

# ARMADALE SETTLERS COMMON STRATEGIC DIRECTIONS

City of Armadale





**ecoscape**

**REPORT FOR THE CITY OF ARMADALE**

**ARMADALE SETTLERS COMMON - STRATEGIC DIRECTIONS  
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Direct all inquiries to:

**Ecoscape (Australia) Pty Ltd**

9 Stirling Highway • PO Box 50 North Fremantle WA 6159  
Ph: (08) 9430 8955 Fax: (08) 9430 8977  
ecoscape@iinet.net.au

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# Acknowledgments

## Armadale Settlers Common - Strategic Directions

There are many people who contributed to the development of this Strategic Directions document

First and foremost Brett Tizard should be acknowledged for his past contributions to the management of Armadale Settlers Common, including the 1990 – 2000 Environmental Management Plan, the 1995 review of the Management Plan and considerable work collating information for the current Strategic Directions document.

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From the City of Armadale the following people should be acknowledged: Ron Van Delft, Environmental Officer (now Senior Planning Officer); Gordon Gillam, Senior CAD Officer; Roger Stephens; Pat Quinlivan, Recreation Officer; Mick McIntosh, Senior Ranger; and Ron Porter, Ranger Services.

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Other stakeholders that contributed to the Strategic Directions document are Sue Moyle, Armadale Scout Group; Bev Edwards, Armadale Primary School; Christine Wells, Federal Department of Environment and Heritage, as well as representatives of Orienteering WA and the Department of Conservation and Land Management. Their contributions are gratefully acknowledged.

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# Foreword

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## Armadale Settlers Common - Strategic Directions

The 376 ha Armadale Settlers Common has been recognised as a significant asset to the region by Council since November 1988 when it supported the establishment of a Management Committee of local residents “for the purposes of preparing a comprehensive management plan for the area”. That Management Plan was prepared and implemented by volunteers associated with the Common. Much was achieved over the years, including the establishment of a Field Study Centre.

In 2002 a consultant was contracted to prepare a fully costed plan for the Common. The plan and the implications of its recommendations were considered by Council on two occasions. In assessing the plan Council determined that in order to adequately manage the Common and its bushland, \$233,000 would be needed over five years, and this did not include any rehabilitation of degraded areas estimated to cost in the order of an additional \$517,000 over five years. When considered in the context that Council has a larger reserve adjacent, namely Bungendore Park at 497ha it became evident that the cost implications of adequately managing both areas of bushland was beyond Council’s resources.

During its discussion Council also noted that 108ha of the 376ha known as Armadale Settlers Common is owned by the Western Australian Planning Commission and that Bungendore Park abuts in excess of 560ha of Western Australian Planning Commission owned land to the south. It was agreed that it would be appropriate for both of these areas to be managed by one authority, rather than having one part managed by Council and another part managed by the State Government.

Furthermore, these assets are regionally significant in terms of their conservation value, and should be managed by an agency with staff experienced in on-ground bushland management.

Council has therefore resolved to lobby the Government of Western Australia to manage the these regional parklands.

In the meantime, the work undertaken by the consultant to prepare a fully costed plan for Armadale Settlers Common should not be wasted. Therefore, it has been converted into this Strategic Directions document which identifies a range of recommended actions and their subsequent priority.

The Strategic directions document will be able to be used by whatever agency manages the Common. It is expected the document will help the Armadale Settlers Common Management Committee identify priority areas for their volunteer efforts and the document would be able to be used to support their applications for funding.

Cr Linton Reynolds JP  
MAYOR

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# Executive Summary

## Armadale Settlers Common - Strategic Directions

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### Executive Summary

The Armadale Settlers Common is an important asset for the residents of the City of Armadale and of the greater Perth Metropolitan Region. It has high value as a large area of natural bushland in the metropolitan area and the opportunities this presents for passive recreation.

#### Study Area

The Armadale Settlers' Common is located in Bedforddale, 29 km south east of the Perth CBD, within the City of Armadale. It has an area of approximately 383 ha of which 278 ha is vested in the City of Armadale for the purpose of "Parks and Recreation" under the title Reserve 4127, and 105 ha is owned by the Western Australian Planning Commission/ Department for Planning and Infrastructure, as part of its Metropolitan Region Scheme (MRS) reserve acquisition program.

#### Biophysical Environment

Armadale Settlers Common has a Mediterranean climate characterised by warm, dry summers and cool, wet winters. It has topographical features typical of the Darling Scarp and associated foothills comprising lateritic soil on the flats, valleys and west facing slopes. The gradient of these slopes varies quite considerably from 50m/km (1 in 200) to 200 m/km (1 in 5). At its lowest point the Common is 85 metres above sea level rising to 265 metres at its peak.

The Common lies on the Darling Scarp which forms the steep western margin of the Darling Plateau. The geology consists of Archaean Rocks consisting of gneisses on the lower slopes of the Common and migmatite on the uplands of the Common (Biggs *et al.*, 1980). The soil types range from lateritic soil to the Pinjarra soil association. The two most extensive soil units are the Darling Scarp unit, which forms the steep slopes to the west and north of the Common, and the Dwellingup Unit associated with the crest and upper gentle slopes of the plateau found on the eastern parts of the Common.

The native vegetation found in the Common is typical of the Northern Jarrah Forest and the Darling Scarp. The dominant vegetation complexes are the Darling Scarp complex along the eastern slopes of the Common and the Dwellingup complex on the crests. Floristic analysis have determined four floristic community types:

- FCT 1a - Upper slope *Eucalyptus wandoo* woodland over low heath/dwarf shrub on mid-upper -Scarp face and valley slopes;
- FCT 1b - *Eucalyptus wandoo* – *Corymbia calophylla* woodlands on winter wet deep loamy clays on creek flats and adjacent to granites and/or dolerite;
- FCT 9 - *Eucalyptus marginata* forest and woodland on lateritic upper slopes and upland Darling Plateau; and
- FCT 10 - *Corymbia calophylla* woodland on deep loams of upland valley slopes.

A total of 318 plant species in 63 families have been found on the Common. The dominant trees are Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*). Other common species include Bull Banksia (*Banksia grandis*) and Parrot Bush (*Dryandra sessilis*) with Grass Trees *Xanthorrhoea preissii*, *X. gracilis* and Zamia Palm (*Macrozamia reidleyi*) frequently visible in the understorey. Two Declared Rare and

Priority Flora (DRPF) have been found in the Common; *Thelymitra stellata* (R), and *Calothamnus rupestris* (P4).

While much of the Common is in *Good* to *Excellent* condition, there are several threats to the ecological integrity of the reserve, many of which are related to disturbance caused by inappropriate access. Threatening processes include:

- weed invasion;
- *Phytophthora* dieback;
- feral animals;
- fire; and
- erosion.

There are 145 vertebrate fauna species that potentially occur in the Common. This includes 58 bird species, 49 reptile species, 24 mammal species and 14 amphibian species. This large array of fauna is due in part to the large size of the reserve and also the unbroken transition from the lower slope or Darling Scarp vegetation to the 'Dwellingup' vegetation on the upper crests. Eight species of Threatened or Priority Fauna also have the potential to occur in the Common. These are Baudin's Cockatoo (*Calyptorhynchus baudinii*); Carnaby's Cockatoo (*C. latirostris*); Forest Redtailed Cockatoo (*C. banksii*); Chuditch (*Dasyurus geoffroi*); Brush-tailed Phascogale (*Phascogale tapoatafa*); Water Rat (*Hydromys chrysogaster*); Quenda (*Isoodon obesulus fusciventer*); and the Western Brush Wallaby (*Macropus irma*).

### **Social Environment**

Over one hundred years ago, the Colony of Western Australia established a series of Commons within its borders. Reserve 4127 was gazetted on 18 June 1897 for the purposes of "Commonage". The remaining land that is now part of the Common was privately owned at that time and was predominantly used for grazing. It was vested in the Armadale-Kelmscott Road Board on 2 August 1912 and the purpose amended to "Common and Timber for Settlers". In 1981, the purpose of the reserve was changed to "Parks and Recreation" and was revested in the Armadale City Council. In 1990, the first Management Plan was published following extensive public consultation and the Armadale Settlers' Common Field Study Centre was open in early 1993. Since that time the building has been extended and a new building added which are used by environmental and community groups throughout the year.

As an integral part of the Darling Scarp, the Common contributes significantly to the amenity value of the district as it forms a significant part of the backdrop to the Armadale City Centre and is part of the Heritage Country Tourist Drive. Much of the bush is in good condition and people make use of the firebreaks for bushwalking and other forms of passive recreation. Armadale Settlers Common has been identified as important for aesthetic and social value by the Western Australia National Estate Aesthetic Value Identification and Assessment Project as part of the Comprehensive Regional Assessment. It was also recommended the inclusion of the Common in the Register of National Estate.

There is one registered Aboriginal heritage site associated with Armadale Settlers Common. Neerigen Brook Camping Area (Site No. S2215). Also of heritage value is a building listed on the City of Armadale's Municipal Heritage Inventory. The former Plymouth Brethren Meeting Hall known as 'Willow Heights' was relocated following the widening of the Albany Highway through Bedfordale in 1997 and is now part of the Field Study Centre Complex.

Armadale Settlers Common has high value as a recreational resource for the community. Individuals and community groups take advantage of the opportunities provided by the Common and its closeness to the metropolitan area to undertake passive recreational

activities including: walking and hiking; orienteering; nature appreciation; picnicking; exercising; and nature photography.

