

# **NORTH COTTESLOE COASTAL MANAGEMENT PLAN 2005-2010**

---

## **TOWN OF COTTESLOE**

Prepared by:

**Ecoscape (Australia) Pty Ltd**

### **Limitations Statement**

This report has been exclusively drafted for the needs of **Cottesloe Coastcare**. No express or implied warranties are made by Ecoscape (Australia) Pty Ltd regarding the research findings and data contained in this report. All of the information details included in this report are based upon the existent land area conditions, research provided and obtained, and so forth at the time Ecoscape (Australia) Pty Ltd conducted its analysis into the area. Ecoscape (Australia) Pty Ltd will not be responsible for the application of its recommended strategies by **Cottesloe Coastcare**.

Please note that the strategies devised in this report may not be directly applicable towards another Community Group's needs or any other specific land area requiring management strategies. We would also warn against the environmental dangers of adapting this report's strategies to another land area which has not been researched and analysed by Ecoscape (Australia) Pty Ltd. Instead, please contact Ecoscape (Australia) Pty Ltd to provide a tailored report for your area's needs. Otherwise, Ecoscape (Australia) Pty Ltd accepts no liability whatsoever for a third party's use of, or reliance upon, this specific report.

Direct all inquiries to:

**Ecoscape (Australia) Pty Ltd**

9 Stirling Highway • PO Box 50 North Fremantle WA 6159

Ph: (08) 9430 8955 Fax: (08) 9430 8977

[mail@ecoscape.com.au](mailto:mail@ecoscape.com.au)



**ecoscape**

**COPYRIGHT STATEMENT FOR:  
North Cottesloe Coastal Natural Areas Management Plan**

**Copyright © 1987-2005  
Ecoscape (Australia) Pty Ltd  
ABN 70 070 128 675**

Except as permitted under the *Copyright Act 1968 (Cth)*, the whole or any part of this report may not be reproduced by any process, electronic or otherwise, without the specific written permission of the copyright owner, Ecoscape (Australia) Pty Ltd. This includes microcopying, photocopying or recording of any parts of the report.

Neither may the information contained in this report be reproduced, transmitted or stored electronically in any form, such as in a retrieval system, without the specific written permission of Ecoscape (Australia) Pty Ltd.

# Table of Contents

## North Cottesloe Coastal Management Plan

<b>Acknowledgments .....</b>	<b>iii</b>
<b>Summary .....</b>	<b>iv</b>
<b>1.0 Introduction.....</b>	<b>1</b>
1.1 Study Area .....	1
1.2 Objectives .....	1
1.3 Aims.....	1
1.4 Methods .....	2
1.5 Community Consultation.....	2
<b>2.0 Planning Context .....</b>	<b>1</b>
2.1 Introduction .....	1
2.2 Relevant Documents .....	1
2.3 Relevant Environmental Projects.....	2
<b>3.0 Site Description .....</b>	<b>3</b>
3.1 Landform and Soils .....	3
3.2 Vegetation and Flora .....	3
3.2.1 <i>Vegetation</i> .....	3
3.2.2 <i>Indigenous Flora</i> .....	4
3.2.3 <i>Exotic Flora (Weeds)</i> .....	5
3.3 Bushland Condition .....	5
3.4 Fauna.....	6
<b>4.0 Plan for Management.....</b>	<b>7</b>
4.1 Weed Control .....	7
4.1.1 <i>Objectives</i> .....	7
4.1.2 <i>Strategy</i> .....	7
4.1.3 <i>Implementation</i> .....	10
4.1.4 <i>Monitoring and Evaluation</i> .....	12
4.1.5 <i>Recommendations</i> .....	13
4.2 Bushland Restoration .....	14
4.2.1 <i>Objectives</i> .....	14
4.2.2 <i>Strategy</i> .....	14
4.2.3 <i>Implementation</i> .....	16
4.2.4 <i>Recommendations</i> .....	20
<b>5.0 Recommendations &amp; Conclusions .....</b>	<b>21</b>
<b>References .....</b>	<b>23</b>
<b>Maps .....</b>	<b>25</b>
<b>Appendix One: Flora Inventory and Revegetation List .....</b>	<b>30</b>
<b>Appendix Two: Reference Sites for Vegetation.....</b>	<b>33</b>

---

**LIST OF TABLES**

Table 3.1 Vegetation Units within the Study Area.....	4
Table 3.2 Extent of Significant Weeds within the Study Area.....	5
Table 3.3 Extent of Bushland Condition Classes in Study Area .....	6
Table 4.1 Recommended Weed Control Techniques .....	11
Table 4.2 Site Characteristics Considered in prioritising Restoration .....	14
Table 4.3 Issues concerning rabbit control methods.....	18
Table 4.4 Indicative costs for Works .....	19
Table A1.1 Flora Inventory .....	30
Table A1.2 Revegetation List.....	31

**LIST OF MAPS**

Map 1 Study Area .....	26
Map 2 Vegetation .....	27
Map 3 Weeds.....	28
Map 4 Bushland Condition .....	29

**LIST OF PLATES**

Plate 1 Foredune.....	33
Plate 2 Cliffs.....	33
Plate 3 Mobile Dune .....	34
Plate 4 Swale .....	34
Plate 5 Stable Dune .....	35

# Acknowledgments

## North Cottesloe Coastal Management Plan

Ecoscope would like to acknowledge the input of all those who contributed to this Management Plan, including the following individuals:

Brett Dal Pozzo, North Metropolitan Coastcare Officer

Mike Ewing, President of Cottesloe Coastcare

Robyn Benken, Cottesloe Coastcare

Luke Handcock, GIS officer Town of Cottesloe

Geoff Trigg, Engineering Services Town of Cottesloe

Peta Varvell, Cottesloe Coastcare

Robert Powell

Jan Walker, Cottesloe Coastcare

# Summary

## North Cottesloe Coastal Management Plan

The coastal reserve for North Cottesloe (9.5 km WSW of the Perth CBD) covers approximately 4.35 hectares between North Street and Forrest Street from the high tide mark eastward to Marine Parade and including Grant Marine Park.

Whilst the entire study area is degraded the vegetation of the study area contributes significantly to the protection of infrastructure through erosion control, forms part of a continuous vegetated corridor along the Perth coast and contributes to the amenity of the area.

Five vegetation units were mapped and a sixth unit was identified but was too small to map. The vegetation and flora of the study area is largely representative of the flora of the Quindalup Dune System but there are relatively few native species present due to the small size and degraded state of the study area. A total of 35 species were recorded onsite, of which 16 were weeds.

No systematic survey was undertaken for fauna but the native Bobtail (*Tiliqua rugosa* subsp. *rugosa*) was observed in the study area as were signs (scats) of introduced rabbits (*Oryctolagus cuniculus*).

There are significant opportunities to improve the condition of the bushland over the next five years, and the cover on the Cottesloe dunes has substantially increased in the last 20 years. A total of 24 recommendations are made in this report, 15 of which are high priorities.

# 1.0 Introduction

## North Cottesloe Coastal Management Plan

### 1.1 Study Area

The coastal reserve for North Cottesloe covers approximately 4.35 hectares and is located 9.5 km WSW of the Perth CBD, as shown in Map 1

Longitudinally, it is located from North Street and south to Forrest Street. Laterally, it is located from the high tide mark eastward to Marine Parade, and includes Grant Marine Park.

The study area is entirely vested with the Town of Cottesloe.

### 1.2 Objectives

This management plan has been commissioned by the Cottesloe Coastcare with the objectives of providing guiding information in the form of maps, strategies and management recommendations to enhance the coastal reserve within the North Cottesloe coastal reserve.

The North Cottesloe Coastal Management Plan is intended to provide benchmark data for use in addressing future coastal management issues and provide strategic guidance to the Town of Cottesloe and Cottesloe Coastcare, both of whom undertake active management of the coastal reserve.

The responsibilities of particular parties with respect to the implementation of this plan was excluded from this management plan on the basis that this was best determined by negotiation between stakeholders after the plan was endorsed by the Town of Cottesloe.

The objectives for this management plan were to develop recommendations but did not include detailed implementation plans for works, nor was infrastructure (such as signs, paths and fences) a focus of the project.

### 1.3 Aims

The aims of the project are:

- improve environmental values of the coastal reserve;
- reduce the impact of threatening processes on the reserve including weed invasion, loss of vegetation and human disturbance;
- mapping of environmental attributes such as vegetation communities, bushland condition, coastal geomorphology and weed distribution;
- preparation of site specific action and management guidelines for the conservation of local biodiversity including the revegetation of areas that have been severely degraded.

## **1.4 Methods**

The site was traversed in the first two weeks of May 2005. The location of weeds were recorded with a GPS and transferred directly into Arcview 3.2.

