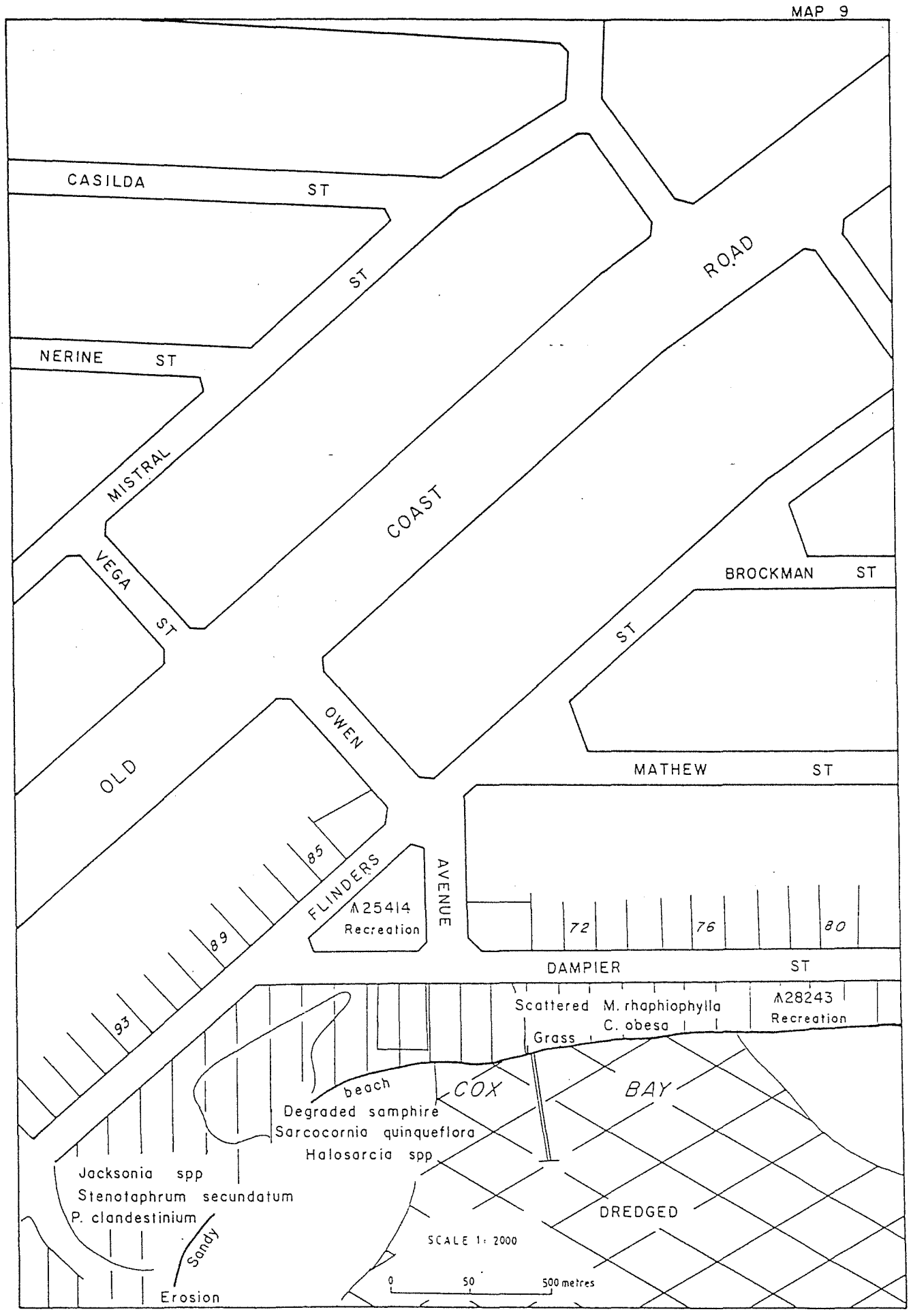
S16 Restrict 4WD access from Glendart Court to the proposed rest area of the Erskine Wetland. Prevent camping and campfires by patrolling area and establishing signs. Revise restriction once management plan is active for Erskine Nature Reserve. (CALM, PIMA)


MAP 7
E. calophylla
Open woodland
81
82
83
84
85
55
54
53
52
51
39
38
37
36
Drainage
sump
GLENDART COURT
Fence
ringlock & wirestrand
Banksia attenuata
Melaleuca preissiana
Jacksonia sternbergiana
J. furcellata
M. cuticularis
Kunzea ericifolia
Regelia ciliata
Macrozomia riedlii
Weed understorey
S16
Jacksonia
scrub
Proposed rest area
Sandy beach
Juncus krausii
Isolepis rodosa
Bulboschoenus caldwelli
Weeds
Occasional
Sarcocornia quinqueflora
Halosarcia indica
Fence
PEEL
INLET
SCALE 1: 2000
0
50
500 metres

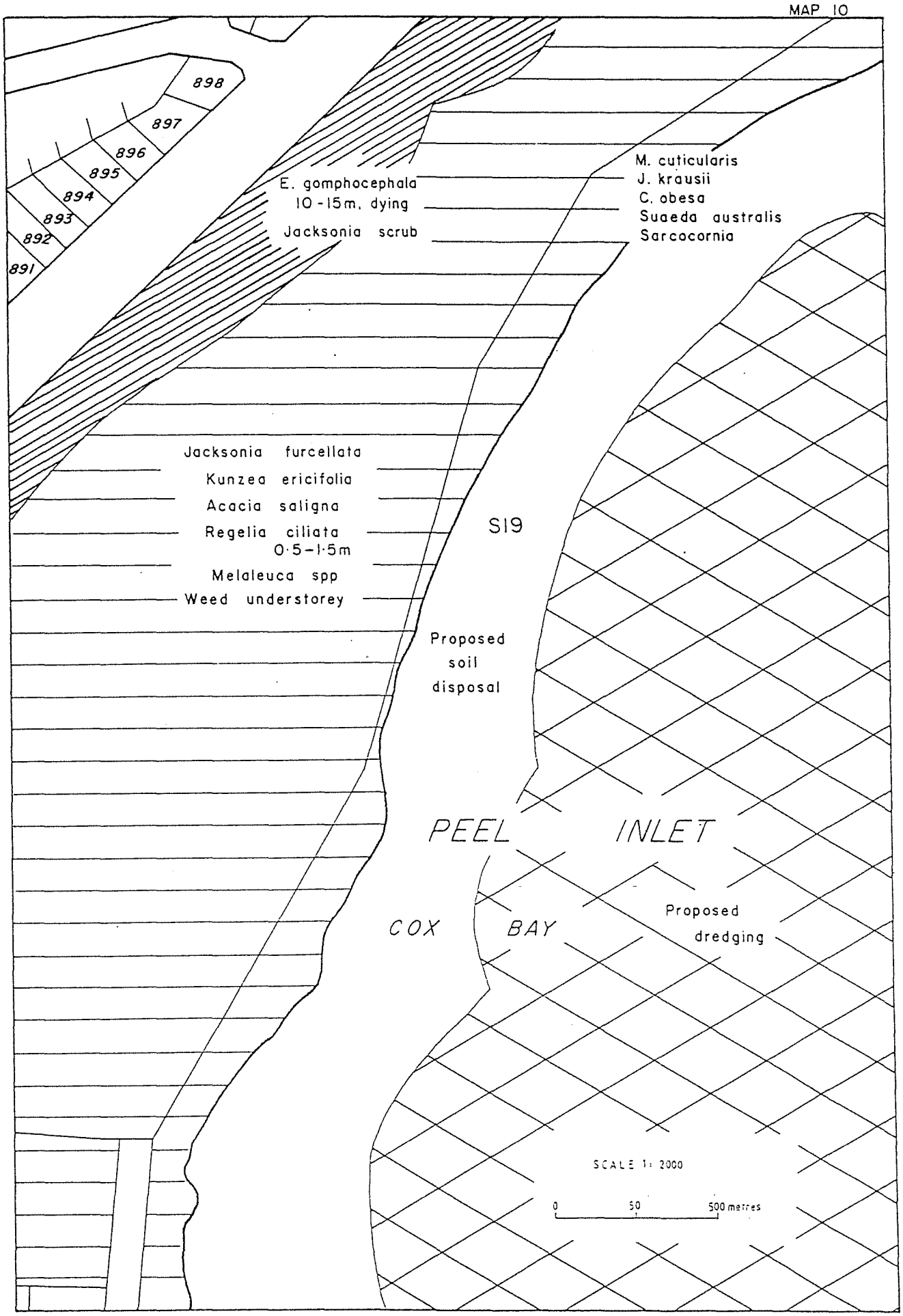
S17 Amalgamate reserves 24729, 28458, 28243 and adjoining Vacant Crown Land to create a reserve for recreation and foreshore management purposes. Vest in the City of Mandurah. (DOLA, CM)

S18 Revegetate Novara Beach recreation reserve (28243, 28458) with sheoak and marri (*Eucalyptus calophylla*) to provide more shade and enhance shelter. (CM, PIMA)


MAP 8
MANDURAH
TOWNSITE
ST
IRVING
DOROTHY
FLINDERS
JANICE
MICHAEL ST
BROCKMAN ST
AVENUE
AVENUE
AVENUE
MATHEW ST
E. calophylla
Closed woodland
M. rhaphiophylla
2m scrub
Recreation
203
200
201
202
228
308
273
272
275
274
78
79
80
150
151
AVENUE
A24729
DAMPIER
A28458
Recreation
E. callophylla
Grass
A28243
Recreation
C. obesa
S18
S17
Melaleuca rhaphiophylla
2m scrub
Sandy beach
Sandy beach
NOVARA BEACH
PEEL INLET
SCALE 1: 2000
0 50 500 metres

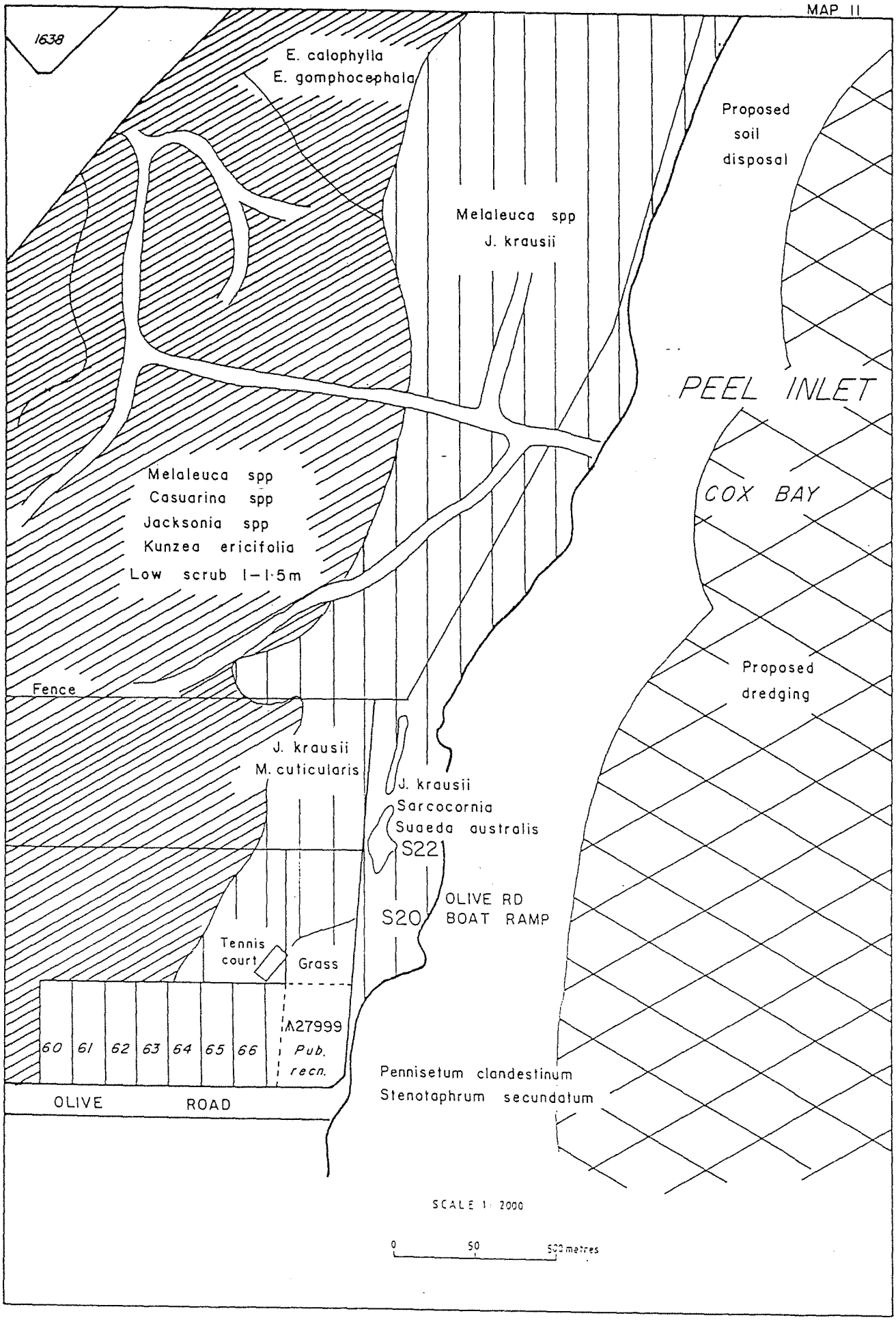

MAP 9
CASILDA ST
ROAD
NERINE ST
MISTRAL
COAST
VEGA ST
BROCKMAN ST
OLD
OWEN
MATHEW ST
FLINDERS AVENUE
A25414 Recreation
85
89
93
72
76
80
DAMPIER ST
Scattered M. rhaphiophylla
C. obesa
Grass
A28243 Recreation
beach
COX BAY
Degraded samphire
Sarcocornia quinqueflora
Halosarcia spp
Jacksonia spp
Stenotaphrum secundatum
P. clandestinium
Sandy
Erosion
DREDGED
SCALE 1: 2000
0 50 500 metres

S19 Develop a foreshore management plan to offset the environmental impacts of dredging and filling operations of the Estuary Gardens Development, in accordance with EPA Bulletin 549. Include provision for a dual use pathway. (Dev)


MAP 10
898
897
896
895
894
893
892
891
E. gomphocephala
10 - 15m, dying
Jacksonia scrub
M. cuticularis
J. krausii
C. obesa
Suaeda australis
Sarcocornia
Jacksonia furcellata
Kunzea ericifolia
Acacia saligna
Regelia ciliata
0·5 - 1·5m
Melaleuca spp
Weed understorey
S19
Proposed
soil
disposal
PEEL INLET
COX BAY
Proposed
dredging
SCALE 1: 2000
0 50 500 metres

S20 Incorporate Vacant Crown Land into reserve 27999 and vest in the City Of Mandurah for recreation and foreshore management purposes.(DOLA, CM)

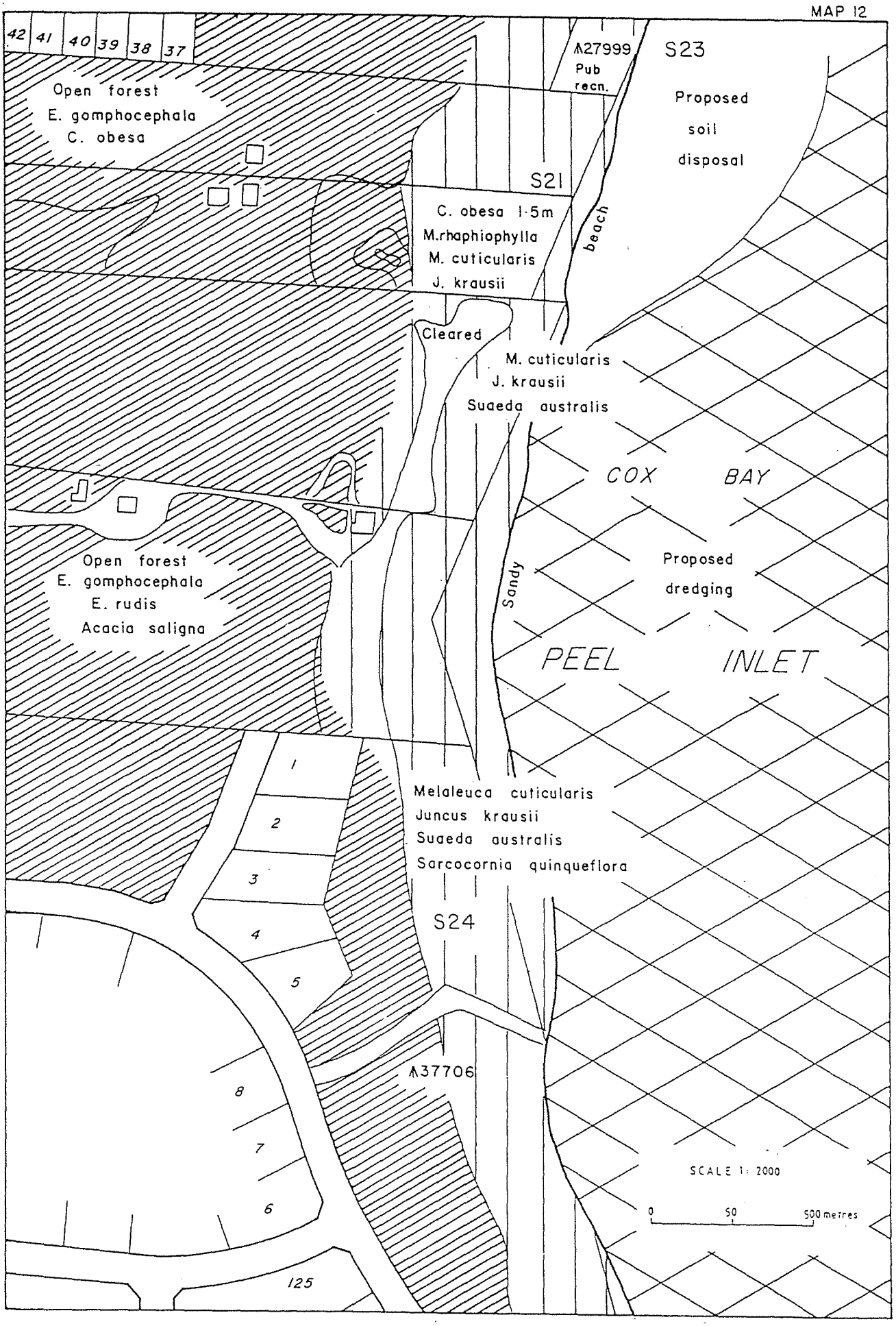
S22 Preserve remnant samphire marsh existing in the road reserve and Vacant Crown Land with assistance from PIMA. (PIMA, CM)

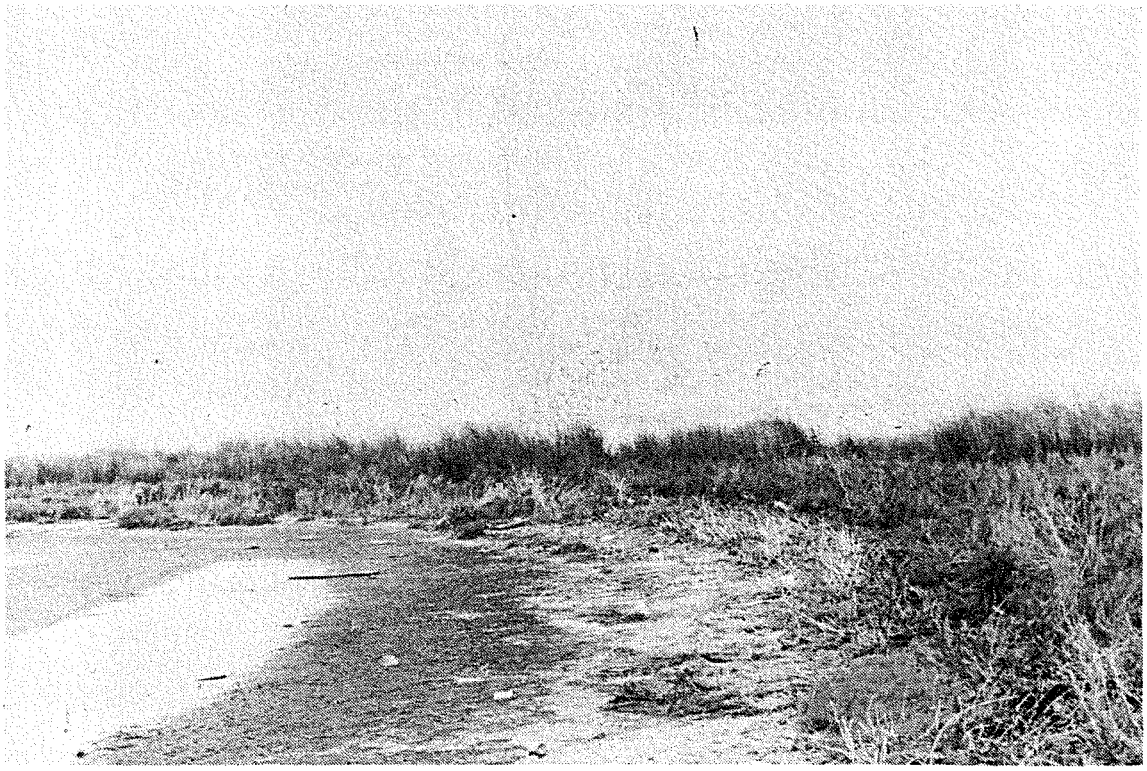

MAP II
1638
E. calophylla
E. gomphocephala
Melaleuca spp
J. krausii
Proposed
soil
disposal
PEEL INLET
COX BAY
Melaleuca spp
Casuarina spp
Jacksonia spp
Kunzea ericifolia
Low scrub 1–1·5m
Fence
Proposed
dredging
J. krausii
M. cuticularis
J. krausii
Sarcocornia
Suaeda australis
S22
S20
OLIVE RD
BOAT RAMP
Tennis
court
Grass
60
61
62
63
64
65
66
A27999
Pub.
recn.
OLIVE
ROAD
Pennisetum clandestinum
Stenotaphrum secundatum
SCALE 1: 2000
0
50
500 metres

S21 Acquire a 50 metre setback from the adjacent Vacant Crown Land as a condition of subdivision of Location 91. Incorporate in reserve 27999 and vest in the City of Mandurah.(DOLA, DPUD, CM, PIMA)

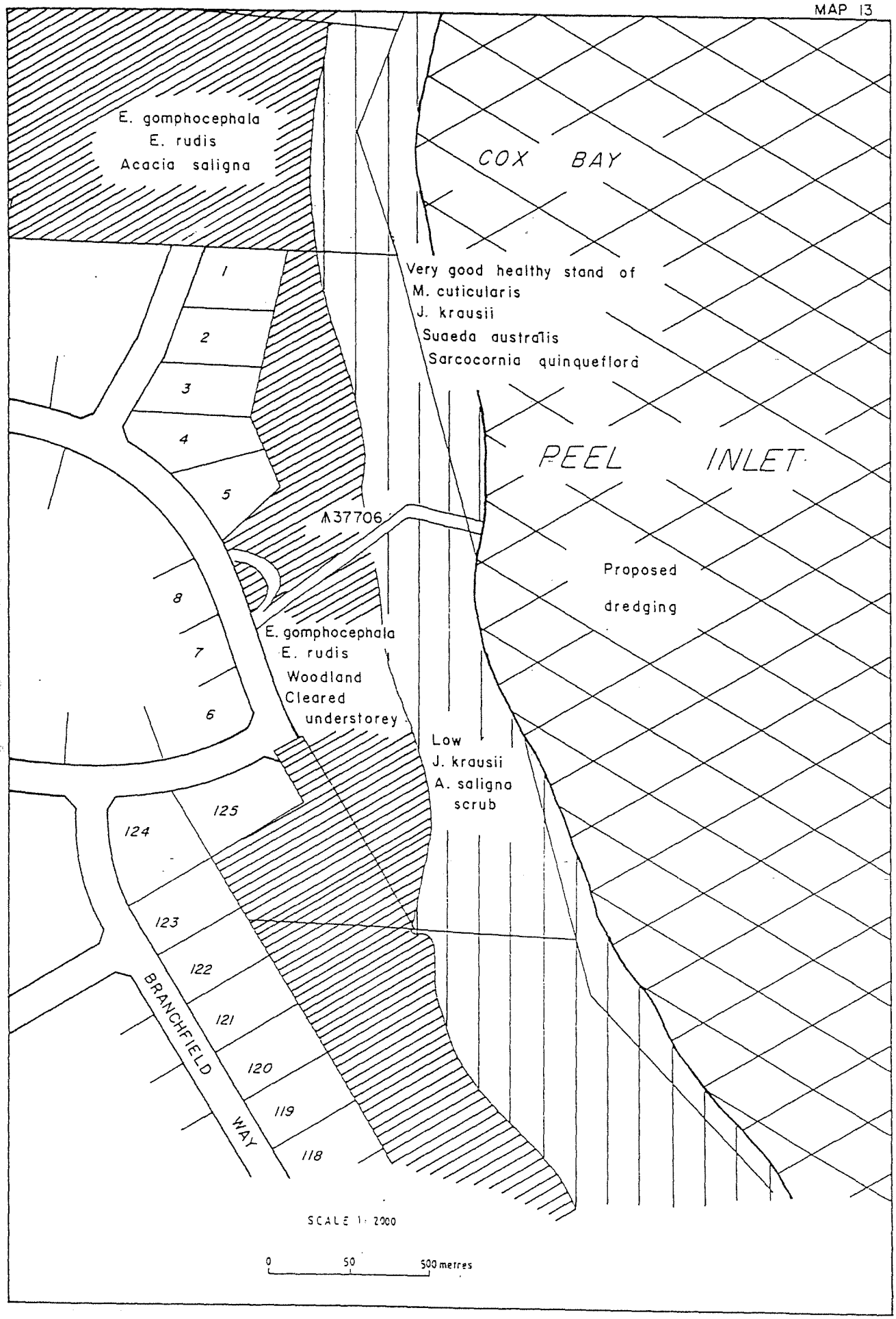
S23 Provide assistance to the Estuary Caravan Park (Olive Road) in revegetating the foreshore with species such as *Casuarina obesa* and *Melaleuca rhaphiophylla*. Undertake enrichment planting of vegetation understorey to further enhance the habitat of the Splendid Blue Wren (*Malarus splendens*). (CM, PIMA, Res)

S24 Extend dual use path constructed by Estuary Gardens through to proposed expanded reserve 27999, down to Pleasant Grove Foreshore Protection Area and ultimately to the proposed Ward Point recreation area. Where possible this work should be undertaken as a condition of development. (CM, Dev)


MAP 12
42
41
40
39
38
37
Open forest
E. gomphocephala
C. obesa
A27999
Pub
recn.
S23
Proposed
soil
disposal
S21
C. obesa 1-5m
M.rhaphiophylla
M. cuticularis
J. krausii
beach
Cleared
M. cuticularis
J. krausii
Suaeda australis
COX BAY
Open forest
E. gomphocephala
E. rudis
Acacia saligna
Sandy
Proposed
dredging
PEEL INLET
1
2
3
4
5
Melaleuca cuticularis
Juncus krausii
Suaeda australis
Sarcocornia quinqueflora
S24
A37706
8
7
6
125
SCALE 1: 2000
0
50
500 metres



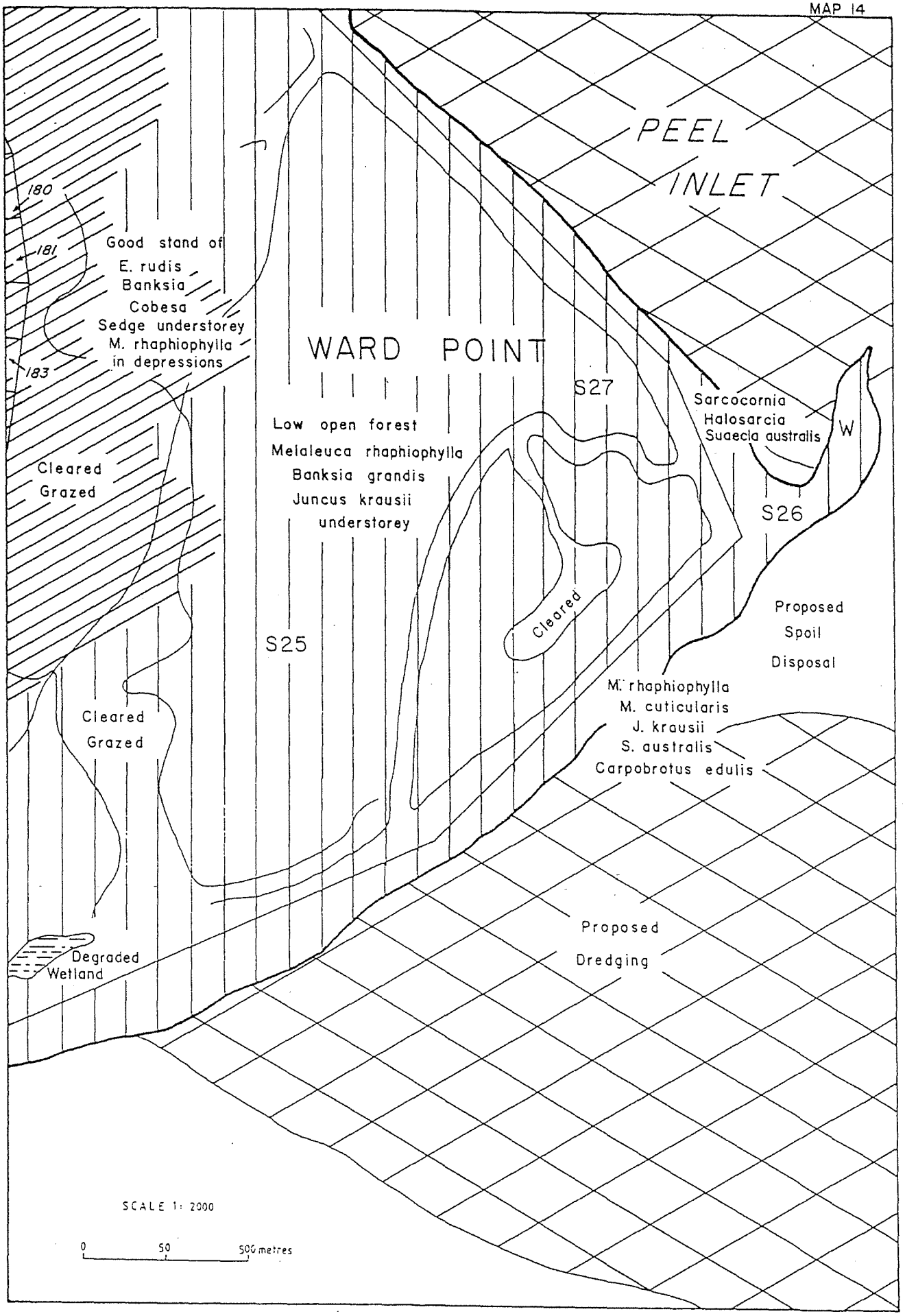
(Plate 9: Littered Foreshore)
Litter along the foreshore is unsightly and unnecessary.

