

WEST COWARAMUP TOWNSITE NATURAL LANDSCAPE MANAGEMENT PLAN

PARKWATER CORPORATION PTY LTD

Prepared by:

Ecoscape (Australia) Pty Ltd

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Management Plan**

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1.0 Introduction

West Cowaramup Townsite Natural Landscape Management Plan

Parkwater Corporation Pty Ltd have been given rezoning approval to develop Lot 21 Cowaramup into a rural based subdivision which consist of bushland lots, road and pathway networks, a central artisan village and remnant bushland set aside as public open space. Lot 21 is the first stage of the proposed West Cowaramup Townsite Strategy which, when fully developed, will provide a range of land use activities for the local region.

Residents and visitors of Lot 21 will be able to spend time in the south-west in an idyllic setting enjoying a number of different pursuits and making a contribution to the region in both a social and economic sense.

Much of the proposed development is to be retained as remnant bushland. This includes areas which are in excellent condition and contain remnant Eucalypt forests and ephemeral creek. It is the intention of Parkwater Corporation Pty Ltd to covenant this bushland with the National Trust of WA in perpetuity for the purposes of conservation. It is also the intention of the Group to place the management responsibilities of the bushland with an appropriate body who has the capability of managing the bushland in terms of appropriate conservation value. At this stage the proposed manager is the National Trust of WA.

In order to establish the management requirements and costs for the bushland conservation area Ecoscape Australia Pty Ltd was commissioned by Parkwater Corporation Pty Ltd to prepare a Management Plan for the conservation area and provide an opinion of probable costs for management.

The following report details the management requirements of the site in terms of:

- Site context;
- Management Issues; and
- Management Cost Estimates.

2.0 Site Context

West Cowaramup Townsite Natural Landscape Management Plan

2.1 Location

Lot 21 is located approximately 1.5 kilometres west of the town of Cowaramup in the Shire of Augusta-Margaret River. It is approximately 320 kilometres south of Perth. The site has an area of approximately 74 hectares.

2.2 Planning

The “West Cowaramup Townsite Strategy” (WCTS) provides guidance for an appropriate and sustainable development for a defined area west of the existing Cowaramup townsite (Figure 1).

The West Cowaramup Townsite Strategy has the following objectives:

- To protect and maintain the areas of landscape value;
- To provide a range of sustainable and innovative landuses that compliment and do not compete with the primacy and growth of the existing Cowaramup townsite;
- To ensure that the area is provided with a sustainable level of community;
- To provide clear and legible pedestrian and vehicle access from the area to the Cowaramup townsite;
- To provide for a transitional area between cleared productive agricultural land and traditional townsite settlement.

Within the WCTS area there are a variety of land uses proposed including:

- Artisan/Tourist Village Centre;
- International Resort;
- Residential development
- Housing clusters;
- Horticulture production;
- Pedestrian and cycle linkages;
- Community and Recreation Facilities; and
- Open Space.

A large tract of existing bushland in good condition running centrally through the WCTS will be retained and managed for its conservation values. The bushland will contain walk trails and interpretive centres which highlight the conservation and heritage values of the site (Figure 2).

Figure 1: West Cowaramup Townsite Strategy

Figure 2: Bushland Area and Walk Tracks

WEST COWARAMUP TOWNSITE STRATEGY FEATURES AND RECOMMENDATIONS

Purpose of the Strategy

The West Cowaramup Townsite Strategy is an extension of the existing adopted 1996 Cowaramup Townsite Strategy. The 1996 strategy identified areas for potential townsite growth within the current townsite boundary.

The West Cowaramup Townsite Strategy aims to identify an appropriate and sustainable level of development for a defined area west of the town that meets the following objectives:

- To protect and maintain the areas landscape values.
- To provide for a range of sustainable and innovative landuses that complement and do not compete with the primary and growth of the existing Cowaramup townsite.
- To ensure that the area is provided with a suitable level of community infrastructure and facilities building upon those provided within the Cowaramup townsite.
- To provide clear and logical pedestrian and vehicle access from the area to the Cowaramup townsite.
- To provide for a transitional area between cleared productive agricultural land and traditional townsite settlement.

The following features and recommendations apply to implementation of the strategy. A number of the recommendations relate to long-term actions to be refined and progressed through the detailed rezoning and subdivision stages.

Physical Features and Services

Drainage

The majority of broad drainage lines within the strategy area have been cleared for summer grazing pastures and provide excellent drainage to the coastal landform of the strategy area. An existing dam is within the western boundary of the strategy area.

A detailed drainage management plan will be required utilizing water sensitive design principles through the construction of nutrient stripping stormwater treatment basins at individual subdivision stages.

Water Supply

The Water Corporation is currently replacing the existing townsite supply with a trunk main from the Ten Mile Creek via a main constructed between Margaret River and Cowaramup. Proposed commercial and residential development will be required to be connected to this upgraded reticulated water service.

Sewerage Services

The Margaret River Waste Treatment plant is soon to be decommissioned and replaced with an upgraded plant to the north of Margaret River. The Water Corporation have committed to the construction of a pressure main from Margaret River to Cowaramup as the effluent disposal strategy for Cowaramup. Proposed commercial and residential development will be required to connect to this upgraded reticulated sewerage service.

Remnant Vegetation and Rehabilitation

Remnant vegetation over the strategy area comprises predominantly regrowth and logged Jarrah, Marri woodland with isolated remnant riparian and parkland cleared areas. Federal Karri trees are also located along the cleared north south drainage line. Understorey vegetation varies from locally cleared pastures to mixed natural species dependent upon the level of grazing and past logging activity. A preliminary environmental assessment has defined areas of quality vegetation to be retained and recommended actions to assist in the maximum retention of remnant vegetation.

Cleared areas not proposed for development are to be the subject of a rehabilitation and tree planting program including the establishment of strategic vegetation linkages.

Proposed Development and Landuses

The defined area of the strategy is viewed as a transitional area between predominantly cleared productive agricultural land and traditional urban townsite development at Cowaramup. The following development concept is recommended for the strategy.

Artisan/Tourist Village Centre Lot 21 Portion of Sesser Location 4490

Lot 21 is proposed to support an artisan/tourist village centre as a central focus for the strategy plan area. The village centre provides an opportunity to create a unique tourist destination within a natural rural setting close to an established townsite. The village also provides an opportunity to provide a more direct and scenic route from the Cowaramup townsite to the established viticultural precinct along Gaves Road. To ensure the primary of the Cowaramup townsite typical development within the village is recommended to include:

- Artisan/tourist production, small server stores, and sales outlets.
- Tourist developments such as restaurants, pubs and galleries.
- Residential apartments and boutique residential/artisan lots.

Strata subdivision is the preferred form of tenure in the village to ensure coordinated community management of surrounding landuses.

Commercial Development

Development control to achieve the strategy objectives for the artisan/tourist village is to be achieved through the introduction of detailed residential use schemes provisions and strata management measures. The emphasis shall be on mixed development within the village to not compete with the range of key commercial and community services within the Cowaramup townsite.

Indicative Housing Clusters and Tenure

Residential development shall be supported based upon a clustered format with defined building envelopes. The strategy shows the indicative location of rural residential development and these areas are to be subject to further detailed planning and assessment as to their suitability for clustered residential development by Council and relevant government agencies, in particular the Department of Environment and Water Government protection and Department of Conservation and Land Management.

A clustered form of residential development is seen as an alternative to traditional rural residential development to create a stronger sense of community and shared ongoing management. Residential development west of the dam is to be equivalent with Amendment 121 to District Town Planning Scheme No.11.

Residential Development and Population Levels

The expected residential lot yields for the strategy plan are shown in the plan (excluding commercial lots). Residential lots will be within the range of 550m² to 2000m² with a corresponding designated residential density code.

Residential densities for the strategy plan will be consistent with the Cowaramup population thresholds established by the Settlement Strategy Table 1 the Lowland-Rural Settlement Edge Statement of Planning Policy, including existing and proposed residential expansion areas identified in the 1996 Cowaramup Townsite Strategy.

Village Production Lots - Lot 21

Lot 21 contains an area of cleared agricultural land identified as a transition zone between the western strata vineyard and the proposed village centre. The area is suitable for 3 to 6 strata rural residential production lots (average lot size 500m²) for horticulture/viticulture.

Pedestrian/Cycle Linkages

The strategy recommends that:

- The existing rails to trails system function as a primary north-south pedestrian and cycle link from the strategy area to the Cowaramup townsite.
- Direct linkages from the proposed village centre to Cowaramup townsite are provided.
- Linkages between individual housing cluster sites, recreation areas, the village centre and the townsite are provided.
- Linkage from Sesser Location 4490 through the original townsite area to Cowaramup is provided.

Community and Recreational Facilities

The Cowaramup townsite contains a range of community facilities including a post office, public hall, recreation oval, playgrounds and primary school.

A range of community facilities are recommended to supplement existing townsite facilities. Proposed developer funded facilities are to include the following:

- Community managed hall within the village centre.
- Recreation sports oval and tennis courts located within cleared flat land.

The existing single primary school has the capacity to cater for the expected long-term growth of the town (approximate population 2000). This is based upon a potential total lot yield of approximately 700 lots being below the Education Department of W.A's catchment of 1800 households per primary school.

Open Space

The provision of public open space as Section 204 reserves is to be provided through the rezoning and subdivision process. Satisfactory arrangements are also to be made for the provision of public access to strategic areas subject to negotiations with Council.

Management of Open Space and Vegetation

Measures for the long-term management of common areas open space and vegetation protection areas are to be demonstrated to the satisfaction of Council and the Western Australian Planning Commission at the Amendment stage.

Infrastructure Contributions Policy

Council and the proponent are to establish and implement a staging and contributions program for major services and strategic road linkages at the time of subdivision.

Fire Control

Detailed fire management plans shall be prepared at the amendment stages. Where possible waterways, road and pedestrian/cycle paths are to function as strategic firebreaks.