The vegetation for Cottesloe was interpreted and mapped at a scale of 1:2000. Monocultures of native plant species were also mapped within these vegetation associations where they were identified at the scale of mapping.

The study area was divided into two sectors in the maps to optimise layouts and not as a reflection of management considerations.

## **1.5 Community Consultation**

The draft North Cottesloe Management Plan was made available for public comment from 29<sup>th</sup> August 2005 to 24<sup>th</sup> September after it was advertised in the local newspaper and Town of Cottesloe website. Comments were received from Peta Varvell, Robyn Benken, Robert Powell and Jan Walker and these were incorporated where they were deemed appropriate and within the scope of the project.

## 2.0 Planning Context

### North Cottesloe Coastal Management Plan

## 2.1 Introduction

To ensure this Management Plan is consistent with other local, regional and national management initiatives, relevant documents, guidelines and policies were reviewed and brief outlines of these documents are given below.

## 2.2 Relevant Documents

### ***North Cottesloe Draft Management Plan (Carrie Pritchard, 2002)***

This management plan discusses the management of Grant Marine Park. The plan identifies the requirement to define boundaries between lawn and native vegetation and focuses on the management of pedestrian access and areas requiring rehabilitation. The plan lists 21 plant species onsite, of which 6 are weeds, and recommends species for revegetation.

### ***South Cottesloe Foreshore Management Plan (Quilty Environmental, 1999)***

The main focus of the South Cottesloe Management Plan is on dune rehabilitation and revegetation with additional recommendations on access, infrastructure and weed control. The dune rehabilitation strategy provides a planting list based on zones of vegetation succession in coastal dunes in the south-west as described by Smith (1973). Existing dominant species present within the foreshore are described; however no detailed vegetation inventory was compiled perhaps due to the degraded nature of the coastline. The area is split into 17 sectors with detailed recommendations made on revegetation; however information on weed control is limited.

### ***Draft Coastal Management Plan, Town of Cottesloe (Dept. Conservation and Environment, 1986)***

The Draft Coastal Management Plan for Cottesloe makes recommendations on improving beach access, upgrading toilets and other facilities, protecting sensitive areas of dune vegetation from pedestrian traffic, and landscaping to improve the amenity of the area. The main focus of the report is on managing usage pressures, improving facilities and access.

### ***Western Suburbs Greening Plan (Ecoscape, 2002)***

The Greening Plan sets out a framework to maintain and enhance linkages between open space, parks and recreational areas to bushland to enhance the ecological processes and the amenity of the region.

The study area is identified as part of the 'Coastal Link' Regional Greenway.

---

## 2.3 Relevant Environmental Projects

Relevant environmental projects being undertaken, as identified by the Town of Cottesloe are:

- South Cottesloe Foreshore Implementation – Coastwest funding;
- Best practice in restoration and coastal management, North Cottesloe – Envirofund;
- Restoring Biodiversity and habitat of remnant vegetation Mudurup rocks, Cottesloe – Envirofund;
- Improvement to Grant Marine Park;
- Birds of the Leighton Peninsular pamphlet in conjunction with Birds Australia and local governments from Cottesloe, Mosman Park and Peppermint Grove – Lotterywest funding pending;
- Various coastal restoration works
- Cottesloe Fish Habitat Protection Area;
- Beach Health Program; and
- Seedbank Project coordinated by the Swan Catchment Council and in partnership with APACE and Conservation Volunteers Australia.

## 3.0 Site Description

### North Cottesloe Coastal Management Plan

### 3.1 Landform and Soils

At the regional (1:250 000) scale landforms were mapped by Heddle *et al.* (1980), the entire study area is identified as being contained within the Cottesloe landform unit of the Spearwood Dune System. This unit consists of shallow yellow brown sand and exposed limestone. However the study area, except Grant Marine Park is immediately adjacent to the beach, and would more accurately be described as being part of the Quindalup Unit (within the Quindalup Dune System) which consists of calcareous sands and occurs as beach ridges and parabolic dunes along the Perth coastline.

### 3.2 Vegetation and Flora

#### 3.2.1 Vegetation

Vegetation classification and mapping in coastal areas needs to be undertaken in the context that the rigid application of height and cover classes would lead to the proliferation of units on the basis of minor differences as:

- Vegetation height is influenced by wind and salt-pruning;
- The depth of soil and position can result in marked variations in density of small distances; and
- The vegetation is dynamic due to regeneration and successional processes (Trudgen, 1991).

There were 5 vegetation units mapped in the study area, as well as an area of limestone rocks. These units are defined in Table 3.1, their distribution shown in Map 2 and photographs of reference sites included in Appendix 2.

**Table 3.1 Vegetation Units within the Study Area**

Landform/vegetation Unit	Extent (ha)	Vegetation Description at Reference Site
Cliffs	0.43	Closed Low Heath of <i>*Tetragonia decumbens</i> , <i>Carpobrotus</i> species and <i>*Trachyandra divaricata</i>
Foredune	1.52	Low Shrubland of <i>Ficinia nodosa</i> , <i>Spinifex hirsutus</i> , <i>*Tetragonia decumbens</i> , <i>*Pelargonium capitatum</i> , <i>*Trachyandra divaricata</i> , <i>Olearia axillaris</i>
Mobile Dune	1.42	Closed Low Heath of <i>Spinifex longifolius</i> , <i>*Tetragonia decumbens</i> , <i>*Trachyandra divaricata</i> , <i>Scaevola crassifolia</i> , and <i>Myoporum insulare</i>
Stable Dune	0.76	Low Open Woodland of <i>Agonis flexuosa</i> over Shrubland of <i>Spyridium globulosum</i> and <i>Scaevola crassifolia</i> over Closed Low Heath of <i>Acanthocarpus preissii</i> , <i>Lepidosperma gladiatum</i> , <i>Conostylis candicans</i> , <i>Olearia axillaris</i> , <i>Acacia lasiocarpa</i> , <i>*Trachyandra divaricata</i> and <i>Lomandra maritima</i>
Swale	0.07	Shrubland of <i>Spinifex longifolius</i> , <i>Scaevola crassifolia</i> , <i>Olearia axillaris</i> , <i>*Pelargonium capitatum</i> , <i>*Tetragonia decumbens</i> , <i>*Trachyandra divaricata</i> , <i>Rhagodia baccata</i> , <i>Carpobrotus</i> species

There is also the *Strand* unit, which occurs between the high water mark and the foredune, which was not mapped due to the very small extent in the study area. This vegetation is highly dynamic and typically consists of the introduced species *Cakile maritima* and *Arctotheca populifolia* (Smith, 1973).

### 3.2.2 Indigenous Flora

The vegetation of the Quindalup Dunes is relatively species-poor (with an average of 11 species per 10m<sup>2</sup> quadrat) (Cresswell & Bridgewater, 1985) but due to the small size and degraded condition of the North Cottesloe study area even fewer indigenous species were recorded. A total of 19 native species were recorded onsite.

However, whilst the vegetation of the Quindalup dunes forms a fine mosaic (Cresswell & Bridgewater, 1985), at a regional scale of the Swan Coastal Plain the floristics are consistent and therefore species that would have occurred onsite can be inferred.

Close to the coast vegetation is fairly homogenous and the same species may be found for hundreds of kilometres and as a result more than 50% of the plants described in *Plants of the Perth Coast and Islands* often are distributed along most of Australia's southern coast and 10% occur in all mainland states (Ripley & Rowland, 1995). This widespread distribution of coastal plants is reflected by Oma *et al.* (1992) providing only one set of revegetation specifications for all coastal dunes south of Kalbarri in Western Australia.

The native species that are to be used for revegetation in the study area are listed in Appendix 1, Table A1.2.

### 3.2.3 Exotic Flora (Weeds)

The sixteen weeds were identified within the study area, as listed in Appendix 1. The distributions of nine weeds are shown in Map 3 and the extent of twelve significant weed species are indicated in Table 3.2.