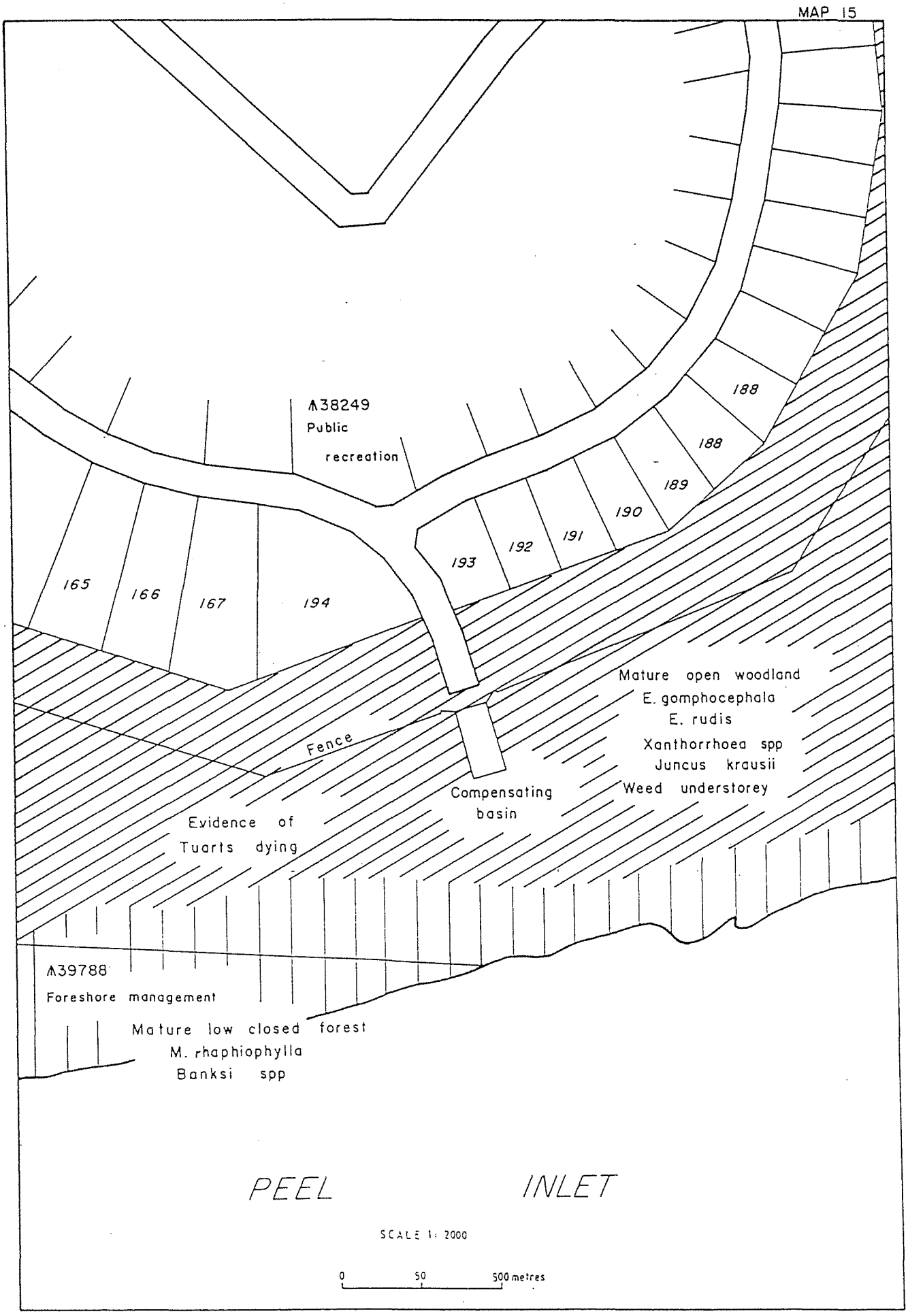

E. gomphocephala
E. rudis
Acacia saligna
COX BAY
Very good healthy stand of
M. cuticularis
J. krausii
Suaeda australis
Sarcocornia quinqueflora
PEEL INLET
M37706
Proposed
dredging
E. gomphocephala
E. rudis
Woodland
Cleared
understorey
Low
J. krausii
A. saligna
scrub
1
2
3
4
5
6
7
8
125
124
123
122
121
120
119
118
BRANCHFIELD WAY
SCALE 1: 2000
0
50
500 metres

S25 Acquire 28.07 POS, shown on the plan prepared by TS Martin for subdivision of Murray Locations 109, Pt 1339 and 124 for Pleasant Grove Pty Ltd and dated January 1980 and incorporate into reserve 37706, as a condition of subdivision. In addition, incorporate adjoining VCL into extended reserve 37706 and vest in the City Of Mandurah for recreation and foreshore management purposes. (DPUD, DOLA, CM)

S26 Restrict 4WD access to Ward Point and undertake litter and weed removal around the samphire marsh. (PIMA)

S27 Develop the extended reserve 37706 for recreation and foreshore management purposes. Include conservation of samphire as an objective within the subsequent foreshore management plan. (CM, PIMA, Dev)


MAP 14
PEEL
INLET
WARD POINT
180
181
183
Good stand of
E. rudis
Banksia
Cobesa
Sedge understorey
M. rhaphiophylla
in depressions
Cleared
Grazed
Low open forest
Melaleuca rhaphiophylla
Banksia grandis
Juncus krausii
understorey
S27
S26
S25
Sarcocornia
Halosarcia
Suaecia australis
W
Cleared
Proposed
Spoil
Disposal
M. rhaphiophylla
M. cuticularis
J. krausii
S. australis
Carpobrotus edulis
Cleared
Grazed
Degraded
Wetland
Proposed
Dredging
SCALE 1: 2000
0
50
500 metres

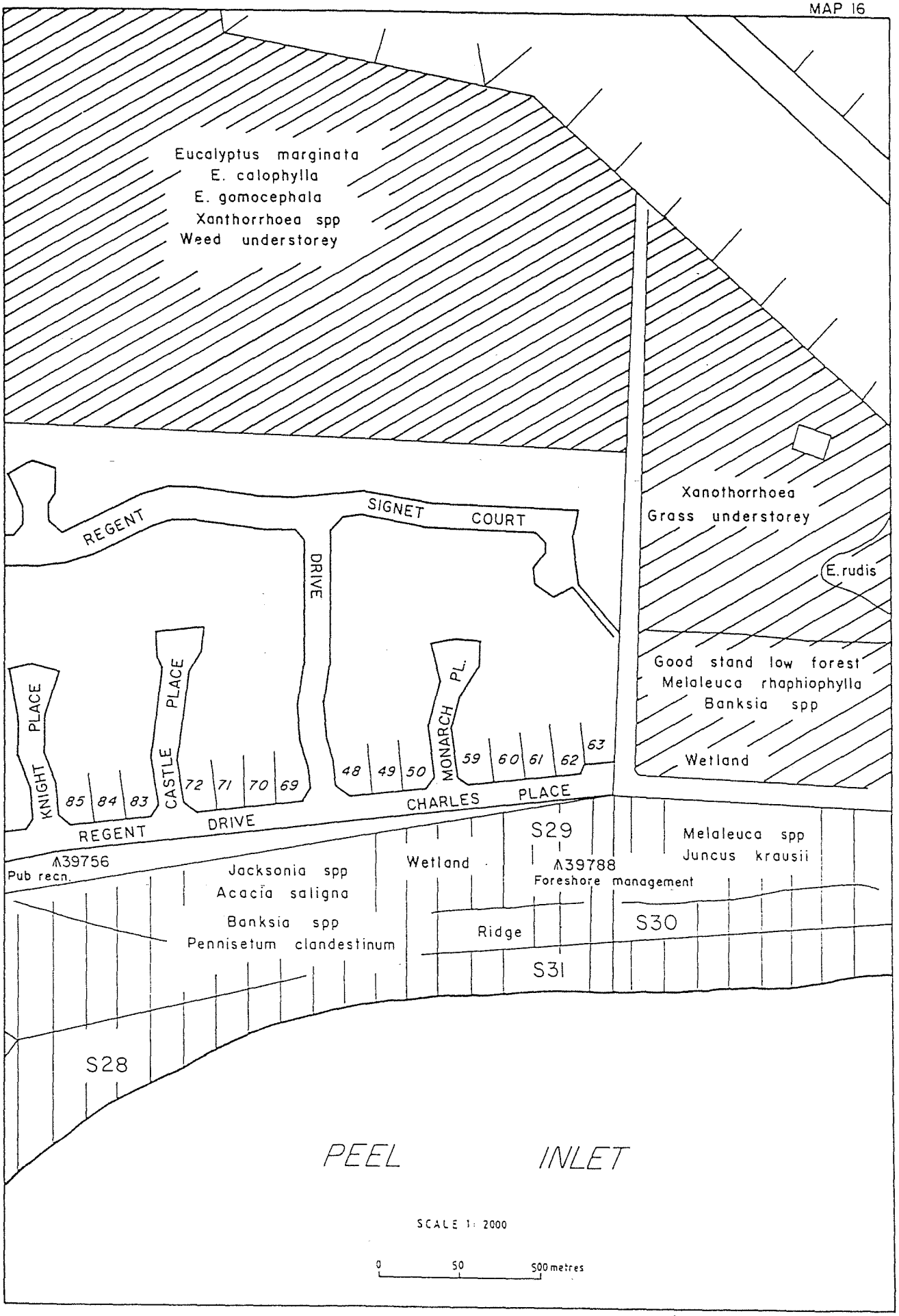

MAP 15
A38249
Public
recreation
188
188
189
190
191
192
193
194
165
166
167
Fence
Mature open woodland
E. gomphocephala
E. rudis
Xanthorrhoea spp
Juncus krausii
Weed understorey
Compensating
basin
Evidence of
Tuarts dying
A39788
Foreshore management
Mature low closed forest
M. rhaphiophylla
Banksi spp
PEEL
INLET
SCALE 1: 2000
0
50
500 metres

S28 Incorporate Vacant Crown Land south of Ward Point into reserve 39756 and 39788. Amalgamate the aforementioned and vest in the City Of Mandurah. City Of Mandurah to prepare a management plan with the assistance from PIMA. (DOLA, CM, PIMA)

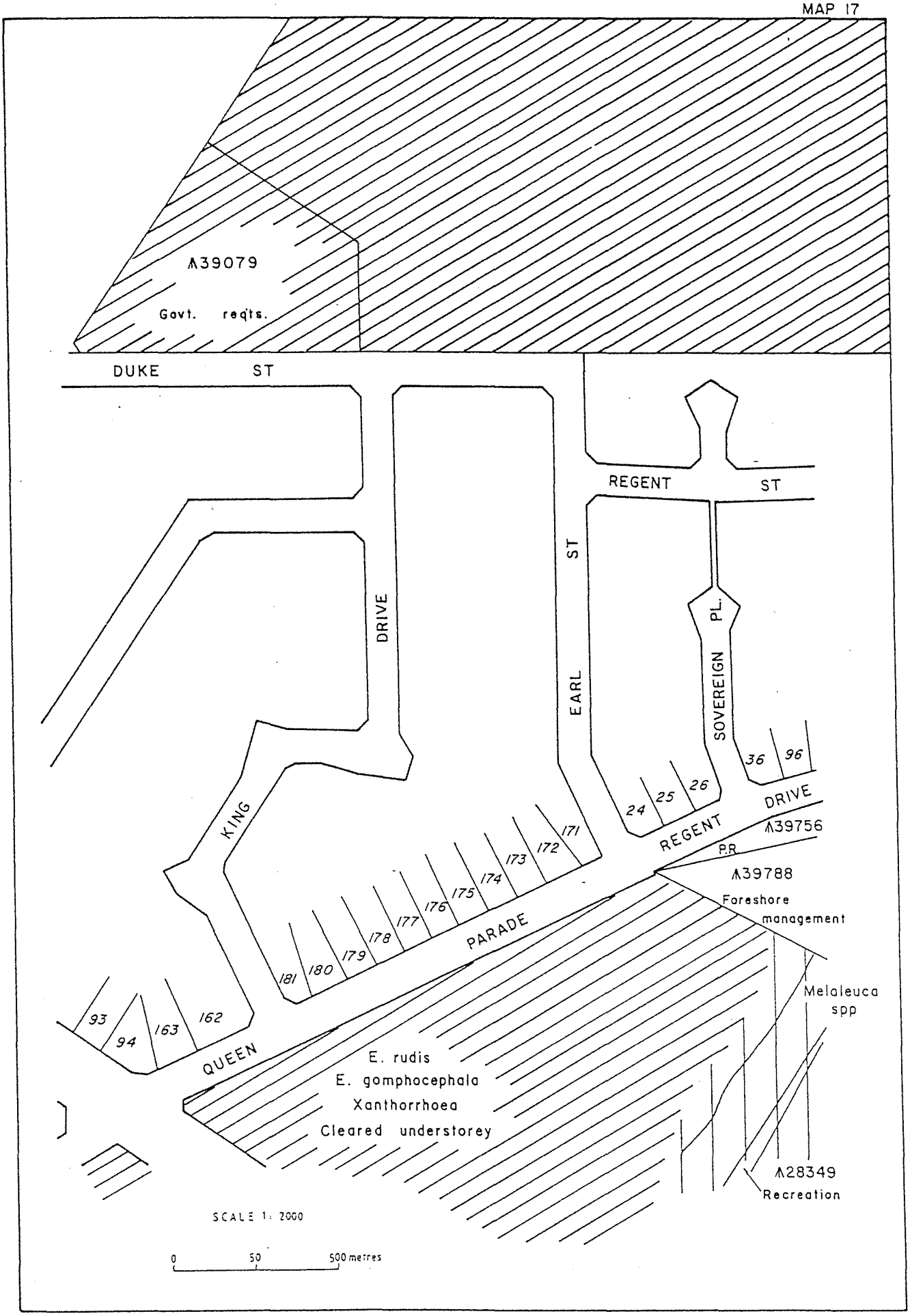
S29 Reinforce existing copper log fencing that prevents 4WD access to reserve 39788 by modifying it to prevent motorcycles gaining entry. (CM)

S30 Improve bushwalk trail by providing a raised boardwalk to cross wet areas in the Beach Ridge Complex. Develop a dual use path up to Estuary Place Boat Ramp. (CM)

S31 Provide interpretation tools along the walk to inform visitors of the importance of the wetlands. (CM, PIMA)

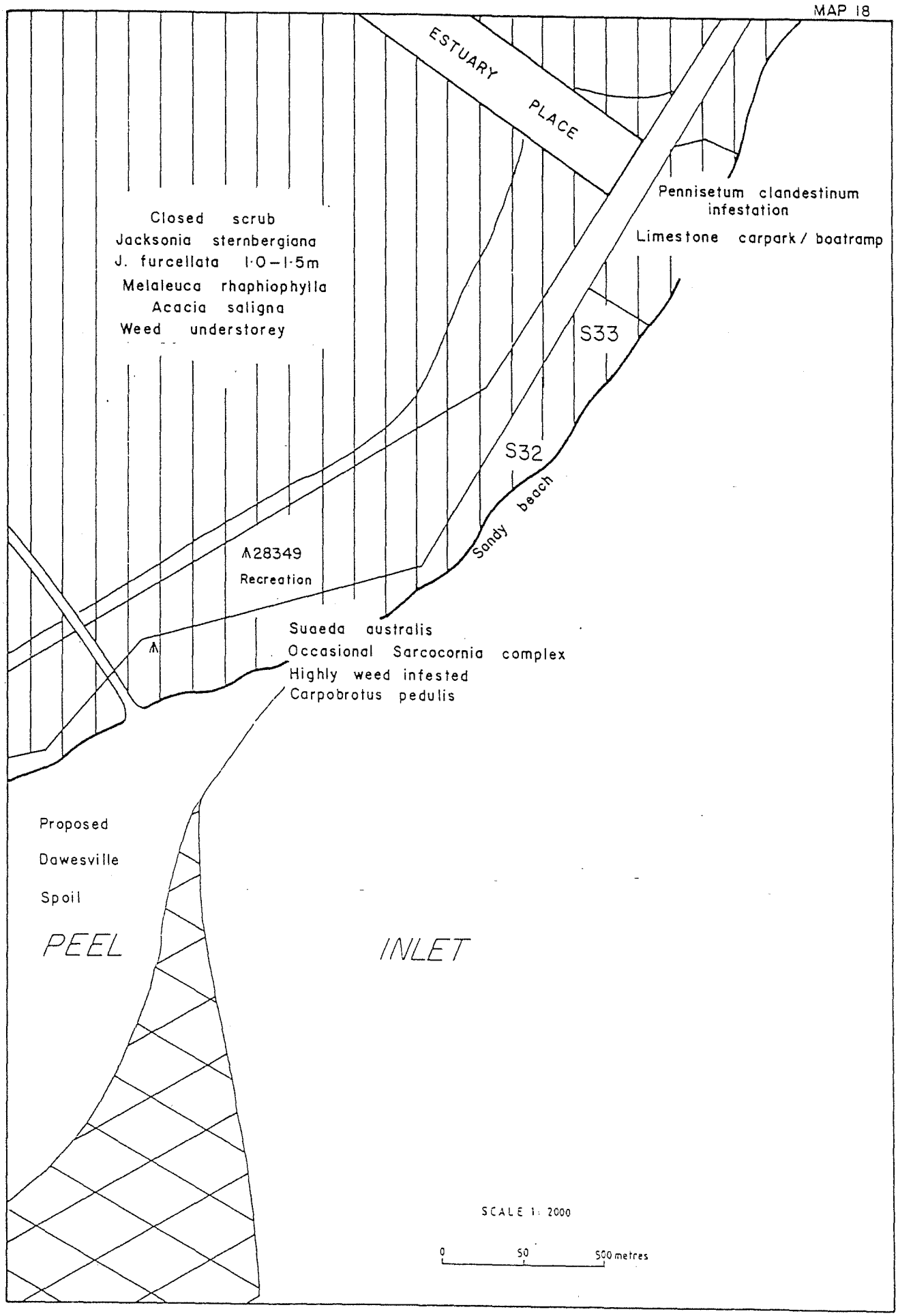

MAP 16
Eucalyptus marginata
E. calophylla
E. gomocephala
Xanthorrhoea spp
Weed understorey
REGENT
SIGNET
COURT
DRIVE
Xanothorrhoea
Grass understorey
E. rudis
KNIGHT PLACE
85 84 83
CASTLE PLACE
72 71 70 69
MONARCH PL.
48 49 50
59 60 61 62 63
Good stand low forest
Melaleuca rhaphiophylla
Banksia spp
Wetland
CHARLES PLACE
REGENT DRIVE
S29
Melaleuca spp
Juncus krausii
A39756
Pub recn.
Jacksonia spp
Acacia saligna
Wetland
A39788
Foreshore management
Banksia spp
Pennisetum clandestinum
Ridge
S30
S31
S28
PEEL INLET
SCALE 1: 2000
0 50 500 metres

MAP 17

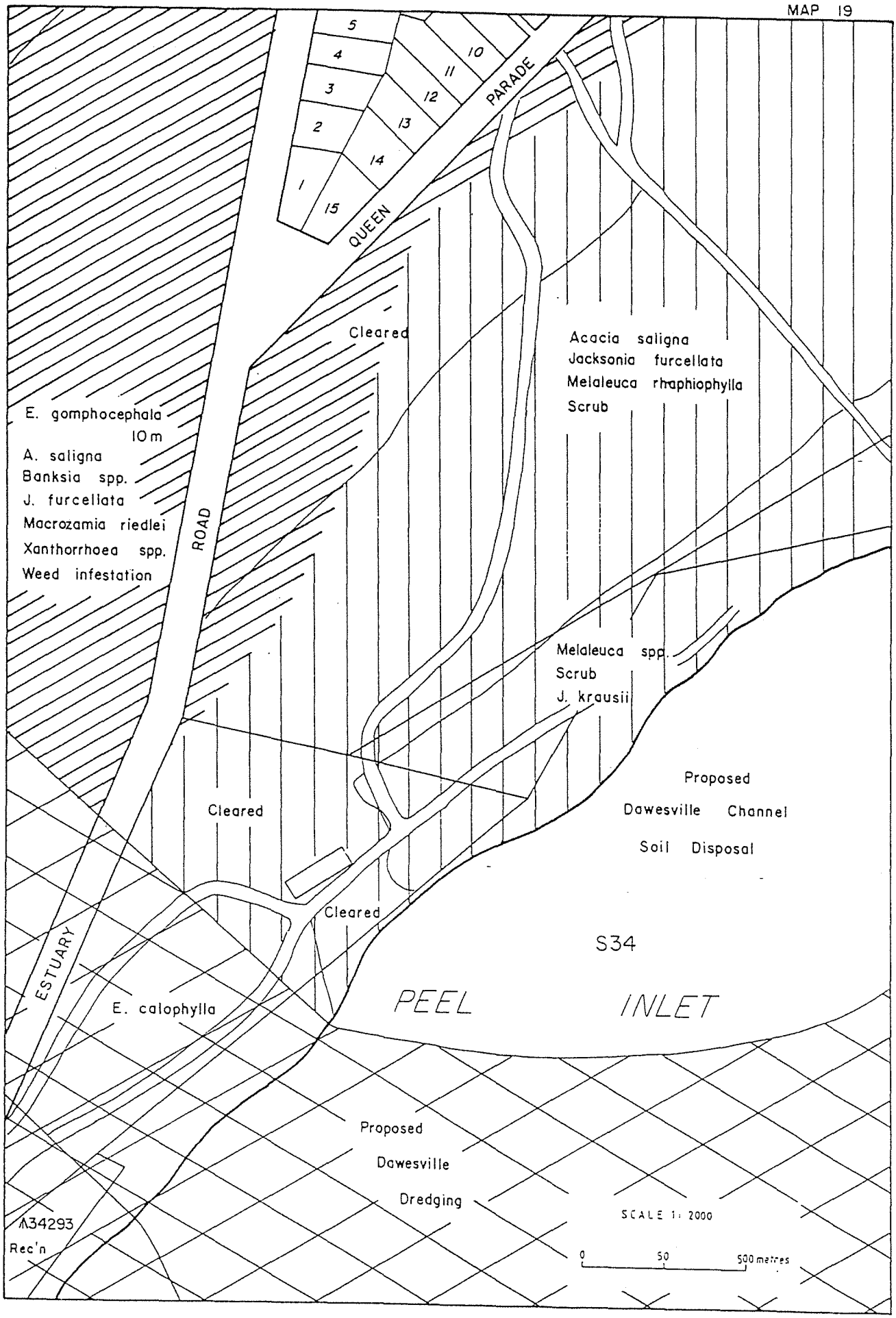

A39079
Govt. reqts.
DUKE ST
REGENT ST
DRIVE
EARL ST
SOVEREIGN PL.
KING
QUEEN
PARADE
REGENT DRIVE
A39756
P.R
A39788
Foreshore management
Melaleuca spp
E. rudis
E. gomphocephala
Xanthorrhoea
Cleared understorey
A28349
Recreation
SCALE 1: 2000
0 50 500 metres

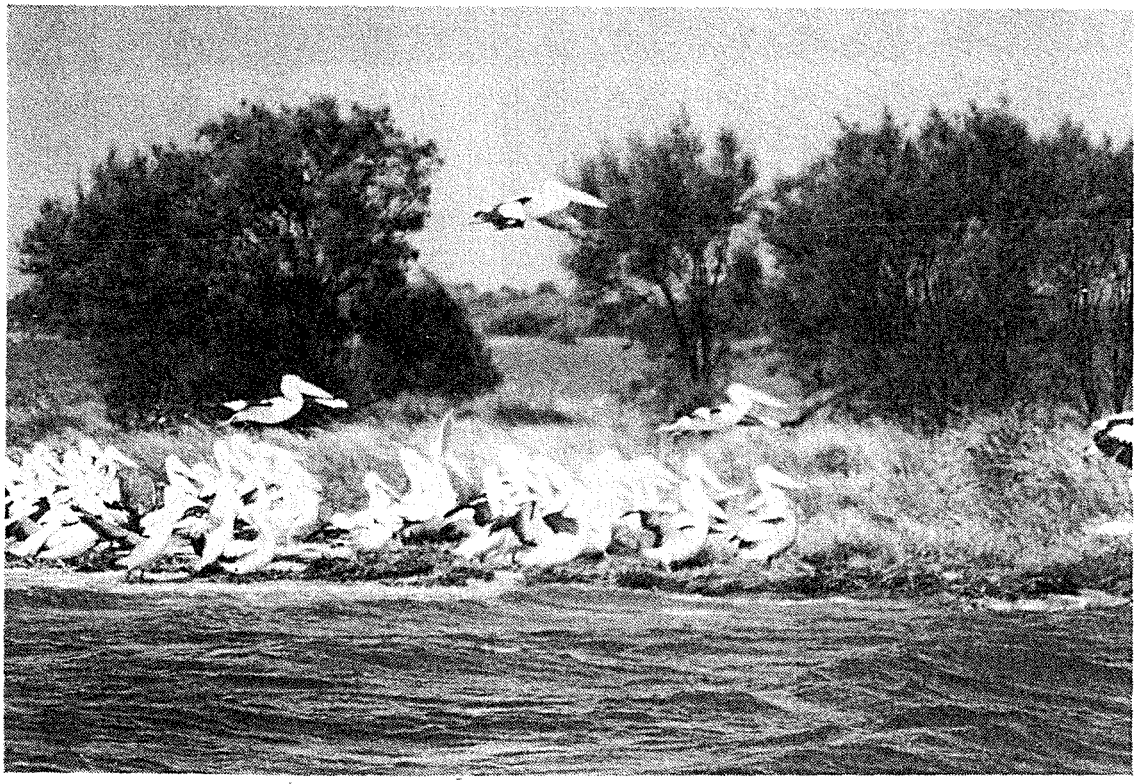
S32 Incorporate Vacant Crown Land into reserve 28349 to be managed by the City Of Mandurah for recreation and foreshore management purposes. (DOLA, CM)