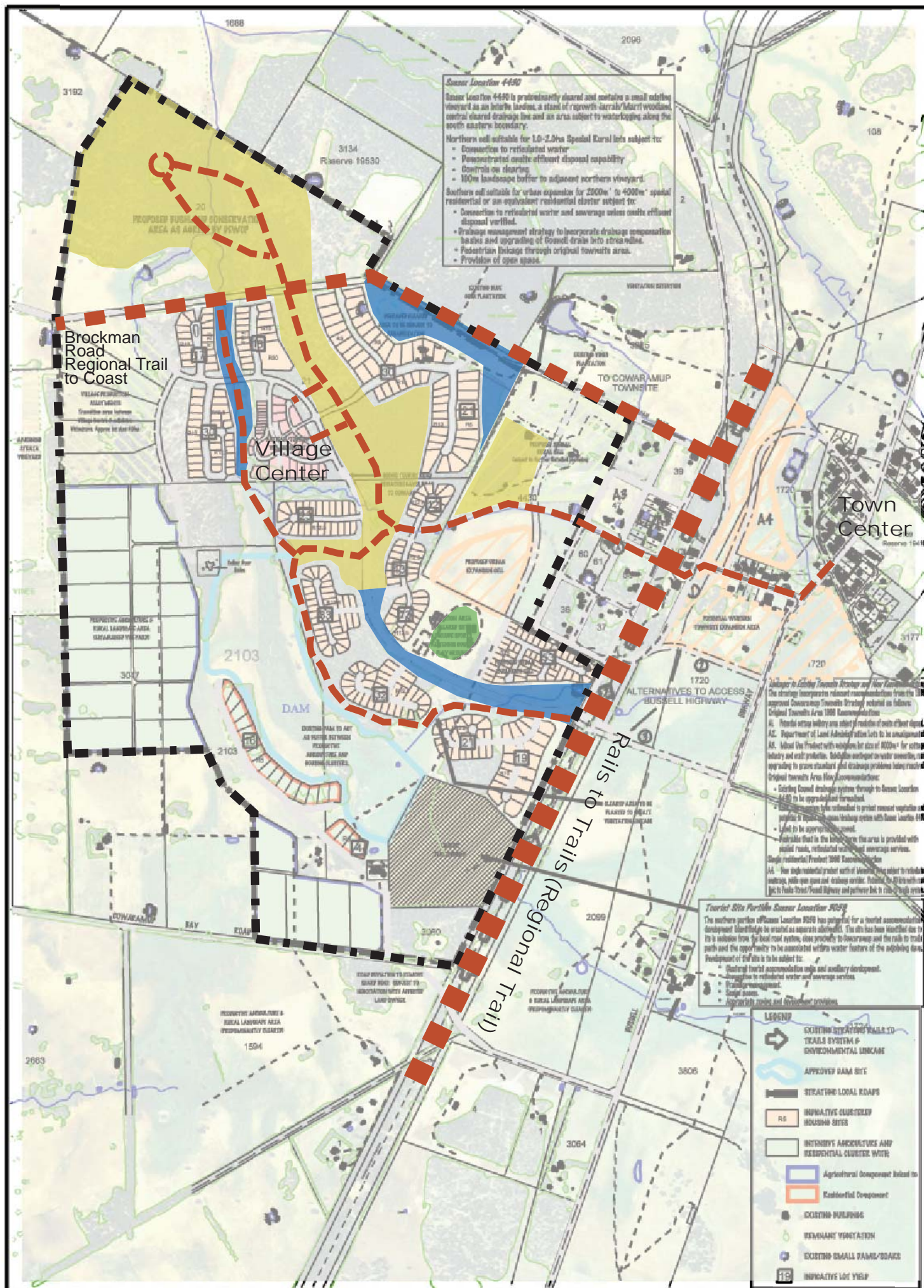
Planning Background and Strategy Summary

The Cowaramup Townsite is recognised within the Lowland-Rural Settlement Edge Statement of Planning Policy as a village with outcrops with potential for a permanent population of 500-1000 people. The town is also identified for expansion within the Shire's Rural Strategy. Lot 21 is identified as a Development Investigation Area within the Augusta-Margaret River Land Release Plan 2004-01 to 2004-05.

The existing townsite supports approximately 150 residential lots with an estimated permanent population of 420 persons based upon an occupancy rate of 2.8 persons per household. The existing Cowaramup Townsite Strategy identified residential expansion areas capable of accommodating approximately 200 additional residential lots (1940 additional people). Planning for some of these areas has already occurred. The strategy also indicated that additional expansion could occur south east of the town subject to resolution of water supply in the longer term (now resolved).

The West Cowaramup Townsite Strategy is based upon the staged release of land adjacent to the town as an alternative to rural residential development. This transition zone between productive agricultural land and the existing townsite is characterised by limited farming operations, interesting landforms and proximity to a range of services. The plan is based upon the physical features of the land to create an overall vision for development. As such the form of development proposed is based on an independent tourist village and clustered residential development.

The area will be developed in stages with stage one being the development of Lot 21 comprising the village centre and clustered residential lots as recommended on the plan. Development of the remainder of the strategy area will be preceded by separate rezoning proposals that will build upon the detail of the strategy. Similarly, the identification and justification of future urban areas will need to be assessed against the demands for growth and the provision of services and infrastructure within the context of established planning frameworks and community expectations at the time.



IMPLEMENTATION

The West Cowaramup Townsite Strategy is to be advertised for public comment prior to adoption by the Council of Augusta-Margaret River and the Western Australian Planning Commission. Following its adoption individual rezoning proposals and subdivision applications can be progressed.

Stage one will commence with the rezoning, subdivision and development of Lot 21 containing the Artisan/Tourist Village and associated housing clusters as recommended on the plan.

Productive Agriculture and Rural Landscape Areas

The strategy area shows productive agricultural land to the west, south and southeast. These areas are predominantly cleared for grazing apart from an adjoining western strata vineyard.

Land visible from Cowaramup Bay Road and Fossil Highway contributes to the rural character of the Cowaramup locality. These areas are recommended to be retained for productive agriculture.

Potential Western Townsite Expansion Area

Land south of Margaret Drive between Fossil Highway and the railway reserve is identified for potential consolidation of traditional urban expansion for commercial, community, recreation and residential use. Prior to detailed investigation a node is preferred in order to create a neighborhood cell of a sustainable size in preference to a series of small developments. The extent of southward townsite expansion can be defined by the definition of Brockman Road. An urban node in this location is a logical area for future western townsite expansion to consolidate the southern built for traditional urban townsite growth due to cleared nature of land in close proximity to services and existing townsite facilities. Issues to consider in planning for this area include drainage, access and justification of commercial expansion.

Future Sesser Drive from Gaves Road to Cowaramup

Brockman Road is proposed to be deviated and extended to function as a future special tourist/scene drive linking Gaves Road, western viticultural area, village and Sesser Location 4490 more directly with the Cowaramup townsite. This scenic route provides an opportunity to create photo areas and stopping points in strategic locations. The following alignment options are proposed:

- Option 1: Interim option utilizing existing road reserve system via Margaret Drive.
- Option 2: Alternative longer-term options to avoid bringing rural traffic directly into the town centre. These alternative future alignments more clearly define the start of the tourist/scene drive via the village to Gaves Road. Option 2 is preferred to define southern townsite expansion boundary subject of separate planning corridor. Any such alignment would be subject to negotiation with the affected landowners.

Related Road Hierarchy

Cowaramup Bay Road is to function as the primary east-west distributor road. A minor potential deviation is shown to remove a sharp bend subject to negotiation with the affected landowner.

Secondary local road links are recommended as follows:

- Road link from the village centre to Margaret Drive via the existing Brockman Road reserve.
- North-south road link from Cowaramup Bay Road to Brockman Road deviation west of existing railway reserve to provide access to potential tourist and residential cluster sites. This alignment provides an alternative local road link to Cowaramup Bay Road to maintain increasing traffic levels on Fossil Highway.
- North-south linkage through Sesser Location 4490.

SOURCE : Premier Mapping Australia

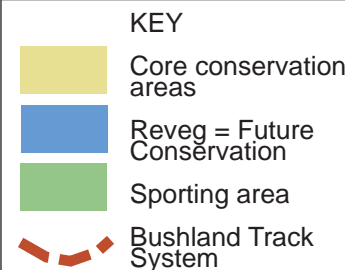


FIG. 02
BUSHLAND AREA AND
WALK TRAILS

SCALE DATE
1 : 15000 FEBRUARY 2003

PLAN No.
00261P-17

WEST COWARAMUP TOWNSITE STRATEGY -SUPPLEMENT TO 1996 COWARAMUP TOWNSITE STRATEGY



The WCTS area covers several landholdings that Parkwater Corporation Pty Ltd has interests in through its shareholding in various entities listed hereunder:

Property	Ownership
Lots 20 & 21 Brockman Road	Parkwater Corporation Pty Ltd
Lot 100 Cowaramup Bay Road (refer note)	Topsouth Pty Ltd
Lot 101 Cowaramup Bay Road (refer note)	Brooklee Investments Pty Ltd
Sussex – Location 4430	Kevin Mashmead

Note – Lots 100 & 101 were created, along with adjacent Lot 300 Cowaramup Bay Road, by subdivision of Locations 3047, 2103 & 3059 referred on the WCTS. This subdivision occurred to provide for the Grand Vin survey strata subdivision of Lot 101 (completed 2004) and future subdivision of the Topsouth Lot 100 site.

Stage One will involve the rezoning, subdivision and development of Lot 21 containing the Artisan/Tourist Village and associated housing clusters.

2.2.1 Town Planning Scheme Amendment No. 125

Amendment No. 125 to the Shire of Augusta Margaret River Town Planning Scheme No. 11 was gazetted on 21 October 2003 to:

- Rezone Lot 21 from “Rural” to “Special Use” (to support development in accordance with the WCTS); and
- Insert in the scheme text permitted uses and requirements in regard to development of Lot 21.

Of specific relevance to your scope of services are the following clauses of Amendment 125:

Amendment 125 Clause No.	Subject
8.0	Fire protection.
9.0	Vegetation Protection.
12.0	Provision of 10% public open space (POS).
12.1	Management and protection of Remnant Vegetation Protection Areas in perpetuity.
12.2	Preparation and implementation of an Environmental Management Plan (EMP) for the Remnant Vegetation Protection Areas.
12.3	Preparation and Implementation of a rehabilitation program for the Revegetation Area.

2.2.2 Subdivision of Lot 21 Brockman Road Cowaramup

An application to subdivide Lot 21 was lodged with the Western Australian Planning Commission in October 2003 (WAPC ref 123507). Conditional approval of the proposed subdivision has been considerably delayed pending satisfaction by Augusta Margaret River Shire and the WAPC that the requirements of Amendment 125 have been adequately addressed.

Most recently, the Augusta Margaret River Shire proposed a number of subdivision conditions as resolutions in the minutes of the Council meeting held 28 April 04, which are now to be provided as a referral response to the Dept of Planning and Infrastructure which are to be amended as seen fit by the Department and issued as formal WAPC conditions of subdivision, anticipated to be issued mid-late May 04.

The conditions will provide for design approvals and construction leading to completion of Stage 1A with issue of titles around Feb 05. Hence service installations, paths and firebreaks are expected to be installed in the construction period that will extend generally from about August 04 to Feb 05.

The site will be developed in a staged manner consisting of the following stages:

- Stage 1a – Residential lots and bushland
- Stage 1b – Rural lots to west
- Stage 1c – Village centre and strata lots

A total of 23 hectares of bushland will set aside as part of the development as shown on Figure 3.

It is anticipated that the bushland including the development of firebreaks, access tracks, pathways and signage, will be ready for hand-over to an appropriate management authority by the year 2007. Included in that timeframe will be three years of bushland restoration work (for degraded areas), fuel reduction activities, weed control, disease control and other bushland enhancement activities.

It is anticipated that the bushland once ready for handover will generally be in good condition with the requisite facilities for enjoyment by the public and generally require minimal future management costs.

The management of different areas of bushland will be divided amongst a number of parties. The core bushland areas are proposed to be managed by the National Trust of WA (17ha), the creekline in part by the Artisan Village Body Corporate (2.3ha) and the Shire of Augusta-Margaret River (2.4ha) and the western bushland area by the Shire of Augusta – Margaret River (3.7ha), as public open space (Figure 4).