**Table 3.2 Extent of Significant Weeds within the Study Area**

Weed	Distribution	Extent (ha)	Density
<b>Agave –</b> <i>Agave americana</i>	See Map 3	28 plants	NA
<b>Marram Grass –</b> <i>Ammophila arenaria</i>	See Map 3	0.24	Low
<b>Norfolk Island Pine –</b> <i>Araucaria heterophylla</i>	See Map 3	2 plants	NA
<b>Pigface –</b> <i>Carpobrotus species*</i>	See Map 3	0.17	Low
<b>Horse Tail Sheoak</b> <i>Casuarina equisetifolia</i>	See Map 3	1 plant	NA
<b>Black Flag</b> <i>Ferraria Crispa</i>	Grant Marine Park	Not mapped – area not calculated	NA
<b>Victorian Teatree –</b> <i>Leptospermum laevigatum</i>	See Map 3	40 plants - 0.15	Low - High
<b>Lupin</b> <i>Lupinus spp.</i>	Southern part of Grant Marine Park	Most plants now removed	NA
<b>Beach Evening Primrose</b> <i>Oenothera drummondii</i>	Throughout Study Area	Not mapped – area not calculated	Low
<b>Pelargonium –</b> <i>Pelargonium capitatum</i>	See Map 3	0.76	Low - High
<b>Tamarix –</b> <i>Tamarix aphylla</i>	See Map 3	1 Plant	NA
<b>Sea Spinach –</b> <i>Tetragonia decumbens</i>	Throughout Study Area	Not mapped – area not calculated	Generally Very High
<b>Onion Weed –</b> <i>Trachyandra divaricata</i>	Throughout Study Area	Not mapped – area not calculated	Moderate
<b>Lawn Grasses –</b> <i>Various species</i>	See Map 3	0.66	Low in Grant Marine Park – High elsewhere

\*Spring survey required to determine whether this is *Carpobrotus virescens* (a pink-flowering native) or *Carpobrotus edulis* (a yellow-flowering weed).

### 3.3 Bushland Condition

The North Cottesloe foreshore reserve has experienced a long history of degradation through high levels of public use and uncontrolled public access across the dune systems. This has resulted in the foreshore dunal vegetation becoming *Degraded* to *Completely Degraded* and the current risks from erosion to infrastructure currently being experienced to Marine Parade dual use path, north of Grant Street, and the North Cottesloe Surf Life Saving Club.

Whilst the entire study area is degraded as is indicated in Map 4 and Table 3.3, the vegetation of the study area contributes significantly to the protection of infrastructure through erosion control, forms part of a continuous vegetated corridor along the Perth coast and contributes to the amenity of the area.

**Table 3.3 Extent of Bushland Condition Classes in Study Area**

<b>Keighery Condition Scale (Keighery 1994)</b>	<b>Extent (ha)</b>
<b>Pristine</b> Pristine or nearly so, no obvious signs of disturbance	0.00
<b>Excellent</b> Vegetation structure intact; disturbance affecting individual species; weeds are non-aggressive species	0.00
<b>Very Good</b> Vegetation structure altered; obvious signs of disturbance	0.00
<b>Good</b> Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.	0.00
<b>Degraded</b> Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.	2.69
<b>Completely Degraded</b> The structure of the vegetation is no longer intact and the area is completely or almost completely without native species	1.50

Whilst the site is degraded, the cover on the Cottesloe dunes has substantially increased in the last 20 years (Quilty Environmental, 1999), and there are significant opportunities to improve the condition of the bushland over the next five years. The site has had significant levels of revegetation undertaken and the foredune in front of North Cottesloe Surf Lifesaving Club is shown as being entirely bare of vegetation after Cyclone Alby in 1978 in the *Coastal Rehabilitation Manual* (Oma *et al.*, 1992).

Infrastructure such as signs, paths and fences were not a focus of this project. However eight drains were identified in the study area and those that deliver water directly into bushland areas have a direct detrimental impact on bushland condition and these drains are shown in Map 4.

### 3.4 Fauna

No systematic survey was undertaken for fauna but the native Bobtail (*Tiliqua rugosa* subsp. *rugosa*) was observed in the study area. There were also signs (scats) of introduced rabbits (*Oryctolagus cuniculus*) throughout much of the study area.

## 4.0 Plan for Management

### North Cottesloe Coastal Management Plan

## 4.1 Weed Control

### 4.1.1 Objectives

The objectives for weed control are to:

- reduce the extent and/or density of targeted weeds;
- prevent introduction of additional weed species;
- prevent increases in weed density and distribution for non-targeted weeds;
- minimise detrimental impacts of the weed control programme such as destabilisation of dunes and off target impacts on the native biota;
- integrate the weed control programme with bushland restoration programmes;
- improve the visual amenity of the coastal reserve;
- reduce potential fire risk.

### 4.1.2 Strategy

#### **Agave - *Agave americana***

A total of 28 Agave plants were observed during the study, as two infestations. The most effective means of control is removal of the entire plant, including roots, by hand. At present these infestations largely consist of small plants and the removal of all plants is achievable with relatively little investment of labour. There are also some introduced *Crassula* plants associated with the northern Agave infestation and these should be removed simultaneously.

#### **Norfolk Island Pine – *Araucaria heterophylla***

One Norfolk Island Pine is located adjacent to the North Cottesloe Surf Lifesaving and another is on the same side of the path as the bushland in Grant Marine Park. Neither of these trees poses a threat of weed invasion into the bushland and can be retained for their amenity, unless the Town of Cottesloe develops a policy of removing such exotics from bushland areas.

#### **Marram Grass - *Ammophila arenaria***

A number of weeds onsite such as *Ammophila arenaria* would have been intentionally established to control erosion. The manual removal of such weeds could destabilise the dunes on which they occur and *Ammophila arenaria* (Marram Grass) dies out quickly where there is competition from other plants (Rippey & Rowland, 1995). Therefore only the two small infestations of Marram Grass immediately north of the North Cottesloe Surf Lifesaving (refer to Map 3) should be removed and control of the larger infestations be undertaken concurrently with the re-establishment of native species.

#### **Pigface - *Carpobrotus virescens***

Pigfaces (*Carpobrotus* species) are distributed irregularly through the study area as distinct clumps. There are two species of *Carpobrotus* in the study area, *Carpobrotus virescens* (which is a pink-flowering native) and *Carpobrotus edulis* (which is a yellow-flowering weed).

The morphological differences between these species are subtle and they can be difficult to

distinguish, except when they are flowering in spring. Therefore a control strategy should be developed after a spring survey determines the distribution of the exotic Pigface.

**Horse Tail Sheoak - *Casuarina equisetifolia***

One plant is located next to a carpark at the southern end of the study area. This is not invading into the bushland area and can be retained for its amenity value.

**Black Flag - *Ferraria crispa***

A small outbreak of this highly invasive annual has been recorded in Grant Marine Park. This species is widespread along the South Cottesloe Foreshore. The opportunity should be taken to control this outbreak through manual removal before it spreads further and monitor carefully.

**Victorian Teatree - *Leptospermum laevigatum***

Approximately 40 Victorian Teatrees were located in the study area. This includes both mature plants and seedlings. Generally the distribution is that of scattered individual plants that can be poisoned or removed without intensive revegetation of the site. In areas where revegetation is not required the removal of Victorian Teatrees can commence as soon as resources become available.

The exception to this is in front of the North Cottesloe Surf Lifesaving Club, due to the high visibility and proximity of the dense stands present. The removal of Victorian Teatrees on the western and southern sides of the Club will have a direct impact on the amenity. Therefore a revegetation plan needs to be developed prior to the removal of these weeds.

**West Australian Blue Lupin - *Lupin cosentinii***

An annual located on the southern side of Grant Marine Park requires hand removal prior to maturation in Spring, and further monitoring.

**Beach Evening Primrose - *Oenothera drummondii***

Beach Evening Primrose is distributed in relatively low density throughout most of the study area. The control of this weed is a low priority for the study area given its generally degraded state and the presence of more serious weeds.

**Pelargonium - *Pelargonium capitatum***

*Pelargonium capitatum* was generally recorded in greatest abundance in the small swales immediately behind the foredune. However its low abundance in Grant Marine Park reflects the intensive Pelargonium removal program that has already been undertaken there, with the plants being recorded in Grant Marine Park being small seedlings. Having had such intensive efforts already invested in this area, then follow-up removal of such germinants is a very high priority.

Given the extent and distribution of Pelargonium in the study area, with the exception of Grant Marine Park where eradication efforts should continue, the focus of control should be on containment and the removal of plants outside the major infestations.

**Tamarix – *Tamarix aphylla***

One individual Tamarix plant was located. This is a serious weed species in coastal environments and should be removed as a priority.

**Sea Spinach - *Tetragonia decumbens***

*Tetragonia decumbens* is the dominant plant through most of the study area. The areas of greatest density of *Tetragonia decumbens* in the study area mimics that observed along the Mandurah Coastline by Trudgen (1991). That is, it tends to dominate areas disturbed by wind erosion (sometimes initiated by wave erosion). This ability to colonise highly hostile environments explains why *Tetragonia decumbens* is the only plant occurring in significant amounts on the cliff areas of the study area.

No control of *Tetragonia decumbens* is proposed onsite given that:

- a significant reduction in its abundance or extent is not likely to be practical;
- it is naturalised throughout the entire study area;
- it is the dominant plant in the study area; and
- it is unlikely to increase in density or distribution in the absence of control.

In areas where future revegetation works are to be undertaken areas of *Tetragonia* can be blanket sprayed prior to planting. This forms a dense organic matting for stabilisation during native plant establishment, and is currently used as a method along the Perth coast.