S33 Undertake revegetation of reserve 28349 with *Melaleuca rhaphiophylla* and *M cuticularis*. Undertake weed control measures, particularly around the Estuary Place Boat Ramp. (CM, PIMA)

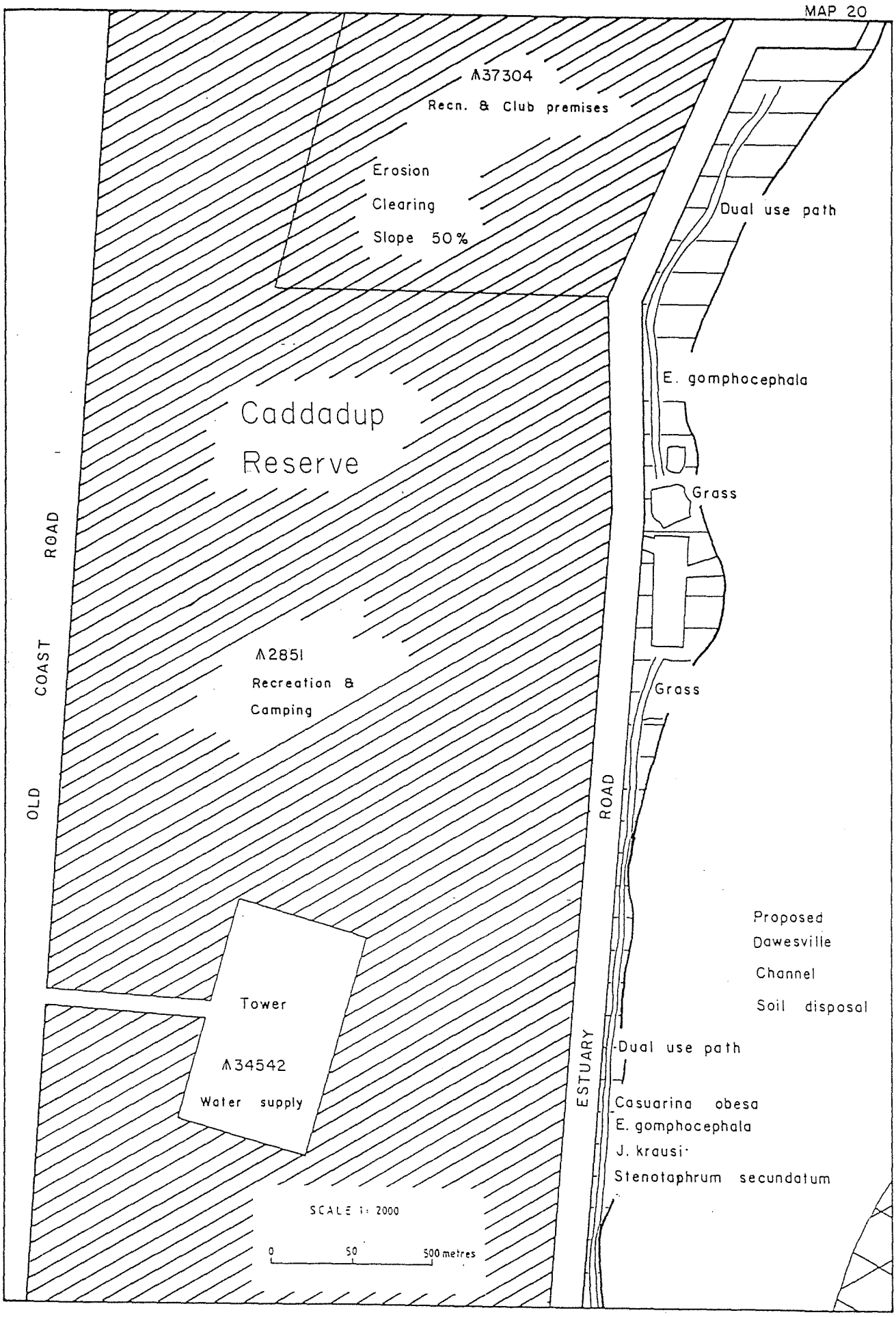

MAP 18
ESTUARY PLACE
Closed scrub
Jacksonia sternbergiana
J. furcellata 1·0–1·5m
Melaleuca rhaphiophylla
Acacia saligna
Weed understorey
Pennisetum clandestinum infestation
Limestone carpark / boatramp
S33
S32
Sandy beach
A28349
Recreation
Suaeda australis
Occasional Sarcocornia complex
Highly weed infested
Carpobrotus pedulis
Proposed
Dawesville
Spoil
PEEL
INLET
SCALE 1: 2000
0
50
500 metres

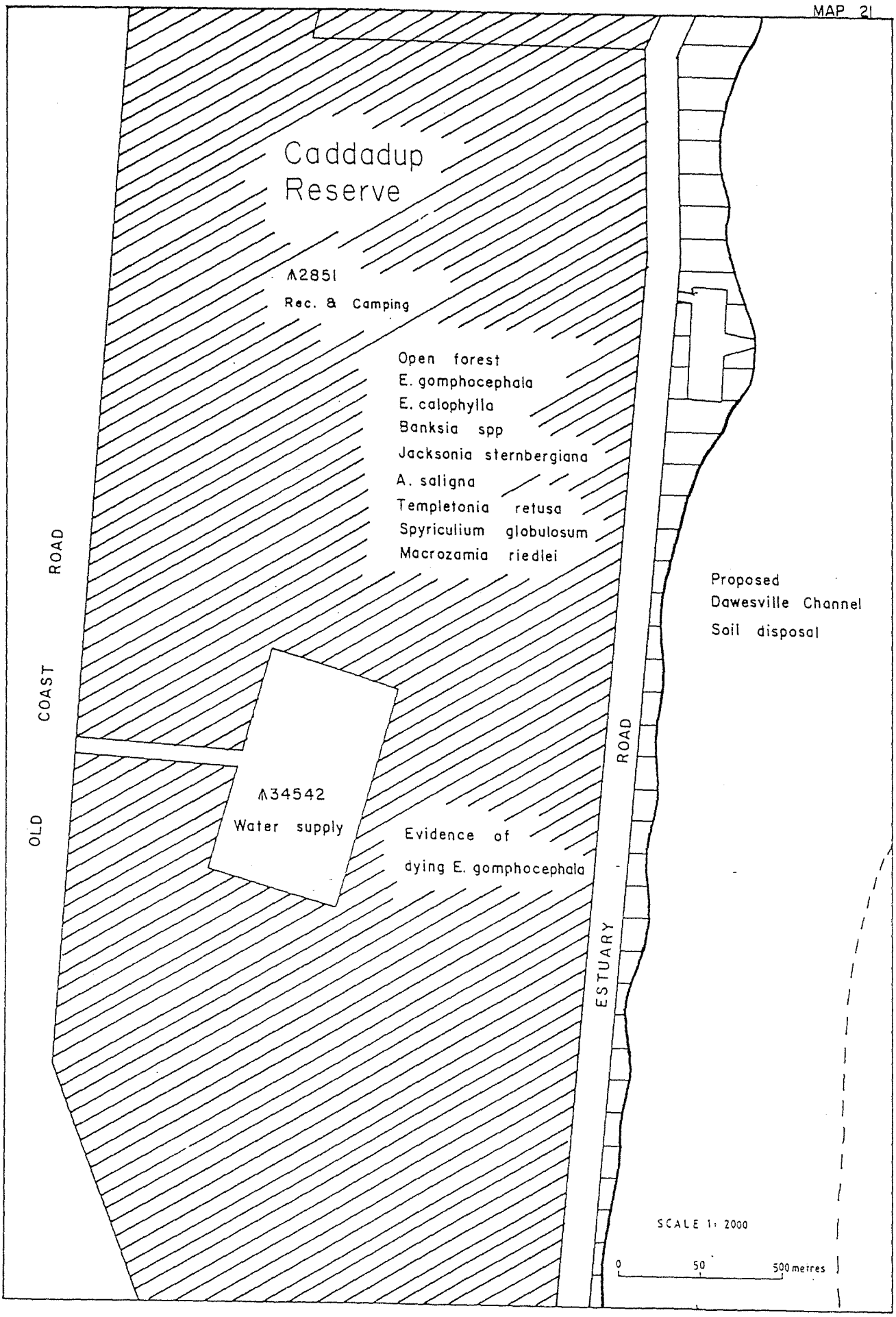
S34 Prepare a detailed landscape and development plan for all foreshore land which will be created during the construction of the Dawesville Channel. (DMH, CM, PIMA)

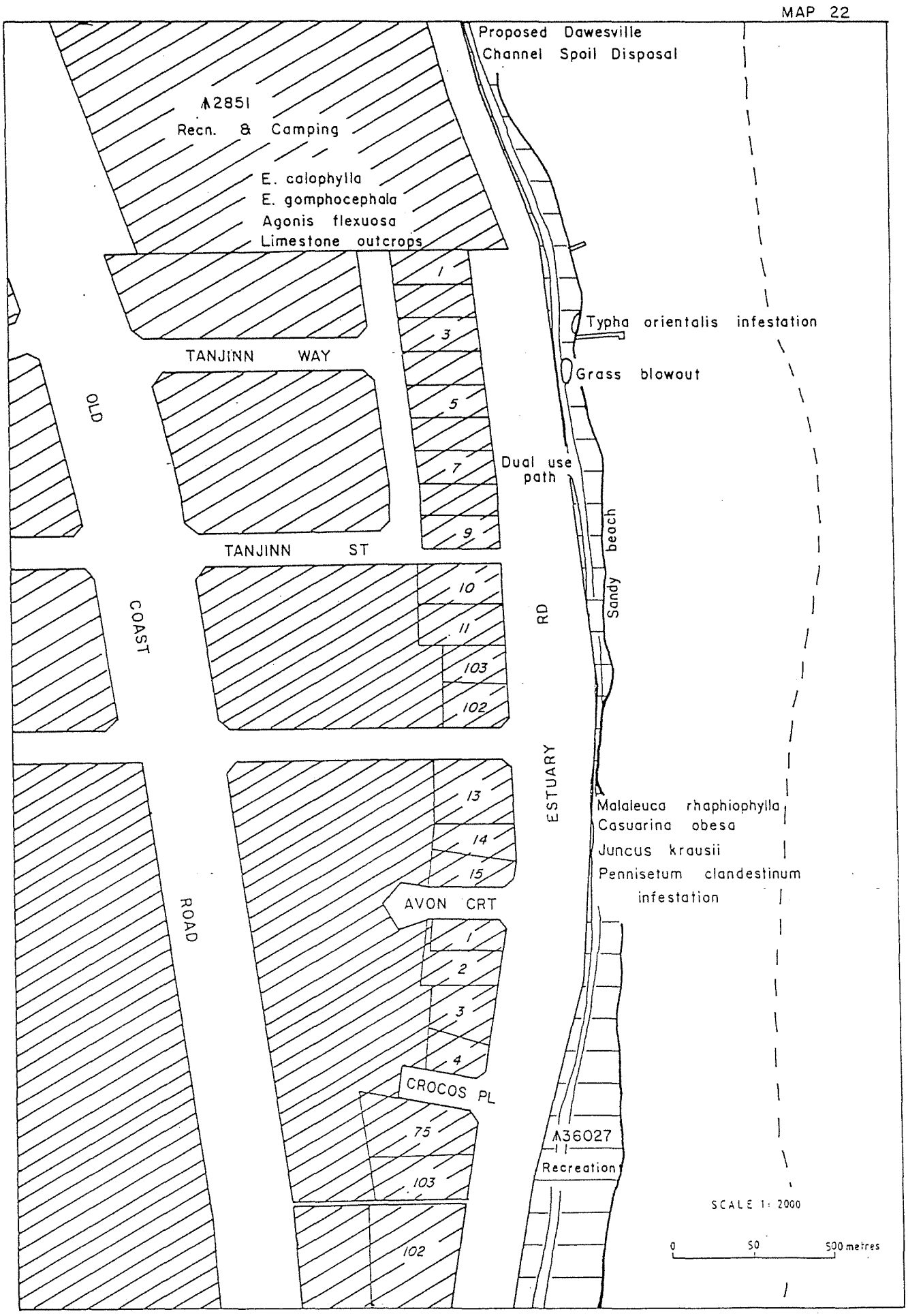

MAP 19
5
4
3
2
1
15
14
13
12
11
10
PARADE
QUEEN
Cleared
Acacia saligna
Jacksonia furcellata
Melaleuca rhaphiophylla
Scrub
E. gomphocephala
10 m
A. saligna
Banksia spp.
J. furcellata
Macrozamia riedlei
Xanthorrhoea spp.
Weed infestation
ROAD
Melaleuca spp.
Scrub
J. krausii
Proposed
Dawesville Channel
Soil Disposal
Cleared
Cleared
S34
ESTUARY
E. calophylla
PEEL
INLET
Proposed
Dawesville
Dredging
A34293
Rec'n
SCALE 1: 2000
0
50
500 metres

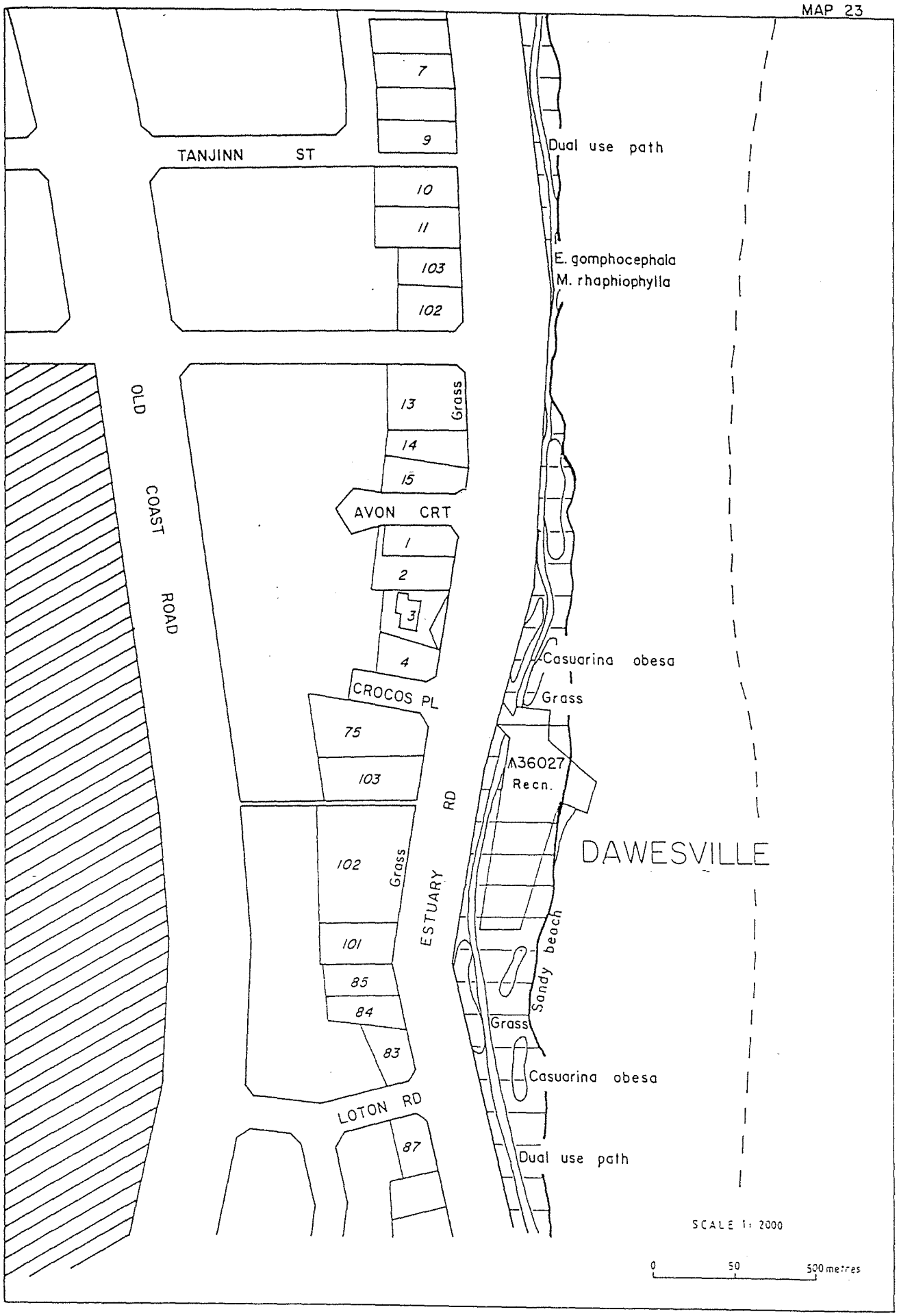


(Plate 10: Pelicans)
The Harvey Estuary is known to support the largest Pelican population of any estuary in south-western Australia.


MAP 20
M37304
Recn. & Club premises
Erosion
Clearing
Slope 50%
Dual use path
E. gomphocephala
Caddadup
Reserve
Grass
OLD COAST ROAD
M2851
Recreation &
Camping
Grass
ROAD
Proposed
Dawesville
Channel
Soil disposal
Tower
M34542
Water supply
ESTUARY
Dual use path
Casuarina obesa
E. gomphocephala
J. krausi
Stenotaphrum secundatum
SCALE 1: 2000
0
50
500 metres

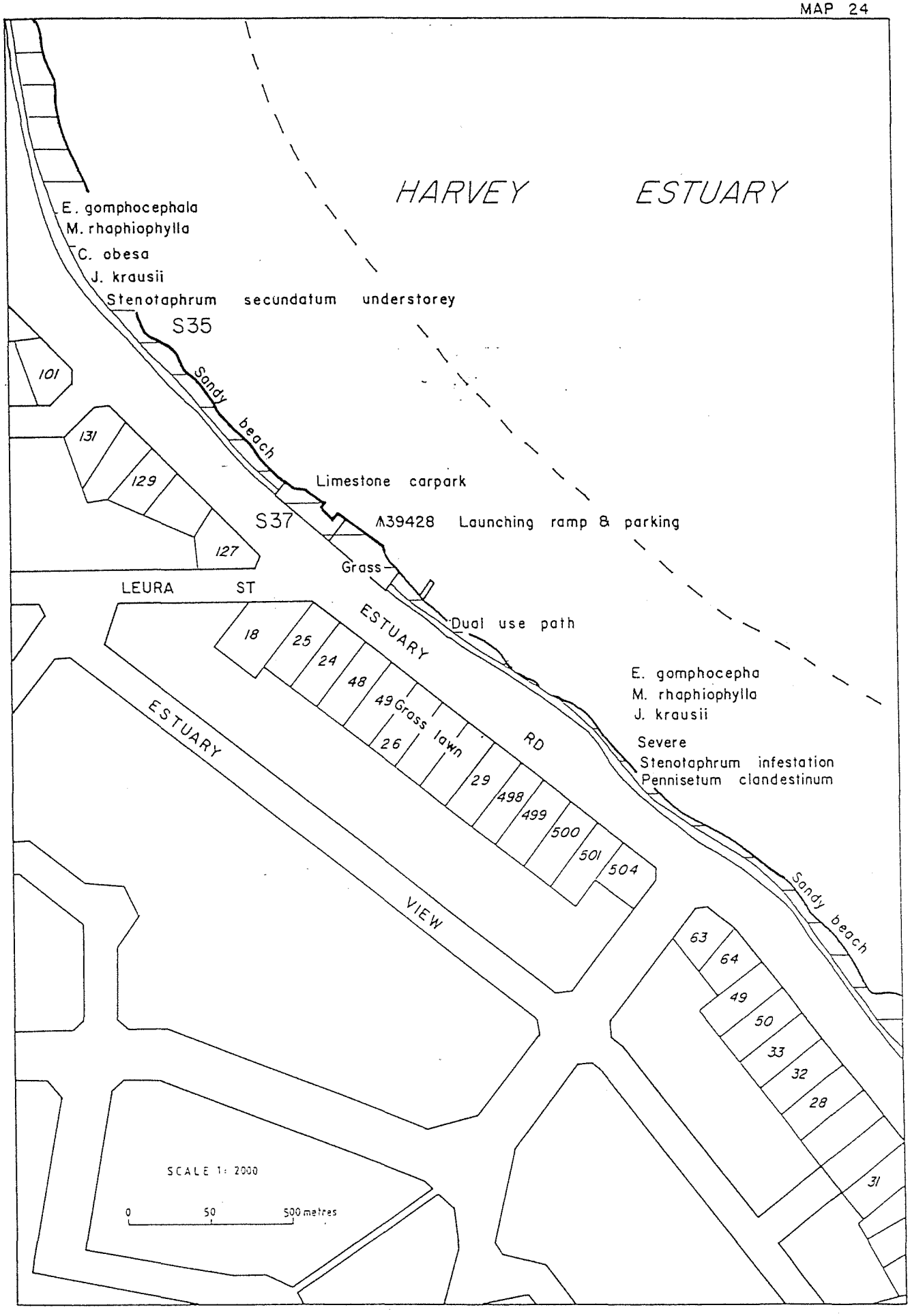

MAP 21
Caddadup Reserve
A2851
Rec. & Camping
Open forest
E. gomphocephala
E. calophylla
Banksia spp
Jacksonia sternbergiana
A. saligna
Templetonia retusa
Spyriculium globulosum
Macrozamia riedlei
Proposed
Dawesville Channel
Soil disposal
OLD COAST ROAD
A34542
Water supply
Evidence of
dying E. gomphocephala
ESTUARY ROAD
SCALE 1: 2000
0 50 500 metres


MAP 22
Proposed Dawesville
Channel Spoil Disposal
A2851
Recn. & Camping
E. calophylla
E. gomphocephala
Agonis flexuosa
Limestone outcrops
TANJINN WAY
TANJINN ST
OLD COAST ROAD
RD
Typha orientalis infestation
Grass blowout
Dual use path
Sandy beach
ESTUARY
Malaleuca rhaphiophylla
Casuarina obesa
Juncus krausii
Pennisetum clandestinum
infestation
AVON CRT
CROCOS PL
A36027
Recreation
1
3
5
7
9
10
11
103
102
13
14
15
1
2
3
4
75
103
102
SCALE 1: 2000
0
50
500 metres


MAP 23
TANJINN ST
7
9
10
11
103
102
Dual use path
E. gomphocephala
M. rhaphiophylla
OLD COAST ROAD
13
Grass
14
15
AVON CRT
1
2
3
4
CROCOS PL
75
103
Casuarina obesa
Grass
A36027
Recn.
ESTUARY RD
DAWESVILLE
102
Grass
101
85
84
83
Sandy beach
Grass
Casuarina obesa
LOTON RD
87
Dual use path
SCALE 1: 2000
0
50
500 metres

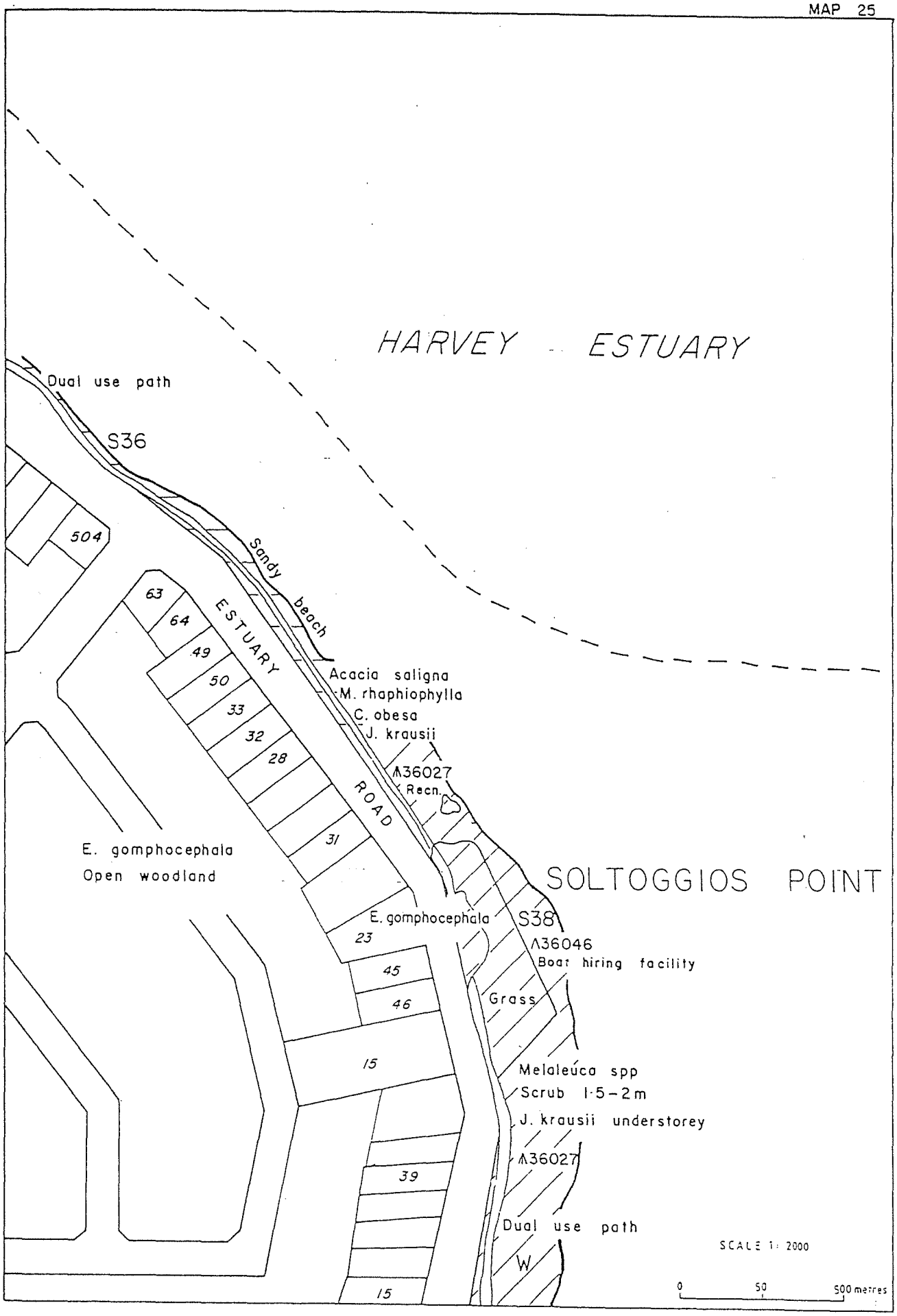
S35 Instigate discussions between PIMA, the City Of Mandurah, Marine And Harbours and boat owners to decide upon optimum number of soft launching sites to cater for short term demand. Gradually phase out privately used unauthorized launching sites and construct a public boating area specifically designed to cater for small yacht launchings, when funds become available. (PIMA, CM, DMH, Res)