Figure 3: Areas to be set aside for bushland conservation purposes



FIG 03

west cowaramup townsite natural landscape management plan

Areas to be set aside
for bushland conservation purposes



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Scale 1 : 4000 @ A3 (This Plan is Diagrammatic Only)

Figure 4: Potential Bushland Managing Agencies



FIG 04

west cowaramup townsite natural landscape management plan

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Potential Bushland
Management Agencies



2.3 Biophysical

2.3.1 Soils

The site is part of the Cowaramup Upland on the Margaret River Plateau (Tille and Lantzke, 1990). It is gently undulating to undulating plain with an average elevation ranging from 80-140m AHD. The Cowaramup Upland land system has been formed on the laterised granitic basement of the Leeuwin Block. The soils within this system consist of (Tille and Lantzke, 1990):

- C – Cowaramup flats (east and west of site) Flats (0-2% gradient) with gravelly duplex (Forest Grove) soils and pale grey mottled (Mungite) soils;
- Cv – Cowaramup Vales – small narrow V-shaped drainage depressions with gravelly duplex Forest Grove) soils;
- Cw – Cowaramup Wet Flats – poorly drained flats and slight depressions with pale grey mottled (Mungite) soils; and
- Ci – Cowaramup Ironstone Flats – flats and gentle slopes (0-5% gradient) with some laterite outcrops and shallow gravelly sands over laterite.

2.3.2 Vegetation

The vegetation of the study area has been reviewed and assessed and described in detail in a series of studies undertaken by Bennett Consulting Pty Ltd (2001, 2004). The vegetation of the site has been previously generally described by Beard (1981) as the Boranup System which is part of the Warren Botanical Province Subdistrict in the Darling Botanical District of the South-west Botanical Province.

Mattiske and Havel (1998) described two Vegetation Complexes for the area:

- Uplands, Cowaramup (C2) – Open forest of *Corymbia calophylla* (Marri) – *Eucalyptus marginata* subsp. *marginata* (Jarrah) – *Banksia grandis* (Bull Banksia) on lateritic uplands in perhumid and humid zones; and
- Valleys, Cowaramup (CW1) – Mixture of open forest to woodland of *Eucalyptus diversicolour* (Karri) – *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* subsp. *marginata* (Jarrah) – *Corymbia calophylla* (Marri) on slopes and low woodland of *Melaleuca preissiana* (Moonah) – *Banksia littoralis* (Swamp Banksia) on depressions in the hyperhumid zone.

In the survey undertaken by Bennett Consulting (2001) two vegetation communities and one degraded community was identified on the site.

The vegetation communities were described as:

- (Ed) Tall Open Woodland of *Eucalyptus diversicolor* (Karri) over a woodland of *Agonis* species (Peppermints) and *Callistachys lanceolata* (Native Willow) over a Sedgeland or where degraded a Herbland;



Plate 1.0: Ed vegetation community

- (CcEm) Woodland to Low Forest of *Corymbia calophylla* (Marri) and *Eucalyptus marginata* subsp.; *marginata* (Jarrah) over either;
 - a) (CcEm(a)) Closed Tall Scrub of *Bossiaea aquifolium* (Waterbush), *Hovea elliptica* (Tree hovea) and *Mirbelia dilatata* (Prickly mirbelia) over an Open Low Heath of *Hibbertia hypericoides* (Buttercup); or
 - b) (CcEm(b)) Tall Shrubland dominated by *Kingia australis* (Black gin) and *Xanthorrhoea preissii* (Grasstree) over an Open Low Heath of mixed species; or
 - c) (CcEm(c)) Closed Heath of *Podocarpus drouyanianus* (Native plum) and *Hovea elliptica* (Tree hovea); or
 - d) (CcEm(d)) Closed Low Heath of *Hibbertia hypericoides* (Buttercups); or
 - e) (CcEm(e)) Open Heath of mixed Species



Plate 2.0: CcEm vegetation community

- (CG) Degraded Community consisting of Closed Grassland (mixed species) with occasional scattered emergent trees.

The above vegetation units were mapped by Bennett Consulting (2001) and are shown on Figure 5.

Figure 5: Vegetation Communities



FIG 05

west cowaramup townsite natural landscape management plan

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Scale 1 : 4000 @ A3 (This Plan is Diagrammatic Only)

Vegetation Communities

Source: Bennet Environmental Consulting, 2001



2.3.3 Vegetation Condition

The vegetation was assessed in terms of its condition using the Bush Forever Scale which ranks it as per below (Government of Western Australia, 2000)

Condition Index	Descriptor	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance of vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

Despite previously logging of the site the vegetation was generally in very good to good condition apart from those areas which had been cleared. Those areas that are proposed to be kept as bushland area generally in good condition.



Plate 3.0: Bushland in good condition.

Note: Logging debris to be removed by developer to reduce fuel loading.

The condition of the bush land is an important factor in terms of management implications. Those areas that have good condition generally have high resilience and require little maintenance because of their self regenerative capacity.

Those areas that are on poor condition on the eastern perimeter of the Lot 21 are to be revegetated using local endemic species. With proper weed control and follow-up replanting this section of this site should be able to be restored to good condition in a number of years, say five to ten.



Plate 4.0: Poor condition areas

The vegetation condition of the site was mapped by Bennett Environmental Consulting (2001) and shown on Figure 6.

2.3.4 Flora

Bennett Consulting undertook a survey of vascular plants on the site and recorded a total of 192 species from 59 plant families and 130 genera. Of the 192 plants species a total of 148 species (77%) were native and 44 (23%) were weed species.

No Rare flora were recorded for the site however one potential Priority 3 Species, *Thysanotus isantherus* was collected but was in late flower and requires future verification. A Priority 4 Flora *Tyrbastes glaucescens* was recorded in the northern section of the natural creek line.

Figure 6: Vegetation Condition

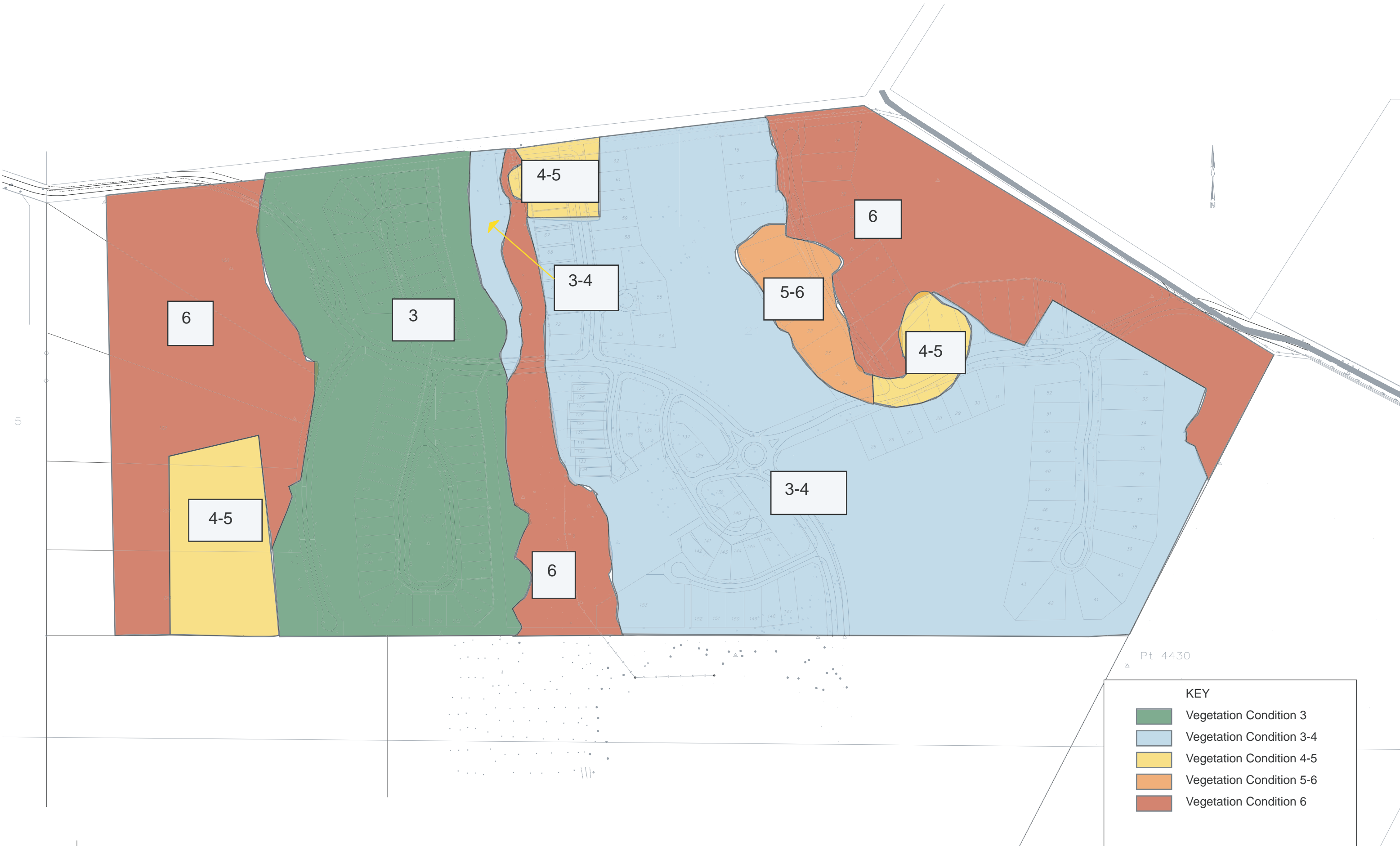


FIG 06

west cowaramup townsite natural landscape management plan

JUNE 2004

PARKWATER CORPORATION PTY LTD



Scale 1 : 4000 @ A3 (This Plan is Diagrammatic Only)

Vegetation Condition

Source: Bennet Environmental Consulting, 2001



3.1 Management Aims

The bushland of most of the site is generally in good condition except those areas that have been previously cleared. Under natural conditions without human pressure the bushland would continue to maintain and improve its condition and natural resilience. However with the development of the area additional pressures will be placed on the ecological values of the site. In managing the conservation values of the bushland areas of Lot 21 it is important to determine the aims of the management program so that appropriate benchmarks can be determined so that the management effort can be measured.

Potential management aims include the following:

- To maintain and improve the condition of the vegetation;
- To maintain fauna habitats and reduce the impacts of feral and domestic animals on the native fauna;
- Ensure that the groundwater dependent ecosystems (GDE's) are maintained through regard for natural hydrological processes;
- Reduce the risk of disease being introduced such as Jarrah dieback etc and if introduced under take quarantine measure to minimise its spread;
- Control the introduction of weed species and reduce the current weed problem through weed management programs; and
- Maintain the diversity of flora assemblages and species and manage fire control regimes so that their impact on species diversity is minimised.

These broad aims will help to improve the natural ecological values of the site and thereby contribute to the enjoyment of local residents and visitors.

More detailed and specific objectives are contained in the following management section.

3.2 Weed Control Strategy

3.2.1 Objectives

The objectives for weed control within Lot 21 are to:

- Identify and control existing weeds with the highest priority for control, and widespread weeds with a moderate priority for control;
- Prevent introduction of additional weed species;
- Prevent further encroachment of weeds into bushland;
- Minimise any detrimental effects of the weed control programme on the native biota;
- Integrate the weed control programme with bushland restoration programmes.

3.2.2 Background

Environmental weeds are plants that establish themselves in natural ecosystems and modify natural processes, resulting in the decline of the communities they invade. Impacts on ecosystem function by environmental weeds include:

- resource competition, as weeds often outcompete native species;
- prevention of seedling recruitment of native species;
- alteration to geomorphological processes, such as increased erosion;
- changes to soil nutrient status;
- alteration of fire regime, usually through increased fire frequency;
- changes to the abundance of indigenous fauna due to less diverse habitat;
- loss of genetic diversity;
- loss of species diversity; and
- changes to the structure of vegetation communities, often by the removal of the shrub layer or native ground covers.