**Onion Weed - *Trachyandra divaricata***

Onion Weed is distributed at moderate density throughout most of the study area. Onion weed is considered a serious weed that has the potential to invade into relatively good condition bushland.

No control of *Trachyandra divaricata* is proposed onsite given that:

- a significant reduction in its abundance or extent is not likely to be practical;
- it is naturalised throughout the entire study area; and
- it is unlikely to increase in density or distribution in the absence of control.

**Exotic Lawn grasses, Couch - *Cynodon dactylon*, Buffalo – *Stenotaphrum secundatum*, Kikuyu- *Pennisetum clandestinum***

Control of all exotic lawn grasses is a high priority and an integrated approach should be utilised in their control, including herbicide application, separation of grassland and bushland areas, removal of drain outlets and revegetation. The issues of drains and revegetation areas are discussed below in section 4.2.

Currently the western edge of the dual use path along the coast is dominated by grass and is invading the coastal reserve, particularly in damp areas and along drainage outlets. Control of grasses along the edge of paths adjacent to foreshore reserves should be undertaken in conjunction with replanting with appropriate species based of safety and maintenance requirements. Appropriate compact species may include *Conostylis candidans*, *Grevillia crithmifolia*, *Hemiandra pungens* and *Leucophyta brownii*.

Grasses are also at low densities in Grant Marine Park and this is the area of highest priority given that these grasses will compete directly with seedlings that are being established onsite.

### 4.1.3 Implementation

#### Weed Control

There are two main methods for controlling weeds: manual control and herbicide application.

##### Manual Control

Manual control refers to the physical removal of the weed by mechanical or human effort. This includes hand weeding, pulling and digging or grubbing out and relates to small infestations of weeds (Dixon and Keighery, 1995). It is often the most expensive form of weed removal but can be the most appropriate method where there are small infestations in areas where bushland can naturally regenerate and are not prone to erosion.

Manual control needs to be carefully managed in order to avoid gross soil disturbance which can encourage further weed infestation and erosion.

##### Herbicide Control

The application of herbicides is often the most cost-effective method for weed control and a wide range of herbicides are available for different weed species.

Dixon and Keighery (1995) identified the following methods of herbicide application:

1. Stem Injection – use a small axe to make cuts at 8 cm intervals at a 45° angle and 4-5 cm long to penetrate the sapwood beneath the bark, or drill at 45° angle with holes 5 cm apart. If the plant is multi-stemmed, treat all stems at chest height. Use a special injector calibrated to deliver the right amount or use a syringe;
2. Cut Stump Application – when the plant is actively growing, cut the stump almost to ground level and apply the herbicide immediately using a paint brush;
3. Herbicide Wipe - wipe herbicide onto part of the plant (for example a leaf/leaves) using a weeding wand, wick applicator (rope), waterproof (pesticide resistant) glove or modified hand sprayer;
4. Spot Spraying - spraying, avoid spraying non-target species unless using selective herbicides such as Fusilade®. Special shields can be purchased or, if necessary, made for spraying close to non-target species; and
5. Blanket Spraying - spraying over large area using boom with a selective herbicide that will not kill desirable plants in area being sprayed.

The first two options are used on shrubs and trees and the other two options are used for all other weeds. The last option, blanket spraying will not generally be appropriate in the study area.

Control of Weeds in Study Area

The recommended techniques for weeds in the study area are listed in Table 4.1.

**Table 4.1 Recommended Weed Control Techniques**

<b>Weeds</b>	<b>Recommended controls</b>
Agave – <i>Agave americana</i>	<b>Manual removal</b> Dig out small infestations <b>Chemical control</b> Stem injection in base leaves 1 part Tordon® / 5 parts diesel.
Norfolk Island Pine – <i>Araucaria heterophylla</i>	No control recommended
Marram Grass – <i>Ammophila arenaria</i>	<b>Manual removal</b> Encourage competing native plants amongst small infestations <b>Chemical control</b> Spray with glyphosate 1% + penetrant.
Pigface – <i>Carpobrotus virescens</i>	<b>Manual removal</b> Roll up mats including roots and remove roots and germinants <b>Chemical control</b> Spray with glyphosate at label rates
Horse Tail Sheoak – <i>Casuarina equisetifolia</i>	No control recommended
Black Flag – <i>Ferraria crispa</i>	<b>Manual removal</b> Due to disturbance caused only isolated individuals may be handweeded, sifting the soil to ensure the removal of all the corms. <b>Chemical control</b> metsulfuron methyl (0.2g/15L) + glyphosate 1%
Victorian Teatree – <i>Leptospermum laevigatum</i>	<b>Manual removal</b> Hand pull seedlings; fell mature plants <b>Chemical control</b> Resprouting has been recorded in some areas so may need to basal bark spray with triclopyr + picloram.
West Australian Blue Lupin – <i>Lupin cosentinii</i>	<b>Manual removal</b> Most plants now removed - hand pull seedlings
Beach Evening Primrose – <i>Oenothera drummondii</i>	No control recommended
Pelargonium – <i>Pelargonium capitatum</i>	<b>Manual removal</b> Hand pull isolated plants taking care to remove entire stem <b>Chemical control</b> Spot spray metsulfuron methyl 5 g/ha + Pulse. Easy to target after fire
Tamarix – <i>Tamarix aphylla</i>	<b>Chemical control</b> Inject neat glyphosate into root crown or cut and paint 30% triclopyr, basal bark or spray regrowth <b>Manual removal</b> Remove once dead
Sea Spinach – <i>Tetragonia decumbens</i>	No control recommended
Onion Weed – <i>Trachyandra divaricata</i>	No control recommended
Exotic Lawn grasses, Couch - <i>Cynodon dactylon</i> , Buffalo – <i>Stenotaphrum secundatum</i> , Kikuyu- <i>Pennisetum clandestinum</i>	spray with 1% glyphosate or Fusilade 10ml / L + wetting agent, 2-3 applications over growing season required.

When weeds are being removed from coastal areas then native plants need to be established to replace them to prevent the dunes becoming destabilised and eroded, and weeds quickly re-establishing. The coastal environment is very susceptible to erosion and therefore any weed control must be carefully staged, and integrated with revegetation to avoid causing erosion problems.

#### **Costs**

The costs of weed control per hectare can vary occurring to access, size of area, herbicides used, density of weeds, number of times the site each year, number and types of weed species. The cost of a commercial herbicide sprayer is in the order of \$650 per day.

#### **4.1.4 Monitoring and Evaluation**

Monitoring and evaluation are key actions that need to be undertaken during weed management to measure the success of control strategies. Performance indicators should be developed to objectively assess the success of weed control strategies. This will not only contribute to accountability where public funds are involved, but also provide a mechanism for modifying the strategy and maintaining its flexibility.

When monitoring site specific projects, the following strategies are suggested:

- Establish monitoring quadrats in areas subject to weed control programs to record the effectiveness of control methods;
- Monitor the effectiveness of different control methods used (manual vs. chemical control; spot spray vs. blanket spray; contractor vs. community control). The use of photographs from set points enhances this process; and
- Monitor quadrats for establishment of new weed species.

#### **Performance Criteria**

In order to determine the effectiveness of any weed control program, there needs to be a method of determining success and ongoing progress. The following gives examples of the factors that could be assessed:

- Removal of a set number of priority weed species (say four or five) from the targeted areas over the next five years;
- Reduction in the area of priority weed infestations by 5% over 5 years; and
- Reduction in the total number of weed species present by 5% over 5 years.

#### 4.1.5 Recommendations

Recommendations	Priority
1. Manually remove all <i>Agave americana</i> individuals (approx. 28)	High
2. Remove three small <i>Ammophila arenaria</i> populations in southern portion of study area	Moderate
3. Plant competing native species amongst larger <i>Ammophila arenaria</i> populations in northern portion of study area	Moderate
4. Survey <i>Carpobrotus</i> species during flowering period (August – September) to determine which plants are <i>Carpobrotus virescens</i> (native) and which are <i>Carpobrotus edulis</i> (weed)	High
5. Determine strategy for removal of <i>Carpobrotus edulis</i> after spring survey	Moderate
6. Remove small <i>Ferraria crispa</i> population within Grant Marine Park and monitor.	High
7. Remove all <i>Leptospermum laevigatum</i> plants as soon as possible, except in immediate vicinity of North Cottesloe Surf Lifesaving Club	High
8. Develop revegetation plans for areas in immediate vicinity of North Cottesloe Surf Lifesaving Club where <i>Leptospermum laevigatum</i> is to be removed	Moderate
9. Remove all <i>Leptospermum laevigatum</i> plants in immediate vicinity of North Cottesloe Surf Lifesaving Club	Low
10. Remove <i>Lupin cosentinii</i> located on the southern side of Grant Marine Park through hand removal prior to maturation in Spring, and further monitoring.	High
11. Remove all <i>Pelargonium capitatum</i> reprints and germinates from Grant Marine Park	High
12. Control <i>Pelargonium capitatum</i> plants outside main populations identified in Map 3.	Moderate
13. Remove the one <i>Tamarix aphylla</i> plant from the study area	High
14. Control all exotic lawn grasses with the highest priority given to Grant Marine Park.	High
15. When revegetating lawn areas adjacent to pathways consider appropriate species based on safety and maintenance requirements.	High
16. No Action to be taken to control <i>Araucaria heterophylla</i> , <i>Casuarina equisetifolia</i> , <i>Oenothera drummondii</i> , <i>Tetragona decumbens</i> or <i>Trachyandra divaricata</i> .	NA
17. Develop a quadrat-based monitoring and evaluation program to measure the success of weed management strategies implemented. Key performance indicators based on number, extent and density of weeds.	Moderate

## 4.2 Bushland Restoration

### 4.2.1 Objectives

The objectives for bushland restoration are to:

- minimise the impact of activities that could result in degradation to vegetation;
- improve the overall condition of vegetation communities within the park;
- optimise use of resources by prioritising areas for restoration; and
- maintenance of a stable dune system, increasing resistance to wind and wave erosion.