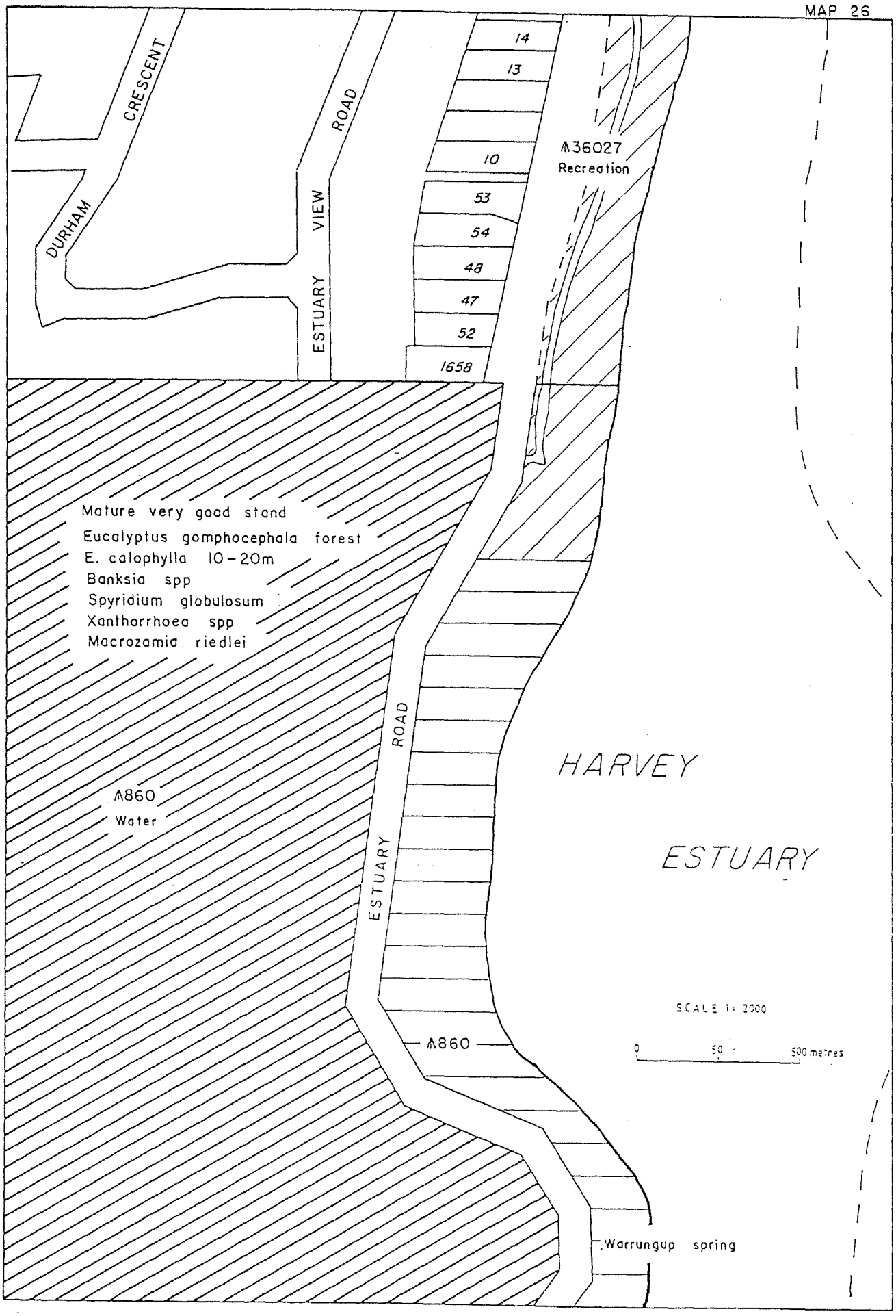
S37 Provide bins at professional launching ramp 1782 on reserve 39428. (CM)


HARVEY ESTUARY
E. gomphocephala
M. rhaphiophylla
C. obesa
J. krausii
Stenotaphrum secundatum understorey
S35
Sandy beach
101
131
129
127
Limestone carpark
S37
A39428 Launching ramp & parking
Grass
LEURA ST
Dual use path
ESTUARY
18
25
24
48
49
26
Gross lawn
RD
29
498
499
500
501
504
E. gomphocepha
M. rhaphiophylla
J. krausii
Severe
Stenotaphrum infestation
Pennisetum clandestinum
ESTUARY
VIEW
Sandy beach
63
64
49
50
33
32
28
31
SCALE 1: 2000
0
50
500 metres

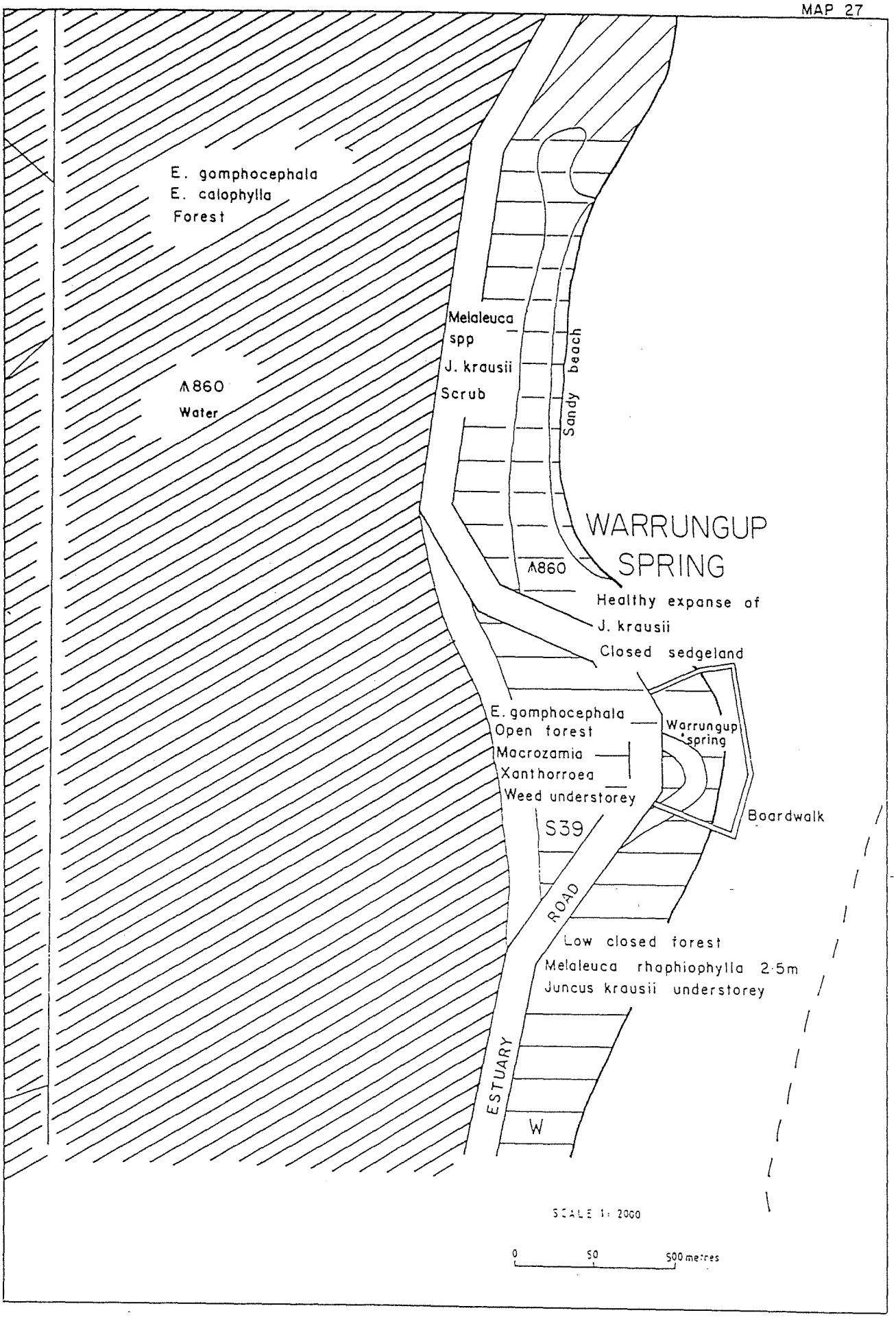
S36 Undertake enrichment planting of foreshore between Dawesville and Soltoggios Point (reserve 36027) using *Juncus krausii* understorey plus *Melaleuca rhaphiophylla* and *Casuarina obesa* as the dominant trees. (PIMA)

S38 Limit development on reserve 36027 to providing limited seating and increasing the number of bins. (CM)


MAP 25
HARVEY ESTUARY
Dual use path
S36
504
Sandy beach
63
64
49
50
33
32
28
31
ESTUARY
ROAD
Acacia saligna
M. rhaphiophylla
C. obesa
J. krausii
A36027
Recn.
E. gomphocephala
Open woodland
SOLTOGGIOS POINT
E. gomphocephala
S38
23
45
46
15
A36046
Boat hiring facility
Grass
Melaleúca spp
Scrub 1·5–2m
J. krausii understorey
A36027
39
15
Dual use path
W
SCALE 1: 2000
0
50
500 metres


MAP 26
CRESCENT
DURHAM
VIEW
ROAD
ESTUARY
14
13
10
53
54
48
47
52
1658
A36027
Recreation
Mature very good stand
Eucalyptus gomphocephala forest
E. calophylla 10-20m
Banksia spp
Spyridium globulosum
Xanthorrhoea spp
Macrozamia riedlei
A860
Water
ESTUARY
ROAD
HARVEY
ESTUARY
A860
SCALE 1: 2000
0
50
500 metres
Warrungup spring

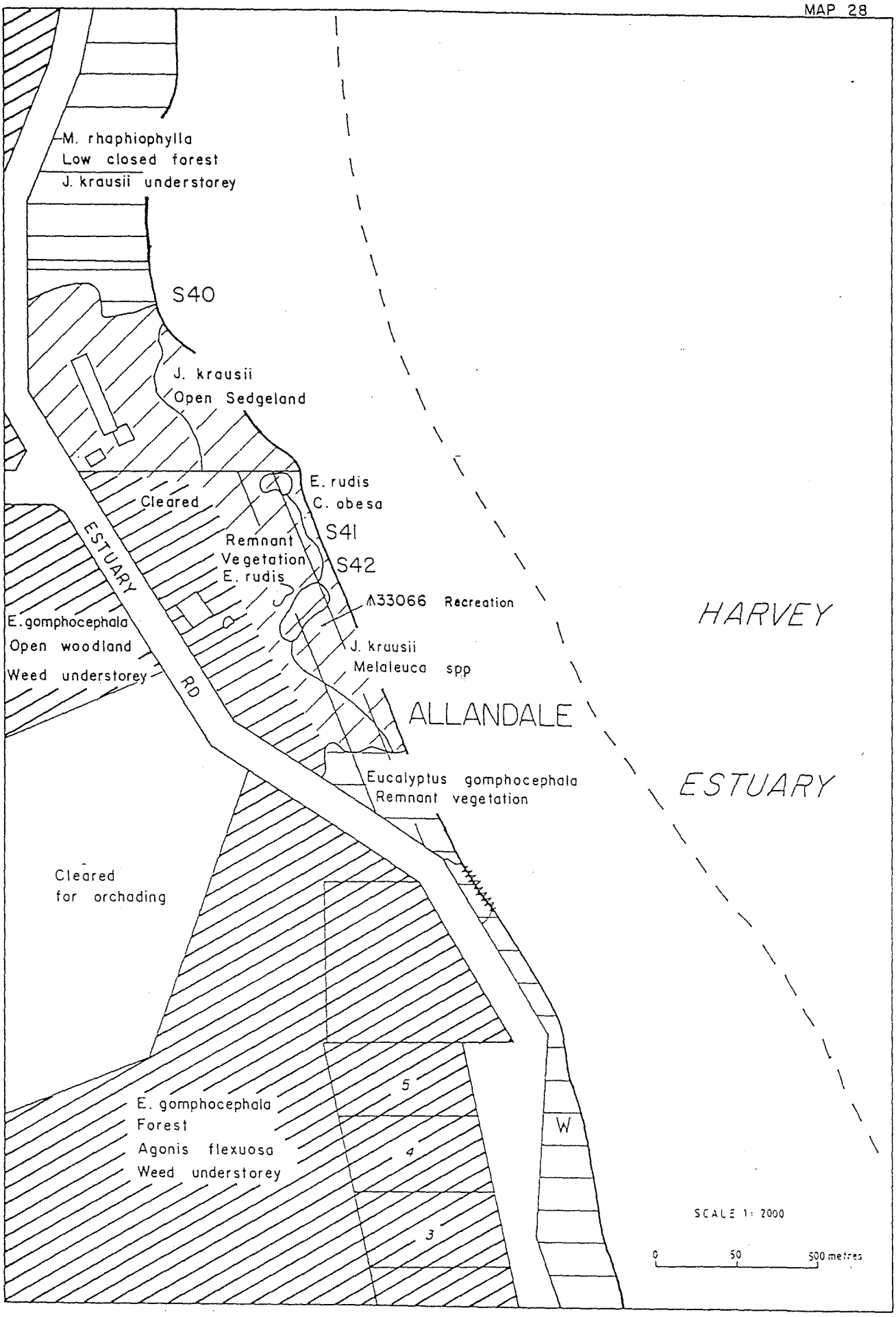
S39 Prepare a management plan for Warrangup Spring (reserve 860), to provide a focus for passive recreation activities by increasing seating, replacing present barbecues with a larger number of gas eqivalents and enhancing the educative value of the area. (CM, PIMA)


MAP 27
E. gomphocephala
E. calophylla
Forest
Melaleuca
spp
J. krausii
Scrub
Sandy beach
860
Water
WARRUNGUP
SPRING
860
Healthy expanse of
J. krausii
Closed sedgeland
E. gomphocephala
Open forest
Macrozamia
Xanthorroea
Weed understorey
Warrungup spring
Boardwalk
S39
ROAD
Low closed forest
Melaleuca rhaphiophylla 2·5m
Juncus krausii understorey
ESTUARY
W
SCALE 1: 2000
0
50
500 metres

S40 Acquire foreshore reserve of 50 metres as a condition of subdivision and vest in the City Of Mandurah.(DOLA, DPUD, Dev, CM)

S41 Incorporate acquired foreshore abutting Lot 2 and Vacant Crown Land east of Allandale into reserve 33066 and vest in the City Of Mandurah for recreation and foreshore management purposes. (DOLA, CM, PIMA)

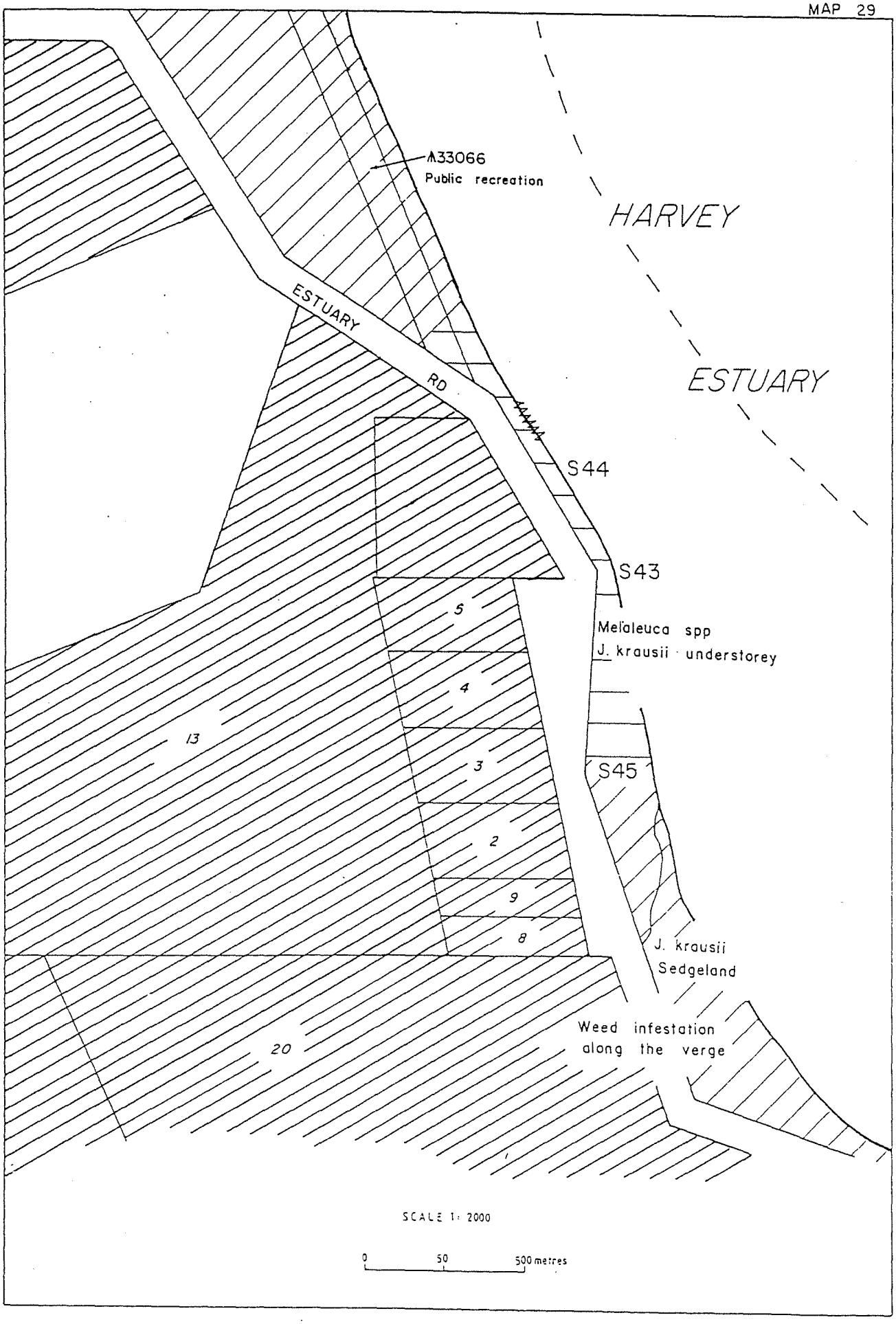
S42 Conduct enrichment planting and revegetation of acquired Lot 2 foreshore plus that of amalgamated Vacant Crown Land and reserve 33066. Enhance environment by planting species such as Juncus krausii and Melaleuca rhaphiophylla along the estuary periphery. Establish seedlings of Flooded Gum (*Eucalyptus rudis*) and *Casuarina obesa* between 10 and 50 metres inland. Remove weeds and landscape appropriately. (CM, PIMA)

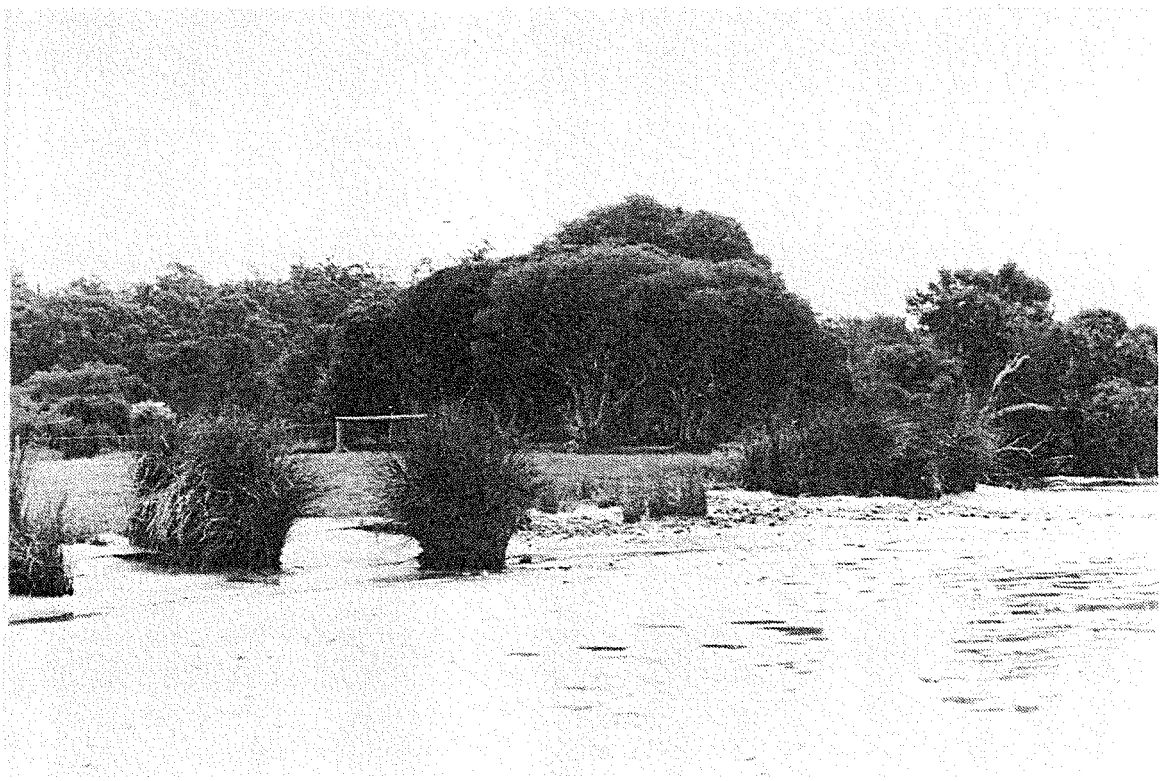

MAP 28
M. rhaphiophylla
Low closed forest
J. krausii understorey
S40
J. krausii
Open Sedgeland
E. rudis
C. obesa
Cleared
S41
S42
Remnant
Vegetation
E. rudis
A33066 Recreation
HARVEY
ESTUARY
RD
E. gomphocephala
Open woodland
Weed understorey
J. krausii
Melaleuca spp
ALLANDALE
Eucalyptus gomphocephala
Remnant vegetation
ESTUARY
Cleared
for orchading
E. gomphocephala
Forest
Agonis flexuosa
Weed understorey
5
4
3
W
SCALE 1: 2000
0
50
500 metres

S43 Vest Vacant Crown Land south of Allandale through to Park Ridge in the Waterways Commission for foreshore management purposes. (DOLA, WWC, PIMA)

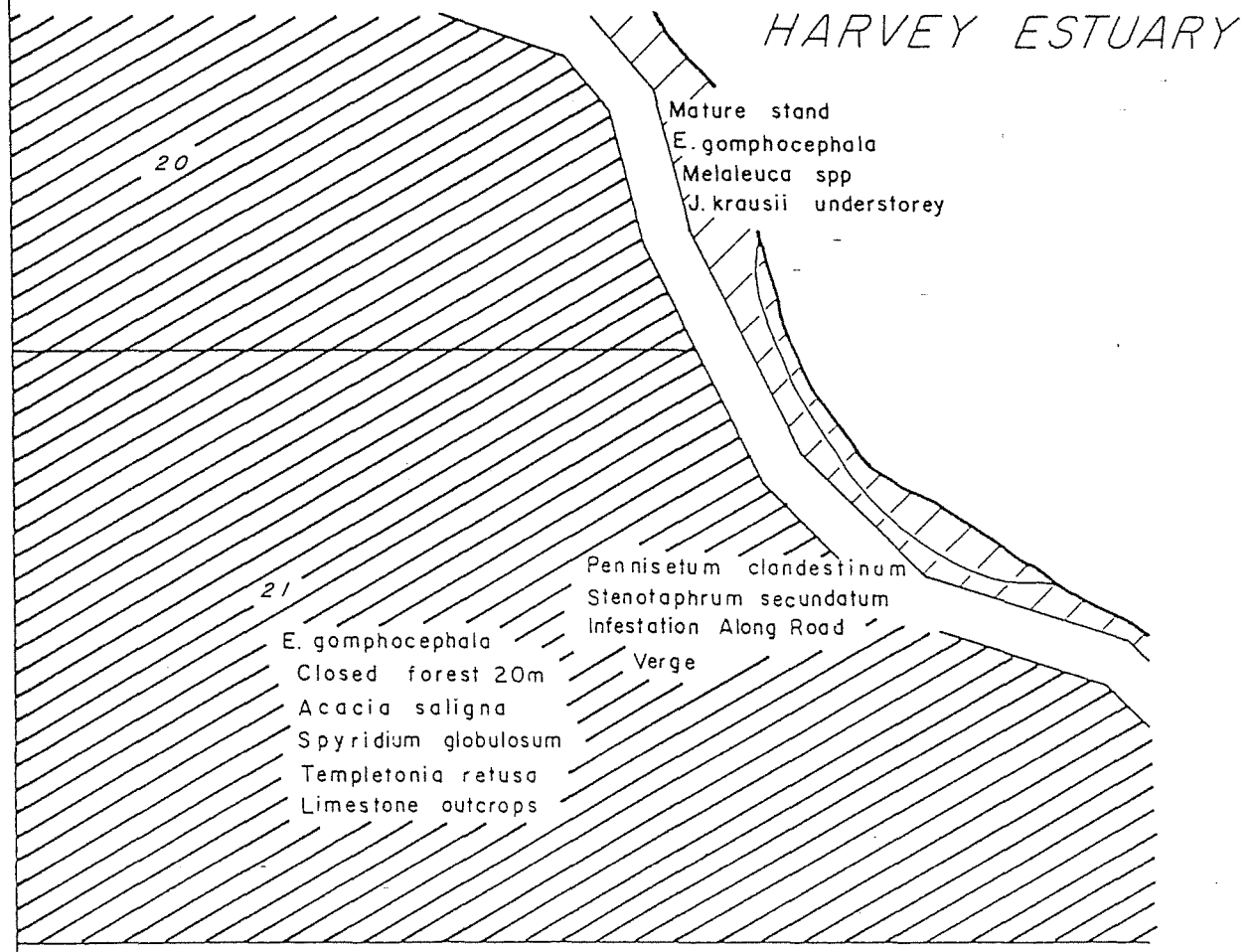
S44 Extend stone walling of present Vacant Crown Land south of Allandale, to consolidate the estuary's bank and prevent further undercutting of Estuary Road. Develop weed control programme and repair eroded foundations of trees. (PIMA, CM)

S45 Extend dual use path from reserve 33066 to Park Ridge (reserve 36707) but limit public access to the foreshore from the path between the nodes of recreation. Path to be constructed so as to minimise vegetation loss. (CM)


A33066
Public recreation
HARVEY
ESTUARY
ESTUARY RD
S44
S43
Melaleuca spp
J. krausii understorey
S45
J. krausii
Sedgeland
Weed infestation
along the verge
5
4
13
3
2
9
8
20
SCALE 1: 2000
0
50
500 metres



(Plate 11: Cleared Foreshore Vegetation)
Revegetation of unauthorized clearing of peripheral vegetation is aprimary management consideration.