In terms of bushwalking and nature appreciation, the Common also presents a number of opportunities including expansive views of the City and large areas of intact native vegetation. At present, tracks suitable for bushwalking are generally limited to a network of fire access tracks. The provision of defined trails with markers would enhance the experience considerably and increase the accessibility to the Common by a greater diversity of users, including tourists.

Some less responsible four-wheel drive enthusiasts have contributed to widespread dieback infection, erosion and the localised destruction of vegetation. There has also been considerable dumping of rubbish in the Common. Weed invasion is generally low in the greater part of the Common, however small infestations of invasive weeds, particularly *Watsonia bulbifera*, pose a large risk to the integrity of the bushland if they are not controlled at an early stage. Due to its size and location, restricting access is difficult.

From an educational perspective, the Armadale Settlers Common represents a unique and important resource. The Field Study Centre, located in the Common, provides a venue for groups to conduct workshops and provides a base from which to study the natural features of the reserve.

## Recommendations Summary

### Planning and Management Structure

The objectives for Planning and Management Structure are to:

- Create an effective management structure with identified roles and responsibilities.
- Management of the Common becomes the responsibility of a single administrative body to achieve coordinated management within five years.

No.	Recommendation	Priority	Cost	Key Performance Indicator
1.1	Investigate the feasibility of transferring vesting and ownership of the part of ASC currently owned by the City of Armadale to the Conservation Commission.	1	Operational	Feasibility investigation completed and acted upon.
1.1	Seek funding to carry out restoration projects annually.	1	Operational	Funding acquired from external sources increases annually

### Management Zones

The objectives of management zones are to:

- divide the Common into relatively homogenous areas that have a uniform basis for management;
- manage the Common in relation to their purpose of Special Conservation, Conservation, Buffer and Education.

No.	Recommendation	Priority	Cost	Key Performance Indicator
2.1	Public access to the Special Conservation Category Zones should be restricted by directing pedestrian traffic onto formalised paths.	2	N/A	Measurable decrease in area of Dieback-free areas of no more than 5% per annum
2.2	Zone boundaries and categories should be periodically reassessed every five years.	5	inclusive w / EMP review	Purpose and acceptable uses are appropriate to management zones

### **Disturbance Management**

The objectives for disturbance management are to:

- minimise disturbance to natural bushland within Armadale Settlers Common; and
- limit and reduce activities that contribute to disturbance and degradation of natural areas.

No.	Recommendation	Priority	Cost	Key Performance Indicator
3.1	Dumped rubbish should be removed as soon as possible after it has been found	1	Operational	Annual reduction in rubbish dumping incidents
3.2	Gradually close and rehabilitate all tracks not depicted in Figure 4.2 and any other tracks agreed by all relevant parties including community groups and the Fire Brigade. Prioritise tracks susceptible to erosion or within dieback-free areas.	2	\$6,000 / annum	1,000 m <sup>2</sup> tracks rehabilitated per annum
3.3	Undertake weekend patrols of ASC perimeter during summer and holidays.	1	Operational	Increase in number of infringement notices given in first year followed by decreasing numbers annually thereafter
3.4	Block all access points not gated with minor earthworks.	2	\$200 per access point	Initial increase followed by annual reduction in reports of off-road activity
3.5	Erect regulatory signs at trail heads to advise of prohibited activities	4	\$1,000	Initial increase followed by annual reduction in reports of prohibited activities
3.6	Encourage local residents to report illegal activities through enhancing reserve custodian program with a focus on ASC by raising awareness with leaflets and website updates	4	\$1,500	Initial increase followed by annual reduction in reports of prohibited activities
3.7	Control of feral bee hives when found	1	Operational	Reduction in number of bee hives in the Common
3.8	Permits for horse riding on the Common should not be issued.	1	Operational	None

### **Weed Control**

The objectives for weed control within Armadale Settlers Common 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 areas;
- Minimise any detrimental effects of the weed control programme on the native biota; and
- Integrate the weed control programme with bushland restoration programmes.

No.	Recommendation	Priority	Cost	Key Performance Indicator
4.1	Undertake Bushland Condition mapping of ASC.	1	\$2,000	Bushland condition map including serious weed infestations

No.	Recommendation	Priority	Cost	Key Performance Indicator
4.2	Undertake annual best practice weed control activities based on the methods and priorities outlined in this document, Map 3.3 and bushland condition map once completed.	1	\$800 - \$1,000 / ha	2 ha weeds controlled per annum
4.3	Monitor success of overall weed control activities by repeating bushland condition mapping every 5 years	5	\$2000	10% of ASC bushland has improved category after 5 years
4.4	Monitor success of individual weed control sites using quadrats that are checked annually.	2	\$300 / quadrat	90% reduction in weed cover at each quadrat

### **Bushland Restoration**

The objectives for ecological restoration within Armadale Settlers Common are to:

- reinstate indigenous flora and vegetation communities, where they have been disturbed and/or depleted;
- 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 Common; and
- ensure that vegetation communities are self-sustaining and are capable of natural regeneration.

No.	Recommendation	Priority	Cost	Key Performance Indicator
5.1	Carry out assisted natural regeneration in <i>Good</i> condition areas following the principles of the Bradley method based on bushland condition mapping.	1	\$1 / m <sup>2</sup> / annum	Area of bushland that has improved its category from the bushland baseline condition survey.
5.2	Carry out reconstruction / revegetation in areas indicated by Figure 3.3 and in <i>Poor</i> and <i>Very Poor</i> Condition areas based on bushland condition mapping.	3	\$5 / m <sup>2</sup> / annum	Area of bushland that has been regenerated with local vegetation to a weed free status equivalent to good condition vegetation.
5.3	Monitor the success of individual restoration projects using quadrats	4	\$300 / quadrat	90% Survivability of planted seedlings / 40% germination from seed

### **Fire Management**

The prioritised objectives for fire management are to ensure:

1. protection of human life;
2. protection of property; and
3. protection of ecological integrity and biological values.

No.	Recommendation	Priority	Cost	Key Performance Indicator
6.1	Prepare and implement a Fire Control Management Plan for the Armadale Settlers Common using FESA guidelines that includes investigation of the mosaic burning and areas with different fire frequencies.	2	\$4,000	Reduction in severity of fire incidents (reviewed annually)
6.2	Continue maintenance of firebreaks within the Common	1	Operational	Reduction in severity of fire incidents (reviewed annually)

No.	Recommendation	Priority	Cost	Key Performance Indicator
6.3	Undertake hazard reduction through physical removal of grassy weeds on the Common's boundaries..	2	\$1,000 per Ha	Reduction in number of bushfire incidents (reviewed annually)
6.4	Continue mosaic hazard reduction burning once fuel loading has reached 8T/Ha	N/A	Operational	No increase in number of bushfire incidents or severity (reviewed annually)
6.5	Engage in post-fire recovery and incident analysis following a bushfire event.	N/A	Operational	Database of fire history for ASC continually updated
6.6	Facilitate research to determine the effects of burn regime in the Common to maintain biodiversity and the ecological values.	3	N/A	No net decrease in floral diversity as a result of hazard reduction burns. Monitored using vegetation survey conducted every five years.
6.7	Develop, and encourage nearby residents to participate in, a 'Fire Watch' programme for early response using signage and leaflets	2	Operational	Reduction in number of bushfire incidents (reviewed annually)

### **Dieback Management**

The objectives for dieback management are to:

- prevent the spread of dieback into uninfected areas beyond its natural rate of expression
- educate bushland regenerators and the community about dieback and ways to limit its spread

No.	Recommendation	Priority	Cost	Key Performance Indicator
7.1	Apply phosphite to the eastern boundary of Area 1, and consider phosphite applications to other parts of the Common in the broader context of other City reserves.	1	Operational	Length of dieback front treated and re-treated every four years.
7.2	Train revegetation and maintenance personnel in dieback hygiene measures	1	\$300 per person	no annual reduction in area of treated dieback-free areas beyond natural rate of expression (1 m / yr)
7.3	Monitor dieback-free areas by mapping every 5 years	1	\$2,000	Dieback mapping on CoA GIS
7.4	Upgrade drainage along Settlers Road to prevent dieback spores infecting dieback-free area	2	\$15,000	no annual reduction in area of Area 4 beyond natural rate of expression (1 m / yr)
7.5	Include information about dieback hygiene in interpretive signage and provide boot-scrub facilities at trail heads.	2	\$2,500	Boot scrub facilities and signage installed on completion of one trail per annum.
7.6	Inject individual significant trees susceptible to dieback	1	N/A	Individual trees agreed to be significant compared with the number treated with phosphite (in the last four years).

### **Erosion Control**

The objectives for erosion control within Armadale Settlers Common are to:

- Control the causes of erosion and rehabilitate existing eroded areas;
- Prevent erosion caused by inappropriately placed tracks; and

- Prevent erosion after weeds have been removed.

No.	Recommendation	Priority	Cost	Key Performance Indicator
8.1	Undertake further earthworks to restore natural stream contours at the old dam site.	3	approx. \$20,000	Reduction in water turbidity 100 m downstream by 50% after rainfall event.
8.2	Construct culvert where track crosses stream fed by old dam spring	2	\$1,000	Culvert operating effectively

### **Fauna Management**

The objectives for fauna management within Armadale Settlers Common are to:

- preserve and improve fauna habitat;
- control feral animals within the Common where possible and appropriate;
- 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 that currently roam within the Common.