The fire-weed cycle that is a primary cause of the degradation of bushland and loss of understorey species. The shrubs, herbs and sedges are gradually replaced by weed species, notably grassy weeds as fire frequency increases. Grassy weeds have characteristics which enable them respond quickly to fires, and which support more frequent fire events, than many of the native perennial understorey shrubs. Some of the contributing factors to the fire-weed cycle are summarised below:

- Weed species are often advantaged by the burst of nutrients available immediately after a fire;
- Weed species, particularly grassy weed species, accumulate biomass rapidly, increasing fuel loads to levels that will sustain fires;
- High growth rates of weed species allows them to outcompete native species;
- Grassy weeds, and many other weed species, are able to set seed within a single year;
- Grassy fuels have a different structure to shrubby fuels. The grasses have a fine, evenly spread structure, compared with the more heterogeneous, discrete structure of native understorey shrubs. This affects fire behaviour and rate of spread, particularly in the initial stages of a fire;
- Native seeder species require time between fires not only to set seed but also to replenish their seed stocks. This may take several years. Frequent fires deplete seed stocks, rapidly eliminating these species from the species assemblage; and
- Native resprouting species (ie. species that have an underground lignotuber) can also succumb to frequent fires if fire recurs before the new growth has had time to harden.

In a previous survey by Bennett Environmental Consulting (2001) a total of 44 weed species were recorded from the site. Most of the weeds found on the site were specific to degraded areas which were moist. Many of the weeds occurring in Western Australia have been rated according to the following criteria CALM (1999):

- Invasiveness – ability to invade bushland in good to excellent condition or ability to invade waterways;
- Distribution – wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world; and
- Environmental Impacts – ability to change the structure, composition and function of an ecosystem, in particular, an ability to form a monoculture in a vegetation community.

The above scale rates the impacts of weed species on biodiversity as one of the following:

- High – a weed species which scores for all three criteria. A weed species that rates as high would be a high priority for control and ongoing monitoring.
- Moderate – a weed species that scores for two of the above criteria. A weed species that rates as moderate would be a high priority for monitoring. The priority for control may vary from site to site depending on conditions and the values at risk.
- Mild – a weed species that scores on only one of the criteria. A weed species that rates as mild should be assessed in relation to site conditions. It should be monitored and controlled where appropriate.
- Low – a weed species that scores for none of the criteria. A low ranking would mean that this species requires a low level of monitoring and is unlikely to require control.

The weed Species found on Lot 21 were accorded a CALM rating by Bennett Consulting (2001) which is shown in Appendix 1.

Of the 44 species 1 was rated high, 27 as moderate, 4 as mild and 12 as low. The high rated species *Bromus diandrus*.

3.2.3 Weed Control Methods

Control options for environmental weeds within Lot 21 include:

- Controlling ecosystem degradation processes;
- Herbicides;
- Manual control; and
- Fire management.

Controlling degradation processes that increase ecosystem vulnerability to weeds is often the most effective way to control weeds in the long term. Controlling degradation processes is one of the main purposes of this management plan, and methods for addressing degradation will be discussed in various sections of this chapter, including fire management, ecological restoration and restricting access. The control methods described in the sections below are herbicide control and manual control.

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).

Manual control is often the most expensive form of weed removal but it is the most appropriate method in many circumstances. It is particularly valuable for small infestations, where chemical control is inappropriate and resource requirements are not too onerous. Manual control needs to be carefully managed in order to avoid gross soil disturbance that can lead to weed replacement. When undertaking manual weed control, the Bradley (1971, 1988) method should be used and revegetation should be undertaken in conjunction with weed removal. Hand-pulling of weeds may be as time-efficient as spraying in certain situations – for example, where low numbers exist in a localised, well-vegetated area of bush – and should be given priority over herbicide spraying.

Herbicide Control

Herbicide application is often the most cost effective method for the control of weeds. A wide range of herbicides are available for weed control. It is important that herbicides should always be used strictly in accordance with directions on the label and their application must be undertaken by personnel trained in the use of herbicide chemicals.

Dixon and Keighery (1995) identified three methods of herbicide control, as follows:

- Herbicide Wipe, Stem Injection and Cut Stump Application
 - 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;
 - Stem Injection – use a small axe to make cuts at 8cm 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; and
 - Cut Stump Application – when the plant is actively growing cut the stump almost to ground level and apply the herbicide immediately using a paintbrush.
- Herbicide Spot Spraying
 - When spot 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.
- Herbicide Blanket Spraying
 - When blanket spraying, spray over large area using boom spray or similar, when the plant is actively growing (early June to no later than mid-August or when specified).

Two of the major herbicides recommended for use are glyphosate (Roundup®) and fluazifop (Fusilade®). Glyphosate is a systematic non-selective herbicide, which is useful for controlling most weeds, particularly bulbous species. Glyphosate should not be blanket sprayed in areas containing native species, as it will also kill them. Fluazifop is a selective herbicide that is effective on most grassy weeds. Fluazifop does not affect non-grass native species. A dye should be added to the herbicide to mark areas sprayed. Herbicides should not be sprayed in wetland areas, nor should a wetting agent or surfactant be added to herbicides in these areas. Alternatives to spraying include wick applicators and other methods that target individual plants. A “frog-friendly” version of Roundup® (known as Roundup® Bioactive) is available for use near wetland areas.

Control Methods for Weeds in Lot 21

The control methods for priority weeds within Lot 21 are shown in Appendix 2 (Bennett Consulting, 2004). As a general indication, grassy weeds should be sprayed during the active stages of growth before seed set, and bulbous species should be controlled after flowering and before seed set.

3.2.4 Guiding Principles for Weed Control

When undertaking weed control programmes, the primary guiding principle is to work from areas in the best condition to those in the worst condition, and all works should be undertaken in conjunction with a restoration strategy (Bradley, 1971; Bradley, 1988; Buchanan, 1989). The bushland condition map presented in Figure 2 should be referred to as a guide for priority weed control as follows:

1. Populations occurring in *Very Good - Excellent* condition bushland areas should be treated first;
2. Those populations occurring in *Fair - Good* condition bushland areas should be treated next, and
3. Populations occurring in *Poor* condition bushland areas should be treated last.

Using bushland condition as a criteria for determining weed control priorities ensures that:

- *Very Good - Excellent* condition bushland is maintained;
- *Fair - Good* condition bushland is enhanced, moved closer to being in *Very Good - Excellent* condition, and prevented from deteriorating to *Poor* condition bushland; and
- *Poor* condition bushland is enhanced, moved closer to being in *Fair - Good* or *Very Good - Excellent* condition, and prevented from deteriorating to *Very Poor* condition bushland.

The *Very Poor* condition bushland areas are generally not suitable for targeted weed control. Instead, weeds in these areas should be addressed within the context of a comprehensive restoration plan.

When working in *Very Good - Excellent* and *Fair - Good* condition bushland, the Bradley method of weed control is recommended. Essentially, this method involves assisted natural regeneration of native plants from seed banks, rather than the use of replanting programmes.

3.2.5 Approaches to Weed Control

Approaches to the control of priority weeds can be categorised into:

- Species-led control;
- Site-led control;
- Resource-led control; and
- Cause-led control.

The approach to weed control within Lot 21 will focus on the first four approaches listed above. There are no significant areas containing threatened flora species or threatened ecological communities within the study area. Only the first three approaches to control will be described below. Cause-led control is a preventative measure which aims to reduce the impact of factors that aid the spread and establishment of weeds, and is a key objective of the entire management plan for the site.

Species-led Control

Species-led control is a proactive strategy to prevent introduction, establishment, survival, reproduction and dispersal of an emerging weed before it becomes a major problem within the park. A number of initiatives should be undertaken at a local level to prevent the introduction and spread of weed species. Actions that will reduce the likelihood of new species being introduced include:

- application of good hygiene practices during construction phases, as this reduces the potential for new weeds to be introduced through soil on vehicles.

Generally, it is recommended that species-led control be undertaken prior to site-led control. Weed species were placed in this category if they:

- Have small populations;
- Are relatively easy to remove;
- Have a high potential to spread and therefore become a problem in the future; and
- Are located in areas that will not be continually reinfested from the soil weed seed bank or from surrounding areas.

Priority weeds that are presently suitable for species-led control include the high and moderately rated weed species (Appendix 1).

Site-Led Control

Site-led control focuses on identifying areas that require weed control to maintain their ecological and commercial values. Generally, it is recommended that site-led control be undertaken after control of weeds recommended for species-led control. Weed species were placed in this category if they:

- have wide-spread and well-established populations;
- require concentrated and/or long-term efforts to remove; and
- are highly detrimental to ecological functions of bushland if left unchecked.

Resource-Led Control

Resource-based weed control is recommended where a particular species is known to be within a defined area, and thereby providing a focus for community projects. A human resources led approach matches volunteer and professional labour to the best possible weed control outcomes. For example, volunteers may be best suited to target small populations of highly visible weeds which are readily removed by simple manual or chemical methods and are ideal for essential follow up and monitoring. Professionals may be best used where spraying or machinery is required or where a concentrated effort is required.

3.2.6 General Weed Control Action Plan

A general Weed Control Action Plan (Table 1.0) was developed, based on the guiding principles and approaches outlined previously. It is provided as a general guide for determining the priority for weed control activities. More detailed weed control action plans for various sections within Lot 21 would require greater detail on the cover/abundance and distribution of priority weed species in these sections. This information could be gained by carrying out grid-based searches of each study area and recording cover/abundance values for priority weeds at defined intervals, for example every 100 or 200 metres.

Cover/abundance should be measured using a standard scale, such as the Braun-Blanquet scale (Table 2.0) (Mueller-Dombois and Ellenberg, 1974). This task could be undertaken by environmental officers, consultants, community groups or students. However, control efforts for priority weeds, especially those recommended for species-led control in known locations, should not be delayed whilst waiting for more detailed information to become available.

Table 1.0: General Weed Control Action Plan

Priority	General Recommendations
Priority 1 Start with species-led control	<p>Species-led control:</p> <ol style="list-style-type: none"> 1. Select weeds for control on a species basis according to time of year and available resources. 2. For each weed species, use bushland condition maps to: <ul style="list-style-type: none"> • Start control efforts in <i>Very Good-Excellent</i> condition bushland • Move to <i>Good-Fair</i> condition bushland • Move to <i>Poor</i> condition bushland <p>The above represents primary weed control. Secondary weed control and long-term monitoring of weed populations will also need to be undertaken.</p>
Priority 2 Move to site- led control	<p>Site-led control:</p> <ol style="list-style-type: none"> 1. Select sites suitable for site-based control. 2. Use bushland condition and weed distribution maps to: <ul style="list-style-type: none"> • Start control efforts in <i>Very Good-Excellent</i> condition bushland • Move to <i>Good-Fair</i> condition bushland • Move to <i>Poor</i> condition bushland <p>Depending on resources and time of year it may be necessary to undertake control of different site-led species, prior to moving to other areas. Again, the above represents primary weed control. Secondary weed control and long-term monitoring of weed populations will also need to be undertaken.</p>
Priority 3 Move to resource-led control	<p>Resource-led control:</p> <ol style="list-style-type: none"> 1. Select sites suitable for resource-based control. 2. Use bushland condition and weed distribution maps to: <ul style="list-style-type: none"> • Start control efforts in <i>Very Good-Excellent</i> condition bushland • Move to <i>Good-Fair</i> condition bushland • Move to <i>Poor</i> condition bushland <p>Again, the above represents primary weed control. Secondary weed control and long-term monitoring of weed populations will also need to be undertaken.</p>

Table 2.0: Braun-Blanquet Scale for Estimating Cover/Abundance.