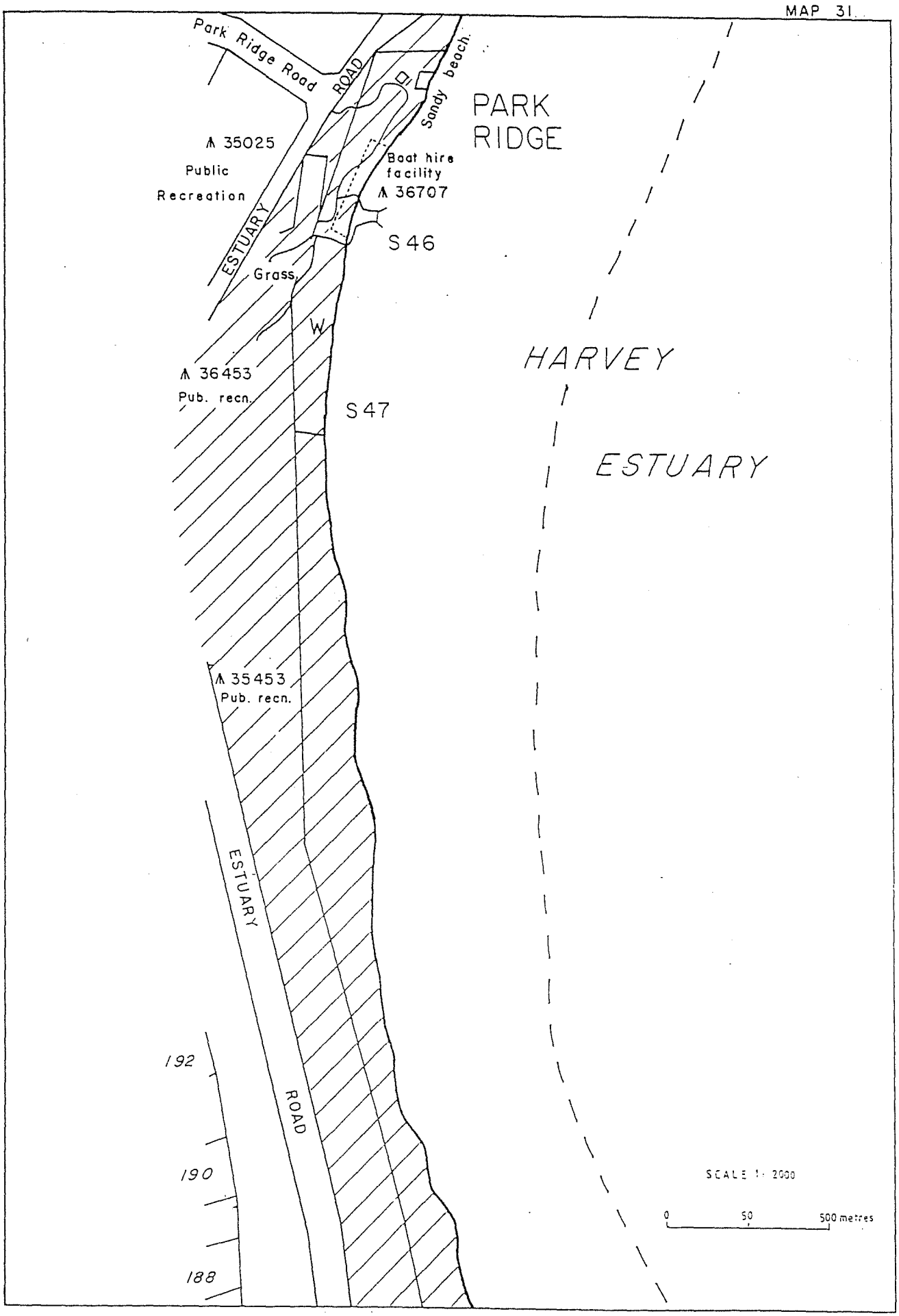


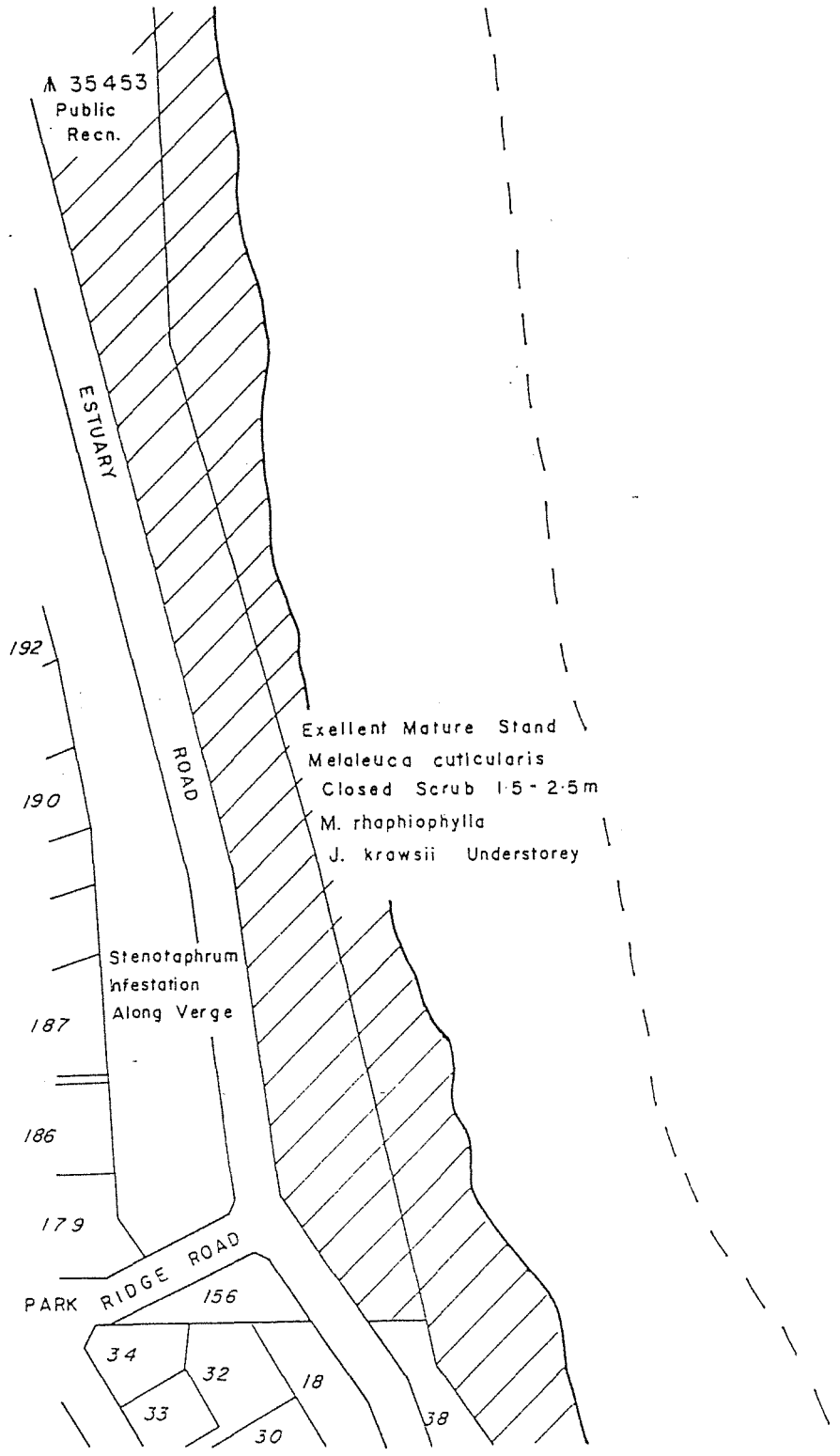
SCALE 1: 2000

0 50 500 metres

S46 Consolidate reserve 36707 by amalgamating the adjoining part of 36453 and vest in the City Of Mandurah for recreation and foreshore management purposes. (DOLA, CM)

S47 Amalgamate Vacant Crown Land south of reserve 36707 and adjacent part of reserve 36453 and incorporate into reserve 34177. Vest in the Waterways Commission for foreshore management and recreation purposes. Restrict public access to the excellent stands of paperbark and sedge understorey.(DOLA, WWC, PIMA)

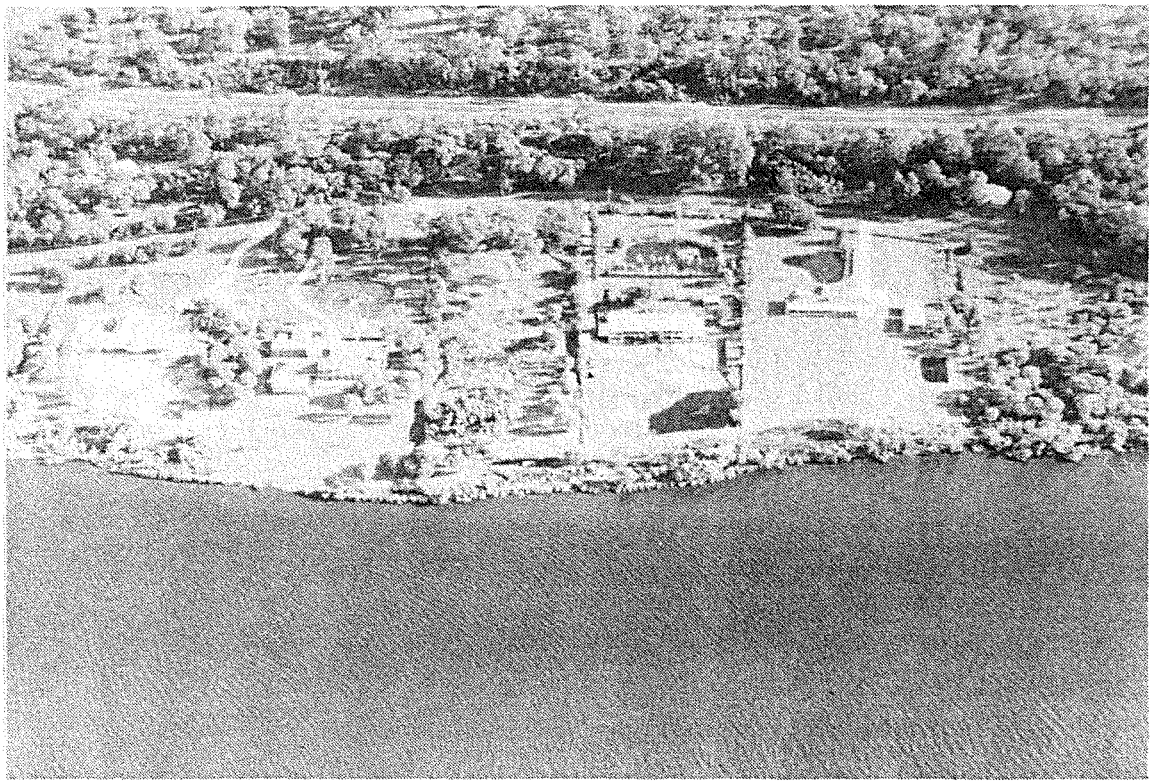

MAP 31
Park Ridge Road
ROAD
Sandy beach
PARK RIDGE
35025
Public Recreation
Boat hire facility
36707
ESTUARY
S46
Grass
W
36453
Pub. recn.
S47
HARVEY
ESTUARY
35453
Pub. recn.
ESTUARY
ROAD
192
190
188
SCALE 1: 2000
0
50
500 metres



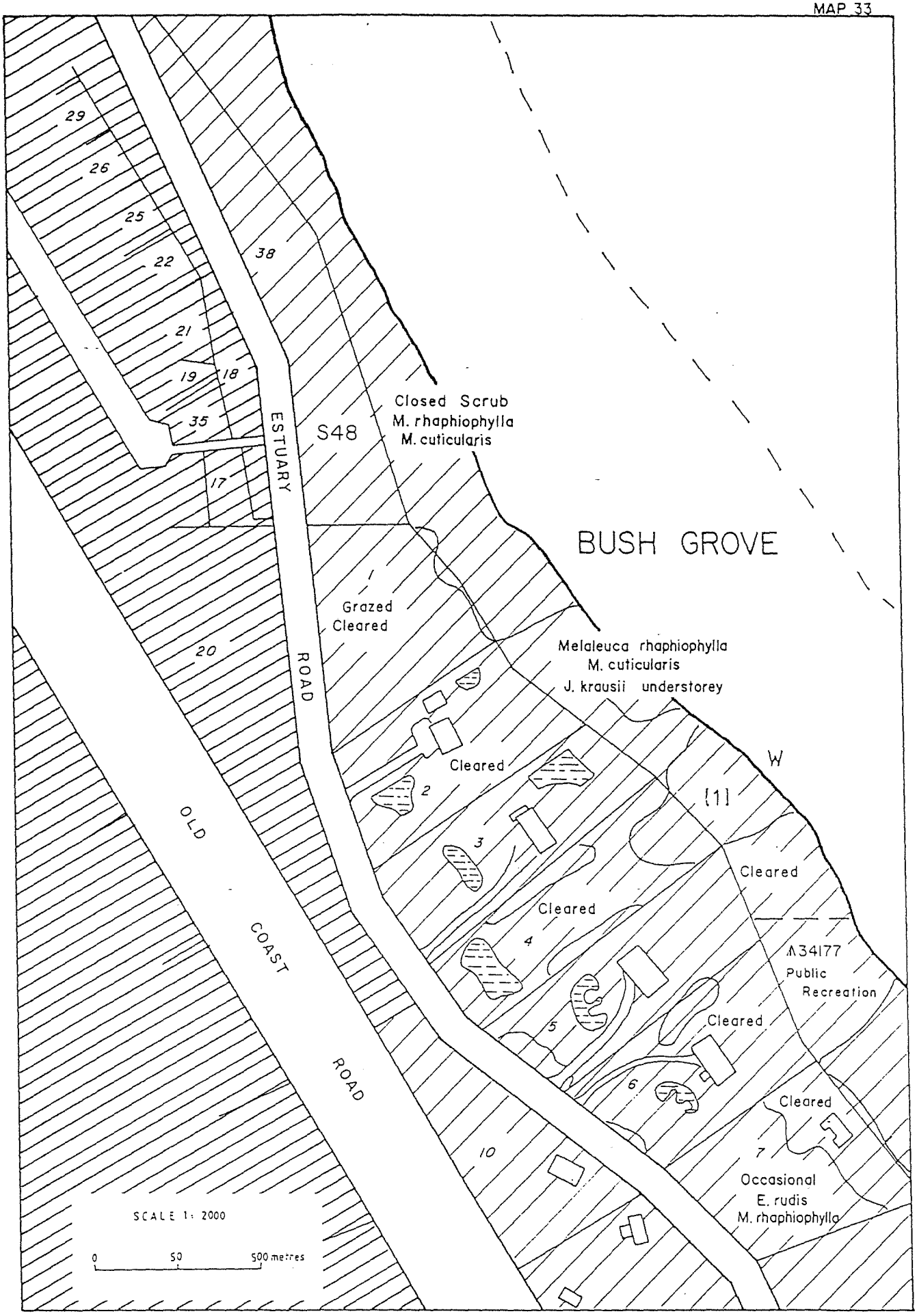
SCALE 1: 2000

0 50 500 metres

S48 Investigate aquisition of Lot 38 by the Crown. Incorporate Lot 38 into the expanded reserve 34177. (DPUD, DOLA, WWC, PIMA)



(Plate 12: Bush Grove)
Clearing of foreshore reserves reduces habitat, promotes erosion and creates a visual alienation of the foreshore.

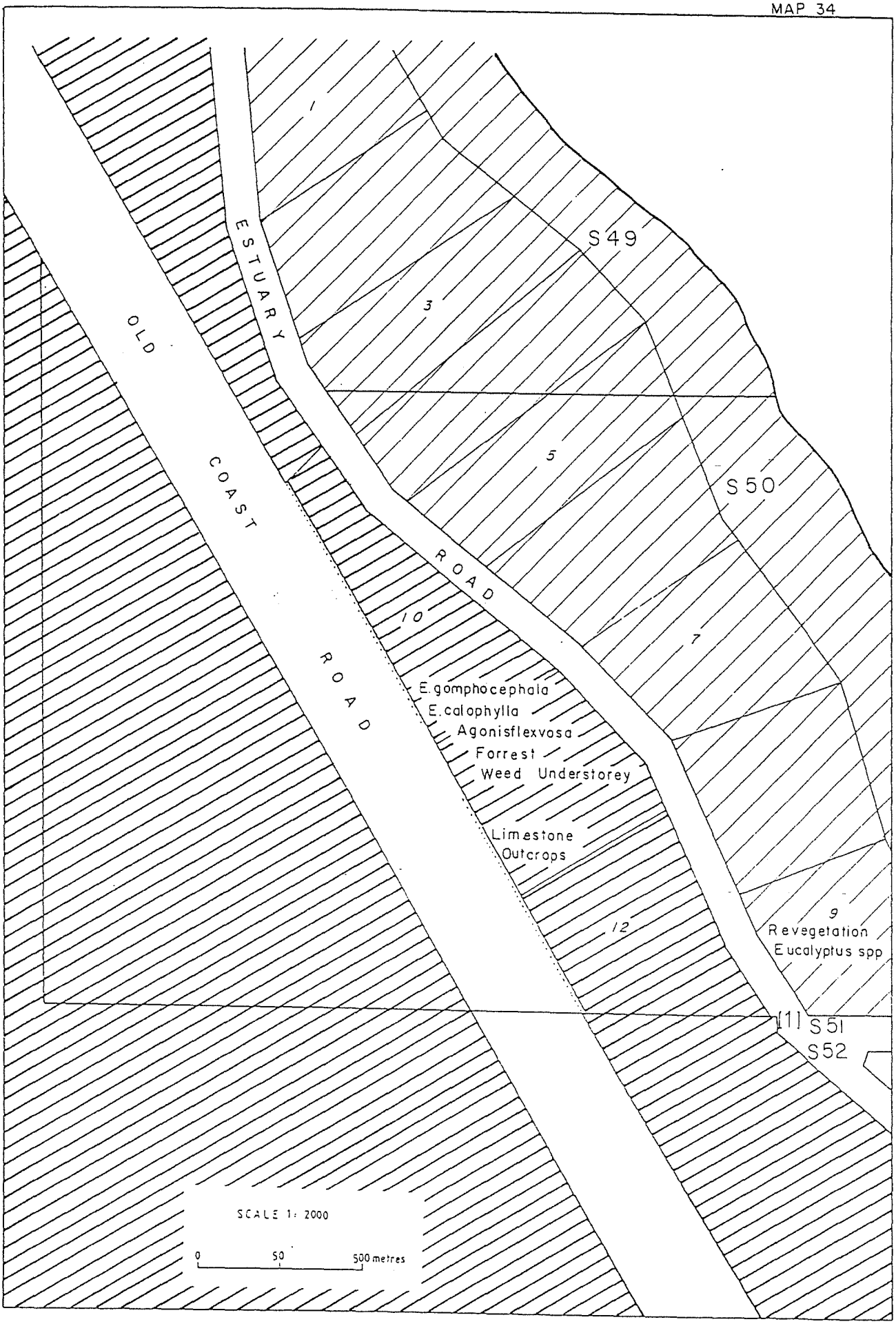

29
26
25
22
21
19
18
35
17
38
20
ESTUARY ROAD
S48
Closed Scrub
M. rhaphiophylla
M. cuticularis
BUSH GROVE
Grazed
Cleared
Melaleuca rhaphiophylla
M. cuticularis
J. krausii understorey
Cleared
2
3
4
5
6
7
10
W
[1]
Cleared
Cleared
A34177
Public
Recreation
Cleared
Cleared
Occasional
E. rudis
M. rhaphiophylla
OLD COAST ROAD
SCALE 1: 2000
0
50
500 metres

S49 Define precise boundary beween private and public land of Lots 1 to 9 of locations 40 and 41 and the adjacent Vacant Crown Land by contracting a licenced survey for the area. (PIMA) [1]

S50 Convene discussions between PIMA and the residents of Bush Grove (Lots 1 - 9 of Loc 40 & 41) to advise owners of benefits of retaining natural foreshore vegetation. Discuss possibility of developing a lease agreement between the Waterways Commission and the pivate land owners. (PIMA, WWC, Res)

S51 Define the precise location and boundaries of the road reserve positioned between Lot 8 and Lot 9 adjacent to reserve 34177 by contracting a licenced survey for the area. (PIMA) [1]

S52 Provide access along existing road reserve south of Lot 9 to facilitate a link from Estuary Road to the foreshore to enhance the recreational potential of the area. (CM, PIMA)

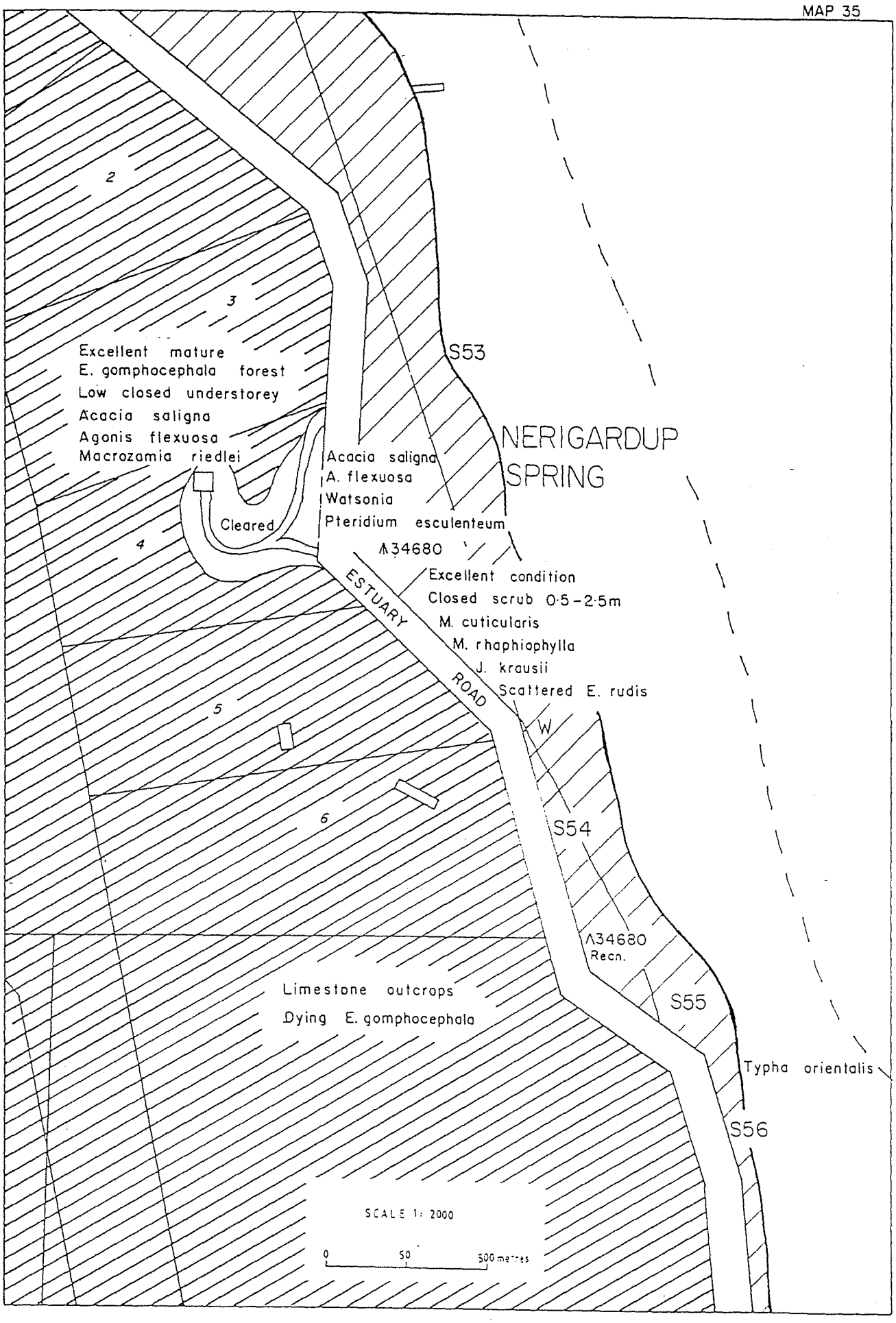

MAP 34
ESTUARY
OLD
COAST
ROAD
ROAD
S49
S50
S51
S52
3
5
7
9
10
12
E.gomphocephala
E.calophylla
Agonisflexvosa
Forrest
Weed Understorey
Limestone
Outcrops
Revegetation
Eucalyptus spp
SCALE 1: 2000
0
50
500 metres

S53 Incorporate Vacant Crown Land (south of road reserve) into reserve 34680 and vest in the City Of Mandurah for recreation and foreshore management purposes. (DOLA, CM, WWC, PIMA)

S54 Create limestone double bay carpark on southern part of Nerigardup Spring (reserve 34680) in presently heavily weed infested area. Construct a walkway, viewing platform, associated seating and enhance educational valu e of the area. (CM, PIMA)

S55 Conduct enrichment planting of proposed lookout area with *Juncus krausii, Melaleuca rhaphiophylla* and *M cuticularis*. (CM, PIMA)

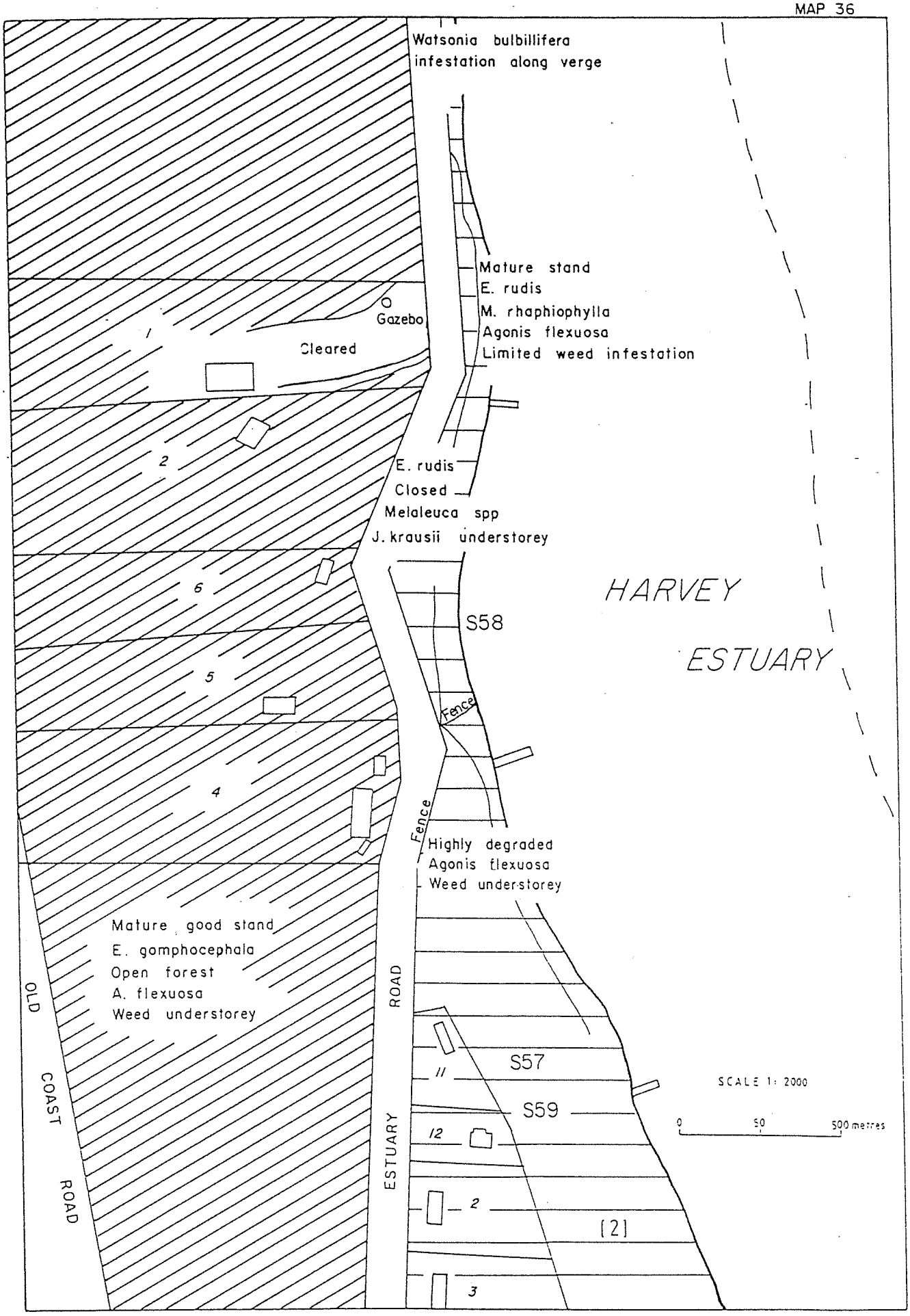
S56 Plan dual use pathway by pegging a 2 metre wide track leading south of Nerigardup Spring. Path to be constructed when funds become available and to be created in a manner which minimizes loss of vegetation. (CM)


MAP 35
2
3
Excellent mature
E. gomphocephala forest
Low closed understorey
Acacia saligna
Agonis flexuosa
Macrozamia riedlei
S53
NERIGARDUP
SPRING
Acacia saligna
A. flexuosa
Watsonia
Pteridium esculenteum
Cleared
4
A34680
Excellent condition
Closed scrub 0·5-2·5m
M. cuticularis
M. rhaphiophylla
J. krausii
Scattered E. rudis
ESTUARY
ROAD
5
W
6
S54
A34680
Recn.
S55
Limestone outcrops
Dying E. gomphocephala
Typha orientalis
S56
SCALE 1: 2000
0
50
500 metres

S57 Define precise boundary between private and public land of Lots 11, 12, 2, 3, 4, 5, 6, 7, 8, 9 and 10 and the adjacent Vacant Crown Land by contracting a licenced survey for the area. (PIMA) [2]

S58 Vest Vacant Crown Land south of Nerigardup Spring (reserve 34680) in the Waterways Commission for the purpose of foreshore management. (DOLA, WWC, PIMA)