### 4.2.2 Strategy

#### Prioritisation

The social and environmental factors considered in setting priorities for bushland restoration are outlined in Table 4.2.

**Table 4.2 Site Characteristics Considered in prioritising Restoration**

Priority	Social Characteristics	Environmental Characteristics
<b>Low</b>	<ul style="list-style-type: none"> <li>• No or limited public access;</li> <li>• Low visitation rates</li> <li>• Not visible from accessible areas</li> <li>• No views from site</li> <li>• Little or no opportunities for interpretation</li> </ul>	<ul style="list-style-type: none"> <li>• Very Poor-Poor Condition Bushland</li> <li>• Vegetation not degrading or unlikely to degrade either due to no degrading impacts or poor condition of bushland</li> <li>• Common vegetation in study area and region</li> <li>• No restoration being undertaken in area</li> </ul>
<b>Medium</b>	<ul style="list-style-type: none"> <li>• Limited public access;</li> <li>• Moderate visitation rates;</li> <li>• Limited interpretation Opportunities</li> <li>• Non-focal point in Public Area;</li> <li>• Moderate Visibility</li> <li>• Moderate views from site</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetation is or may degrade slowly</li> <li>• Fair-Good Condition Bushland</li> <li>• Vegetation common in Study Area</li> <li>• Restoration already scheduled for area</li> </ul>
<b>High</b>	<ul style="list-style-type: none"> <li>• High degree of public access</li> <li>• Highly visible</li> <li>• focal Point of Public Area</li> <li>• Extensive views from site</li> <li>• Wide range of activities facilitated</li> <li>• Unique activities</li> <li>• Extensive interpretation opportunities</li> <li>• Public Liability risks</li> <li>• Provides protection for infrastructure (e.g. coastal erosion) or public (e.g. industry buffer)</li> </ul>	<ul style="list-style-type: none"> <li>• Good – Excellent Bushland</li> <li>• Flora, fauna or vegetation uncommon in Study Area</li> <li>• Rare or significant species at regional scale</li> <li>• Significant degrading factors present (e.g. disease, changes in hydrology, noxious weeds, large perimeter to area ratio; adjacent areas in much poorer condition)</li> <li>• Significant degrading activities present (e.g. informal tracks being used)</li> <li>• Restoration currently being undertaken in area</li> </ul>

These characteristics provide a basis for assigning priorities to restoration efforts and it should be noted that all the characteristics for a particular level of priority are not expected to coincide at any one site. The table is intended to give a general indication of the relative

importance of undertaking work in an area rather than producing a rigid order of priorities and as such the table does not have a quantitative component.

### **Existing Rehabilitation Sites**

#### Unstable cliffs north of Grant Street

Geotextile bags, wooden revetments and Jutematting have been placed at two sites in the North Cottesloe Coastal Area in 2004, following slips in late 2003. Establishment of Spinifex species has been unsuccessful to date. *Tetragonia decumbens* is establishing on the edges of the slip, and may assist in restabilising this areas with time.

The Town of Cottesloe advises that further works are to be undertaken which will include sand renourishment and the planting of endemic species.

#### Grant Marine Park

Significant amounts of volunteer time, NHT and Coastwest grants have been invested within Grant Marine Park over the past two years. Resources have focused on control of access, reducing weed cover and the planting of locally indigenous seedlings.

Given the amount of weeds removed from the site and large amount of seedlings in early stages of establishment, ongoing input will be required onsite for a number of years. This will include hand weeding and the herbicide control of perennial grasses.

Cottesloe Coastcare advises further infill planting, species enrichment, hand weeding and herbicide control is to continue throughout 2005.

#### Swale at North Street

This site is on the municipal boundary of the Town of Cottesloe and City of Nedlands and this is the only site within the study area where there is an issue of potential conflicts regarding jurisdiction. Given the fact that the boundary doglegs between two paths, the strict demarcation of works along the municipal boundary is not practical and liaison should occur between the Local Government Authorities to ensure cost sharing and outcomes are to both parties satisfaction. There have been a significant number of seedlings planted at this site by the City of Nedlands.

### **Proposed Rehabilitation Sites**

#### Surrounds of North Cottesloe Surf Life Saving Club and adjacent buildings

Three sides of the North Cottesloe Surf Lifesaving Club in *Very Poor* condition require revegetation with a total area of 0.32 hectares.

The removal of weeds (and in particular *Leptospermum laevigatum*) on the western and southern sides of the Club will have a direct impact on the amenity. Therefore a revegetation plan needs to be developed prior to the removal of these weeds.

The areas to the north and south of the Club are completely degraded with limited amenity value, native plant species or structural diversity. Revegetating these areas will result in an increase in amenity as well as increasing the long term stability of the primary dune system.

### 4.2.3 Implementation

#### Revegetation Species

The vegetation of the Quindalup Dunes is relatively species-poor (with an average of 11 species per 10m<sup>2</sup> quadrat) (Cresswell & Bridgewater, 1985) but due to the small size and degraded state of the North Cottesloe study area not all the indigenous species that would have naturally occurred onsite have been retained.

Therefore species used for the revegetation within the study area should be based on what species would naturally occur onsite rather than only be restricted to those species presently recorded onsite during this project. A list of species suitable for each vegetation unit is included in Appendix 1. This list was developed on the basis of what species occurred in the study area, with additional species incorporated on the basis of references listed in this report in the study area.

Revegetation should include consideration of ecological niches that species fill such as *Olearia axillaris* being one of the first shrub species to colonise recently stabilised sand (Grasby, 1983), *Olearia axillaris* and *Rhagodia baccata* typically dominate the summits of dune ridges (Cresswell & Bridgewater, 1985) and *Lepidosperma gladiatum* grows particularly well in hollows (Rippey & Rowland, 1995).

Appropriate species should be selected when revegetating along the edge of paths adjacent to foreshore reserves based on safety and maintenance requirements. Appropriate compact, prunable species which do not obstruct pathways may include *Conostylis candidans*, *Grevillia crithmifolia*, *Hemiandra pungens* and *Leucophyta brownii*.

The use of *Agonis flexuosa* as a species for revegetation is uncertain as it is close to its northern most distribution (Bold Park). DNA fingerprinting of the existing species by the Botanical Parks and Garden Authority will confirm whether the species is native to the North Cottesloe foreshore.

Species from Appendix One would be strongly encouraged for use in amenity and landscape plantings by the Town of Cottesloe, in areas adjacent to the foreshore reserve. This would provide a more uniform character to the North Cottesloe landscape, reduce weed introduction and reduce water use.

#### Erosion

Erosion is not extensive in the study area. Areas that become eroded could be covered with brush material, mulch or matting to facilitate the revegetation of the area, and minimise pedestrian traffic through the area.

Brushing, mulching or matting protects the young plants and bare surfaces from erosive wind, sand blasting, sand creep and helps to conserve soil moisture, while creating a suitable environment for seed germination and establishment of young plants. Stabilising should incorporate strategic wind fencing, matting materials and intensive planting of dune stabilising species such as *Spinifex longifolius* and *hirsutus* along the front of foredunes.

Matting is used in areas with highly unstable dunes where new vegetation may not be able to establish unless the potential for soil movement is mitigated through stabilisation with matting or netting of some type.

Brushing has the added advantage of acting as a reservoir for wind blown sand and is a deterrent to pedestrians (Oma *et al.*, 1992). The presence of brush controls sand movement by impeding the surface wind flow, trapping sand and sheltering plants. *Melaleuca* and pine prunings are ideal brush materials as they retain leaves for long periods, increasing their ability to trap sand and protect the surface (Oma *et al.*, 1992).