No.	Recommendation	Priority	Cost	Key Performance Indicator
9.1	Undertake habitat supplementation such as nesting boxes and raptor platforms and monitor their use	4	\$2,500	Habitat supplementation being used by native species
9.2	Assess the need to prepare and adopt a Local Law and/or Planning Policy to control cats near reserves	4	Operational	Needs analysis completed and acted upon
9.3	Investigate the feasibility of Armadale Settlers Common participating in species recovery programs	4	Operational	Feasibility investigated
9.4	Investigate the location and protection of ecological linkages to other conservation areas.	2	Operational	Town Planning Scheme No. 4 identifies and protects linkages.

### **Cultural Heritage Management**

The objectives for the cultural heritage management within the Common are:

- to prevent damage to cultural heritage values;
- to maintain European and Aboriginal cultural heritage values, structures and artefacts; and
- to promote awareness of cultural values through education.

No.	Recommendation	Priority	Cost	Key Performance Indicator
10.1	Investigate and consider renomination of Armadale Settlers Common for inclusion on the Register of National Estate	1	Operational	ASC included or rejected in register for National Estate
10.2	Facilitate further research on the identification of cultural heritage values	5	\$1,000	Report on cultural heritage values compiled

### **Access and Recreation**

The objectives for access and recreation management are to:

- provide an appropriate level of access to minimise recreational conflicts and preserve the ecological and cultural values of Armadale Settlers Common;
- facilitate appropriate recreational activities by providing suitable resources and infrastructure; and
- provide a safe environment for passive recreation.

No.	Recommendation	Priority	Cost	Key Performance Indicator
11.1	Audit potential walking tracks for standards and erosion management and determine upgrade requirements and cost	1	\$2,500	Report completed
11.2	Undertake a comprehensive safety audit of public access areas within ASC	2	\$1,500	Report completed
11.3	Establish signposted, named walking trails in the Common with informative signage at trail heads as indicated in Figure 6.5	2	approx \$1,000 per trail head plus	Number of trails completed.
11.4	Continue to promote and hold the annual 'Walk the Common' event	1	\$3,000	increasing numbers of participants annually
11.5	Update and redistribute ASC brochure,	2	\$2,000	Increased number of visitors to ASC
11.6	Monitor visitor numbers annually	5	\$1,000	Increased number of visitors to ASC
11.7	Explore implications and investigate methods for the control of access from private property	1	operational	Report on access completed

### **Education, Interpretation and Ecotourism**

The objectives for interpretation and education-based activities are to:

- inform and educate visitors on the natural and cultural values of the Common;
- develop opportunities for ecotourism with minimal impact on the environment;
- increase the level and quality of information available to the community on the flora, vegetation and fauna of the park; and
- increase knowledge of Armadale Settlers Common's environmental, local and regional significance.

No.	Recommendation	Priority	Cost	Key Performance Indicator
12.1	Provide potable water to Field Study Centre	1	\$6,000	Level of use for Field Study Centre increases annually
12.2	Monitor use of the field study centre	1	Operational	Level of use for Field Study Centre increases annually
12.3	Annually update relevant internet web pages upon adoption of this document. Include 'counter' to monitor site visitors	2	Operational	Increased number of 'hits' on website annually

### **Infrastructure and Amenities**

The objectives for the management of infrastructure and amenities are to:

- provide a level of amenities to aid the enjoyment and function of the reserve;
- provide security for the biophysical values in the Common; and
- maintain the existing infrastructure and amenities to an acceptable standard.

No.	Recommendation	Priority	Cost	Key Performance Indicator
13.1	Audit and ensure signage consistent and complies with AS 2156	1	\$250 / sign	inconsistent signage replaced
13.2	Provide disabled access to Field Study Centre and toilet facilities to AS 1428	2	\$12,000	Increased annual use of Field Study Centre
13.3	Provide sewerage infrastructure to Field Study Centre.	2	\$15,000	Increased annual use of Field Study Centre

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<b>No.</b>	<b>Recommendation</b>	<b>Priority</b>	<b>Cost</b>	<b>Key Performance Indicator</b>
13.4	Investigate the feasibility of providing a walk trail suitable for disabled access	5	Operational	Feasibility study completed
13.5	Reopen car park on Carradine Road redesigned with reduced area to discourage antisocial behaviour.	4	\$4,000	No more than 10 complaints of antisocial behaviour per annum
13.6	Construct information shelters at trail head indicated in Figure 6.5	3	\$8,100	One shelter erected per annum
13.7	Construct an additional electric BBQ at the Field Study Centre complex	5	\$2,400	Barbecue installed



# 1.0 Introduction

## Armadale Settlers Common - Strategic Directions

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### 1.1 General Description

The Armadale Settlers Common is located in Bedforddale, 29 km south east of Perth, within the City of Armadale. The reserve is comprised of two separate areas: The western area, the larger of the two, extends from the intersection of Carradine Rd and Carrawatha Ave in the west, up the Scarp to Waterwheel Rd in south easterly direction and is bordered by Albany Highway, Triton Crescent, Waterwheel Road, Canns Road, Carradine Road and Locke View as well as extensive sections of private property; the second, north easterly, area is intersected by Canns Rd and surrounded by private property.

The Common is approximately 383 hectares and is one of the few remaining large areas of bushland close to the metropolitan area. It provides a cross-section of the Darling Scarp, from the the foothills to the plateau, and is an integral part of the Darling Range Regional Park. In addition to its natural heritage values, the Common's social and aesthetic values have been noted in the System 6 Red Book and during the Comprehensive Regional Assessment component of the Regional Forest Agreement for Western Australia.

Throughout this document, with the exception of the historical documentation, "the Armadale Settlers' Common", "the Common", and "the Reserve" all refer to Reserve 4127 and the adjoining land currently owned by the Department for Planning and Infrastructure and leased to the City of Armadale by the Western Australian Planning Commission.

## 2.0 Planning Context

### Armadale Settlers Common Strategic Directions

## 2.1 Land Tenure and Vesting

The Armadale Settlers Common comprises land reserved for Parks and Recreation vested in the City of Armadale, and land owned by the Western Australian Planning Commission.

The Common has an area of approximately 383 ha of which 278 ha is vested in the City of Armadale for the purpose of "Parks and Recreation" under the title Reserve 412, while 105 ha is owned by the Western Australian Planning Commission as shown in Figure 2.1.

## 2.2 Management Framework and Stakeholders

### 2.2.1 City of Armadale

The following Council Directorates are involved in the management of Common:

Development Services Directorate – Environment, Planning

Technical Services Directorate – Parks and Reserves

Community and Corporate Services – Recreation Services, Ranger Services

#### ***Development Services Directorate***

##### **Environmental Services**

Environmental Services represented by the Environmental Officer coordinates environmental work within the Common and liaises with the various management committees and the City's Parks Department. The Environmental Officer is also responsible for monitoring the implementation of management activities in the Common.

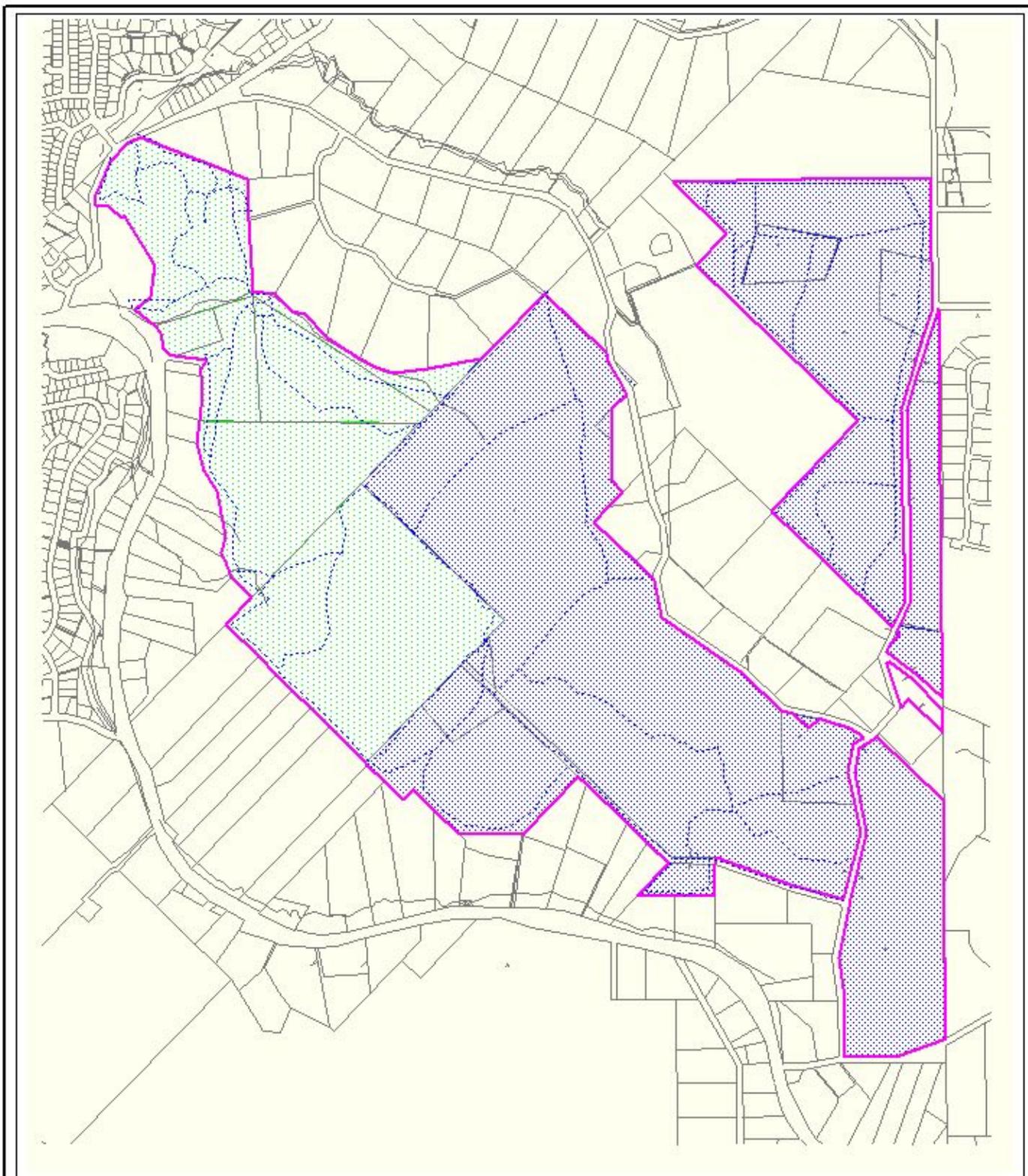
##### **Planning Services**

Planning Services implements the Town Planning Scheme which determines appropriate land uses in the City of Armadale. The planning department assesses development applications for areas surrounding the Common and may take into account the potential impact this may have when making planning decisions.