Braun-Blanquet Cover Abundance Scale	
0.1	solitary, with small cover (occurs once)
0.5	few, with small cover (<1%)
1	numerous, but less than 5% cover, or scattered with cover up to 5%
2	any number, with 5-25% cover
3	any number, with 25-50% cover
4	any number, with 50-75% cover
5	any number, with >75% cover

3.2.7 Control of non-Priority Weed Species

Weed species which were not included in the list of priority species should not be excluded from control activities on that basis. These species should be included in any weed control programme as species which could be controlled if resources allow, but which are not of as high a priority for control. As weed control of priority species progresses, other weed species which previously may not have been rated as highly, may become more important. Therefore, it is important to keep weed control programmes flexible and updated according to monitoring data, to ensure that as bushland condition changes and weed species dominance changes, the control activities are adjusted accordingly.

The priority status of individual weed species should be used as a basis for its control, along with factors such as its abundance and distribution. For example, weed species with a *Moderate* or *Mild* priority for control, but which has a limited distribution should be controlled if resources allow, rather than left to spread and become a bigger problem. In general, those species with a *High* priority rating should be tackled first, but the situation at each site needs to be assessed in context with which other species are present and what resources are available.

3.2.8 Post-fire Weed Management

Following fire, weed species have an opportunity to increase in density and abundance. Ongoing weed management must also include post-fire weed management to break the fire-weed cycle. Post-fire weed control requires diligence and a high degree of care from operators. Training should be provided to staff carrying out these duties, or specialist bush regenerators employed in order to achieve the desired outcome without compromising the ability of the bushland to regenerate. The post-fire environment is susceptible to further damage, and weed control works should be undertaken at a time that will give the bushland the greatest chance of successful regeneration. Implementation of weed control in the post-fire environment should incorporate the following factors:

- If the fire occurs in early summer, weed control should be carried out three months after a fire;
- With later summer fires, inspections should be carried out at four, six and eight weeks after the fire in order to assess the most appropriate interval at which to carry out weed control. The interval will vary according to weather conditions and possibly groundwater availability;
- The affected area should be monitored and, if necessary, a follow-up treatment should be applied; and

- As with all weed control programmes in bushland areas, it should be linked to bushland regeneration. Assessment of individual situations is required to determine the needs for each site.

3.2.9 Monitoring and Evaluation

Monitoring and evaluation are key actions that need to be undertaken in weed management to measure the success of strategies advocated in this report. As part of objectively assessing the success of a weed control strategy, performance indicators need to be developed. This will not only contribute to its accountability where public funds are involved, but also provide a mechanism for modifying the strategy and maintaining its flexibility.

When monitoring site specific projects within the park, the following strategies should be adopted:

- Establish monitoring quadrats in areas subject to weed control programmes to record the effectiveness of control methods;
- For species-led control – monitor effectiveness of control of discrete weed populations or patches, including presence or absence, and, if present, the degree of new infestation;
- For site-led control – establish monitoring quadrats and survey and record annually;
- For both 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.

As indicated previously, it is recommended that the distribution and abundance of priority weeds within the site should be mapped to aid control programmes. This task should be repeated at regular intervals, for example every five years, using the same methodology, to give an indication of the general status of weeds within the study area.

Performance Criteria

In order to determine the effectiveness of any weed control programme, there needs to be a method of determining success and ongoing progress. Further data on weed abundance and distribution would be required to determine appropriate performance criteria, but the following gives an indication of the factors that could be assessed:

- Removal of a set number of priority weed species (say four or five) from the park 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 in the site by 5% over 5 years.

3.2.10 Recommendations

1. A comprehensive weed control programme should be implemented within the site, following the principles of the general weed control action plan and other guidelines in this management plan. The weed control programme will include targeted weed control of priority species and assisted natural regeneration in bushland areas, working from areas in the best condition into areas of progressively worse condition. Weed control will include primary weeding, secondary weeding and maintenance.
2. Post-fire weed control measures should be implemented if a fire occurs. Weed control works should be undertaken at a time that will give the bushland the greatest chance of successful regeneration.
3. A grid-based survey of priority weeds within Lot 21 should be undertaken to determine their distribution and abundance. At each recording site, the cover/abundance of each priority weed should be assessed using a standard scale, such as the Braun-Blanquet scale. Grid-based surveys should be repeated at least every five years.
4. Information gained from detailed weed surveys should be used to develop more detailed weed action plans for defined zones within Lot 21, and performance criteria for evaluating the success of weed control. Control of priority weeds, particularly those recommended for species-led control, should not be delayed whilst waiting for this detailed information to become available.
5. Weed monitoring quadrats will be established in areas subject to weed control to assess the effectiveness of control methods, and any new weed species will be recorded and incorporated into the weed control programme as appropriate.
6. Ensure weed control contractors have adequate training and experience in working in bushland areas.
7. Train community volunteers in bush regeneration techniques so that they can contribute to effective bush regeneration and weed control, particularly through hand weeding, other non-chemical methods, seed collection and resource-led weed control programmes.
8. Notify the public prior to spraying of weeds in the study area by letter drop and media coverage. Adjacent residents and the public should also be notified of the impacts and illegality of dumping garden refuse in the study area, by letter drop or media coverage.

3.3 Fire Management

3.3.1 Objectives

The objectives for fire management for Lot 21 are to ensure:

- Protection of human life;
- Protection of property; and
- Protection of ecological integrity and biological values.

3.3.2 General Impacts of Fires on the Biological Environment

Both the immediate and cumulative impact of fires on biological values are of major concern.

Fires can impact upon the natural vegetation in a number of ways including:

- Promotion of weed growth;
- Alteration of species composition;
- Threat to the viability of rare, endangered or geographically restricted species; and
- Threat to the viability of obligate seeder species (which are typically more sensitive to fire than lignotuberous species that can resprout following fire).

Fires at intervals more frequent than the inherent regenerative capacity of the vegetation can promote the spread of exotic weeds by creating the required conditions, including:

- Increased light penetration through burnt-out overstorey;
- Reduced competition from native perennial species; and
- Increased availability of nutrients.

Increased weed growth, particularly annual grassy weeds, greatly increases the fire risk in a number of interrelated ways, including:

- Forming a fine-textured fuel which is highly flammable;
- Producing a high fuel load annually depending on climate and growth rate. Native plants take much longer to reach the same fuel levels;
- Forming a continuous fuel bed, permitting a fire to spread quickly. Native plants usually have gaps between them which act to slow down the spread of fire; and
- Creating a very hot fire at ground level.

This situation leads to a cycle of increased weed growth leading to increased fire risk and thus increased fire intensity and frequency, which in turn lead to increased weed growth. The effect this situation has on natural communities is profound and can quickly lead to a greatly reduced diversity of flora and fauna.

3.3.3 Fire History and Ignition Risk

Fire history has a major role to play in the determination of fuel condition and quantity. The recording of accurate fire histories is an essential component of fire management planning. This involves the recording, preferably on GIS, of the following factors:

- Location of ignition;
- Cause of ignition (if known);
- Season/date and time of ignition;
- Fire perimeter; and

- Fire intensity and locations of unburnt refugia within the perimeter. Fire intensity will vary within the fire perimeter and these variations should be recorded, possibly from aerial photos taken soon after the fire

Fire histories built up in this way will provide a firm basis for identifying areas at high risk because of frequent burning. Identification of the time since the last burn will allow more accurate mapping of fuel loads in bushland areas of good condition. Time since last burn is of less importance in areas where grassy understorey is present as this returns to pre-fire fuel loads rapidly. Mapping of fire histories will also allow identification of areas that have not been burnt for many years, as these are also an important conservation value.

The fire history of Lot 21 has not specifically been recorded but the last fire in the area was 10 years ago (Steve Palmer, pers. comm).

3.3.4 Existing Fire Management

The Fire and Emergency Services Authority (FESA) is the umbrella organisation for the Fire and Rescue Service (FRS) and the Bush Fire Brigades (BFB).

Fire suppression throughout the rest of the site falls to Bush Fire Brigades (BFBs). BFBs are managed by Local Governments, and receive training and partial funding from FESA. BFB vehicles are 4WD and are able to operate on unsealed tracks in bushland areas. The Cowaramup BFB's area of primary responsibility is bushland around Cowaramup. Margaret River BFB act as back-up if needed for the Cowaramup BFB.

3.3.5 Strategy

The proposed fire management for Lot 21 has four core elements as follows:

- Hazard reduction;
- Fire suppression;
- Public education; and
- Post-fire recovery and incident analysis.

A draft broad Fire Management Plan has been prepared by the Busselton Survey Office for the site and currently a more detailed Fire Management Plan (FMP) is being prepared by FirePlan WA. The purpose of the Fire Management Plan is to reduce the frequency of ignitions, either accidental or deliberate, and minimise the occurrence of fires within the bushland. A further aim is to minimise adverse environmental impacts of any fires that do occur.

Hazard Reduction

Hazard reduction involves actively removing the incidence of fire ignition and reducing fuel levels. Ignition reduction involves removing or reducing the causes of fires within the site eg no open fires, no wood-fired barbeques etc.

Fuel reduction involves reducing fuel levels to a point where any potential fire can be controlled by fire fighting crews on a normal summer's day. A brief assessment of fuel loads in Lot 21 show that they range from 12t/ha to 17t/ha (C. Broadbent, pers. comm, May 2004). The fuel load is comprised of leaf and twig litter, logging overburden, weed loads, herbs and small shrubs. The main approach to fuel reduction in Lot 21 should be through a hazard

reduction spring burn to remove the majority of fuel. Following the spring burn over most of the site (proposed for 2004) a programme of carefully planned prescribed autumn burns for defined areas on a rotational basis of at least 5-8 years should be considered for the site, in consultation with CALM, Fire and Emergency Services Authority (FESA) and the Bush Fire Brigade (BSB) and other relevant agencies. Prescribed burns could be carried out on a small scale (handkerchief scale) to reduce the visual and smoke impacts on adjoining neighbours. A mosaic of small scale burns are more appropriate to maintaining the bushland amenity compared to a larger hazard reduction burn across the site.

In addition to reducing the fuel load through hazard reduction burns it will be a requirement to construct Building Protection Zones (BPZ) to reduce fire intensity close to dwellings. The BPZ is a low fuel area immediately surrounding a building. BPZ's are calculated on landform slope and hazards. In the case of Lot 21 the BPZ will need to be 20m around all buildings. Generally in BPZ's the fuels including understorey species must be maintained below 100mm. Overstorey species such as trees must be spaced such that their canopies are at least 10m apart. It maybe possible to retain natural groundcovers and herb providing the leaf and twig litters is removed annually. There are businesses in the south-west that provide a service of annual removal of fuel. In the case of Lot 21 this maybe desirable to maintain some ecological value as the BPZ will extend into the proposed conservation areas. Some provision has been made to reduce the level of the BPZ extension into the conservation area through a the provision of a 16m building setback covenant from rear boundaries on certain blocks. In fact this applies to all blocks on the eastern side of the development but some on the west will only have a 10m setback. Figures 7 and 8 show the relationship between the blocks, the BPZ and the conservation zone. The Fire Management Plan currently being developed by FirePlan WA will provide more detail on hazard reduction measures that need to be applied to Lot 21.