Brushing material should not be utilised where there is a risk of erosion onto the strand due to issues of public risk and liability through injury to beach users. Brushing should be limited to less than 150mm deep, openly spaced, not to contain leaf material (fire risk), free of seed material to prevent weed introduction and to be less than 2cm in diameter to enable more rapid decomposition and aid soil making.

Mulching with locally available materials, which could include seaweed, will also stabilise sandy surfaces. No wood chips should be used due to lack of ability to decompose in the nitrogen depleted dune sands. Mulch has a much lower capacity than brush to trap sand, and will not protect seedlings from sand blasting or wind once pore spaces have been filled (Oma *et al.*, 1992). This technique is best used where sand drift and sand blasting are not an issue, in sheltered sites and dune swales. Thick layers of mulch can help retain soil moisture for seedlings whilst denying weed seeds access to light and thereby restricting their growth. Following the application of manual and herbicide weed control, weed-free mulch can be spread around seedlings in bare areas to help reduce weed growth. A light cover of mulch (1-2 cm deep) is recommended over the direct seeded areas. If there are large quantities of mulch available, then 5-10 cm is optimum for areas planted with seedlings. Care must be taken in sourcing mulch to ensure that it is not contaminated with weed seeds or disease.

An alternative, which could be explored if the results of mulching are unsatisfactory, is part way between the mulching and brushing: tritter. Tritter consists of guillotined brush material, which means that brush can lie flatter and interlock more, without as much pore space. Trittering would involve a higher cost than mulching.

### **Rabbits**

Evidence of rabbits was observed in the study area but rabbit numbers are low and in insufficient numbers to have a significant impact on the vegetation. This in part could be attributed to the narrowness of the study area, however suitable habitat areas occur in Grant Marine park and the swale area to the north of the study area. A baiting program has recently been implemented south of the study area, which has targeted major breeding areas and is expected to affect the entire area in the long term.

The additional options for rabbit control include warren fumigation and destruction, fencing, tree guards and biological control. However, these other methods have been found difficult to implement in coastal areas, are not as cost effective or as easy to maintain as the current baiting program. The considerations in choosing rabbit control methods are listed in Table 4.3.

**Table 4.3 Issues concerning rabbit control methods**

<b>Control Method</b>	<b>Considerations</b>
Baiting	Pindone® baiting already undertaken. There is the potential of poisoning of non-target species including domestic dogs but bait stations are used to reduce the risk and vitamin K can be used as an antidote for Pindone®
Fencing	Consideration needs to be given to the aesthetics, costs and possible effects on native animal species. Wire netting should have holes large enough for species such as Bobtails but not large enough for rabbits.
Warren Fumigation and Destruction	In coastal dunes rabbits usually reside amongst dense vegetation rather than establish extensive warrens and therefore warren fumigation is not appropriate
Tree guards	Tree guards can be effective in protecting seedlings in revegetation projects.
Biological Control	Whilst useful in controlling overall rabbit numbers, their impacts are variable and none of these diseases will result in the elimination of rabbits. Therefore it is crucial that biological controls are not relied upon alone for the sustained long-term effectiveness of rabbit control programs in Australia. (WA Ag Dept, 2004)

### **Fire**

Fire is not considered a major threat to the study area, because although it could destabilise portions of the study area it is likely that fire suppression would be highly effective in the area because:

- fuel loads are relatively low;
- the site is highly visible which would minimise the time it takes for a fire to be reported;
- there is a high level of access to the site for firefighters;
- fires will be contained by adjoining roads and beach; and
- the bushland is very narrow in the direction of the greatest slopes and prevailing winds, which is the direction in which fire would spread fastest.

If a fire should establish in the study area then fire suppression should be paramount, and the need to control access and weeds will need to be assessed as soon as practical after the fire.

### **Infrastructure**

Infrastructure such as signs, paths and fences were not a focus of the project, but some pertinent observations were made during the preparation of the management plan and these are discussed below.

### Drains

Eight drains were identified in the study area and six of these deliver water directly into bushland areas. These have a direct detrimental impact on the native vegetation by encouraging the proliferation of weeds, particularly exotic grasses. The outlets of these drains should therefore be closed and the water diverted elsewhere (preferably into developed areas, or if this is not feasible then onto the beach).

### Access

There is currently adequate access through the coastal dunes to the beach and this is controlled through fencing of bushland areas, and the provision of formal paths.

Uncontrolled access can contribute to the degradation of coastal areas. Areas at greatest risk from pedestrian traffic are generally narrow areas without large undulations, without dense vegetation and adjacent to focal points for people such as carparks and popular beaches. The areas of greatest risk in the study area are adjacent to the Forest Street car park and the North Cottesloe Surf Life Saving Club. These areas have already been fenced.

Additional areas have been prioritised for fencing as indicated in Map 4. The Town of Cottesloe has already developed a schedule for further fencing in the study area, including a project of fencing the western side of dunes along the Cottesloe foreshore. This will help to minimise the amount of dune degradation caused by opportunistic access through the dune system by beach users.

One submission to the draft management plan during public comment stated a desire for the dog exercise area to remain on the beach (time restrictions currently in place). The use of the beach is outside the scope of this management plan which only deals with the dunes and cliffs behind the beach. The impact of dogs on the bushland areas will not be significant if access is sufficiently controlled with fencing.

### Signage

Infrastructure was outside the scope of works for this management plan. There is considerable signage in the study area at present, most of a regulatory nature. Additional signage could be considered to educate the public about the values and fragility of the coastal dunes, and discourage the traffic of pedestrians and any domestic dogs through bushland areas.

### **Indicative Costs**

The costs of works will be highly variable depending upon the final form in which the recommendations are implemented (the degree to which volunteers undertake tasks; the style of signage used and the engineering constraints for diverting drains). As a result a detailed breakdown of costs for all items is not provided. Indicative costs of items with relatively fixed prices are listed in Table 4.4.

**Table 4.4 Indicative costs for Works**

<b>Works</b>	<b>Cost</b>	<b>Unit</b>
Fencing for access control	\$27	metre
Rabbit baiting	\$10	kg
Tubestock supply	\$1.20	each
Tubestock planting	\$0.67	each
Supply and install seedling guards	\$1.90	each

#### 4.2.4 Recommendations

Recommendations	Priority
18. Continue revegetation at Grant Marine Park & the Swale at North St	High
19. Liaise with City of Nedlands with regards to bushland management in vicinity of North St	High
20. Monitor two areas of jutematting for a further 12 months and reassess at this time	High
21. Develop Revegetation Plan for surrounds of North Cottesloe Surf Lifesaving Club & revegetate	Moderate
22. Determine whether <i>Agonis flexuosa</i> is native to North Cottesloe foreshore in consultation with Botanical Parks and Garden Authority prior to use in revegetation projects.	Moderate
23. Remove/redirect the six drains in the study area that deliver water into the bushland	High
24. Continue fencing the western side of dunes based on priorities shown on Map 4	High
25. Continue placing signage and brushing of bare areas and informal access tracks to discourage access into the dunes after fencing western sides of dunes.	High

## 5.0 Recommendations & Conclusions

### North Cottesloe Coastal Management Plan

Whilst the entire study area is degraded the vegetation of the study area contributes significantly to the protection of infrastructure through erosion control, forms part of a continuous vegetated corridor along the Perth coast and contributes to the amenity of the area.

There are also significant opportunities to improve the condition of the bushland over the next five years, and the cover on the Cottesloe dunes has substantially increased in the last 20 years. To improve the condition of the study area a total of 25 recommendations are made below, ten of which are high priorities.