#### ***Technical Services Directorate***

##### **Parks and Reserves Services**

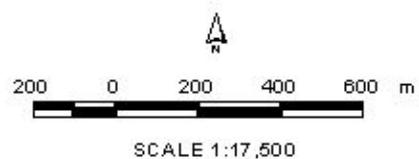
Parks and Reserve Services are responsible for maintenance of the Common on the advice of the Environmental Officer and other management bodies. Parks and Gardens undertake the 'on ground' works such as track maintenance, fencing, signage and maintenance of other assets and facilities. They also carry out weed control and may assist in bushland restoration.



**LEGEND**

-  STUDY AREA
-  CROWN RESERVES  
Vested in Local Government
-  WAPC FREEHOLD

-  CADASTRE
-  TRACKS



Vesting of Armadale Settlers Common

CLIENT	CITY OF ARMADALE
PROJECT:	1037
JOB NO:	1037-2.1
DATE:	05-08-03



## **Community and Corporate Services Directorate**

### **Recreation Services**

Recreation Services are responsible for the organisation of recreational events including the annual 'Walk the Common', as well as providing recreational facilities. They also have a role in the provision of literature to aid recreation such as pamphlets and publications such as 'Heritage Country Trails – Bushwalks and Trails in Perth's Heritage Country' (City of Armadale, 1999).

### **Ranger Services**

Ranger Services carry out the dual role of fire management and law enforcement within the Common. The provision of fire access tracks, controlled burns, access and the issuing of infringement notices and fines for restricted activities are undertaken by Ranger Services. Prohibited activities in the Common include: golf; public rallies; sales of goods; camping; erection of signs; littering; rubbish dumping; fires; destruction or interference with trees or revegetation works; and unauthorised vehicles including trail bikes and bicycles.

### **Community Development**

The Community Development Team supports and enhances the community by developing and providing opportunities that bring about positive growth.

The Team focus includes:

- community planning for community services, activities and facilities in partnership with the community, Government and Non-Government agencies;
- community support for individuals and organisations in providing and developing services and activities;
- project development of specific projects that result from community planning; and
- service delivery using State and Federal grant funds.

## **2.2.2 Western Australian Planning Commission**

The Western Australian Planning Commission owns 108ha of the Common as freehold land. The Western Australian Planning Commission purchased the land as a result of the the land being reserved for Parks and Recreation under the Metropolitan Region Scheme. Western Australian Planning Commission landholdings are ordinarily managed by the Department for Planning and Infrastructure on behalf of the Commission. However most of the Commissions land in the Darling Range Regional Park is managed by Department of Conservation and Land Management under an agreement negotiated by the State Government under Section 16 of the *Conservation and Land Management Act 1984*.

## **2.2.3 Bushcare and Environmental Advisory Committee**

The Bushcare and Environmental Advisory Committee (BEAC) comprises 12 members from the community as well as one councillor and the City of Armadale's Environmental Officer. The role of the BEAC is to advise the City on policy matters associated with the environment and to coordinate conservation groups and committees including the Armadale Settlers Common Management Committee. It also has a role in administering funds to these groups and supporting specific projects.

## **2.2.4 Armadale Settlers Common Management Committee**

From 1986 management of the Common has been guided and management actions implemented by the Armadale Settlers Common Advisory Committee. This is a Standing Committee of the City formed after the introduction of the *Local Government Act, 1995*. The Committee administers specific works within the Common such as the creation of walking tracks and revegetation activities.

### **2.2.5 Armadale Settlers Common Field Study Centre Inc.**

The Armadale Settlers Common Field Study Centre Inc. (ASCFSC) is an incorporated body created to enable applications to be made for funding such as Bushcare and Lotteries Commission grants. Funding bodies often require that applicants are incorporated. There are not currently any active members of the ASCFSC, however the group's charter and constitution remain and it is still registered as an incorporated body.

### **2.2.6 Friends of Armadale Settlers Common**

A friends group has recently been established for the Armadale Settlers Common and it is made up of people who are willing to undertake works for the improvement of the Common. The main objectives of the Friends of Armadale Settlers Common (FOASC) are to create a safe environment for passive recreation and undertake bushland restoration. Some members of the group are planning to undertake training in Bushland Regeneration, Seed Sourcing, Weed Control and First Aid.

### **2.2.7 Commonwealth and State Government Agencies**

#### ***Commonwealth Department of Environment and Heritage & the Australian Heritage Council***

The *Environment Protection and Biodiversity Conservation Act 1999* and establishes the heritage regime for the Commonwealth. The Act sets out the steps for entering places on the National Heritage List and the Commonwealth Heritage List, management of National and Commonwealth heritage places, requirements for impacts of proposals involving National Heritage places and requirements for Commonwealth agencies in relation to Commonwealth Heritage Places.

The Act also prescribes criteria for listing National Heritage places and Commonwealth Heritage places and management principles for National Heritage places and Commonwealth Heritage places.

The Australian Heritage Council Act 2003 establishes the Australian Heritage Council, sets out the structure of the Council and states the Council's functions in relation to maintaining the Register of the National Estate. Listing in the Register of the National Estate gives some protection.

Under now superceded legislation (the *Australian Heritage Commission Act 1975*) Armadale Settlers Common was nominated for listing on the National Register during the research phase of the regional forest agreement. It was found to have significant aesthetic and social value. The nomination has since expired but there are significant grounds for renomination of the Common as a National Heritage site under the *Environment Protection and Biodiversity Conservation Act 1999*.

#### ***Western Australian Department of Environment***

The Department of Environment (DE) provides technical advice on matters relating to the Environmental Protection Act (1986) which relates to prevention, control and abatement of environmental pollution and the conservation, preservation, protection, enhancement and management of the environment. The Environmental Protection Act is administered by the *Environmental Protection Authority* working closely with the DE.

### **Department of Conservation and Land Management**

The Department of Conservation and Land Management (CALM) is responsible for managing land under their control, administering the Conservation and Land Management Act and conserving wildlife. Armadale Settlers Common is part of the Darling Range Regional Park, the management of which is coordinated by CALM. Ongoing liaison between the City of Armadale, the Western Australian Planning Commission and the Department of Conservation and Land Management is required to ensure consistency in management objectives for the Regional Park.

#### **2.2.8 Private Landholders**

The Armadale Settlers Common is largely bounded by private property consisting of residential lots, farms and vineyards. Private landholders are responsible for maintaining fencing and maintaining fire access tracks on their property.

#### **2.2.9 Key to Stakeholder Abbreviations**

The following are abbreviations used throughout this document to refer to the above stakeholder and management groups.

##### **City of Armadale**

Env Srv	Environmental Services
Plan Srv	Planning Services
P&R Srv	Parks and Reserves Services
Rec Srv	Recreation Services
Ranger Srv	Ranger Services

##### **Management Organisations**

BEAC	Bushcare and Environmental Advisory Committee
ASCMC	Armadale Settlers Common Management Committee
ASCFSC	Armadale Settlers Common Field Study Centre Inc
FOASC	Friends of Armadale Settlers Common

##### **State Government Agencies**

DPI	Department of Planning and Infrastructure
WAPC	Western Australian Planning Commission
AHC	Australian Heritage Commission
DE	Department of Environment
CALM	Department of Conservation and Land Management
FESA	Fire and Emergency Services Authority of Western Australia

##### **Other**

Priv	Private Landholders
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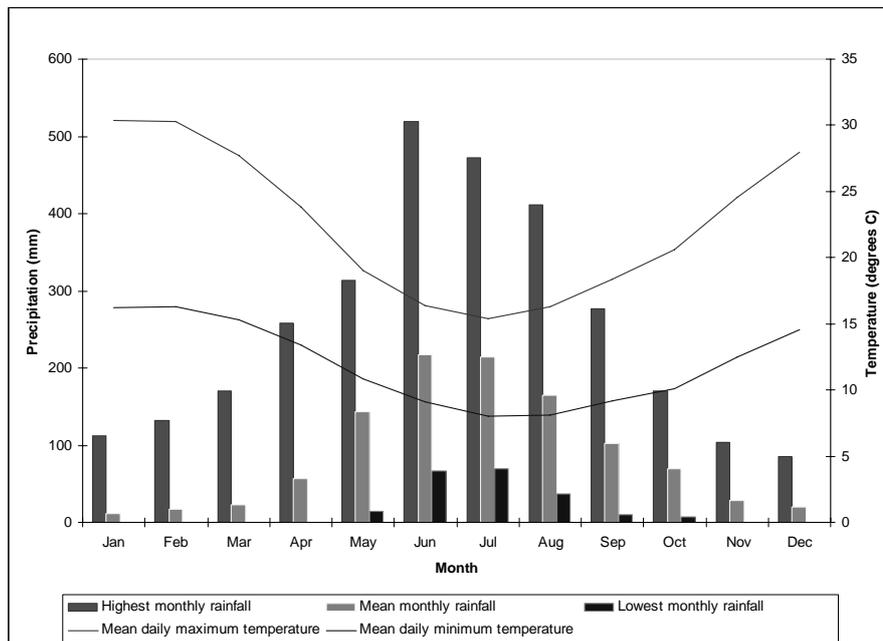
# 3.0 Biophysical Environment

## Armadale Settlers Common - Strategic Directions

### 3.1 Climate

The Common has a Mediterranean climate characterised by warm, dry summers and cool, wet winters. Bedforddale has an average rainfall of 1256 mm with 70% falling in four months. (Bureau of Meteorology, 2000). Climatic averages for Kalamunda (near Armadale Settlers Common) are shown in Figure 3.1.