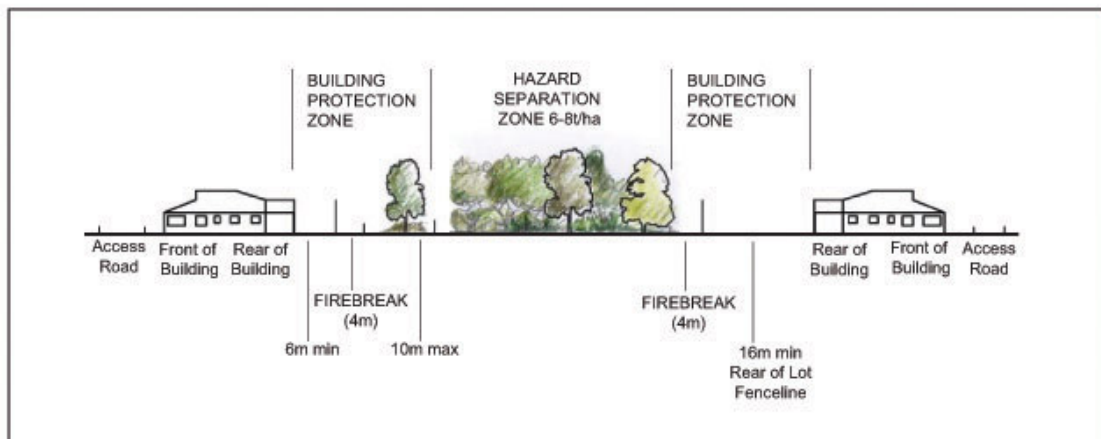


Figure 7 : Cross Section AA of Fire Managment Zones
THIS DIAGRAM IS NOT TO SCALE

Fire Suppression

Fire suppression involves fire-fighting application once a fire has started and taken hold. Fire suppression can only be effective if fires are detected quickly and fire fighters can respond and access the fire and contain it before it becomes uncontrollable. A "Fire Watch" programme can be of great assistance in alerting fire control authority to fires.

Fire suppression requires trained, experienced staff and volunteers, with suitable equipment, who are available within a short response time to fight fires. Fire suppression activities have the potential to degrade the environment through the unplanned construction of firebreaks and tracks, which lead to erosion, destruction of vegetation, and the proliferation of tracks. Fire suppression cannot be relied upon as the main fire control technique. Fire suppression must be integrated with effective ignition and fuel reduction programmes.

A system of strategic and internal firebreaks has been proposed for the site as per the broad draft Fire Management Plan for the site (Figure 4) (please note that the Fire Management Plan being prepared by FirePlan will address the access tracks in more detail). The strategic firebreaks will be cleared to 6m wide and constructed to 4m wide with a base suitable for the trafficability of 2 wheel drive vehicles. The strategic firebreaks will have a 4.5m vertical clearance of vegetation. The internal firebreaks shall be 3m wide with vertical clearance of vegetation. It is the intention of the draft Fire Management Plan that all the firebreaks will be available and trafficable for firefighting equipment and personnel and maintenance at all times.

A network of paths are proposed for the site which will divide the site into a number of cells and provide additional access for fire suppression activities.

Public Education

A community education programme should be developed for the site which highlights the dangers of wildfires to human life and property, and the destructive cumulative effects of frequent fire on flora and fauna. Education should focus on the risk of accidental fire lighting and the need for the public to be vigilant against arsonists. Education programmes should also include methods of preventing wildfire, controlling their spread and ensuring human safety in the event of a major fire within the park.

Figure 8: Fire Management Zones within Core Bushland Area



FIG 08

west cowaramup townsite natural landscape management plan

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Scale 1 : 4000 @ A3 (This Plan is Diagramatic Only)

Fire Management Zones
with Core Bushland Areas



Figure 9: Fire Management Plan

Post-fire Recovery and Incident Analysis

Bushland is in a highly sensitive condition following fire. Most of the fine material is scorched or burnt, so that photosynthetic processes are reduced or cease. This affects food webs which shift, at least temporarily, from a herbivore base to a scavenger base. The soil is left bare and sensitive to erosive processes, such as vehicle and foot movements, heavy summer rain and wind. Some of the fauna will have perished in the fire, others will have sought unburnt refuges, placing greater strain on the resources of unburnt areas. Regrowth and germinating seedlings will be subject to intense grazing pressure, not only from vertebrates, but also from invertebrates such as crickets.

Following a fire, an initial assessment should be undertaken of the potential for erosion of bare ground. Erosion control measures should be implemented as soon as possible after the fire. Access to any burnt areas should be limited to management purposes only for the first six to twelve months. In areas of the park with high pedestrian use, foot access should be limited to stabilised tracks or other firm surfaces. Signage can be used to encourage sensible behaviour, as well as to explain the regenerative processes that can be observed following fire.

Seed germination and resprouting in vegetation should be monitored for a year following fire. Although recovery should be adequate if grazing and weed control measures are implemented, additional direct seeding and tubestock replanting may need to be considered if germination success is low.

Following fire, weed species have an opportunity to increase in density and abundance. Weed control measures will need to be implemented within the site if a fire occurs. The post-fire environment is susceptible to further damage, and weed control works should be undertaken at a time that will give the bushland the greatest chance of successful regeneration.

Fire fighting operations have the potential to cause mechanical damage through trampling of vegetation, water erosion and small scale clearing. This cannot be entirely avoided, though should be minimised where possible through appropriate training within the fire-fighting authorities. Trained bush regenerators should carry out reparation of mechanical damage.

Post-fire incident analysis is an important facet of fire management which enables fire fighters and fire control authorities to review procedures, strategies and tactics and revise them in light of experience. All fires that occur within the site should be recorded. Information that should be compiled includes the date, season, time, cause of ignition, intensity and extent of the fire, fire control methods used and damage caused by the fire. This information can be used for long-term fire management planning.

Fire Control Working Plan

The management authority for Lot 21 bushland should take a pro-active approach to fire control in the park through the development of a Fire Control Working Plan (FCWP). This document should be a printed document with maps and be written in co-operation with the Fire and Rescue Service, the local Volunteer Bush Fire Brigade, the community and the Shire.

3.3.6 Recommendations

1. A ban on all open fires at all times should be instigated within the site. This may necessitate the installation of electric or gas barbeques in picnic areas and throughout the subdivision.
2. Develop a Fire Control Working Plan (FCWP) for the park, which documents the Fire Control Policy and Fire Management Plan for the park. This Working Plan should be widely distributed and contain Fire Notification Procedures. A Fire Control Working Map (FCWM) should be developed as part of the FCWP. This map should contain all physical features of the site which could hinder or assist fire suppression including location of firebreaks, fire access trails, low fuel buffer zones, fences, gates, water sources and environmental features to be defended, such as locations of protected flora and wetlands. The study area should be divided into a number of cells that can be protected in the event of a major fire. These compartments should be divided by effective fire breaks or low fuel, buffer zones and be accessible for fire suppression activities. The cells should be indicated on the FCWM.
3. Fuel reduction should be carried out in the form of weed control, slashing or mowing as appropriate. Small scale rotational hazard reduction or prescribed burns should be carried out where required.
4. Continue annual maintenance of the firebreaks and fire access trails
5. Ensure that the Fire and Rescue Service and the Cowaramup Bush Fire Brigade are aware of the management objectives for the study area and aim to protect the area's biological values and ecological functions when attending fires in the area.
6. Devise and implement a "Fire Watch" programme with a significant fire education component through liaison between managers, users and neighbours of the study area. This programme should clearly describe notification procedures in the event of a fire in the study area.
7. Keep records of the date, time, duration, intensity, personnel attending, cause of ignition, fire control methods used and damaged caused by all fires within the study area, and map their extent.
8. Following a fire, an initial assessment should be undertaken of the potential for erosion of bare ground. Erosion control measures should be implemented as soon as possible after the fire. Access to any burnt areas should be limited to management vehicles only for the first six to twelve months. Seed germination and resprouting of vegetation or regeneration should be monitored for a year following fire. Grazing control and weed control measures should be implemented for at least a year following fire. Weed control works should be undertaken at a time that will give the bushland the greatest chance of successful regeneration.
9. Fire fighting operations have the potential to cause mechanical damage through trampling of vegetation, water erosion and small scale clearing. This cannot be entirely avoided, though should be minimised where possible through appropriate training within the fire-fighting authorities. Trained bush regenerators should carry out rehabilitation of mechanical damage.

3.4 Access and Recreation

3.4.1 Objectives

The objectives for access and recreation within Lot 21 are to:

- Provide for a co-ordinated system of management access for fire control, weed control and other management requirements;
- Establish and maintain a system of pedestrian, disabled and cycle paths compatible with the conservation of the study area's ecological integrity and biological values;
- Link pathways within the study area with existing pedestrian access and paths within and adjacent to the study area; and provide for access points from future urban subdivisions;
- Restrict private vehicle access to sealed tracks and roads through the study area;
- Provide facilities and management for a range of recreational activities that are compatible with conservation of the natural environment of the park;
- Ensure that recreational facilities and activities are planned and managed to have minimal impact on the natural environment; and
- Promote the biological, physical and cultural values of Lot 21 to recreational users.

Access management is relevant to recreational use and management of the park. As the two purposes are closely related, and as many of the tracks developed for management access will also be used for recreational use and vice versa, the two issues are dealt with together.

3.4.2 Background

The proposed trails (Figure 10) and firebreaks within Lot 21 are design to maximise the recreation use and management requirements of the bushland and facilities of the site. The proposed network will link into other more regional pathways and offer regional users access to both bushland and the diverse activities proposed for the village.

3.4.3 Strategy

Access needs to consider access by management authorities, including fire control units, and the general public. Vehicular access within the bushland will be restricted to management purposes only.

The blocking of trail entrances to vehicles is not proposed at this stage but will need to be monitored to see if illegal use of trails by vehicles becomes a problem. If blocking tracks to private vehicle use is required then simple frangible bollards should be placed at trail heads. The frangible nature of the bollards will permit fire fighting equipment easy access to tracks.

Fire fighting vehicles will access the site using formed roads, dual-use pathways, firebreaks and some walking trails which will be sufficiently wide to cater for them. Access for fire-fighting purposes will be available from a number of locations around the site.

Figure 10: Potential Trails



FIG 10

west cowaramup townsite natural landscape management plan

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Scale 1 : 4000 @ A3 (This Plan is Diagrammatic Only)

Potential Trails



All the paths within the bushland are to be 3m wide and made of rolled lateritic earth. The trail system provides a number of bush walks which link to the village centre. It is proposed that regional Dual Use Path linking the site to the Cowaramup will be placed in the road reserve and managed by the Shire.

Recreational activities within the bushland should be compatible with the values of the site and have minimal environmental impact. Recreational facilities within the park will consist largely of a network of walking trails, interpretation material of the site's cultural values. Picnic and playground areas will be provided in the village precinct.

Access points to walking trails will be provided at focal centres such as the proposed artisan village. It may also be possible to integrate a number of cycle paths with the walk trail network by providing suitable surface for cyclists.

Walking trails should be accompanied by interpretive and general signage, indicating features of interest in the surrounding area, and encouraging patrons to stay on the path to reduce disturbance to the bush.

Horse riding within the bushland should be prohibited, due to the potential negative impacts of horse riding on the biological environment through the introduction and spread of weeds and dieback, and potential conflicts with other park users such as pedestrians.

3.4.4 Recommendations

1. Recreational activities within the park should be compatible with the goals of ecotourism and have minimal environmental impact. Recreational facilities will consist largely of a network of graded walking trails to cater for varying levels of fitness and mobility. Walk trails should be constructed of rolled lateritic earths.
2. Walk trails should be accompanied by interpretive and general signage, indicating features of interest in the surrounding area, and encouraging patrons to stay on the path to reduce disturbance to the bush.