Recommendations	Priority
1. Manually remove all <i>Agave americana</i> individuals (approx. 28)	High
2. Remove three small <i>Ammophila arenaria</i> populations in southern portion of study area	Moderate
3. Plant competing native species amongst larger <i>Ammophila arenaria</i> populations in northern portion of study area	Moderate
4. Survey <i>Carpobrotus</i> species during flowering period (August – September) to determine which plants are <i>Carpobrotus virescens</i> (native) and which are <i>Carpobrotus edulis</i> (weed)	High
5. Determine strategy for removal of <i>Carpobrotus edulis</i> after spring survey	Moderate
6. Remove small <i>Ferraria crispa</i> population within Grant Marine Park and monitor.	High
7. Remove all <i>Leptospermum laevigatum</i> plants as soon as possible, except in immediate vicinity of North Cottesloe Surf Lifesaving Club	High
8. Develop revegetation plans for areas in immediate vicinity of North Cottesloe Surf Lifesaving Club where <i>Leptospermum laevigatum</i> is to be removed	Moderate
9. Remove all <i>Leptospermum laevigatum</i> plants in immediate vicinity of North Cottesloe Surf Lifesaving Club	Low
10. Remove <i>Lupin cosentinii</i> located on the southern side of Grant Marine Park through hand removal prior to maturation in Spring, and further monitoring.	High
11. Remove all <i>Pelargonium capitatum</i> re-sprouts and germinates from Grant Marine Park	High
12. Control <i>Pelargonium capitatum</i> plants outside main populations identified in Map 3.	Moderate
13. Remove the one <i>Tamarix aphylla</i> plant from the study area	High
14. Control all exotic lawn grasses with the highest priority given to Grant Marine Park.	High
15. When revegetating lawn areas adjacent to pathways consider appropriate species based on safety and maintenance requirements.	High

16. No Action to be taken to control <i>Araucaria heterophylla</i> , <i>Casuarina equisetifolia</i> , <i>Oenothera drummondii</i> , <i>Tetragonia decumbens</i> or <i>Trachyandra divaricata</i> .	NA
17. Develop a quadrat-based monitoring and evaluation program to measure the success of weed management strategies implemented. Key performance indicators based on number, extent and density of weeds.	Moderate
18. Continue revegetation at Grant Marine Park & the Swale at North St	High
19. Liaise with City of Nedlands with regards to bushland management in vicinity of North St	High
20. Monitor two areas of jute matting for a further 12 months and reassess at this time	High
21. Develop Revegetation Plan for surrounds of North Cottesloe Surf Lifesaving Club & revegetate	Moderate
22. Determine whether <i>Agonis flexuosa</i> is native to North Cottesloe foreshore in consultation with Botanical Parks and Garden Authority prior to use in revegetation projects.	Moderate
23. Remove/redirect the six drains in the study area that deliver water into the bushland	High
24. Continue fencing the western side of dunes based on priorities shown on Map 4	High
25. Continue placing signage and brushing of bare areas and informal access tracks to discourage access into the dunes after fencing western sides of dunes.	High

# References

## North Cottesloe Coastal Management Plan

- Cresswell ID & Bridgewater PB (1985) Dune Vegetation of the Swan Coastal Plain, Western Australia, in *Journal of the Royal Society of Western Australia*, Vol. 67, Parts 3 & 4, pp 137-148, Royal Society of Western Australia, Perth.
- Dixon, B and Keighery, G (1995) Weeds and their Control. In: Scheltema M and Harris J (Eds) *Managing Perth's Bushlands* Pp. 65-141. Greening WA, Perth, Western Australia.
- Ecoscope (2002) *Western Suburbs Greening Plan*. Western Suburbs Regional Organisation of Councils, Perth, W.A.
- Grasby JC (1983) *Common Plants of the Coastal Dunes – Farmnote 169/83*, Department of Agriculture, Perth.
- Hesp PA, Wells MR, Ward BHR & Riches JRH (1983) *Land Resource Survey of Rottnest Island, An Aid to Land Use Planning – Bulletin 4086*, Western Australian Department of Agriculture, Perth.
- Keighery, BJ (1994) *Bushland Plant Survey – A Guide to Plant Community Survey for the Community, Wildflower Society of WA (Inc.)*, Nedlands, Western Australia.
- Lipple SL & Shaw LD (2002 revision) *City of Nedlands – Natural Landscape Inventory – A report on the Natural Resources Particularly Native Vegetation Remnants within the Urban Environment of the City of Nedlands (Volume 1)*, unpublished report for the City of Nedlands.
- McArthur WM (1998) *Changes in Species and Structure in the Major Plant Communities of Garden Island, WA, 1990-1996 - HMAS Stirling Environmental Working Paper No.11*, unpublished report for the Department of Defence.
- Oma VPM, Clayton DM, Broun JB & Keating CDM (1992) *Coastal Rehabilitation Manual*, Department of Agriculture, Perth.
- Pen LJ & Green JW (1983) Botanical Exploration and Vegetational Changes on Rottnest Island, in *Journal of the Royal Society of Western Australia*, Vol. 66, pp 20-24, Royal Society of Western Australia, Perth.
- Quilty Environmental (1999) *South Cottesloe Foreshore Management Plan*, unpublished report for the South Cottesloe Coastcare Association.
- Ripsey E & Rowland B (1995) *Plants of the Perth Coast and Islands*, University of Western Australia Press, Perth.

- Seddon G. (1972) *Sense of Place*, University of Western Australia Press, Perth, Western Australia.
- Smith GG (1973) *A Guide to the Coastal Flora of South-Western Australia - Handbook 10*, Western Australian Naturalists' Club, Perth.
- Trudgen ME (1991) *A Flora and Vegetation Survey of the Coast of the City of Mandurah*, Department of Planning and Urban Development, Perth.
- Twigg, L and Lowe, T (2003) *Farmnote 38/2003 - Bait stations and rabbit control*, Vertebrate Pest Research Section, Department of Agriculture, Perth.
- WA Ag Dept – Western Australian Department of Agriculture (2004) *1080 summary information – Alternatives to 1080 in Western Australia*, [http://www.agric.wa.gov.au/servlet/page?\\_pageid=449&\\_dad=portal30&\\_schema=PORTAL30](http://www.agric.wa.gov.au/servlet/page?_pageid=449&_dad=portal30&_schema=PORTAL30) [accessed online 02/06/04].

# Maps

## North Cottesloe Coastal Management Plan





Northern Sector



**Legend**

- Reference Sites
- Native flora**
- *Agonis flexuosa*\*
- *Hemiandra pungens*
- *Lepidospermum gladiatum*
- *Melaleuca lanceolata*\*
- *Myoporum insulare*
- *Scaevola crassifolia*
- *Spyridium globulosum*
- Vegetation associations**
- ▨ Cliffs
- ▨ Foredune
- ▨ Mobile Dune
- ▨ Rocks
- ▨ Stable Dune
- ▨ Swale

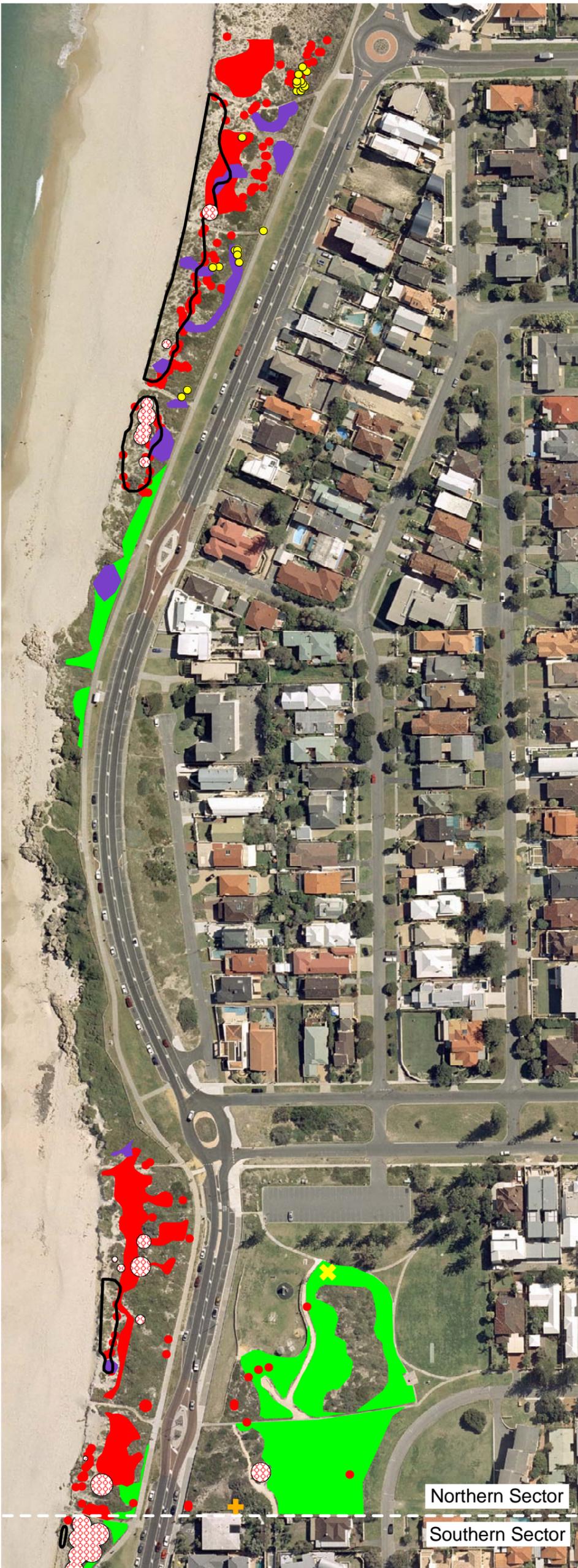
\* Naturally occur in region but potentially introduced to site