Figure 3.1 Climatic Averages for Kalamunda (1908-1994)



Source: Bureau of Meteorology

### 3.2 Topography, Geomorphology and Soils

#### 3.2.1 Topography

The Armadale Settlers Common has topographical features typical of the Darling Scarp and associated foothills, and is composed of lateritic soil on the flats, valleys and west facing slopes. The gradient of these slopes varies quite considerably from 50m/km (1 in 200) to 200 m/km (1 in 5). At its lowest point, the Common is 85 metres above sea level rising to 265 metres at its peak.

#### 3.2.2 Geology and Geomorphology

The Armadale Settlers Common lies on the Darling Scarp which forms the steep western margin of the Darling Plateau. The geology consists of Archaean Rocks consisting of gneisses on the lower slopes of the Common and migmatite on the uplands of the Common (Biggs *et al.*, 1980).

### 3.2.3 Soils

The soil types range from lateritic soil to the Pinjarra soil association. The laterite or 'ironstone' is made up of spherical pebbles cemented in a buff coloured matrix which has been leached of silica and has a high content of iron and aluminium oxides.

Four Soil Units representing four Landscape Types as defined by Churchward and McArthur (1980) are found in the Common (Table 3.1).

**Table 3.1 Landforms and Soils of the Common**

Landscape Unit	Soil Unit	Soil Landform Characteristics
Lateritic Uplands	Dwellingup	Yellowish-brown sandy gravels and lateritic duricrust on crests and upper gentle slopes
Minor Valleys	Yarragil	Yellowish-brown sandy gravels on gentle slopes; "orange earths", with some yellowish-brown sands on narrow floors
Major Valleys combining Slopes and Floors	Murray	Red and yellow earths on moderate to steep slopes of deeply incised valleys
Major Valleys, Slopes and Scarps	Darling Scarp	Very steep slopes with shallow red and yellow earths and many rock outcrops.

Adapted from Churchward and McArthur (1980)

The two most extensive units are the Darling Scarp unit, which forms the steep slopes to the west and north of the Common, and the Dwellingup Unit which is associated with the crest and upper gentle slopes of the plateau and is found on the eastern parts of the Common including the isolated north-east section. The other, less extensive units on the Common include: the Yarragil unit, found along the north-east margin of the southern section of the Common; and the Murray unit which may have minor incursion into the Common along its southern edge. Vegetation complex mapping, shown in Figure 3.1, is based on soil-landform characteristics.

## 3.3 Vegetation and Flora

### 3.3.1 Native Vegetation

The native vegetation found in the Common is typical of the vegetation found on the Darling Scarp and the Northern Jarrah Forest. The Scarp forms a biogeographical boundary between the vegetation of the Swan Coastal Plain and the Northern Jarrah Forest Bioregion in the South West Botanical Province. This is a floristically diverse region (Markey, 1997) and there are 2057 species of flowering plants listed as occurring in the Swan Coastal Plain and at least 784 species in the Northern Darling Scarp (Markey, 1997). The most common families represented on the Scarp are Proteaceae (70), Papilionaceae (68) and Myrtaceae (63).

#### **Vegetation Communities**

The vegetation complexes present at Armadale Settlers Common are described below in Table 3.2. Vegetation Complexes were described by Heddle *et al.* (1980) using structural classification of vegetation, soil and landform units, annual rainfall and site-vegetation types derived from a floristic analysis of key understorey species. While this is a useful indicator of vegetation type, particularly in its relationship to soils and landscape, it has a relatively broad scale (1:50,000) and may obscure local patterns in vegetation communities (Markey, 1997).

**Table 3.2 Vegetation Complexes in the Common**

Complex	Landform	Characteristics
Dwellingup	Lateritic Uplands	Open forest of <i>Eucalyptus marginata</i> – <i>Corymbia calophylla</i> .
Yarragil	Minor Valleys	Open forest of <i>E. marginata</i> – <i>C. calophylla</i>
Murray	Major Valleys Combining Slopes and Floors	Open forest of <i>E. marginata</i> – <i>C. calophylla</i> with some <i>E. patens</i> on slopes to fringing woodland of <i>E. rudis</i> – <i>Melaleuca raphiophylla</i> on valley floors
Darling Scarp	Major Valley Floors and Scarps	Vegetation range from open woodland to lichens according to depth of soils. Woodland components chiefly <i>E. wandoo</i> with <i>E. laeliae</i> in the north, <i>E. haematoxylon</i> in the south and <i>C. calophylla</i> throughout.

Adapted from Heddle *et al.* (1980)

The vegetation complexes described above follow the same pattern as the Landform and soils of Churchward and McArthur (1980) outlined in section 3.2.3 above. The dominant complexes are the Darling Scarp complex along the eastern slopes of the Common and the Dwellingup complex on the crests. The Yarragil complex is present to a limited extent on the north eastern margin of the southern section of the Common, with a small patch on the north eastern edge of the northern section. Vegetation complexes in Armadale Settlers Common are shown in Figure 3.2.

Floristic Community Types of the Darling Scarp have been determined from a floristic analysis of vegetation on the Northern Darling Scarp by Markey (1997). Floristic analyses are based on understorey composition rather than vegetation structure or species composition of the dominant strata. Table 3.3 shows the Floristic Community Types found on the Common.

**Table 3.3 Floristic Community Types in the Common**

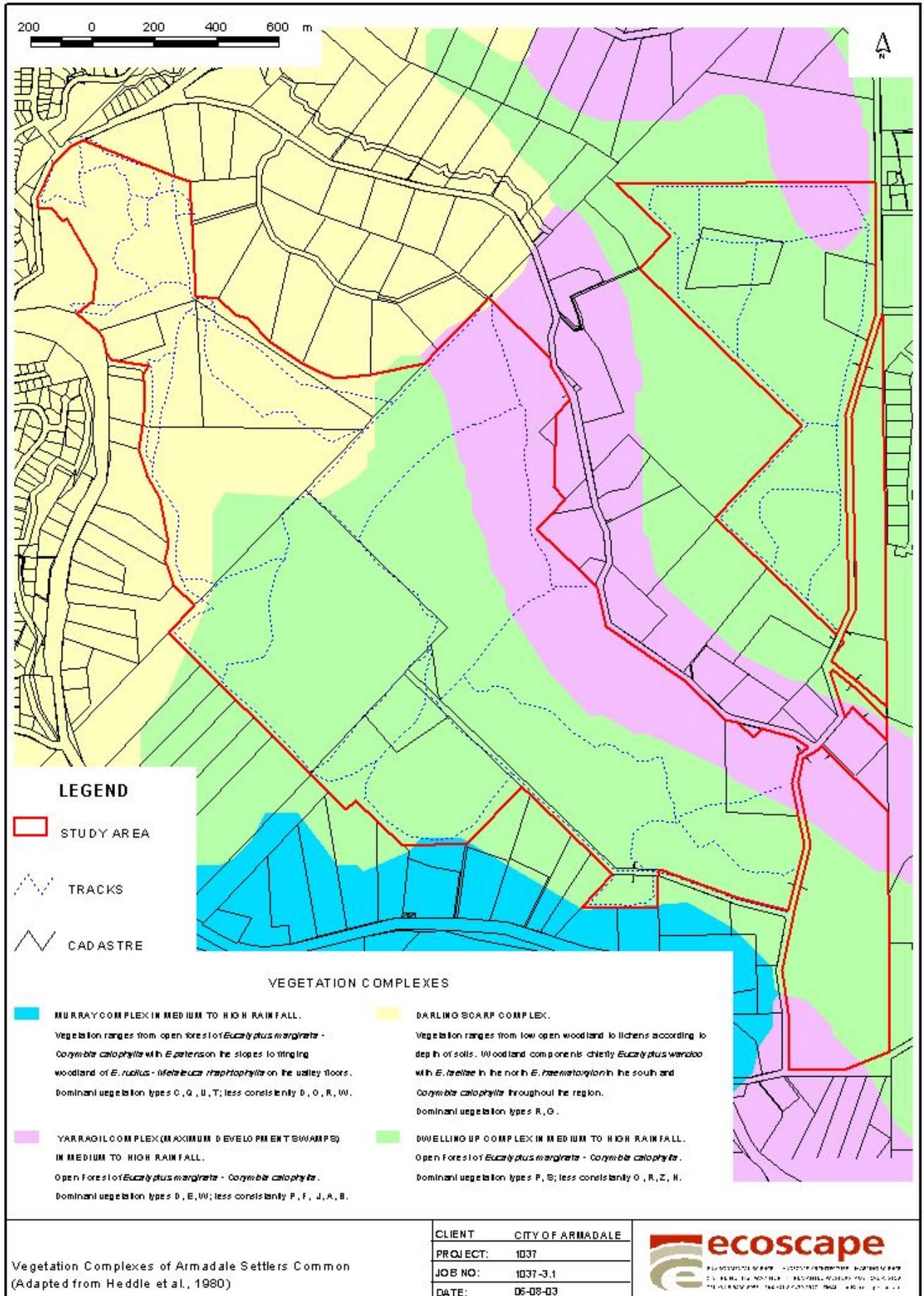
Type	Description	Species Richness
1a	Upper slope <i>Eucalyptus wandoo</i> woodland over low heath/dwarf shrub on mid-upper -Scarp face and valley slopes.	66.9±8.9
1b	<i>Eucalyptus wandoo</i> – <i>Corymbia calophylla</i> woodlands on winter wet deep loamy clays on creek flats and adjacent to granites and/or dolerite.	69.1±5.2
9	<i>Eucalyptus marginata</i> forest and woodland on lateritic upper slopes and upland Darling Plateau.	68.7±12.3
10	<i>Corymbia calophylla</i> woodland on deep loams of upland valley slopes. Species poor.	25.5±5.5