3.5 Disease Management

3.5.1 Objectives

The objectives for disease management within Lot 21 are to:

- Quantify the presence or absence of dieback disease from vulnerable areas of the site;
- Prevent the introduction of dieback disease into the site, or the disease is already present, prevent further spread of dieback from infested areas; and
- Monitor the vegetation of the area for the presence of fungal disease such as *Phytophthora*, *Armillaria* and other plant pathogens.

3.5.2 Background

Dieback

No surveys have been undertaken for the presence of dieback and other diseases within Lot 21. If *Phytophthora* is present in this environment, it could be transported in soil or plant root material to dieback-free areas within susceptible areas of the site and neighbouring areas where it could result in dieback disease.

CALM has specified factors that indicate the degree of risk of spreading dieback (CALM, 1992). The risk of spreading dieback is related to the nature of the proposed operation or development, and the nature of the site. The sort of operations and activities that could occur within Lot 21 that relate to dieback include track and firebreak construction, track and firebreak maintenance, weed control, bushland restoration, building construction, general maintenance, vehicle movement and pedestrian movement. Table 3.0 defines the risk factors related to the type of operation to be performed Table 4.0 details risk factors associated with the nature of the site in relation to site factors present within Lot 21.

Table 3.0: Risk Factors for Spreading Dieback Due to the Nature of the Operation

Source: CALM (1992)

Highest Risk	Lowest Risk	Risk for Lot 21
Operation over large area	Operation over small area	High
Complex operation	Simple operation	High
Much machinery	Little machinery	Low
Much movement of soils	Little movement of soils	Low
Untrained personnel	Well trained personnel	Low
Inexperienced personnel	Experienced personnel	Low

Table 4.0: Risk Factors for Spreading Dieback Due to the Nature of the Site

Source: CALM (1992)

Highest Risk	Lowest Risk
Wet conditions	Dry conditions
Sticky soils	Non-sticking soils
Low-lying site	Elevated site
Dieback known nearby	Dieback not known nearby

Using the factors and areas listed in Table 4.0, the areas at highest risk of dieback spread are the eastern wet sections of the site and adjacent to the creekline.

Dieback can be spread by vectors such as vehicles, earth-moving equipment, humans, bikes and horses through movement of infested soil and plant matter on tyres, boots and hoofs. The disease could also be introduced to the study area through plants and soil used for bushland restoration. Dieback disease would be best managed as part of an integrated disease management strategy for the entire site.

Armillaria luteobalbina

Another plant pathogen is *Armillaria luteobalbina* (also known as honey fungus), which is a mushroom-producing fungus that is native to Western Australia and commonly occurs in the south-west of the state. *A. luteobalbina* has the potential to be a greater threat to vegetation communities within the site than *Phytophthora* species, as it is not restricted to certain soil types and could occur anywhere within the park.

Armillaria luteobalbina has been not been found within Lot 21. It appears as a golden yellow fruiting body at the base of tree stumps around June or July. The infection is caused by the aerial dispersion of spores, or through mycelium in root systems. Infection entry points for the spores may be provided by wounds caused by fire, broken limbs and insect damage. As *A. luteobalbina* is not purely a soil-borne pathogen, it is impossible to contain the pathogen by utilising current hygiene practices. There is no known cure for the disease. The best strategy for minimising the impact of the fungus would be to reduce plant stress to enable plants to resist and combat fungal attack, and to avoid spreading infected plant material during any earth-moving activities.

Aerial Canker

Most living trees have numerous small fungal infections. Recently a new fungal threat has emerged in Western Australia. Several air-dispersed fungi have infested many native plant communities, especially in areas along the south coast. Species from the Myrtaceae and Proteaceae families appear to be particularly susceptible.

Aerial canker kills twigs in the lower crown and causes lesions called cankers in the bark of the main stem and roots. Severe cankers can cause death in parts of the plants above the canker. The fungus usually enters the plant through an existing wound (insect attack or wind

damage). If the tree is healthy and not stressed it can effectively fight the fungus, with no adverse effects on the tree.

At present there are no mechanisms to control the fungus, so the best mitigating action would be to minimise factors that can cause stress, allowing plants to effectively combat infection.

3.5.3 Strategy

As there is no practical large-scale cure for dieback, prevention of infection is the primary means of defence. This involves preventing movement of dieback infested soil, plant matter and water into uninfested areas, and careful placement of tracks so that they do not cross between dieback infested and uninfested areas. Any soil or plant material used for bushland restoration or landscaping should be certified as *Phytophthora*-free. Dieback management within Lot 21 eastern wet areas and riparian corridors, as these are the most susceptible locations. A dieback survey should be conducted in these areas to confirm that the areas are currently dieback-free.

Protection of individual plants can be achieved using phosphite, which is injected or sprayed onto individual trees. The method is a non-toxic way of preventing the disease attacking the plant. Even after infection, an injection of phosphite can help the plant recover. However, the treatment only lasts for 3 to 5 years. The major disadvantages of this method are that it is relatively expensive due to the intensive labour requirements, and can only be effectively used on small or isolated occurrences of dieback.

There are no known methods for controlling aerial canker or *Armillaria luteobalbina*. The best defence against these species is to reduce disturbances within the site that could stress plants, such as frequent fire and alterations to hydrologic regime.

3.5.4 Recommendations

1. Reduce operations involving movement of soil, such as firebreak and track construction and maintenance, to a minimum, and carry out these operations under strict dieback hygiene practices.
2. All construction activities to be maintained within specified areas so that vehicle movements do not encroach on the bushland. All residential and village development zones should be marked off and contractors penalised for infringements beyond these zones.
3. All firebreaks and walking tracks should be constructed of suitable dieback free material to minimise the risk of dieback spread.
4. Any soil or plant material used for bushland restoration should be certified as *Phytophthora*-free. Nurseries commissioned to grow plants for revegetation works should be accredited dieback-free nurseries, preferably those specialising in contract growing of revegetation species.

3.6 Feral and Domestic Animal Control

3.6.1 Objectives

The objectives for feral animal control within Lot 21 are to:

- Control feral animals to a level where they have a minimal impact on the study area's biological values if eradication is not possible;
- Ensure that feral animal control measures do not adversely impact on the native biota of the study area or on people visiting the area; and
- Restrict the movements of domestic animals.

3.6.2 Background

There are potential feral animal within Lot 21, as well as future domestic cats and dogs when the site is urbanised. Possible vertebrate feral animal species are:

- | | |
|-----------------------------|----------------------------------|
| • Cat | <i>Felis catus</i> |
| • European Red Fox | <i>Vulpes vulpes</i> |
| • Rabbit | <i>Oryctolagus cuniculus</i> |
| • House Mouse | <i>Mus musculus</i> |
| • Black Rat | <i>Rattus rattus</i> |
| • Rock Dove or Feral Pigeon | <i>Columba livia</i> |
| • Laughing Turtle Dove | <i>Streptopelia senegalensis</i> |
| • Laughing Kookaburra | <i>Dacelo novaeguineae</i> |

The feral rodents, the House Mouse and Black Rat, are ubiquitous species commonly associated with human settlement and are difficult to control in bushland areas. The Rock Dove and Turtle Dove would be impossible to control within Lot 21 and there is little evidence that they have a major impact on native species. The Laughing Kookaburra does have a deleterious impact on native fauna through predation on small reptiles and young birds. The kookaburra is aggressive and will displace native bird species. However, kookaburras are difficult to control and any control efforts within the study area would be wasted without a regional control programme.

Feral cats and foxes are predators of a wide range of small native animals, including birds, mammals, frogs and reptiles. Fox control using 1080 poison (sodium monofluoroacetate) would not be appropriate within the area due to the proximity of the bushland to future urban areas. Low levels of 1080 poison are tolerated by native animals, but the poison is highly toxic to humans and domestic animals as well as feral animals. Control of feral cats is extremely difficult, although selective trapping and removal of individuals could be implemented if cats became a significant problem in the area.

Rabbits are present within the study area, although their presence is not obvious in comparison to some areas of urban bushland, where rabbit warrens and droppings are abundant.

3.6.3 Control Strategy

The preferred strategy is to remove all non-native fauna from the study area. At present, this would not be practical due to the likelihood of re-invasion of many species from surrounding land. In the future the site will be largely surrounded by urban developments. The optimal strategy in this situation is to minimise the deleterious impacts of feral species on the native biota.

The best approach is to monitor the existing situation to gain data on the size of feral animal populations within the site, particularly cats, foxes and rabbits, and to prevent any additional feral species from establishing within the area. In addition, improving the condition of the bushland will make it more attractive to native species, and possibly displace feral species. Domestic animals should be restrained from entering the bushland wherever possible.

The responsibility for control of feral animals within the study area will lie with the managing body. Control priorities should centre around those feral species with the greatest impact on native wildlife and their habitat – cats, foxes and rabbits.

3.6.4 Recommendations

1. Construct advisory signs indicating that dogs are only allowed on a leash on pathways within conservation management zones and should be kept under control within all areas of the bushland at all times. Construct advisory signs indicating that cats are not permitted within the bushland at any time.
2. Estimate the size of feral cat, fox and rabbit populations.

3.7 Ecological Restoration

3.7.1 Objectives

The objectives for ecological restoration within Lot 21 are to:

- Reinstall indigenous flora and vegetation communities, where they have been disturbed and/or depleted, particularly after infrastructure works;
- Minimise the impact of activities that could result in degradation to vegetation communities through the use of appropriate management strategies;
- Improve the overall condition of vegetation communities within the site; and
- Ensure that vegetation communities are self-sustaining and are capable of natural regeneration.

3.7.2 Background

Ecological restoration involves restoring the vegetation and habitats through means of reinforcing and reinstating the system's ongoing natural regenerative processes. This involves reducing or eliminating disturbance factors, removal of inhibitors to natural regeneration such as weeds, and the reconstruction of the ecosystem in highly disturbed areas where the potential for natural regeneration has been markedly reduced or lost.

The bushland condition map presented in Figure 3 can be used as a tool for determining restoration strategies. This map expresses the impacts of disturbance factors that cause changes to vegetation structure, floristic composition and weed invasion. The following terms describe the techniques that should be applied to the various condition areas:

Assisted natural regeneration

This method is used where a remnant of vegetation exists in *Fair – Good to Very Good – Excellent* condition and retains its natural regenerative capacity. It can also be used once a reconstructed community regains its natural regenerative capacity. Assisted natural regeneration involves removing weeds and disturbance factors from the environment.

Reconstruction

This technique is applicable where a bushland remnant is seriously depleted – for example where only some overstorey species are left, or when there is no remnant vegetation left. Reconstruction relies on methods to re-establish vegetation such as replanting, topsoil relocation and direct seeding.

3.7.3 Strategy

The restoration of the vegetation should aim to maintain the resilience of good areas while restoring disturbed areas of the site. The restoration plan should follow three basic principals of bush regeneration known as the Bradley method. This method involves selective weeding around native species to decrease competition, increase the size and number of native plants and gradually improve the condition of the bushland.

The underlying principals of this method are:

- Work from areas in good condition to areas in poor condition. Start regeneration work in areas with least disturbance and increase the area's resilience and then gradually work into areas with more weeds;
- Minimise disturbance while working. This is important so that regeneration work does not simply create conditions suitable for weed invasion. Minimise disturbance to soils and trampling of plants; and
- Let the rate of natural regeneration determine rate of weed removal. This can be important, as over-weeding will leave large bare areas that can be reinvaded by more or different weeds.