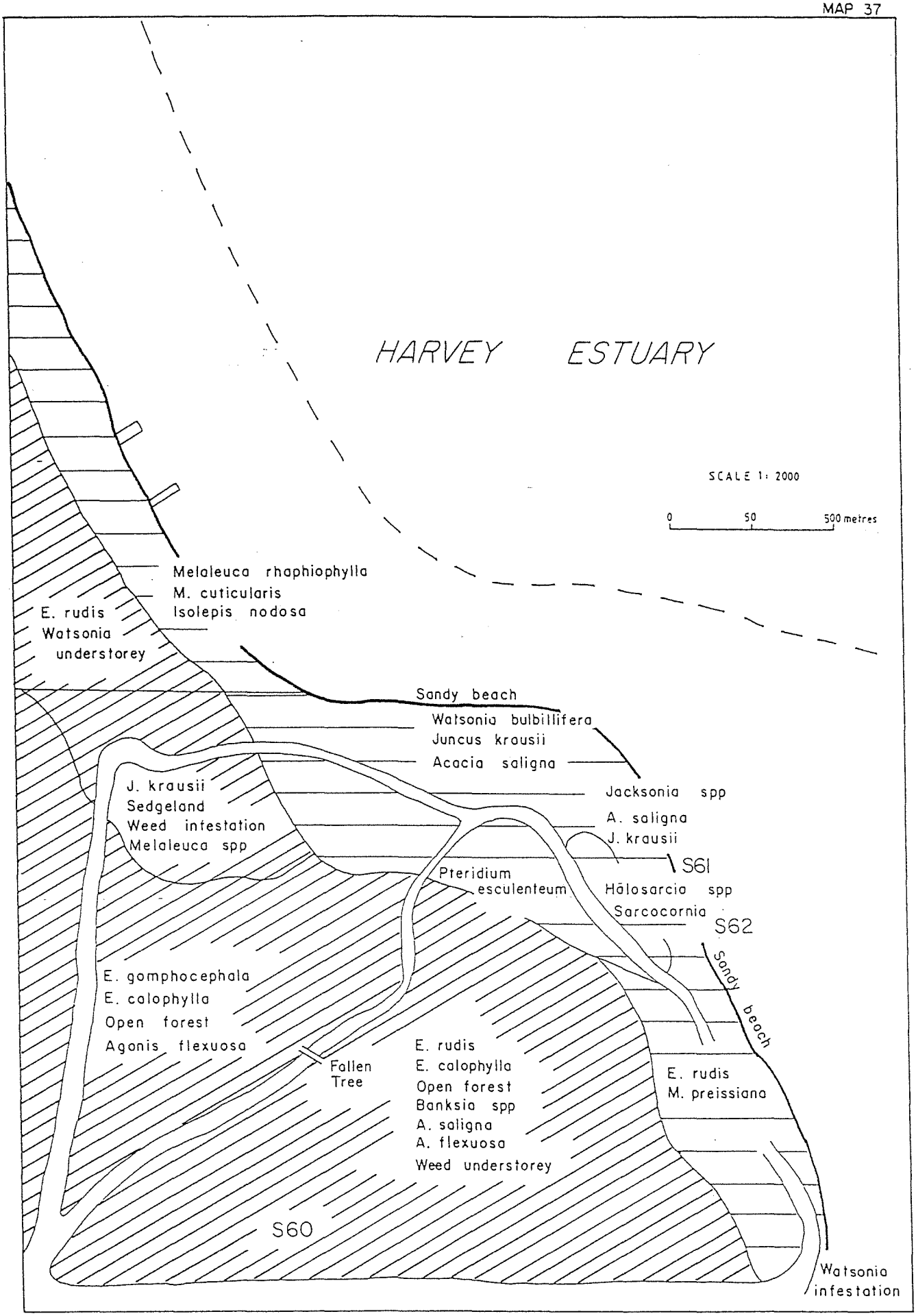
S59 Convene discussions between PIMA and the residents of Lots 11, 12, 2, 3, 4, 5, 6, 7, 8, 9 and10 to advise owners of benefits of retaining natural foreshore vegetation. Discuss possibility of developing a lease agreement between the Waterways Commission and the private land owners. (PIMA, WWC,Res)

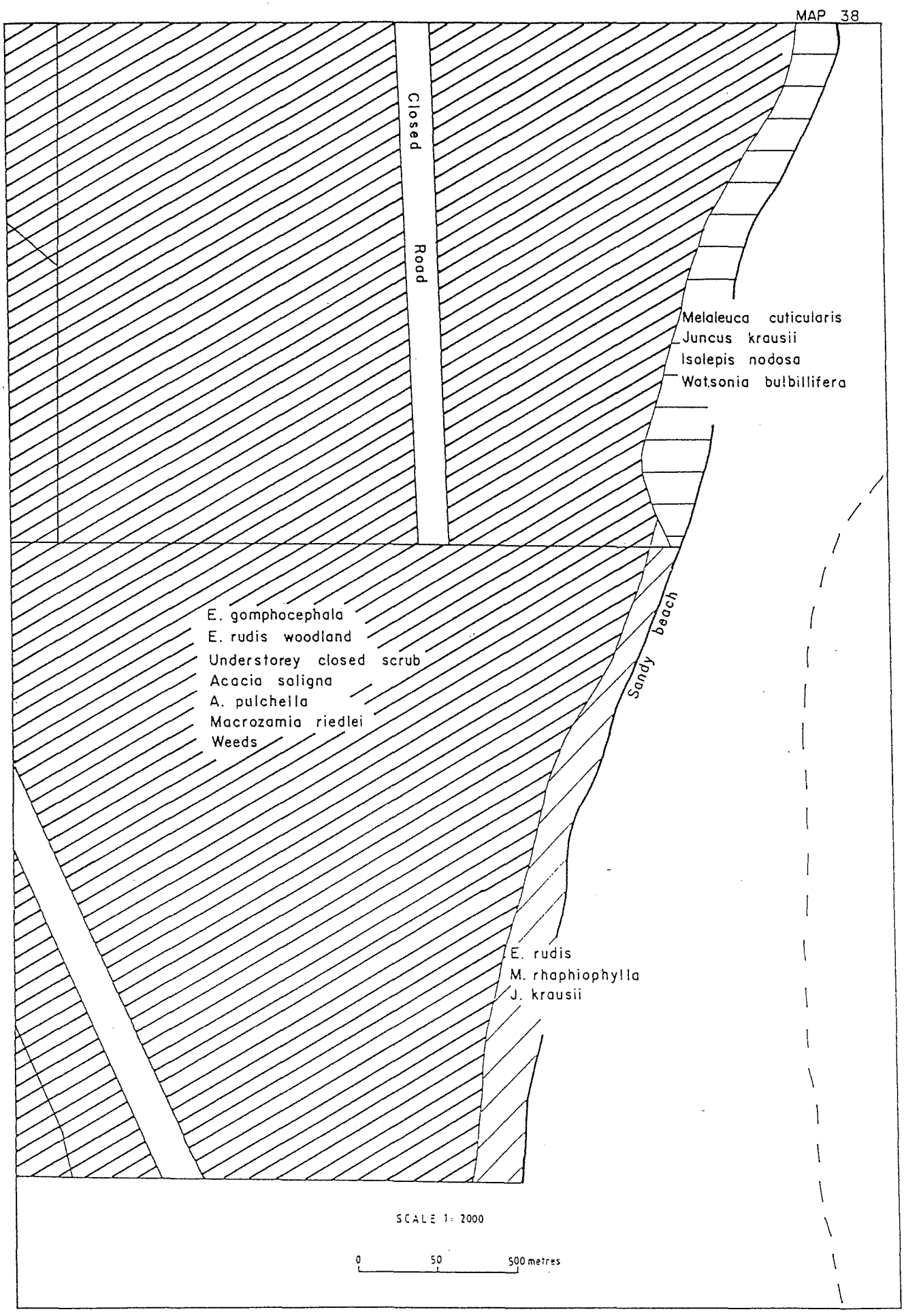

Watsonia bulbillifera
infestation along verge
Mature stand
E. rudis
M. rhaphiophylla
Agonis flexuosa
Limited weed infestation
Gazebo
Cleared
1
2
E. rudis
Closed
Melaleuca spp
J. krausii understorey
6
5
4
S58
HARVEY
ESTUARY
Fence
Fence
Highly degraded
Agonis flexuosa
Weed understorey
Mature good stand
E. gomphocephala
Open forest
A. flexuosa
Weed understorey
OLD COAST ROAD
ROAD
ESTUARY
11
S57
S59
12
2
[2]
3
SCALE 1: 2000
0
50
500 metres

S60 Acquire foreshore reserve in accordance with Waterways Commission policy as a condition of subdivision of Locations 69,73,74 and 39. Incorporate into adjoining reserve recommended in A57. Vest in the WWC for foreshore management purposes. (DOLA, DPUD, WWC, PIMA)

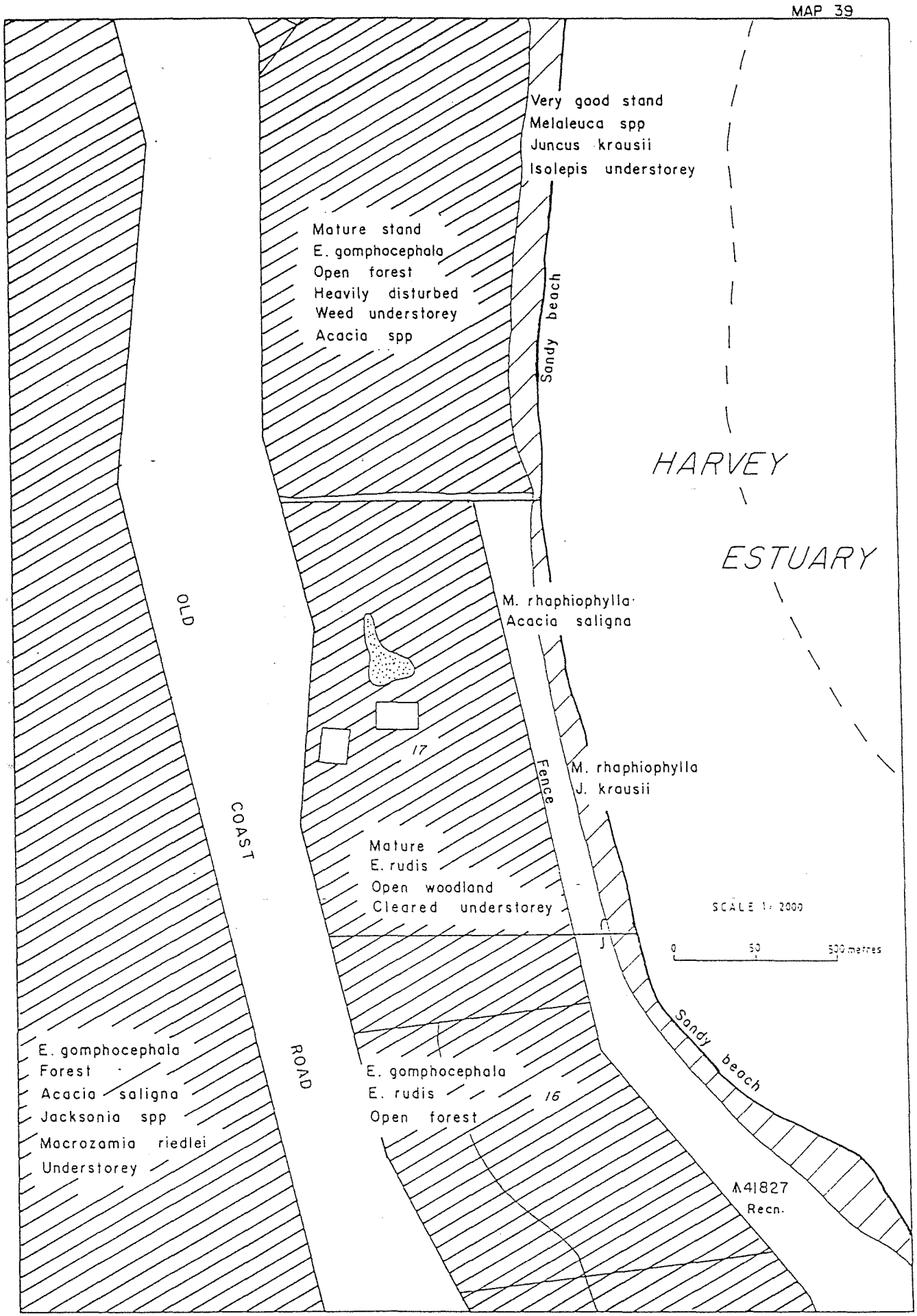
S61 Restrict access to the samphire marsh in the north east of Lot 69. Undertake litter and weed removal and allow area to regenerate subject to long term management objectives for the area being developed. (WWC, PIMA)

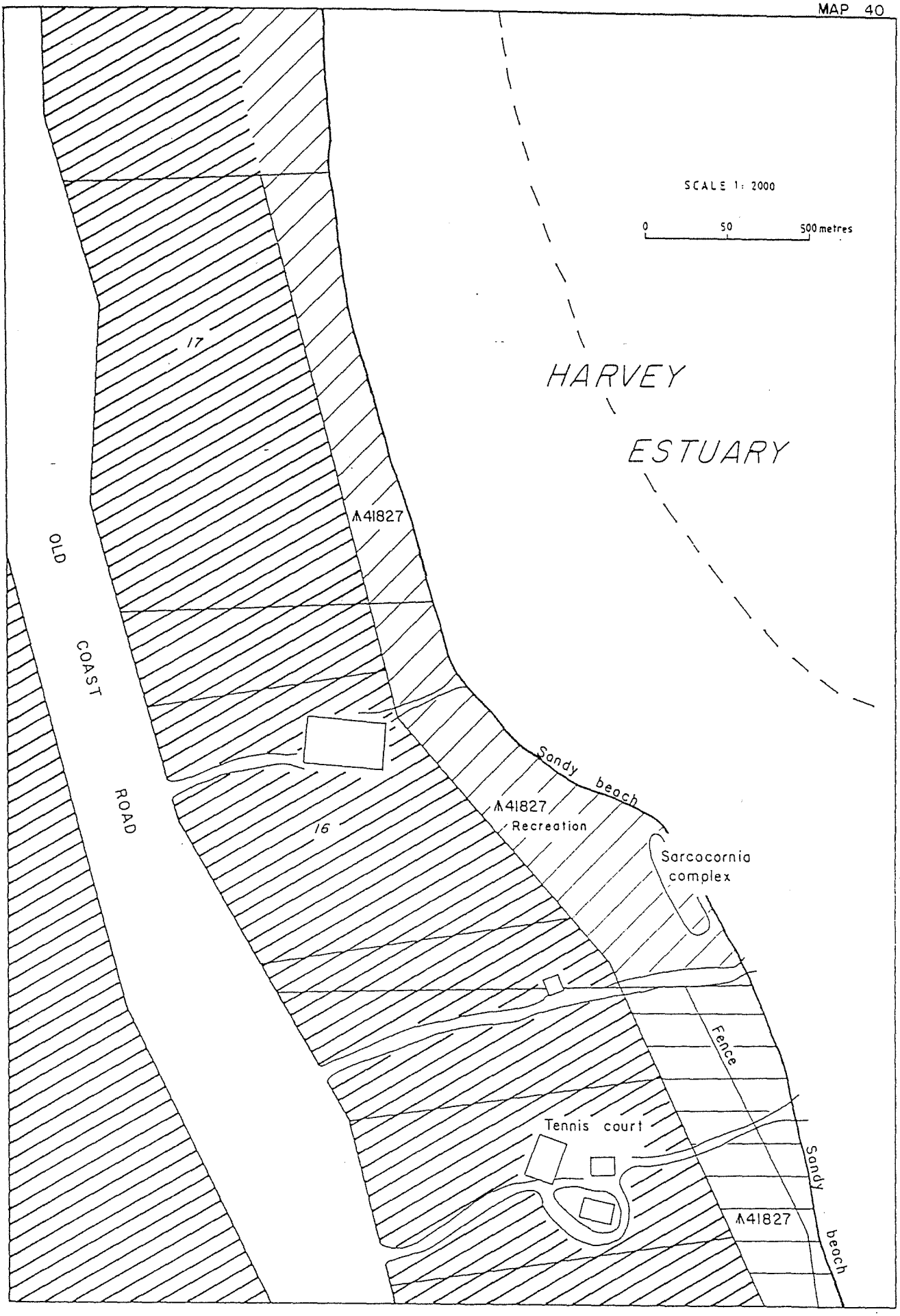
S62 Rehabilitate surrounding vegetation with *Juncus krausii, Isolepis nodosa, Melaleuca rhaphiophylla, M preissiana* and *Eucalyptus rudis* on the estuary's periphery. (PIMA)


HARVEY ESTUARY
SCALE 1: 2000
0 50 500 metres
Melaleuca rhaphiophylla
M. cuticularis
Isolepis nodosa
E. rudis
Watsonia
understorey
Sandy beach
Watsonia bulbillifera
Juncus krausii
Acacia saligna
Jacksonia spp
A. saligna
J. krausii
S61
J. krausii
Sedgeland
Weed infestation
Melaleuca spp
Pteridium
esculenteum
Hālosarcia spp
Sarcocornia
S62
Sandy beach
E. gomphocephala
E. calophylla
Open forest
Agonis flexuosa
Fallen
Tree
E. rudis
E. calophylla
Open forest
Banksia spp
A. saligna
A. flexuosa
Weed understorey
E. rudis
M. preissiana
S60
Watsonia
infestation


MAP 38
Closed Road
Melaleuca cuticularis
Juncus krausii
Isolepis nodosa
Watsonia bulbillifera
E. gomphocephala
E. rudis woodland
Understorey closed scrub
Acacia saligna
A. pulchella
Macrozamia riedlei
Weeds
Sandy beach
E. rudis
M. rhaphiophylla
J. krausii
SCALE 1: 2000
0
50
500 metres

(Plate 13: Grazed Land)
The Management Plan seeks to provide a balance between land use and foreshore protection.


MAP 39
Very good stand
Melaleuca spp
Juncus krausii
Isolepis understorey
Mature stand
E. gomphocephala
Open forest
Heavily disturbed
Weed understorey
Acacia spp
Sandy beach
HARVEY
ESTUARY
M. rhaphiophylla
Acacia saligna
OLD
COAST
ROAD
17
Fence
M. rhaphiophylla
J. krausii
Mature
E. rudis
Open woodland
Cleared understorey
SCALE 1: 2000
0
50
500 metres
J
Sandy beach
E. gomphocephala
Forest
Acacia saligna
Jacksonia spp
Macrozamia riedlei
Understorey
E. gomphocephala
E. rudis
Open forest
16
A41827
Recn.


MAP 40
SCALE 1: 2000
0 50 500 metres
HARVEY
ESTUARY
17
16
A41827
OLD
COAST
ROAD
Sandy beach
A41827
Recreation
Sarcocornia
complex
Fence
Tennis court
Sandy
beach
A41827

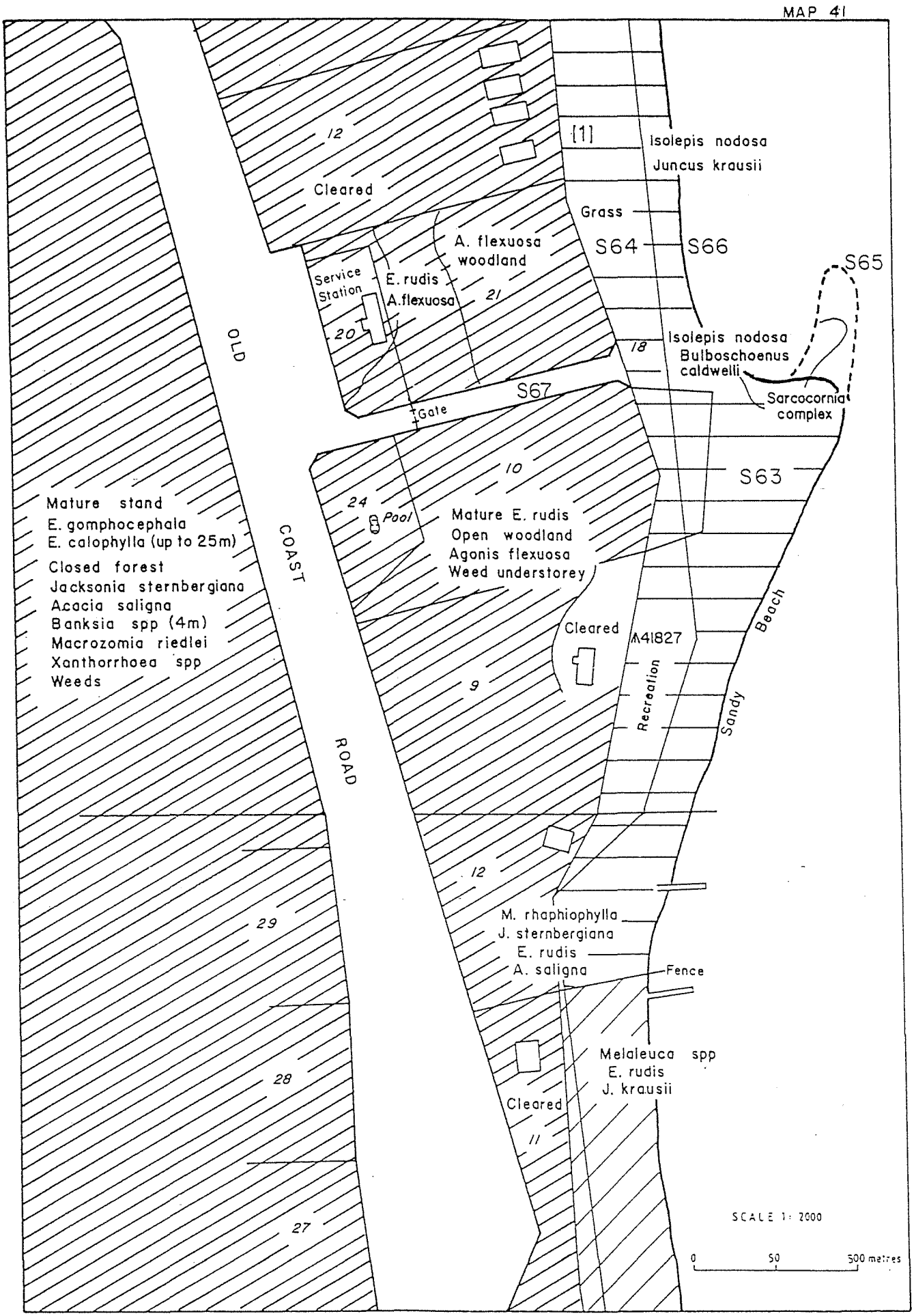
S63 Vest Vacant Crown Land south of reserve 41827 in WWC for foreshore management purposes. (DOLA, WWC, PIMA)

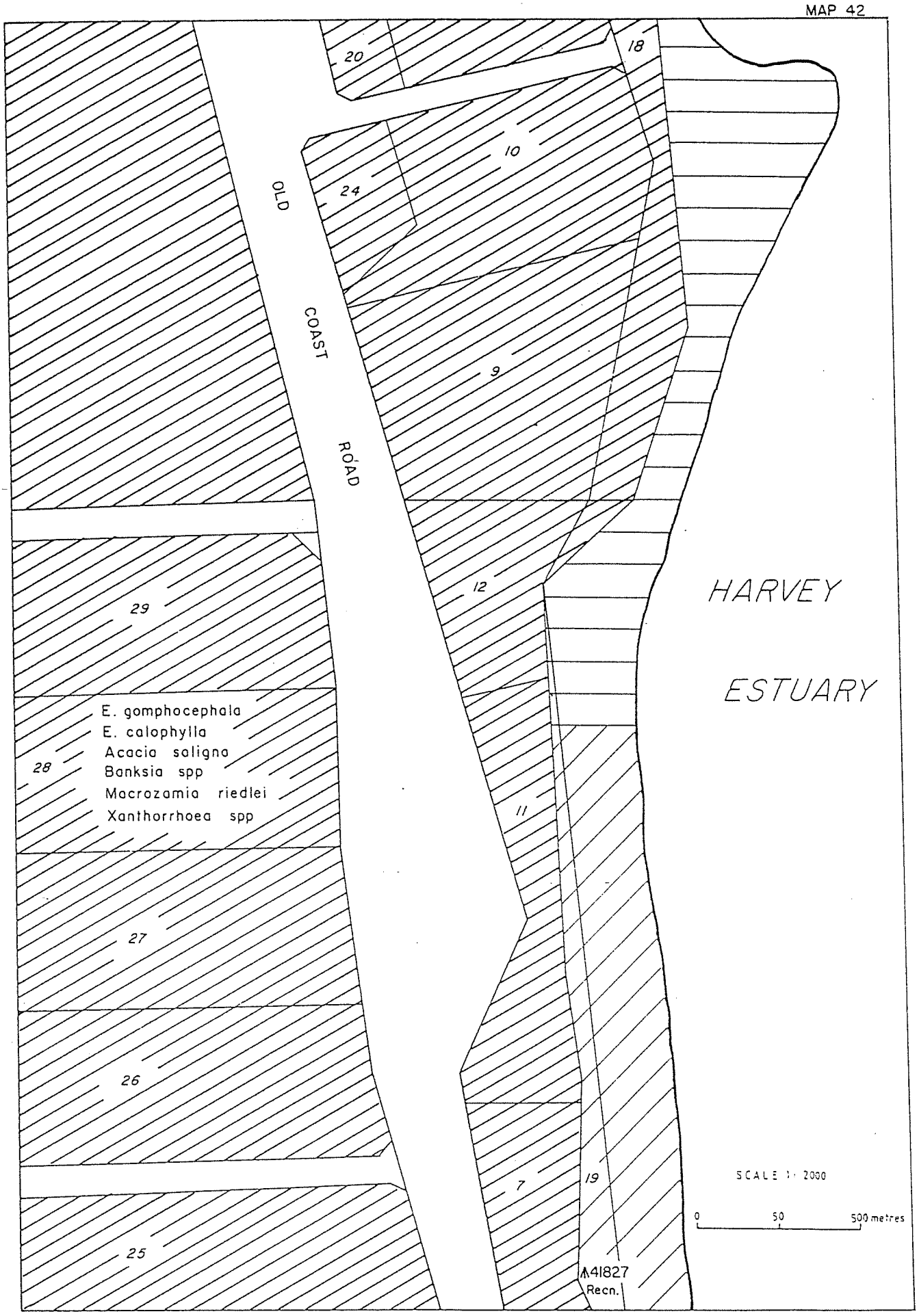
S64 Define precise boundary between private and public land of Lots 17, 16, 15, 14, 13, 12, 21, 10 and 9 adjacent to reserve 41827 and the Vacant Crown Land by contracting a licenced survey for the area. (PIMA) [1]

S65 Erect signs around the samphire marsh east of the Caravan Park to inform the public and discourage degradation of the saltmarsh that exists on the spit. (PIMA)

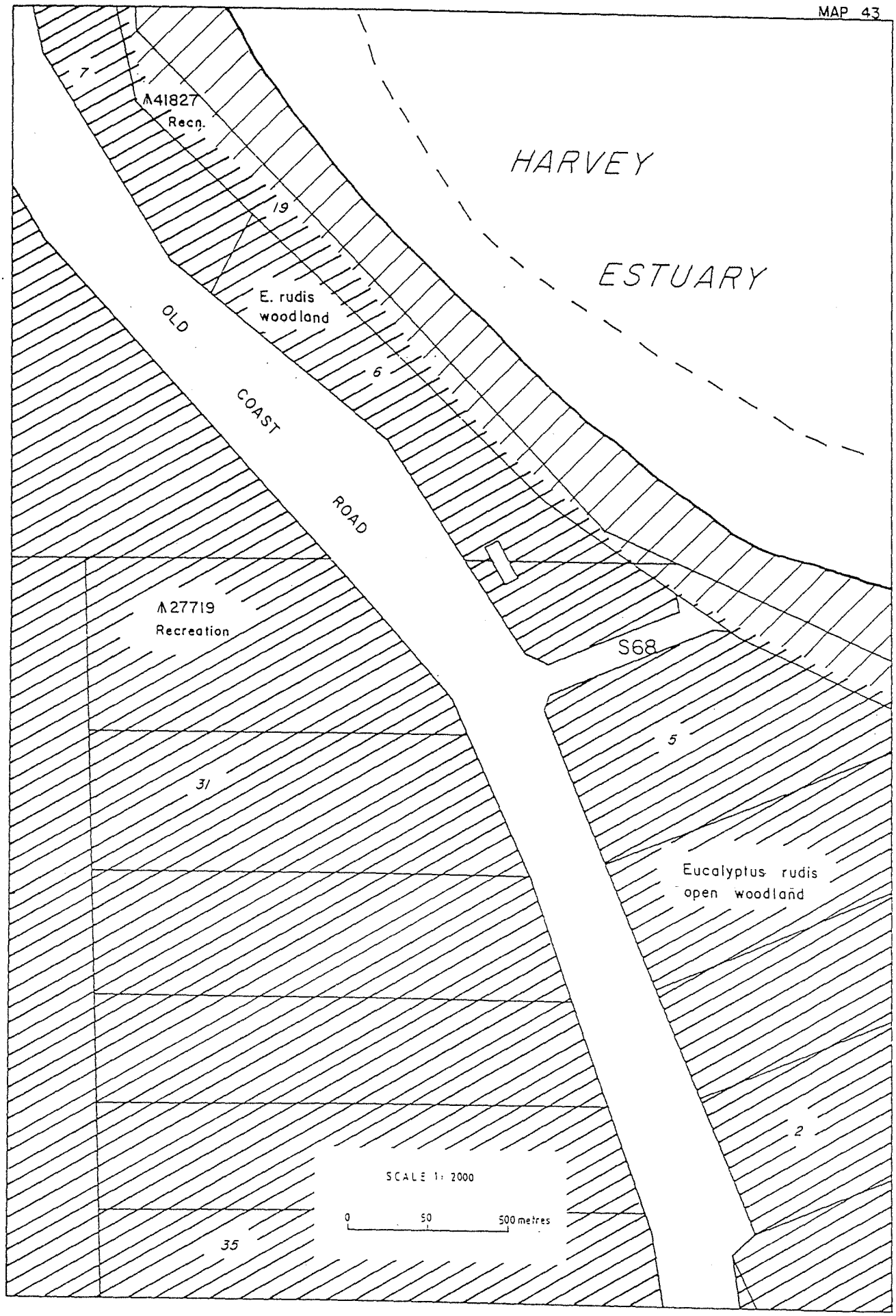
S66 Rehabilitate fringing vegetation on Vacant Crown Land abutting the Goldenacre Chalet Resort and the Waters Edge Caravan Park. Harden access points and enrich vegetation with sedge (*Juncus krausii*), Peppermint Trees (*Agonis flexuosa*), and Flooded Gum (*Eucalyptus rudis*). (WWC, PIMA, Res)