Adapted from Markey (1997)

### **Native Flora Species**

The number of species and genera in each of the 63 families of flowering plants found on the Common are shown in Table 3.4. The dominant families are Proteaceae (29 species), Papilionaceae (27 species) and Orchidaceae (22 species). Also well represented are species of the Poaceae (20 species), Asteraceae (19 species), Cyperaceae (17 species), Anthericaceae (16 species), Stylidaceae (16 species) and Myrtaceae (15 species). An amalgamated list of flora species potentially occurring in the Common is included as Appendix One.

**Figure 3.2 Vegetation Complexes of Armadale Settlers Common (adapted from Heddle et al.,**



**Table 3.4 Number of Species and Genera of the 63 Families of Flowering Plants of Armadale Settlers Common**

Family	Genera	Species	Family	Genera	Species
Adiantaceae	1	1	Lobeliaceae	2	3
Amaranthaceae	1	1	Loranthaceae	2	2
Anthericaceae	9	16	Mimosaceae	1	7
Apiaceae	6	7	Myrtaceae	8	15
Araceae	1	1	Orchidaceae	11	22
Asteraceae	17	19	Orobanchaceae	1	1
Boraginaceae	1	1	Oxalidaceae	1	1
Brassicaceae	1	1	Papilionaceae	15	27
Caesalpiniaceae	1	1	Philydraceae	1	1
Campanulaceae	1	1	Phormiaceae	2	2
Caryophyllaceae	1	1	Pittosporaceae	1	1
Casuarinaceae	1	2	Poaceae	14	20
Centrolepideae	1	2	Polygalaceae	1	3
Colchicaceae	1	1	Primulaceae	1	1
Convolvulaceae	1	1	Proteaceae	10	29
Cyperaceae	7	17	Ranunculaceae	1	1
Dasyogonaceae	2	9	Restionaceae	1	1
Dennstaedtiaceae	1	1	Rhamnaceae	2	3
Dilleniaceae	1	8	Rubiaceae	1	3
Droseraceae	1	5	Rutaceae	1	1
Epacridaceae	4	7	Scrophulariaceae	2	3
Euphorbiaceae	1	1	Solanaceae	1	1
Gentianaceae	2	2	Stackhousiaceae	1	1
Goodeniaceae	4	8	Sterculiaceae	1	1
Haemodoraceae	4	11	Stylidiaceae	2	16
Haloragaceae	1	1	Thymelaeaceae	1	3
Hypoxidaceae	1	1	Tremandraceae	1	2
Iridaceae	5	8	Verbenaceae	1	1
Juncaginaceae	2	3	Violaceae	1	1
Lamiaceae	1	1	Xanthorrhoeaceae	1	2
Lauraceae	1	2	Zamiaceae	1	1
Linaceae	1	1			
			<b>Total</b>	<b>162</b>	<b>318</b>

The dominant trees in Armadale Settlers Common are Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*). Other common species include Bull Banksia (*Banksia grandis*) and Parrot Bush (*Dryandra sessilis*) with Grass Trees (*Xanthorrhoea preissii*, *X. gracilis*) and Zamia Palm (*Macrozamia reidleyi*) frequently visible in the understorey. Numerous orchids and trigger plants can be seen flowering in spring as well, as can the State's emblem, the red and green kangaroo paw (*Anigozanthus manglesii*). Wilsons Grevillea (*Grevillea wilsonii*, which forms part of the Common's emblem, is also a prominent understorey shrub.

### **Species Endemic to Darling Range**

The Northern Jarrah Forest has a number of species endemic to the Darling Range and the majority of endemic taxa in the Perth Region appear to occur on the Darling Scarp foothills, slopes and western margin (Markey, 1997). Table 3.5 shows the endemic plant species found in the Common.

**Table 3.5 Plant Species found within the Common Endemic to the Darling Range**

<b>Endemic Taxa Restricted to Darling Scarp (Bullsbrook to North Dandalup)</b>
<i>Conostylis setosa</i> <i>Hakea cristata</i> <i>Hibbertia aff glomerata</i> <i>Pimelea imbricata ssp piligera</i>
<b>Endemic Taxa Restricted to Darling Scarp from Gingin to Harvey</b>
<i>Conostylis setigera ssp setigera</i> <i>Thysanotus fastigiatus</i> <i>Trymalium ledifolium var rosmarinifolium</i>
<b>Near Endemics with Outlying Disjunct Populations</b>
<i>Calothamnus rupestris</i> <i>Grevillea bipinnatifida</i>
<b>Northern Species with Southern Limit on Darling Scarp</b>
<i>Melaleuca radula</i>

Adapted from Markey (1997)

### 3.3.2 Declared Rare and Priority Flora

Declared Rare and Priority Flora (DRPF) are taxa that are rare, threatened or have reduced populations. Definitions of DRPF are shown in Table 3.6.

Two DRPF have previously been found in the Common; a rare orchid and *Calothamnus rupestris* (P4).

It is the policy of the Department of Conservation and Land Management not to publicise the locations of populations of Declared Rare Flora. In accordance with this, details on the location and management of this species has been included in Appendix Six, which will not appear in public versions of this Management Plan.

*Calothamnus rupestris* (Mouse-Ears) is classified as a Priority 4 species and occurs frequently on the Darling Scarp. It is largely confined to the Metropolitan Region on granite soils and in some places laterite soils. Distribution is limited to Red Hill, Gosnells, St. Ronans Nature Reserve and Boyagin Rock. It is killed by fire and subsequent seedlings need ten to twenty years to grow to near full size. It is a dense, usually spreading shrub that grows 2-4 meters tall. It produces small clusters of rich pink flowers between August and October. (Powell, 1990).

**Table 3.6 Definitions of Declared Rare and Priority Flora.**

Category	Definition
Declared Rare	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection
Priority 1	Taxa which are known from one or a few (generally <5) populations which are under threat
Priority 2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat
Priority 3	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat
Priority 4	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors

Adapted from Atkins (2003)

### 3.3.3 Weeds and Introduced Species

A total of 42 weed species have been previously recorded from several surveys (Table 3.7). This also includes ratings of priority for control in accordance with the *Environmental Weed Strategy for Western Australia* (EWSWA) (Department of Conservation and Land Management, 1999a, 1999b). This categorises weed species in terms of their priority for control according to the following criteria:

- 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 EWSWA 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.

**Table 3.7 Weed Species Previously Recorded in the Common and their EWSWA Rating.**

Scientific Name	Common Name	EWSWA rating
<i>Lupinus cosentinii</i>	Sandplain Lupin	High
<i>Watsonia bulbifera</i>	Watsonia, Bugle Lily	High
<i>Zantedeschia aethiopica</i>	Arum Lily	High
<i>Freesia sp</i>	Freesia	High
<i>Cerastium glomeratum</i>	Mouse Ear Chickweed	Low
<i>Cicendia filiformis</i>	Slender Cicendia	Low
<i>Cytisus proliferus</i>	Tree Lucerne, Tagasaste	Low
<i>Linum trigynum</i>	French Flax	Low
<i>Lolium multiflorum</i>	Rye Grass	Low
<i>Lotus angustissimus</i>	Narrow leafed Trefoil	Low
<i>Tolpis fatua</i>	Yellow Hawkhead	Low
<i>Ipomoea indica</i>	Morning Glory	Mild
<i>Poa annua</i>	Winter Grass	Mild
<i>Raphanus raphanistrum</i>	Wild Radish	Mild
<i>Trifolium scabrum</i>	Rough Clover	Mild
<i>Aira caryophyllaea</i>	Silvery Hairgrass	Moderate
<i>Anagallis arvensis</i>	Scarlet or Blue Pimpernel	Moderate
<i>Avena fatua</i>	Wild Oats	Moderate
<i>Bellardia trixago</i>	Bellardia	Moderate
<i>Briza maxima</i>	Blowfly Grass	Moderate
<i>Briza minor</i>	Shivery Grass	Moderate
<i>Centaurium erythraea</i>	Common Centaury	Moderate