Assisted natural regeneration following the Bradley method should be undertaken in bushland in *Fair – Good* condition or better.

Replanting and reconstruction should only occur where the exclusion of disturbance does lead to regeneration. The areas likely to require reconstruction are:

- The cleared area to the east of the site;
- Those areas where infrastructure is to be placed eg sewerage, water, drainage;
- Areas damaged during construction phase; and
- The riparian zone of the centrally located creek.

It is the aim of the developer of Lot 21 to undertake ecological reconstruction work for the above degraded areas for a period of three years prior to handover to the managing authority. This will ensure that the conditions necessary for full regeneration of the site are in place and only follow-up management (eg weed control) is required.

A detailed design plan will need to be developed for each area requiring reconstruction.

Techniques that will need to be followed in the rehabilitation and reconstruction of the bushland are detailed below.

Seedling planting

Native seedlings should be planted in late autumn and early winter to ensure good establishment from beneficial winter rains. Seedlings should only be planted after initial rainfall has thoroughly moistened the soil. Seedlings which have grown beyond post-emergent stage (around four to nine months, depending on species growth rates) are considered most suitable for planting. Mature stock, although less suitable, do provide an obvious statement to the general public that a regeneration programme is underway and are useful in some places. Native seedlings should include a range of ground strata, middle strata and upper strata species with a view to achieving the floristic and structural composition of the original vegetation community.

Adequate ground preparation is important for good plant establishment. A small area approximately 50 cm in diameter should be cleared of weeds either by manual hoeing or with herbicides. Thick layers of mulch can deny weed seeds access to light and thereby restrict their growth. Following the application of the manual and herbicide control, weed-free mulch can be spread around revegetated seedlings to help reduce weed growth. Care must be taken in the use of mulch as it may be contaminated with weed seeds or disease, and may

also suppress native seed germination. It is not necessary to water plants on planting provided they are well watered before planting and the planting precedes good wetting rains.

Plants should preferably be grown from fertile seeds or cuttings collected within the study area or surrounding areas of similar vegetation type. All of the propagated plants should be grown by accredited *Phytophthora*-free nurseries, preferably those specialising in contract growing of revegetation species. No fertilisers should be used at the time of planting. Seedlings should not be staked for support. Free standing plants become more durable and strong. Care should be taken that plants are not evenly spaced or planted in rows. Seedlings should be randomly clumped or spaced to achieve a natural effect.

Direct Seeding

Direct seeding will be a useful technique in the reconstruction areas. Native plant seed should be obtained from within the study area, as it is desirable to use seeds with the same genetic background as naturally occurring plants. Some seed will need to be scarified or heat treated before planting. Areas to be planted should be weed free and the ground lightly tilled to create random furrows approximately 50 mm deep in which the seed can lodge. The seed should be mixed and bulked with an inert material before broadcasting by hand. Application rates for direct seeding should be 2-3 kg/ha, although this will depend on the viability of seeds of individual species. A light cover of mulch (1-2 cm deep) is recommended over the direct seeded areas. Kings Park should be contacted to discuss the use of smoke to stimulate seed germination of some of the more difficult native species.

Seed Collecting

If seed is to be collected specifically for the study area by the council or community, a CALM seed collecting licence will be required. Collection should only be carried out under the close supervision of qualified seed collectors. Volunteers and involved council staff should be given training to avoid potential damage to plants and to ensure that viable seed is collected. No more than one third of the available seed should be collected from any individual plant. Several "parent" plants should be used for each species, preferably from different locations within the study area.

3.7.4 Monitoring

Bushland condition can be used to measure the success of ecological restoration, as it can be used to demonstrate increases in area of *Very Good – Excellent* or *Fair – Good* condition bushland, through improvements to the proportion of native species present, the structural integrity of the bushland and a decline in the number and/or level of disturbances present. Accordingly, targets can be set to determine what increase in area of *Very Good – Excellent* or *Fair – Good* condition bushland is required over the term of the management plan. An example of a suitable performance criterion is increasing the area of bushland condition assessed as *Very Good - Excellent* and *Fair - Good* by 2% each year respectively over five years.

3.7.5 Recommendations

1. Assisted natural regeneration should be carried out where needed throughout the site following the principles of the Bradley method. In general, assisted natural regeneration will be appropriate in areas of *Fair – Good* condition bushland, and in some areas of *Very Good – Excellent* condition bushland where weeds are apparent. Assisted natural regeneration should commence in areas of the best condition, and gradually progress into areas in worse condition. Ecological restoration works should be integrated with weed control programmes.
2. In areas where the exclusion of disturbance has not led to regeneration, reconstruction/revegetation will be required. Detailed design plans should be developed for each area requiring reconstruction before works commence. All revegetation programmes, either planting or direct seeding, should use seed or cuttings sourced from the local area only.
3. A suitable increase in the area of *Fair – Good* and *Very Good – Excellent* condition bushland over the next five years should be set as a criteria for determining the success of the ecological restoration programme, and bushland condition reassessed after five years.

4.0 Management Costs

West Cowaramup Townsite Natural Landscape Management Plan

4.1 Management Costs

The following cost for each key management area are proposed for the site once infrastructure and bushland restoration efforts have been completed. Essentially these costs are for maintenance of the site and are based generally on maintenance rates for the metropolitan area;

Item	Description	Unit	Quantity	Rate	Cost (\$)	Comments
1	Weed control in good bushland	m2	120735.5m ²	\$0.03	3622.06	Assumes focus on problems areas such as path edges, boundaries etc
2	Weed control in restored bushland and disturbed areas	m2	56357.44m ²	\$0.05	2817.87	Areas which have been revegetated may require two sprays per year. This cost should reduce as the bushland condition improves
3	Maintenance of firebreaks	ln	820m	\$1.00	820.00	Firebreaks to be graded each year
4	Maintenance of pathways	ln	2491	\$0.60	1500.00	Minor repairs to pathways as required
5	Maintenance of drainage basins	m2	1900	\$0.10	190.00	Removal of debris and clean-out of soil.

6.	Fuel reduction measures – hazard reduction burns	Item	One-off payment	na	1000.00	To be undertaken by the Cowaramup Bush Fires Brigade – financial donation made. This will serve as training for the volunteers
	Removal of plant biomass	Item	7000	\$0.30	2100.00	Requires racking of leaf and twig debris annually in Building Protection Zone (within bushland area)
7.	Risk assessment – checking potential for tree falls or limb falls along tracks	Item	1 day	1200.00	1200.00	Generally undertaken on a yearly basis
8.	Removal of limbs, trees and tree debris along tracks after severe storm events	Item	Once per year	2000.00	2000.00	May be required two to three times per year
9	Project Management including NT overview costs (5 days/year), local supervisor (30 days/year)	Item	Ongoing	7500.00	7500.00	Supervisor required to help oversee bushland management
10	Community management including training of community volunteers	Item	Ongoing	1500.00	1500.00	
11	Feral animal control	Item	Periodic	500.00	500.00	Possible trapping
12	Signage maintenance	Item	Yearly		1500.00	Repair of signs or replacement
Total					26,249.93	

The estimated total management cost for the bushland and facilities is \$26,249.93. This translates into approximately \$1483.00 per hectare. Furthermore this is approximately \$0.15 per square metre.

In addition to the requirements for ongoing management there will requirement to set aside funds for the preparation of a Bushland Maintenance Plan and determination of a Construction Management Plan to ensure impacts on the bushland are minimised during the construction phase of the subdivision and during housing construction. These costs could be in the order of \$10 –20K.

4.1.1 Funding Sources

Funds will be required on an annual basis to management the bushland environmental and facilities. Negotiations between Parkwater Corporation Pty Ltd and the Shire of Augusta-Margaret River have indicated that the most appropriate method to collect maintenance revenue is through a Special Levee which will be raised against all residents of Lot 21.

Effectively this will be a special area rate that will provide sufficient recurrent funding for bushland management purposes. The levee will be of sufficient size that funds will accumulate on a year to year basis so that in the event of a large capital requirement sufficient money will be available.

4.1.2 Management Body

A bushland management body will be required to manage the day to day maintenance requirements of the bushland and its facilities. At this stage it is proposed that the National Trust will be the managing body and it may delegate certain operations to the local Shire or other public or private agencies capable of bushland management. It is the intention of Parkwater Corporation Pty Ltd that the bushland will be placed under a Conservation Covenant with the National Trust.

References

West Cowaramup Townsite Natural Landscape Management Plan

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Appendix One: Weed Species List

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Scientific Name	CALM Rating		
	Rating	Invasiveness	Impacts
* <i>Bromus diandrus</i>	High	✓	✓
* <i>Aira caryophylla</i>	Moderate	✓	
* <i>Anagallis arvensis</i> var. <i>arvensis</i>	Moderate	✓	
* <i>Anagallis arvensis</i> var. <i>caerulea</i>	Moderate	✓	
* <i>Anthoxanthum odoratum</i>	Moderate	✓	
* <i>Arctotheca calendula</i>	Moderate	✓	
* <i>Avena barbata</i>	Moderate	✓	
* <i>Briza maxima</i>	Moderate	✓	
* <i>Briza minor</i>	Moderate	✓	
* <i>Carduus pycnocephalus</i>	Moderate	✓	
* <i>Centaurium erythraea</i>	Moderate	✓	
* <i>Cynodon dactylon</i>	Moderate	✓	
* <i>Cyperus brevifolius</i>	Moderate	✓	
* <i>Cyperus tenellus</i>	Moderate	✓	
* <i>Disa bracteata</i>	Moderate	✓	
* <i>Holcus lanatus</i>	Moderate	✓	
* <i>Hypochaeris glabra</i>	Moderate	✓	
* <i>Juncus bufonius</i>	Moderate	✓	
* <i>Lolium rigidum</i>	Moderate	✓	
* <i>Lythrum hyssopifolia</i>	Moderate	✓	
* <i>Orobancha minor</i>	Moderate	✓	
* <i>Parentucellia viscosa</i>	Moderate	✓	
* <i>Polypogon monspeliensis</i>	Moderate	✓	
* <i>Solanum nigrum</i>	Moderate	✓	
* <i>Sonchus oleraceus</i>	Moderate	✓	
* <i>Trifolium dubium</i>	Moderate	✓	
* <i>Vellereophyton dealbatum</i>	Moderate	✓	
* <i>Vulpia bromoides</i>	Moderate	✓	
* <i>Cynosurus echinatus</i>	Mild		
* <i>Petrorhagia dubia</i>	Mild		
* <i>Rumex pulcher</i> subsp. <i>divaricatus</i>	Mild		
* <i>Trifolium repens</i>	Mild		
* <i>Acetosella vulgaris</i>	Low		
* <i>Bromus hordeaceus</i>	Low		
* <i>Conyza bonariensis</i>	Low		

Scientific Name	CALM Rating		
	Rating	Invasiveness	Impacts
* <i>Cotula turbinata</i>	Low		
* <i>Cyathea cooperi</i>	Low		
* <i>Filago gallica</i>	Low		
* <i>Hordeum geniculatum</i>	Low		
* <i>Lotus angustissimus</i>	Low		
* <i>Lotus uliginosus</i>	Low		
* <i>Mentha</i> sp.	Low		
* <i>Ranunculus muricatus</i>	Low		
* <i>Trifolium ligusticum</i>	Low		