S67 Seek road access between Lots 21 and 10, to foreshore reserve (41827). (DOLA, PIMA)

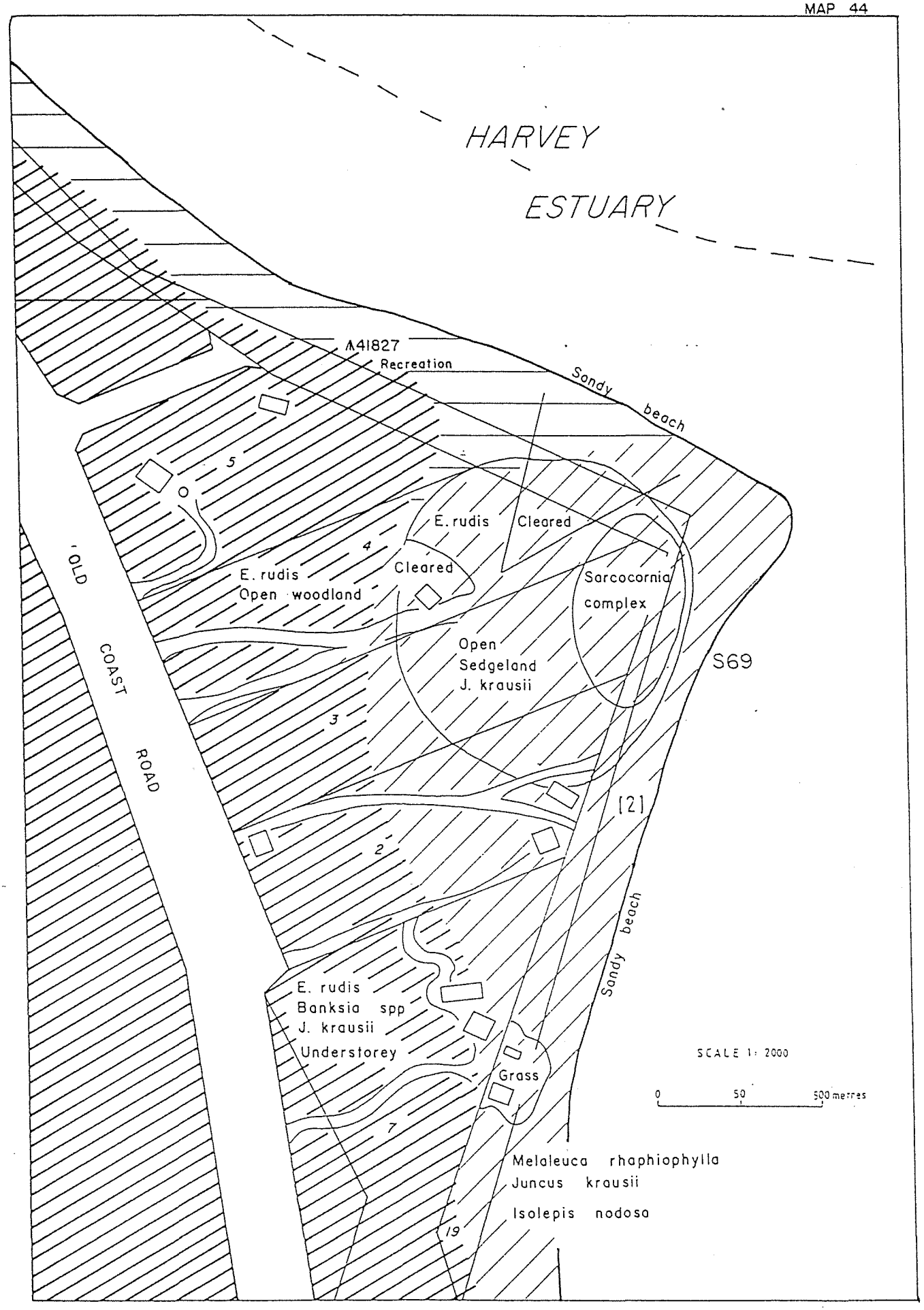

MAP 41
12
Cleared
[1]
Isolepis nodosa
Juncus krausii
Grass
S64
S66
S65
A. flexuosa
woodland
Service
Station
E. rudis
A.flexuosa
21
20
18
Isolepis nodosa
Bulboschoenus
caldwelli
Sarcocornia
complex
OLD
COAST
ROAD
S67
Gate
10
S63
24
Pool
Mature E. rudis
Open woodland
Agonis flexuosa
Weed understorey
Mature stand
E. gomphocephala
E. calophylla (up to 25m)
Closed forest
Jacksonia sternbergiana
Acacia saligna
Banksia spp (4m)
Macrozomia riedlei
Xanthorrhoea spp
Weeds
Cleared
A41827
Recreation
Sandy
Beach
9
12
M. rhaphiophylla
J. sternbergiana
E. rudis
A. saligna
Fence
29
28
Melaleuca spp
E. rudis
J. krausii
Cleared
11
27
SCALE 1: 2000
0
50
500 metres


MAP 42
20
18
10
24
OLD
COAST
ROAD
9
12
HARVEY
ESTUARY
29
E. gomphocephala
E. calophylla
Acacia saligna
28
Banksia spp
Macrozamia riedlei
Xanthorrhoea spp
11
27
26
7
19
SCALE 1: 2000
0
50
500 metres
25
41827
Recn.

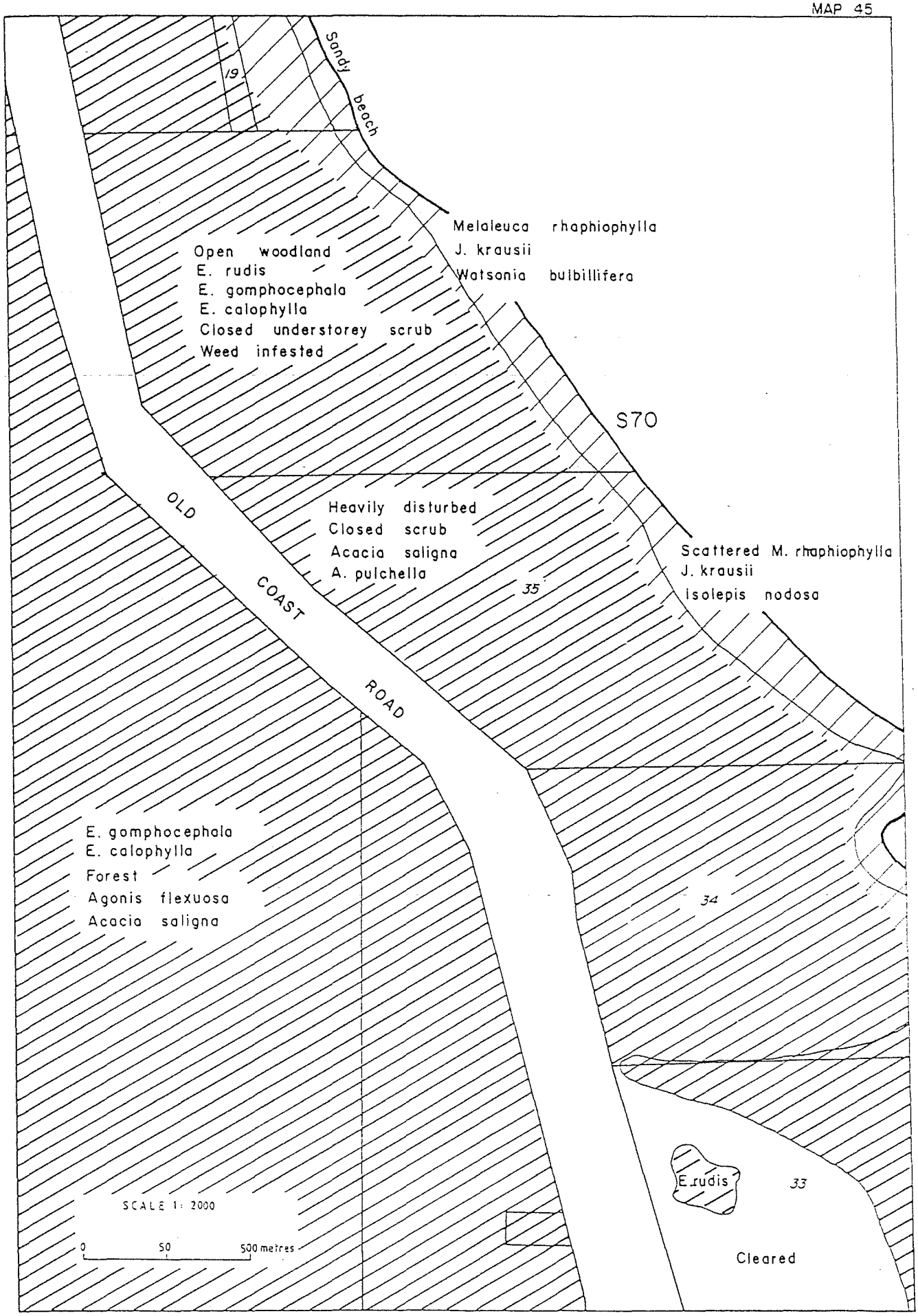
S68 Seek road access between Lots 5 and 6, to foreshore reserve (41827). (PIMA, DOLA)

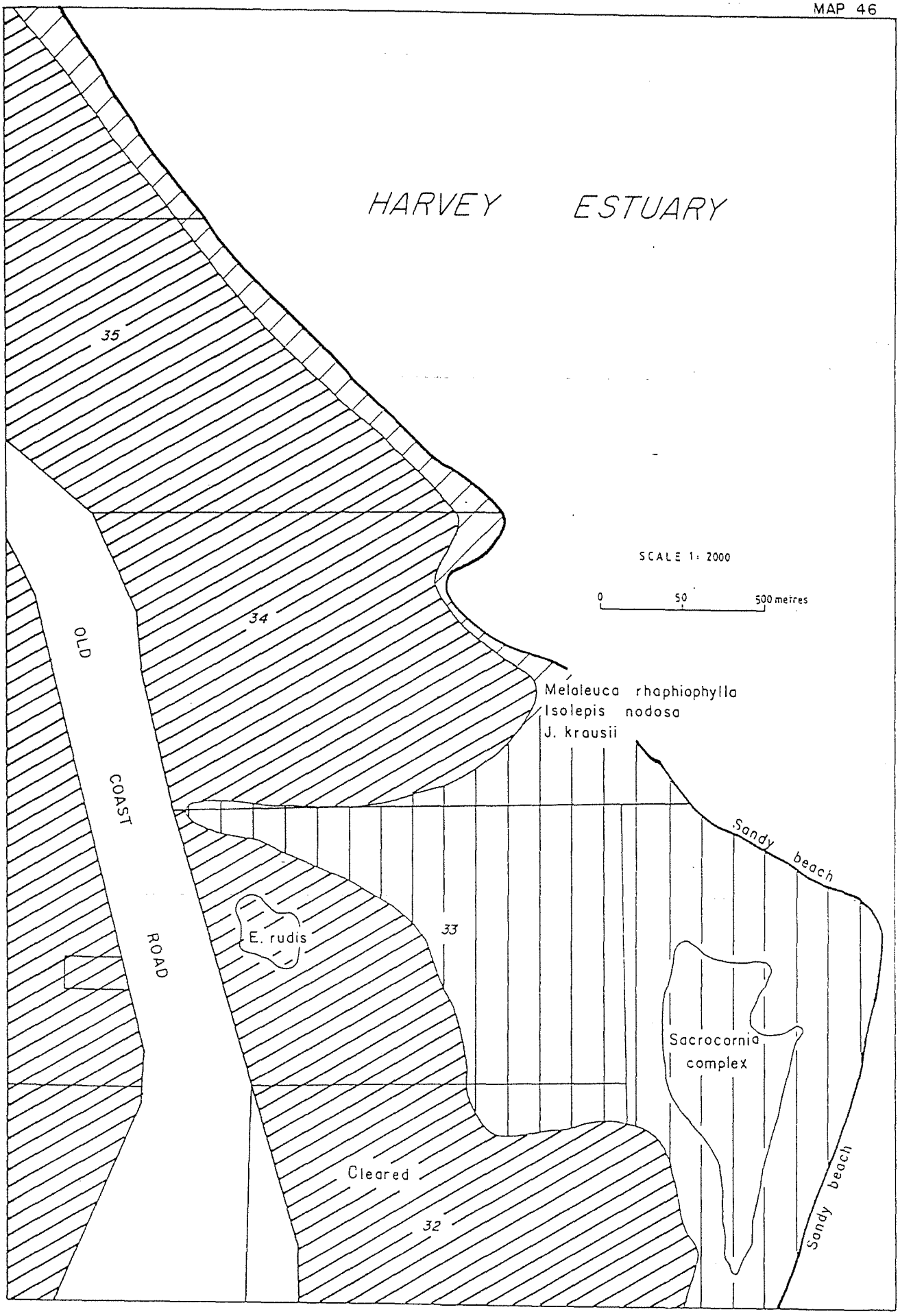

MAP 43
HARVEY
ESTUARY
OLD
COAST
ROAD
A41827
Recn.
E. rudis
woodland
A27719
Recreation
S68
Eucalyptus rudis
open woodland
7
19
6
31
5
2
35
SCALE 1: 2000
0
50
500 metres

S69 Define precise boundary between private and public land of Lots 1 to 5 adjacent to reserve 41827 and the Vacant Crown Land by contracting a licenced survey for the area. (PIMA) [2]


HARVEY
ESTUARY
A41827
Recreation
Sandy beach
5
4
3
2
7
19
E. rudis
Cleared
Cleared
E. rudis
Open woodland
Sarcocornia
complex
Open
Sedgeland
J. krausii
S69
[2]
OLD COAST ROAD
Sandy beach
E. rudis
Banksia spp
J. krausii
Understorey
Grass
Melaleuca rhaphiophylla
Juncus krausii
Isolepis nodosa
SCALE 1: 2000
0
50
500 metres

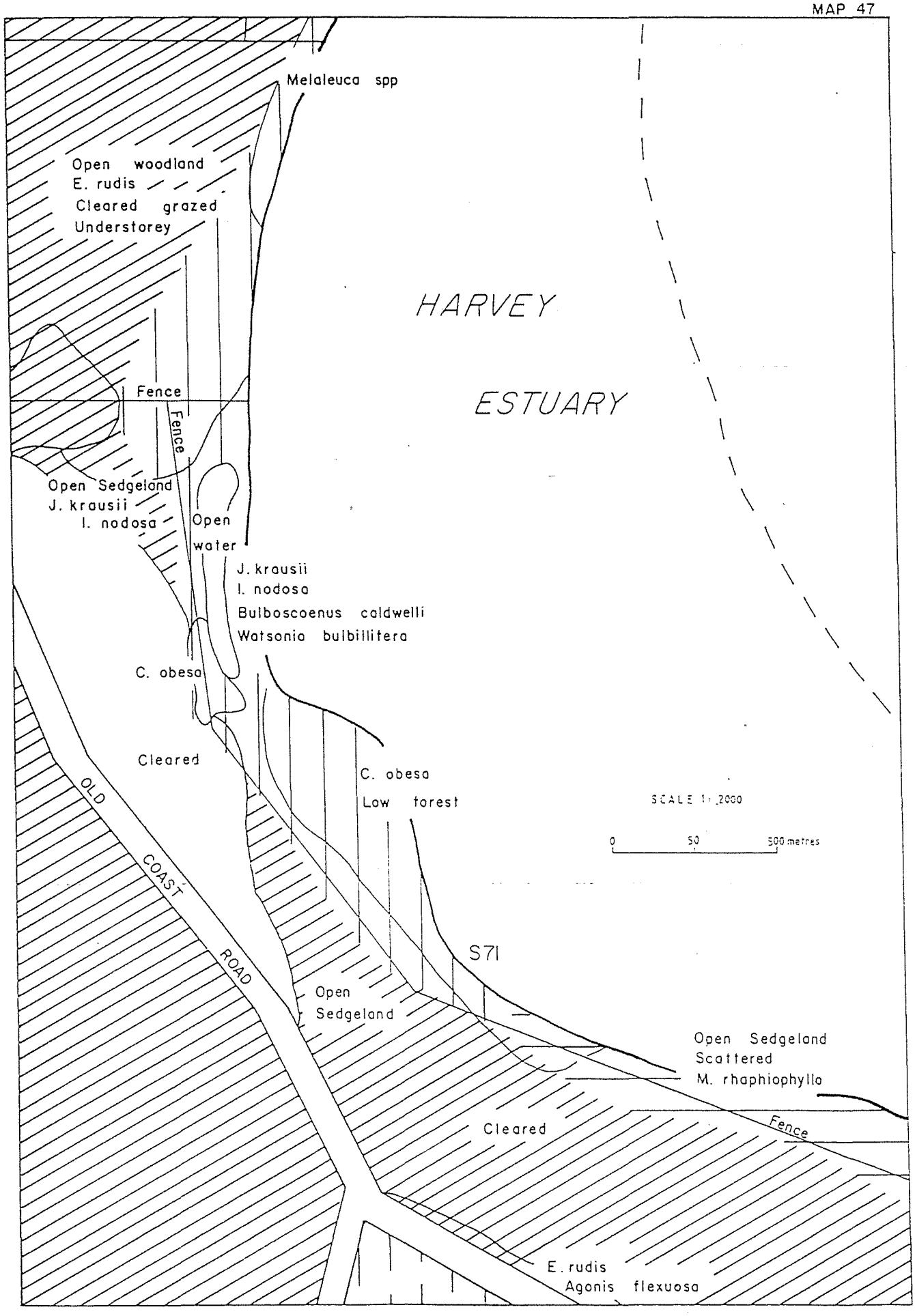
S70 Acquire foreshore reserve at time of rezoning, subdivision or strata title development of Lots 36, 35, 34 and 57.Vest in the City Of Mandurah for recreation and foreshore management purposes. (DPUD, DOLA, CM, PIMA)

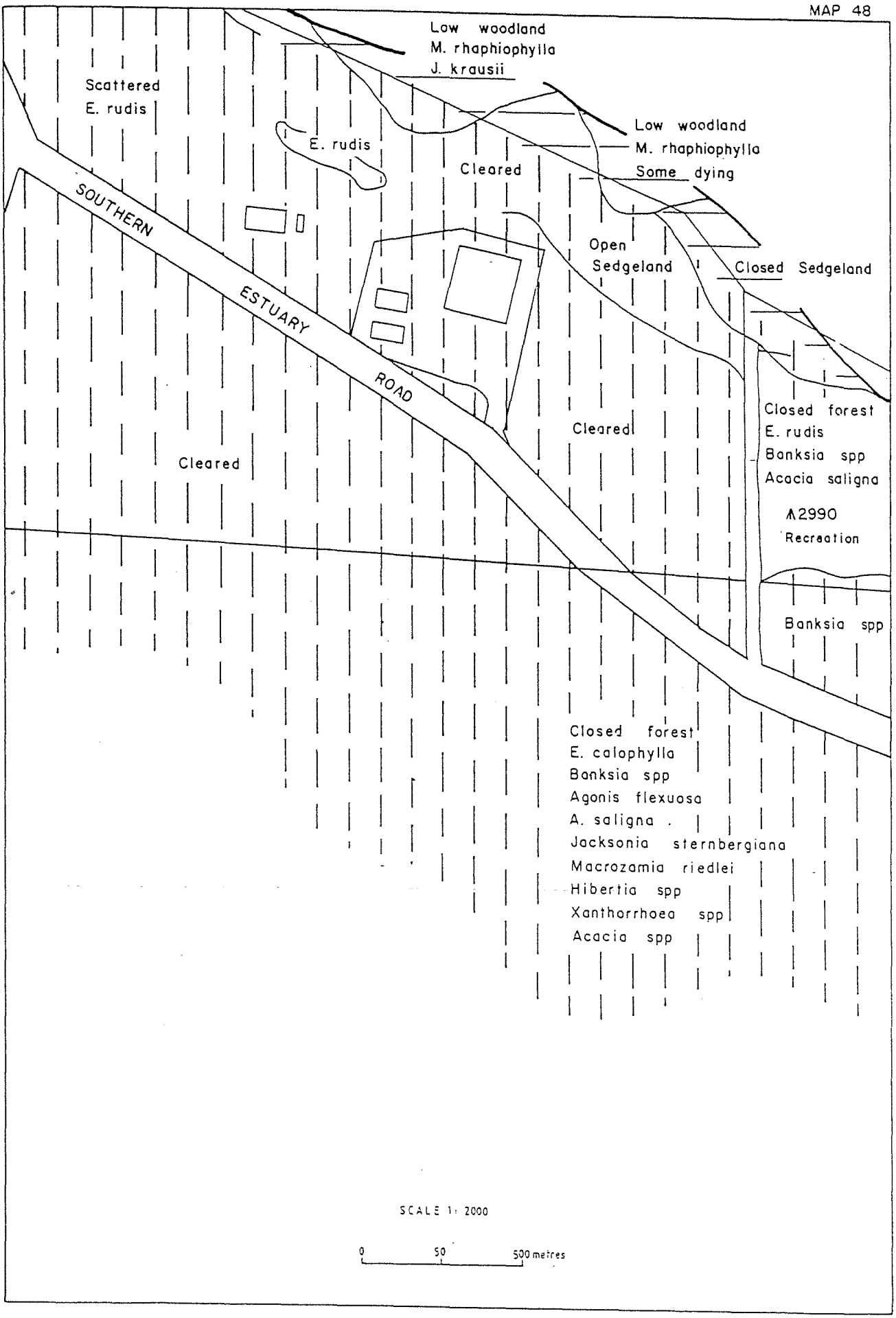

Sandy beach
19
Melaleuca rhaphiophylla
J. krausii
Watsonia bulbillifera
Open woodland
E. rudis
E. gomphocephala
E. calophylla
Closed understorey scrub
Weed infested
S70
OLD COAST ROAD
Heavily disturbed
Closed scrub
Acacia saligna
A. pulchella
35
Scattered M. rhaphiophylla
J. krausii
Isolepis nodosa
E. gomphocephala
E. calophylla
Forest
Agonis flexuosa
Acacia saligna
34
E. rudis
33
Cleared
SCALE 1: 2000
0 50 500 metres


HARVEY ESTUARY
35
34
33
32
OLD COAST ROAD
SCALE 1: 2000
0 50 500 metres
Melaleuca rhaphiophylla
Isolepis nodosa
J. krausii
Sandy beach
E. rudis
Sacrocornia complex
Cleared
Sandy beach

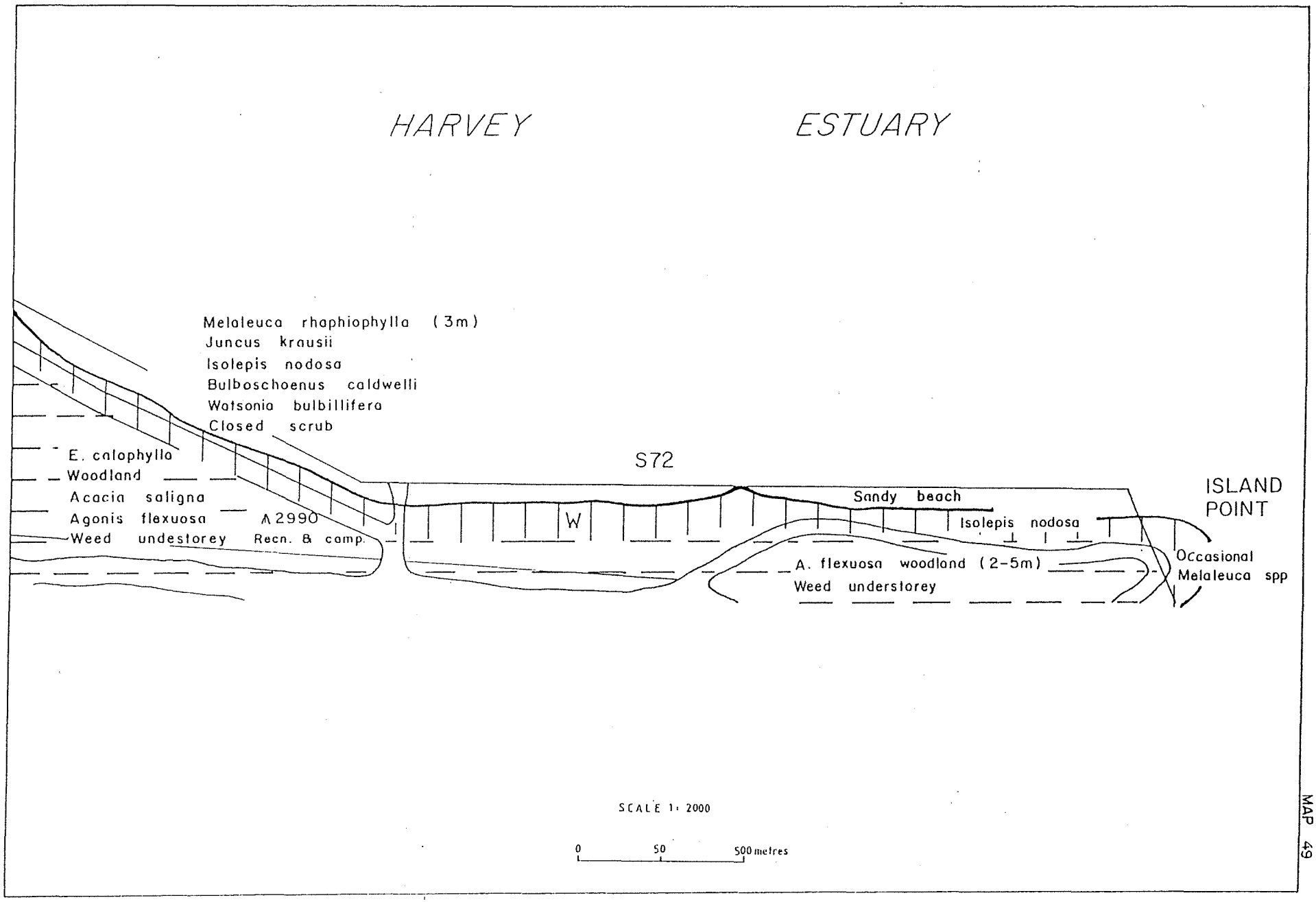
S71 Vest Vacant Crown Land south of Location 57 in the City Of Mandurah and incorporate in reserve 2990 for recreation and foreshore management purposes. (DOLA, WWC, CM)