Scientific Name	Common Name	EWSWA rating
<i>Cyperus tenellus</i>	Tiny Flat Sedge	Moderate
<i>Hypochoeris glabra</i>	Smooth Catsear	Moderate
<i>Juncus capitatus</i>		Moderate
<i>Lantana camara</i>	Lantana	Moderate
<i>Monadenia bracteata</i>	Brown Fingure Orchid	Moderate
<i>Orobanche minor</i>	Lesser Broomrape	Moderate
<i>Parentucellia latifolia</i>	Common Bartsia	Moderate
<i>Parentucellia viscosa</i>	Sticky Bartsia	Moderate
<i>Senecio diaschides</i>	Fireweed	Moderate
<i>Solanum nigrum</i>	Backberry Nightshade	Moderate
<i>Sonchus oleraceus</i>	Common Sow Thistle	Moderate
<i>Trifolium campestre</i>	Hop Clover	Moderate
<i>Trifolium dubium</i>	Suckling Clover	Moderate
<i>Ursinia anthemoides</i>	Ursinia	Moderate
<i>Vulpia bromoides</i>	Squirrel Tail Fescue	Moderate
<i>Vulpia myuros</i>	Rat's Tail Fescue	Moderate
<i>Echium plantagineum</i>	Paterson's Curse	Unrated
<i>Freesia affin leichtlinii</i>	Freesia	Unrated
<i>Rhynchelytrum repens</i>	Red Natal Grass	Unrated
<i>Romulea rosea var australis</i>	Guildford Grass	Unrated

EWSWA rating adapted from the Department of Conservation and Land Management (1999a, 1999b)

There are relatively few weeds in most areas of the Common, particularly on the crests and upper slopes. In these areas, weed invasion is restricted to small outbreaks near roads, along fence lines and previous sites of high disturbance such as gravel pits, old farm dams and old pasture. The old pasture areas, found on the lower slopes to the north and west of the Common, has an abundance of grassy weeds such as Wild Oats (*Avena fatua*) and Veldt Grass (*Ehrharta calycina*). As well as a long history of grazing, early management of this area included annual prescribed burning which resulted in the proliferation of highly flammable weeds such as Wild Oats and the suppression of all other forms of vegetation. The exclusion of fire from this portion of the Common since 1990 has since allowed some native species, mainly *Acacia pulchella*, to re-establish.

The two gravel pits and an old farm dam that has been infilled are a source of weeds in the good condition bushland located on the crest and upper slopes of the Common. While there has been little invasion of environmental weeds into the surrounding bushland, these highly disturbed, though relatively compact areas remain a source of weed spread and are a potential fire hazard. These areas should therefore become a priority for control.

There are four weeds that have been found in the Common that are listed as a high priority in the Environmental Weed Strategy for Western Australia (Department of Conservation and Land Management, 1999a, 1999b). These are Sandplain Lupin (*Lupinus cosentinii*), Watsonia (*Watsonia bulbifera*) Arum Lily (*Zantedeschia aethiopica*) and Freesia (*Freesia sp.*). These weeds have been known to have a high invasiveness, wide or potentially wide distribution and potentially high environmental impacts. Of these species, the most prevalent are localised infestations of *Watsonia bulbifera* (Figure 3.3).

In addition Paterson's Curse (*Echium plantagineum*) is a 'declared plant' for the Armadale district. Plants are 'declared' by the Agricultural Protection Board under the *Agriculture and Related Resources Protection Act, 1976* (Pierce and Pratt, 2002). Under the P1 category that applies to this district plants cannot be introduced or spread. However, active management is not mandatory.

Weed Infestations found within Armadale Settlers Common are shown in Figure 3.3. Management of Weeds within Armadale Settlers Common is described in Section 6.4.

### 3.3.4 Revegetation

The 1990-2000 Management Plan for Armadale Settlers Common noted that there were several areas in need of rehabilitation including gravel pits, areas of heavy clearing (including tracks) and the old pasture land. Since then, rehabilitation has been undertaken in several of the gravel pits and there has been a significant reduction in the number of tracks in the Common (Tizard, 2000).

A significant portion of the land on the lower slopes on the western side of the Common has a history of intensive grazing. The area, while having adequate tree cover, was largely devoid of native understorey due to the combination of historic grazing and annual burning. This allowed flammable weeds, particularly Wild Oats (*Avena fatua*), to proliferate and prevented the regrowth of native vegetation. A 'no-burn' policy initiated in this area since the release of the previous management plan has allowed some level of natural regeneration to take place. Revegetation methods and requirements within Armadale Settlers' Common are described in Section 6.5. Areas requiring significant revegetation are shown in Figure 3.3.

## 3.4 Fungi and Microflora

Fungi and soil microflora play an important part in ecosystem processes as they are involved in the breakdown of dead organic material and are essential in the recycling of nutrients that enter the ecosystem. Fungi, including the mycorrhizal associations present in the roots of many native plants, enhance their ability to uptake and assimilate soil nutrients.

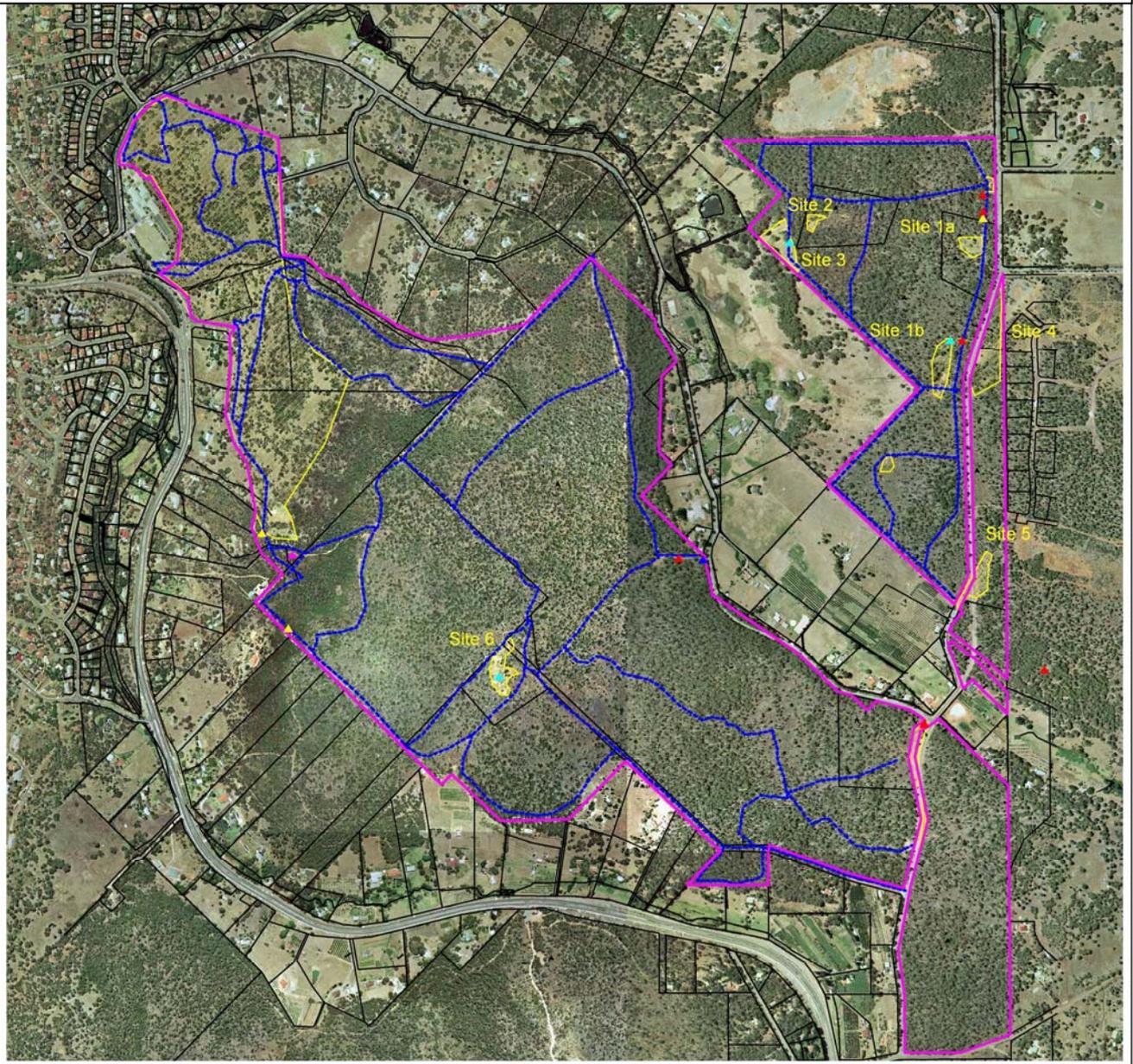
A preliminary survey by Dr. Neale Bougher in 1999 indicated significant Fungi populations and diversity. A complete list of fungi found in the Armadale Settlers Common is included in Appendix Two

## 3.5 Dieback and Plant Disease

*Phytophthora cinnamomi* is a soil-borne water-mould that kills a wide selection of native plant species. Infection by *P. cinnamomi* leads to dieback disease, characterised by necrosis of the upper parts of infected plants and eventual plant death. Human activity is perhaps the biggest factor contributing to the spread of the disease as infected soil is rapidly spread via vehicles, bikes, footwear, animal movements (stock and horse riding), road construction and earth moving equipment.

The active phase of the *Phytophthora* life cycle requires moist conditions that favour survival, sporulation and dispersal. As *Phytophthora* is a parasite, it requires a living host on which to feed and extracts its food by a mass of thread-like mycelium, which forms the body of the organism. The fungus kills the host by girdling the base of the stem, destroying the roots and depriving the plant of access to nutrients and water.

**Figure 3.3 Areas of Weed Infestation and Potential Revegetation Sites in Armadale Settlers Common**



**WEED TYPES**

- ▲ *Briza* infestation
- ▲ *Eragrostis curvula* infestation
- ▲ *Freesia* infestation
- ▲ *Oxalis pes-caprae* infestation
- ▲ *Watsonia* infestation

- STUDY AREA
- BUSHLAND RESTORATION SITES
- TRACKS
- CADASTRE



Areas of Weed Infestation and Potential Revegetation Sites in Armadale Settlers' Common.