Southern Sector



1 : 2000 @ A3





Northern Sector



Southern Sector

**Legend**

- Agave americana
- ✕ Araucaria heterophylla
- ▲ Casuarina equisetifolia
- ⊕ Tamarix aphylla
- ▭ Ammophila arenaria
- ▨ Leptospermum laevigatum
- Pelargonium patches.shp
- Carpobrotus species\*
- Lawn Grasses

\* Needs to be surveyed in Spring to determine whether it native or introduced species





Northern Sector



Southern Sector

**Legend**

- Drains
- Fencing**
- 1st Priority - Constructed
- 2nd Priority - < 12 months
- 3rd Priority - > 12 months
- Bushland condition**
- Pristine
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded



20 0 20 40 60 80 100 Meters

1 : 2000 @ A3

*North Cottesloe Coastal Management Plan*  
**Bushland Condition, Fencing and Drains**

Cottesloe Coastcare / Town of Cottesloe  
 Aerial imagery supplied by the Town of Cottesloe

Map 4

May 2005



# Appendix One: Flora Inventory and Revegetation List

## North Cottesloe Coastal Management Plan

Table A1.1 Flora Inventory

Weed	Species	Recorded in Study Area	Distribution				
			Foredunes	Swale	Mobile Dune	Stable Dune	Cliffs
	<i>Acacia cyclops</i>				X	X	
	<i>Acacia lasiocarpa</i>						
	<i>Acacia rostellifera</i>					X	
	<i>Acacia saligna</i>						
	<i>Acanthocarpus preissii</i>	X				X	
*	<i>Agave americana</i>	X			X	X	
	<i>Agonis flexuosa</i> #	X				X	
	<i>Alyxia buxifolia</i>					X	
*	<i>Ammophila arenaria</i>	X	X	X	X		
*	<i>Araucaria heterophylla</i>	X			X	X	
	<i>Austrostipa elegantissima</i>				X		
*	<i>Cakile maritima</i>	X	X				
	<i>Callitris preissii</i> #					X	
	<i>Carpobrotus virescens</i>	X		X	X	X	
	<i>Cassynia racemosa</i>				X	X	
*	<i>Casuarina equisetifolia</i>	X			X		
*	<i>Crassula species</i>	X		X			
	<i>Clematis linearifolia</i>				X	X	
	<i>Conostylis candidans</i>	X				X	
*	<i>Dimorphotheca ecklonis</i>	X	X				
	<i>Enchylaena tomentosa</i>		X			X	
	<i>Eremophila glabra</i> subs. <i>albicans</i>		X				
*	<i>Euphorbia paralias</i>	X	X				
	<i>Exocarpos sparteus</i>				X	X	
	<i>Ficinia nodosa</i>	X		X	X	X	
	<i>Frankenia paucifolia</i>						
	<i>Fumaria capreolata</i>				X	X	
*	<i>Gazania linearis</i>	X			X		
	<i>Grevillea crithmifolia</i>	X			X		
	<i>Hardenbergia comptoniana</i>	X				X	
	<i>Hemiandra pungens</i>	X					X
	<i>Hibbertia subvaginata</i>					X	
*	<i>Lagurus ovatus</i>	X			X		
	<i>Lepidosperma gladiatum</i>	X			X	X	X
	<i>Leucophyta brownii</i>		X	X	X		
	<i>Leucopogon parviflora</i>					X	
	<i>Lomandra maritima</i>	X				X	
	<i>Melaleuca lanceolata</i> #	X			X		
	<i>Myoporum insulare</i>	X			X	X	

	<i>Oenothera drummondii</i>	x	x	x	x		
	<i>Olearia axillaris</i>	x			x	x	
	<i>Olearia dampieri</i> subs. <i>dampieri</i>				x		
*	<i>Oxalis species</i>	x			x		
	<i>Ozothamnus cordatus</i>					x	
	<i>Parietaria debilis</i>					x	
*	<i>Pelargonium capitatum</i>	x	x	x	x	x	
	<i>Poa porphyroids</i>			x	x		
	<i>Rhagodia baccata</i>	x				x	x
	<i>Santalum acuminatum</i>					x	
	<i>Scaevola crassifolia</i>	x		x	x	x	
	<i>Senecio pinnatifolius</i>					x	
	<i>Spinifex hirsutus</i>	x	x				
	<i>Spinifex longifolius</i>	x		x	x	x	
	<i>Sporobolus virginicus</i>						x
	<i>Spyridium globulosum</i>	x				x	
*	<i>Tamarix aphylla</i>	x			x		
	<i>Templetonia retusa</i>					x	
*	<i>Tetragonia decumbens</i>	x	x				
	<i>Threlkeldia diffusa</i>				x		x
*	<i>Trachyandra divaricata</i>	x		x	x	x	
	<i>Tricoryne elatior</i>					x	

# planted in study area

Table A1.2 Revegetation List

Weed	Species	Recorded in Study Area		Distribution			
			Foredunes	Swale	Mobile Dune	Stable Dune	Cliffs
	<i>Acacia cyclops</i>				x	x	
	<i>Acacia lasiocarpa</i>						
	<i>Acacia rostellifera</i>					x	
	<i>Acacia saligna</i>						
	<i>Acanthocarpus preissii</i>	x				x	
	<i>Alyxia buxifolia</i>					x	
	<i>Austrostipa elegantissima</i>				x		
	<i>Carpobrotus virescens</i>	x		x	x	x	
	<i>Cassutha racemosa</i>				x	x	
	<i>Clematis linearifolia</i>				x	x	
	<i>Conostylis candicans</i>	x				x	
	<i>Enchylaena tomentosa</i>		x			x	
	<i>Eremophila glabra</i> subs. <i>albicans</i>		x				
	<i>Exocarpos sparteus</i>				x	x	
	<i>Ficinia nodosa</i>	x		x	x	x	
	<i>Frankenia paucifolia</i>						
	<i>Fumaria capreolata</i>				x	x	
	<i>Grevillea crithmifolia</i>	x			x		
	<i>Hardenbergia comptoniana</i>	x				x	
	<i>Hemiandra pungens</i>	x					x
	<i>Hibbertia subvaginata</i>					x	
	<i>Lepidosperma gladiatum</i>	x			x	x	x
	<i>Leucophyta brownii</i>		x	x	x		
	<i>Leucopogon parviflora</i>					x	
	<i>Lomandra maritima</i>	x				x	
	<i>Melaleuca lanceolata</i> #	x			x		
	<i>Myoporum insulare</i>	x			x	x	
	<i>Oenothera drummondii</i>	x	x	x	x		
	<i>Olearia axillaris</i>	x			x	x	
	<i>Olearia dampieri</i> subs. <i>dampieri</i>				x		
	<i>Ozothamnus cordatus</i>					x	
	<i>Parietaria debilis</i>					x	
	<i>Poa porphyroids</i>			x	x		
	<i>Rhagodia baccata</i>	x				x	x
	<i>Santalum acuminatum</i>					x	
	<i>Scaevola crassifolia</i>	x		x	x	x	
	<i>Senecio pinnatifolius</i>					x	
	<i>Spinifex hirsutus</i>	x	x				
	<i>Spinifex longifolius</i>	x		x	x	x	
	<i>Sporobolus virginicus</i>						x
	<i>Spyridium globulosum</i>	x				x	
	<i>Templetonia retusa</i>					x	
	<i>Threlkeldia diffusa</i>				x		x
	<i>Tricoryne elatior</i>					x	

# Appendix Two: Reference Sites for Vegetation

## North Cottesloe Coastal Management Plan



**Plate 1 Foredune** - Low Shrubland of *Ficinia nodosa*, *Spinifex hirsutus*, *Tetragonia decumbens*, *Pelargonium capitatum*, *Trachyandra divaricata*, *Olearia axillaris*



**Plate 2 Cliffs** - Closed Low Heath of *Tetragonia decumbens*, *Carpobrotus* species and *Trachyandra divaricata*



**Plate 3 Mobile Dune** – Closed Low Heath of *Spinifex longifolius*,  
*\*Tetragonia decumbens*, *\*Trachyandra divaricata*, *Scaevola*  
*crassifolia*, and *Myoporum insulare*



**Plate 4 Swale** - Shrubland of *Spinifex longifolius*, *Scaevola*  
*crassifolia*, *Olearia axillaris*, *\*Pelargonium capitatum*, *\*Tetragonia*  
*decumbens*, *\*Trachyandra divaricata*, *Rhagodia baccata*,  
*Carpobrotus* species



**Plate 5 Stable Dune** - Low Open Woodland of *Agonis flexuosa* over Shrubland of *Spyridium globulosum* and *Scaevola crassifolia* over Closed Low Heath of *Acanthocarpus preissii*, *Lepidosperma gladiatum*, *Conostylis candicans*, *Olearia axillaris*, *Acacia lasiocarpa*, \**Trachyandra divaricata* and *Lomandra maritima*