MAP 47

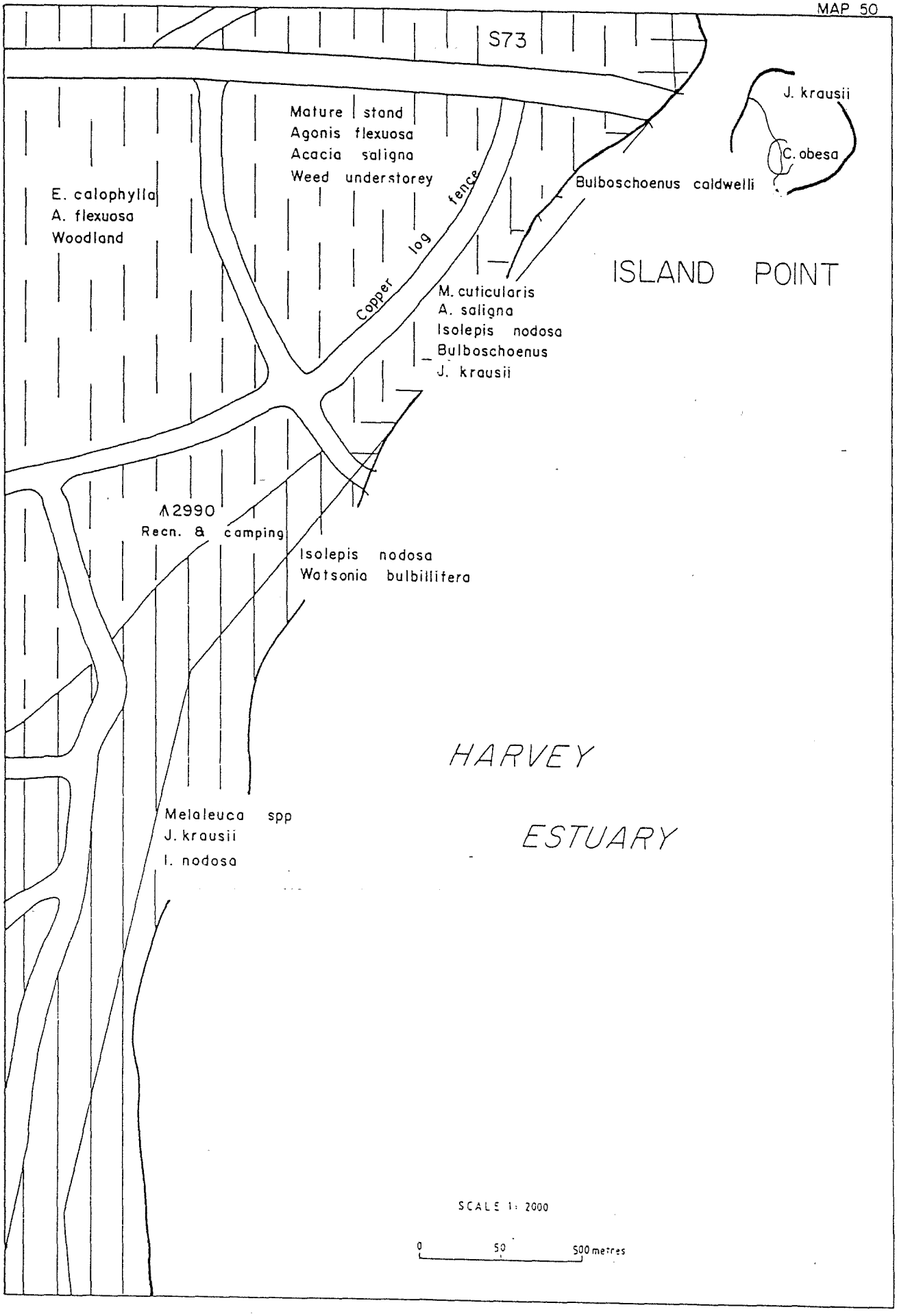

Melaleuca spp
Open woodland
E. rudis
Cleared grazed
Understorey
HARVEY
ESTUARY
Fence
Fence
Open Sedgeland
J. krausii
I. nodosa
Open
water
J. krausii
I. nodosa
Bulboscoenus caldwelli
Watsonia bulbillifera
C. obesa
Cleared
C. obesa
Low forest
SCALE 1:2000
0 50 500 metres
OLD
COAST
ROAD
S71
Open
Sedgeland
Open Sedgeland
Scattered
M. rhaphiophylla
Cleared
Fence
E. rudis
Agonis flexuosa


MAP 48
Low woodland
M. rhaphiophylla
J. krausii
Scattered
E. rudis
E. rudis
Cleared
Low woodland
M. rhaphiophylla
Some dying
SOUTHERN
ESTUARY
ROAD
Open
Sedgeland
Closed Sedgeland
Cleared
Cleared
Closed forest
E. rudis
Banksia spp
Acacia saligna
▲2990
Recreation
Banksia spp
Closed forest
E. calophylla
Banksia spp
Agonis flexuosa
A. saligna
Jacksonia sternbergiana
Macrozamia riedlei
Hibertia spp
Xanthorrhoea spp
Acacia spp
SCALE 1: 2000
0
50
500 metres

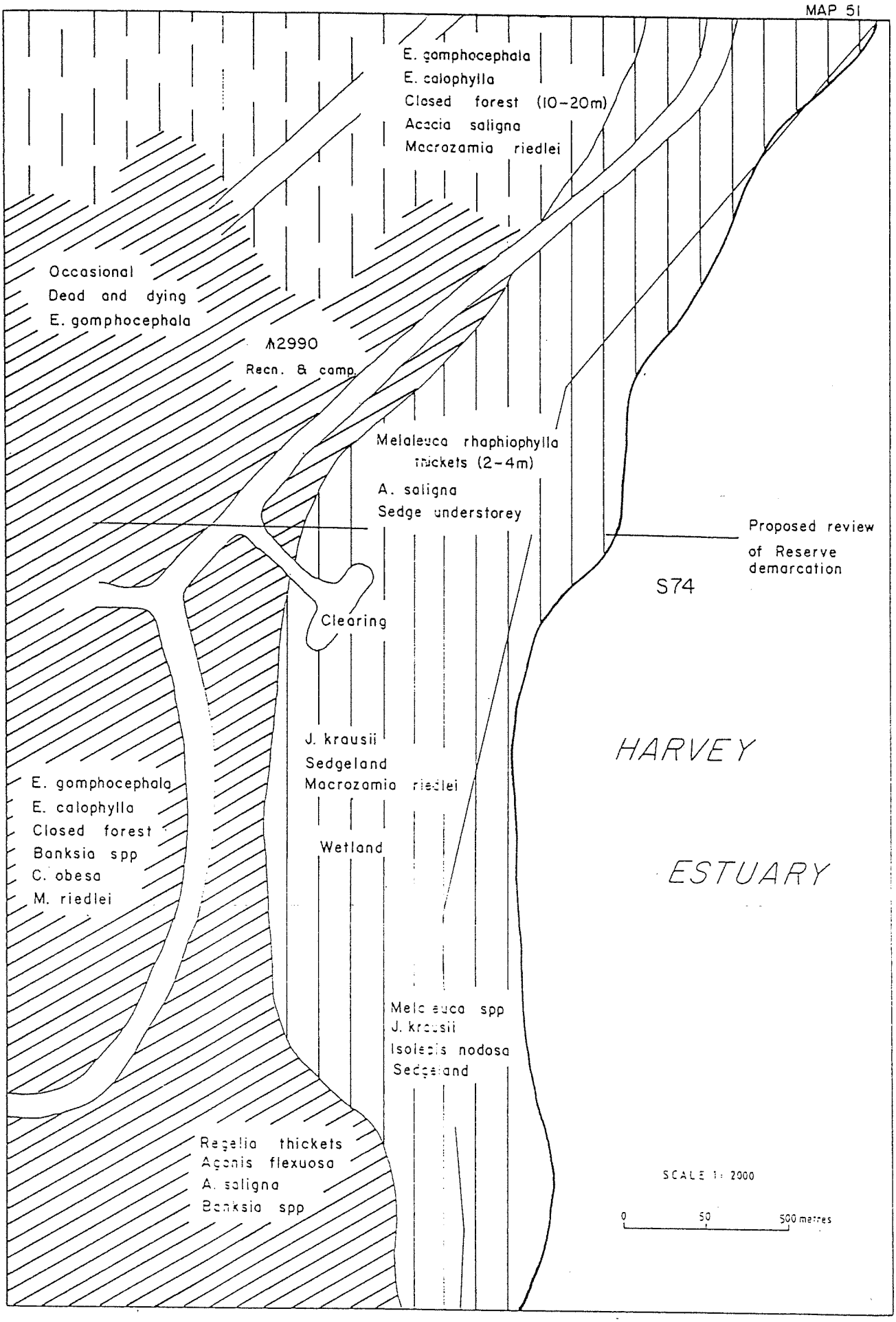
S72 Prepare a management plan to enable appropriate use of Island Point (reserve 2990). Should address recreational needs including camping and boat launching requirements, particularly in respect to dredging a new channel for boat access to the northern shore. (CM, PIMA)


HARVEY
ESTUARY
Melaleuca rhaphiophylla (3m)
Juncus krausii
Isolepis nodosa
Bulboschoenus caldwelli
Watsonia bulbillifera
Closed scrub
E. calophylla
Woodland
Acacia saligna
Agonis flexuosa
Weed undestorey
A 2990
Recn. & comp.
S72
W
Sandy beach
Isolepis nodosa
A. flexuosa woodland (2-5m)
Weed understorey
ISLAND POINT
Occasional Melaleuca spp
SCALE 1: 2000
0
50
500 metres

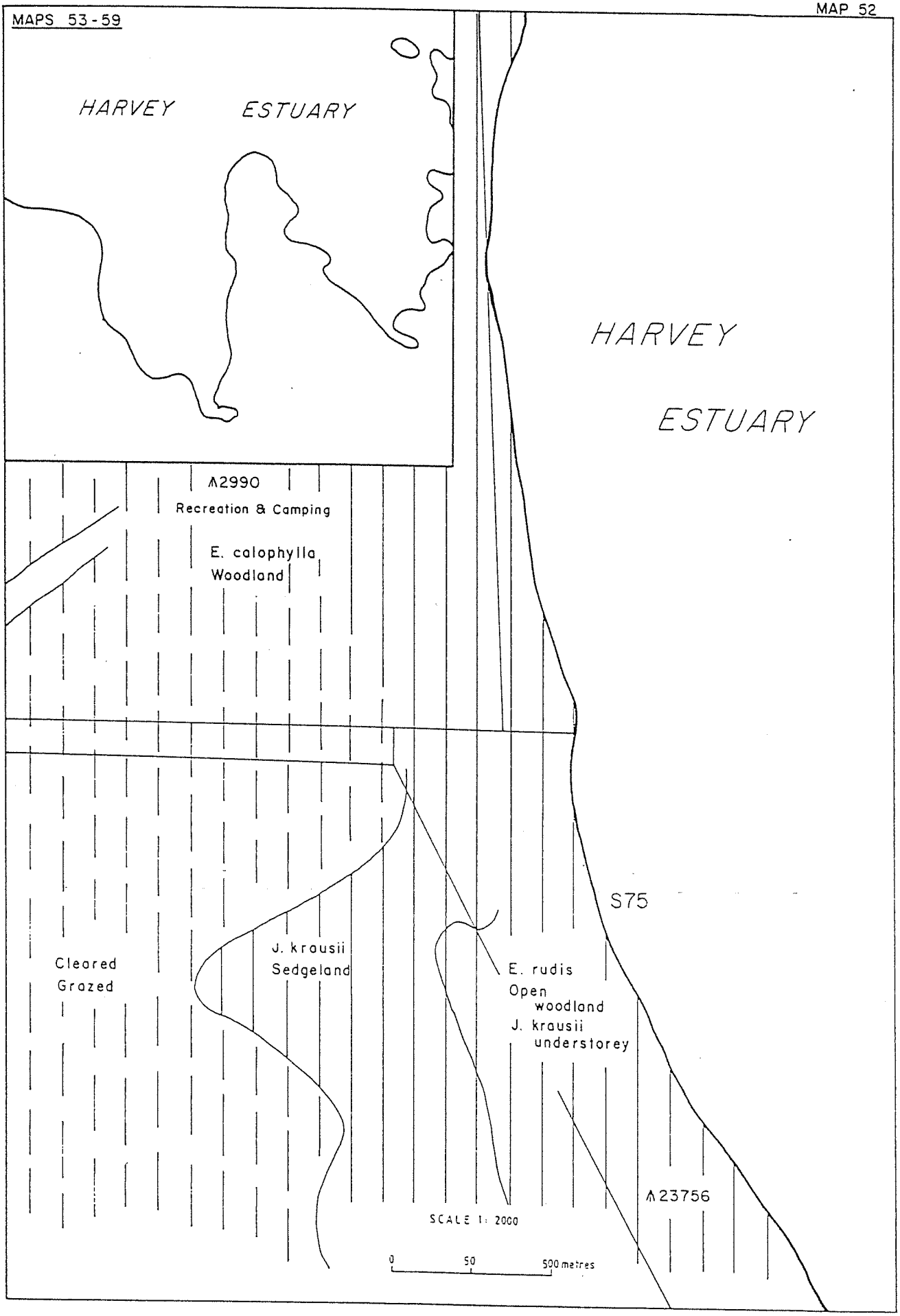
S73 Enrichment planting of Island Point with Peppermint Trees on the higher ground and revegetation of the foreshore with sedge and Paperbarks is required to further shelter the recreation area and limit erosion. (CM, PIMA)


MAP 50
S73
Mature stand
Agonis flexuosa
Acacia saligna
Weed understorey
E. calophylla
A. flexuosa
Woodland
Copper log fence
J. krausii
C. obesa
Bulboschoenus caldwelli
ISLAND POINT
M. cuticularis
A. saligna
Isolepis nodosa
Bulboschoenus
J. krausii
2990
Recn. & camping
Isolepis nodosa
Watsonia bulbillifera
HARVEY
ESTUARY
Melaleuca spp
J. krausii
I. nodosa
SCALE 1: 2000
0
50
500 metres

S74 Incorporate part of reserve 2990 in reserve 23756 and vest in the NPNCA for the purpose of conservation of flora and fauna. The proposed demarcation of the recreation reserve and the nature reserve is illustrated opposite. (DOLA, NPNCA, CM, CALM)


MAP 51
E. gomphocephala
E. calophylla
Closed forest (10-20m)
Acacia saligna
Macrozamia riedlei
Occasional
Dead and dying
E. gomphocephala
A2990
Recn. & camp.
Melaleuca rhaphiophylla
thickets (2-4m)
A. saligna
Sedge understorey
Proposed review
of Reserve
demarcation
S74
Clearing
J. krausii
Sedgeland
Macrozamia riedlei
Wetland
HARVEY
ESTUARY
E. gomphocephala
E. calophylla
Closed forest
Banksia spp
C. obesa
M. riedlei
Melaleuca spp
J. krausii
Isolepis nodosa
Sedgeland
Regelia thickets
Agonis flexuosa
A. saligna
Banksia spp
SCALE 1: 2000
0
50
500 metres

S75 Prepare a management programme for reserve 23756. (CALM)


MAPS 53-59
MAP 52
HARVEY ESTUARY
HARVEY ESTUARY
A2990
Recreation & Camping
E. calophylla
Woodland
S75
J. krausii
Sedgeland
Cleared
Grazed
E. rudis
Open
woodland
J. krausii
understorey
A23756
SCALE 1: 2000
0 50 500 metres

Note: [*] denotes

1 - high priority survey

2 - priority survey

Location Illustrated On Maps.

Identified Priority Weed Removal Areas

Priority -: 1 V. High

2 High

3 Moderate

Table 3.

Location	Priority	Authority Responsible
Chimney Spit	1	CALM
Erskine Wetland	1	CALM
Ward Point	1	PIMA
Reserve 36027 & 36046	2	CM / PIMA
Warrangup Spring Foreshore (36027)	2	CM / PIMA
Allandale - Park Ridge	2	PIMA
Park Ridge (36707)	3	CM / PIMA
VCL abutting Loc 40 & 41	2	PIMA
Nerigardup Spring (34680)	1	CM / PIMA
Island Point (2990)	3	CM / PIMA

* Locations denoted on map by W

Recommended Management Plans to be Developed for the Western Foreshore.

Table 4.

Location	Organization Responsible
Chimney Spit	CALM
Mandurah Quay	Forx PtyLtd / CALM /CM
Erskine Wetland	CALM / Dev
Estuary Gardens	Meiyu Aust.PtyLtd / CM
Ward Point	City of Mandurah / Dev
Dawesville Channel Fill	DMH / CM / PIMA / Dev
Warrangup Spring (860)	CM / PIMA
VCL south of Allandale (S41)	PIMA
Island Point (2990)	CM
Harvey Estuary Nature Reserve (23756)	CALM

6. Glossary

Artificial Wetland/Lake This document uses the term artificial wetland/lake to denote a waterbody created by humans where no lake previously existed and wetlands that have been modified to the extent that their previous boundary and / or depth has been changed significantly from its natural state.

Bloom This document uses the term bloom to denote the readily visible proliferation of the blue - green algae, *Nodularia spumigena*.

Community A collection of individual organisms of different species living together in one place at a particular time.

Conservation The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Thus conservation is positive, embracing preservation, maintainance, sustainable utilisation, restoration and enhancement of the natural environment.

Conservation Area This document uses the term conservation area to describe any land to be set aside or used for the protection of the environment. This includes nature reserves and conservation parks vested with the National Parks Nature Conservatiuon Authority to be managed by the Department of Conservation and Land Management.

Development For the purposes of this document, development refers to any use of the land which includes construction of buildings, any earthworks or landscape modification.

Estuary Semi enclosed coastal area where salt water meets fresh water.

Fauna The animal life of a geological period or region.

Flora The plant life of a geological period or region.

Habitat The native environment or place where a plant or animal naturally grows or lives.

Node For the purpose of this document, a node refers to a control location which contains the concentration of leisure, access or conservation activities, servicing the surrounding areas.

Nutrients Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorus (phosphate). Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.

Peel Inlet Management Programme Review A review of the 1982 Peel Inlet Management Programme for the Peel Inlet Management Authority as required by Section 35(5) of the Waterways Consevation Act 1976 -82.

Preservation Keeping in existence unchanged, natural resources, structures or situations which have been inherited from the past.

Population A group of organisms of the same species living in a particular place at a particular time.

Remnant Vegetation The parts of the natural vegetation still existing after a major change to the environment.

Soft Launching Area A foreshore site used for launching small craft without the assistance of a trailer. Typically includes sandy beaches for the launching of dinghys and/or catamarans.

Vacant Crown Land The land under the control of the Minister for Lands which is not reserved and vested in an authority for specific purposes, contracted to be granted in fee simple or subject to the right of purchase.

Vector A carrier of disease.

Weed Herbaceous exotic plant that exists in an area where its growth is not desirable.

(Plate 14: Watsonia Infestation)
The control of weeds is a significant issue in appropriately managing the estuary's foreshore.

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Appendix 1: Advertisement

The advertisement printed in the *Mandurah Mail, Mandurah Telegraph* and *Coastal District Times*

PEEL INLET MANAGEMENT AUTHORITY

DRAFT MANAGEMENT PLAN - WESTERN FORESHORE OF THE PEEL HARVEY ESTUARY

The Peel Inlet Management Authority is preparing a draft management plan for the unvested reserves and Vacant Crown Land on the Western Foreshore of the Peel Harvey Estuary, between the Sticks Channel and the Harvey River.

The study will describe the existing environment in terms of its geology landscape wildlife values and erosion problems. In addition, the study will define existing use of foreshore land.

The draft plan will make detailed recommendations about the future reservations, vesting and management of Crown land on the foreshore.

People wishing to provide information relating to the study area should write to the WATERWAYS COMMISSION 184 St Georges Terrace, PERTH 6000, by October 25.

O H Tuckey

Chairman

Appendix 2: Public Submissions

Appendix 3: Tuart Dieback

Outline of research to be conducted by Chris Chilcott.

Project Title : Tuart (*Eucalyptus gomphocephala*) Dieback in Remnant Bushland in the Kwinana Area

Client : Alcoa of Australia Limited

Client Supervisor : Mr John Gardner

Academic Supervisor : Professor Arthur McComb

Project Student : Chris Chilcott

Objective :

The project aims to identify the causes of dieback of Tuarts within remnant bushland in the Kwinana area and to formulate management strategies to counter the causes. This involves the following areas of enquiry ;

1. a review and analysis of existing information on tree decline

2. a review of the existing distribution of Tuarts and their relative health.

3. a listing of hypotheses of the possible causes of Tuart dieback in the Kwinana remnant bushland

4. a systematic process of elimination of hypotheses through proper scientific methodology in order to determine the cause(s) of dieback.

5. possible experimental studies on remaining hypotheses to determine the specific causes of dieback

6. investigation of management techniques to counter Tuart dieback, dependent on the cause.

Suspected causes of Tuart Dieback.

Biological - succession
- natural process
- seedling failure

Soils - toxic
- acid
- increased nutrients
- decreased nutrients
- salt
- mycorrhizal problems
- watertable + or -
- salt laden waterlogging
- impenetrable soil layers

Air - pollution from sulphur dioxide, lead, ammonia, car emissions and other industrial emissions
- dust

Herbivory - Tuart Bud Weevil (*Haplonyx tibialis*)
- Tuart Borer (*Phorocantha impavida*)
- Stem Girdler (*Cryptophasa untpunctata*)
- Pin - hole Borer (*Atractocerus kreuslerae*)
- Tuart Miner (*Nepticula spp.*)
- Christmas Beetles (*Scarabaeidae*)
- caterpillars
- Leaf Blister Saw Fly (*Phylacteophaga froggatti*)
- other insects
- birds
- grazing animals
- rabbits

Pathogens - Phytophthora
- Armillaria
- cankers
- wound parasites (*Piptoporus* spp.)
- Botrysphaeia and Fusarium (seedlings)
- Chestnut Blight (*Endothoia*)

Cultural - firewood
- vandalism
- pesticides
- fire (too frequent, wrong time or not common or fortuitous)
- clearing and removal of understorey
- exposure (predisposing effect)

Combinations - fertilisers / insects
- pesticides / birds/ insects
- weeds / increased frequency of fire
- fire / insect attack or epicormic growth
- impaired root development / drought

Appendix 4: Mosquito Control Research

Outline of Jane Lachford's Mosquito Control Research On Site A23

In November 1990 the State Government of Western Australia approved a five year funding grant for mosquito control and research. One of the research programmes funded aims to determine if runnelling is an effective means of controlling mosquito populations and if so, find out if the technique produces unacceptable change in the ecology of the saltmarshes. This study is being conducted at Murdoch University by Jane Lachford and is jointly supervised by Professor Arthur McComb, Dr Jenny Davis and the Mosquito Control Advisory Committee.

During the summer of 1988-89 Western Australia had its largest recorded outbreak of Ross River Virus. A large proportion of the cases were recorded within the City of Mandurah and the Shire of Murray. This aspect, coupled with increased urban growth, led to this area being chosen for the study. The strategy is to choose several sites with mosquito breeding pools and where possible include treated (runnelled) and control (non-runnelled) areas at each site. The sites range from saline to relatively fresh.

At each site the plant and animal communities will be documented in relation to water levels (tide and groundwater) and nutrient concentrations (in water and sediment) because these factors control the primary productivity which underpins food webs. Particular attention will be given to growth and biomass of the dominant saltmarsh plants and the abundance of non - target aquatic invertebrates. Effects on waterbirds will be examined by regular census of bird populations.

Monitoring of all sites commenced in July 1991 and at present is planned to proceed for two full years. One of the sites chosen for the study is the recently reserved A23 which was partly modified in April 1990 under the Mosquito Control Interim Strategy. The modifications consisted of connecting several mosquito breeding pools with a series of hand-dug runnels to the Sticks Channel. This area is the central site of the study and thus extremely important.

The hypothesis will be examined that, under conditions which control mosquito populations, there is no effect on the marsh ecology. Since detectable effects are in fact expected, the study will subsequently address the definition of what is an acceptable disturbance. An assessment of these changes is especially important for the management of mosquitoes in conservation reserves, such as the proposed A23 site.

In addition to its importance for mosquito control, the work will contribute to an understanding of the functions of fringing marshes. This information can then be used as an aid to the use and management of these saltmarshes.

Appendix 5: Vegetation Description Methodology

To initially determine the structure and content of the Peel - Harvey Estuary western foreshore vegetation a field survey was conducted utilizing the 'Specht Plant Classification System' as the basis for its description. This methodology, which was developed for the Australian environment, employs life form, height and projective foliage cover as its primary criteria.

The vegetation was then broadly categorised according to the Semeniuk (1990) geomorphological classification. This identifies the vegetation in terms of previously defined communities by inter - relating both the plant life and its underlying structure and their associated sedimentologic processes.

The detailed vegetation descriptions are illustrated in the maps associated with the Specific Recommendations with the overlay relating the Semeniuk geomorphical classifications.

Structural formations in Australia (modified from Specht 1970)

Life form of tallest stratum		Foliage Projective Cover of tallest stratum				
		100–70% (4)†	70–50% (3+)	50–30% (3–)	30–10% (2)	< 10% (1)
Trees* > 30 m	(T)†	Tall closed-forest	Tall forest	(Tall open-forest)‡	(Tall woodland)‡	–
Trees 10–30 m	(M)	Closed-forest	Forest	Open-forest	Woodland	Open-woodland
Trees < 10 m	(L)	Low closed-forest	Low forest	Low open-forest	Low woodland	Low open-woodland
Shrubs* > 2 m	(S)	Closed-scrub	Scrub	Open-scrub	Tall shrubland	Tall open-shrubland
Shrubs 0·25–2 m						
Sclerophyllous	(Z)	Closed-heathland	Heathland	Open-heathland	Shrubland	Open-shrubland
Non-sclerophyllous	(C)	–	–	Low shrubland	Low shrubland	Low open-shrubland
Shrubs < 0.25 m						
Sclerophyllous	(D)	–	–	–	Dwarf open-heathland (fell-field)	Dwarf open-heathland (fell-field)
Non-sclerophyllous	(W)	–	–	–	Dwarf shrubland	Dwarf open-shrubland
Hummock grasses	(H)	–	–	–	Hummock grassland	Open hummock grassland
Herbaceous layer						
Graminoids	(G)	Closed (tussock) grassland	(Tussock) grassland	(Tussock) grassland	Open (tussock) grassland	Very open (tussock) grassland
Sedges	(Y)	Closed-sedgeland	Sedgeland	Sedgeland	Open-sedgeland	Very open-sedgeland
Herbs	(X)	Closed-herbland	Herbland	Herbland	Open-herbland	Very open-herbland
Ferns	(F)	Closed-fernland	Fernland	Fernland	–	–

* A tree is defined as a woody plant usually with a single stem; a shrub is a woody plant usually with many stems arising at or near the base.

† Symbols and numbers given in parentheses may be used to describe the formation, e.g. tall closed-forest—T4, hummock grassland = H2

‡ Senescent phases of Tall forest.

PLANT SPECIES LIST

SCIENTIFIC NAME	COMMON NAME
Acacia pulchella	Prickly Moses
Acacia saligna	Port Jackson Wattle
Actinostobus pyrimidalis	
Agonis flexuosa	Peppermint
Banksia attenuata	Candle Banksia
Banksia grandis	Bull Banksia
Banksia littoralis	Swamp Banksia
Banksia menziesii	Firewood Banksia
Bulboschoenus caldwelli	Club Rush*
Bulrush	Typha orientalis*
Carpobrotus edulis	Pigface*
Casuarina obesa	Salt Sheoak
Ehrharta longiflora	Veldt Grass*
Eucalyptus calophylla	Marri
Eucalyptus gomphocephala	Tuart
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Frankia pauciflora	
Halosarcia bidens	
Halosarcia halocnemoides	
Halosarcia indica	
Isolepis nodosa	Club Rush
Jacksonia furcellata	
Jacksonia sternbergiana	
Juncus krausii	Shore Rush
Kunzea ericifolia	
Macrozamia riedlei	Macrozamia
Melaleuca cuticularis	Saltwater Paperbark
Melaleuca hamulosa	
Melaleuca leptoclada	Heath Paperbark
Melaleuca preissiana	Moonah Paperbark
Melaleuca rhaphiophylla	Swamp Paperbark

Pennisetum clandestinum	Kykuyu*
Pteridium esculentum	Bracken
Regelia ciliata	
Sarcocornia quinqueflora	Samphire
Spyridium globulosum	Basket Bush
Stenotaphrum secundatum	Buffaloe Grass*
Suaeda australis	Seablite
Templetonia retusa	
Watsonia bulbillifera	Wild Watsonia*
Xanthorrhoea preissii	Blackboy

Denotes Weed : *

Abbreviations

CALM : Department of Conservation And Land Management

CER : Consultative Environmental Review

CLAG : Contiguous Local Authority Group

CM : City of Mandurah

Con. : Consultants

Dev. : Developer

DMH : Department of Marine and Harbours

DOLA : Department of Land Administration

DPUD : Department of Planning and Urban Development

Env. : Environment

EPA : Environmental Protection Authority

ERMP : Environmental Review and Management Programme

HD : Health Department of Western Australia

LGA : Local Government Authority

MCAC : Mosquito Control Advisory Committee

MCTF : Mosquito Control Task Force

NPNCA : National Parks Nature Conservation Authority

PER : Public Environmental Review

PIMA : Peel Inlet Management Authority

PHCDC : Peel Harvey Conservation and Development Committee

Res. : Resident/s

VCL : Vacant Crown Land

HCWA : Heritage Council of Western Australia

WATC : Western Australian Tourism Commission

WWC : Waterways Commission