<b>CLIENT</b>	City of Armadale
<b>PROJECT:</b>	ASC Management Plan
<b>JOB NO:</b>	1037-3.2
<b>DATE:</b>	06-08-03



Dieback disease requires three factors: the pathogen (*Phytophthora cinnamomi*), a host, and suitable environmental conditions. *Phytophthora* has a very wide host range, with possibly up to one third or more of all Western Australian plant species susceptible to infestation. Generally, the indigenous species most affected by the pathogen belong to the Proteaceae, Epacridaceae, Papilionaceae and Myrtaceae families.

Reliable indicator species of *Phytophthora* within Armadale Settlers Common include: *Adenanthos barbigerus*; *Banksia grandis*; *Bossiaea ornata*; *Daveisia decurrens*; *Dryandra sessilis*; *D. nivea*; *Eucalyptus marginata*; *Isopogon dubius*; *Xanthorrhoea preissii*; and *X. gracilis*.

Dieback infestation in the Armadale Settlers Common has been mapped by Glevan Dieback Consultancy Services (Tuffnell, 2000). The report suggested that *Phytophthora* has been present in the Common for many years. Five dieback free areas were found and are shown in Figure 3.4. The rest of the Common is either dieback infected or uninterpretable.

Dieback management for Armadale Settlers Common is described in Section 6.7.

## **3.6 Fauna**

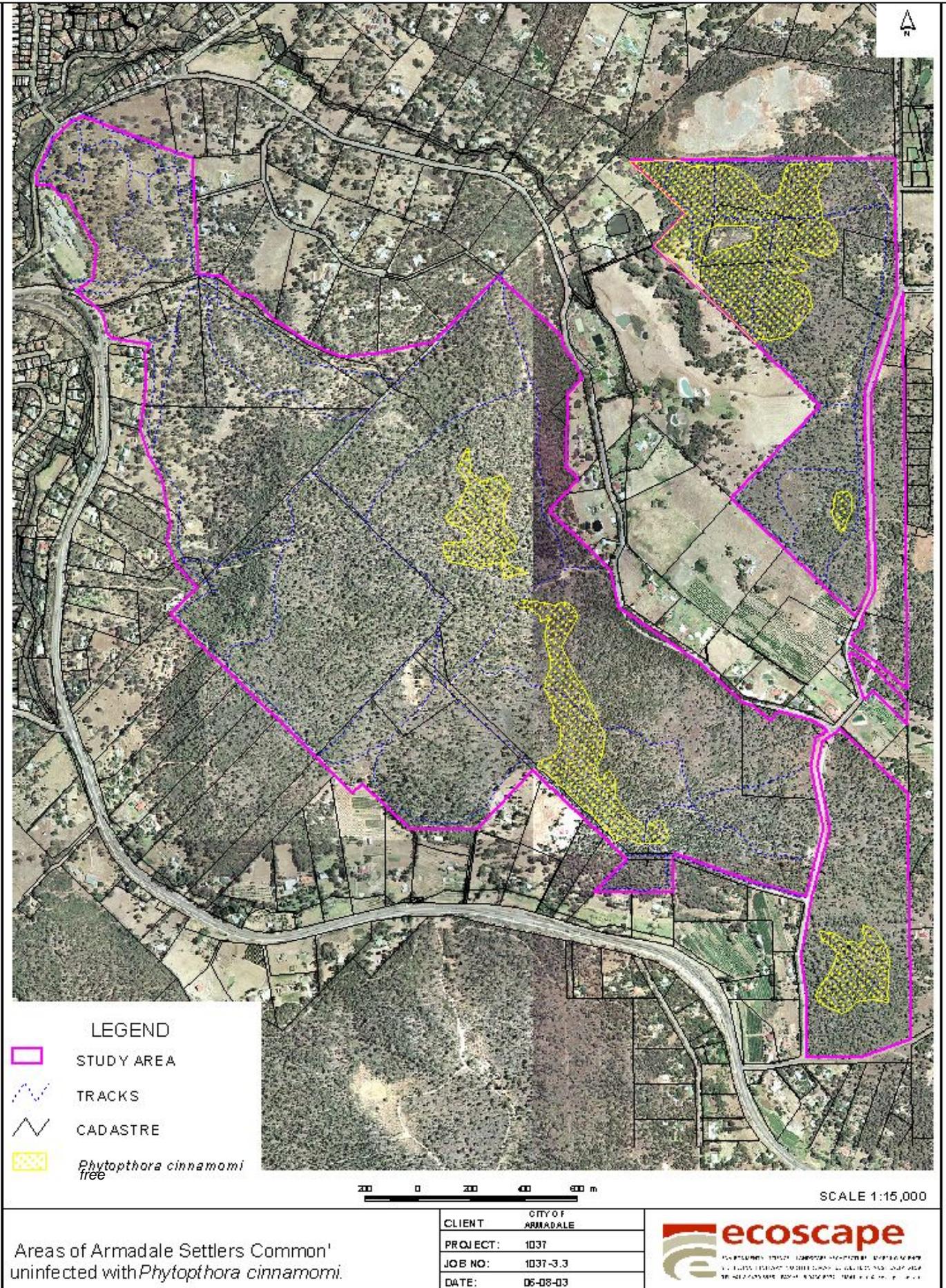
### **3.6.1 Fauna Habitat**

The large size of Armadale Settlers Common is conducive to the provision of fauna habitat. Large reserves can support more diverse fauna populations, as there is a greater amount of available resources, lower levels of disturbance and a higher diversity of habitat types. Large reserves also generally have a large area to perimeter ratio and so are likely less impacted by 'edge effects'.

The Armadale Settlers Common also acts as an important link for wildlife as it is a large area of bushland that situated between the Darling Range Regional Park to the north and east, and Bungendore Park to the south. Together these large areas of remnant bushland form a near-continuous habitat along this part of the Darling Scarp. Armadale Settlers Common can therefore be expected to provide habitat for many more fauna species, particularly birds, than if it was located at a greater distance to other large areas of bushland.

A total of 145 vertebrate fauna species potentially occur in the Common (see Appendix 4). This includes 58 bird species, 49 reptile species, 24 mammal species and 14 amphibian species. The Common also forms the habitat of thousands of species of insect. This large array of fauna is probably due in part to the large size of the reserve and also the unbroken transition from the lower slope or Darling Scarp vegetation to the 'Dwellingup' vegetation on the upper crests. This change in vegetation is likely to favour fauna diversity as it allows the movement of fauna species that may rely on both types of vegetation during their life cycle. For example terrestrial frog species that inhabit the woodland vegetation on the crests may require wetland and damp vegetation of the scarp for breeding.

Figure 3.4 Areas of Armadale Settlers Common uninfected with *Phytophthora cinnamomi*



Eight species of Threatened or Priority Fauna also potentially occur in the Common. Table 3.8 shows the status of threatened or priority fauna under the Commonwealth *Environmental Protection and Biodiversity Act 1999* (EPBC Act) and the Western Australian *Wildlife Conservation Act, 1950*

**Table 3.8 Selected Threatened or Priority Fauna Species occurring in the Northern Jarrah Forest**

Species name	Common name	Status (EPBC Act)	Status (CALM)
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo	Vulnerable	Threatened (Vulnerable)
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo	Endangered	Threatened (Endangered)
<i>Calyptorhynchus banksii</i>	Forest Redtailed Cockatoo	Not Listed	Priority 3
<i>Dasyurus geoffroii</i>	Chuditch	Vulnerable	Vulnerable
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Not Listed	Priority 3
<i>Hydromys chrysogaster</i>	Water Rat	Not Listed	Priority 4
<i>Isoodon obesulus fusciventer</i>	Quenda	Not Listed	Priority 4 / Conservation Dependant
<i>Macropus irma</i>	Western Brush Wallaby	Not Listed	Priority 4

Relevant categories of protection under the EPBC Act are as follows:

Endangered:	taxa facing a very high risk of extinction in the wild in the near future;
Vulnerable:	taxa facing a high risk of extinction in the wild in the medium-term future; and

Relevant CALM categories of conservation are as follows:

Threatened	Fauna which is rare or likely to become extinct
Priority 3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	Taxa in need of monitoring.

Fauna management in Armadale Settlers Common is described in Section 6.9.

### 3.6.2 Mammals

The Northern Jarrah Forest is home to 24 species of mammals, nine of which have been recorded in the Common. This is more than is usually found in a reserve that is so close to the metropolitan area and this is likely to be due to the large size of the reserve and the range of habitats it supports.

Native species recorded in the Common from opportunistic sightings (Tizard, 2000) include *Macropus fuliginosus* (Western Grey Kangaroo), *M. irma* (Western Brush Wallaby), a CALM priority 4 species, *Trichosurus vulpecula* (Brushtail Possum), *Tarsipes rostratus* (Honey Possum), *Antechinus flavipes* (Mardo), *Sminthopsis murina* (Common Dunnart), *Isoodon obesulus fusciventer* (Quenda), a Priority 4 species, and *Tachyglossus aculeatus* (Short-beaked Echidna).

### 3.6.3 Birds

There is a substantial bird population with 40 species recorded within the Common. An additional 30 species could be expected to occur there at different times.

Among birds opportunistically sighted in the Common are three species of black cockatoo, *Calyptorhynchus banksii*, *C. baudinii* and *C. latirostris*. *Acanthorhynchus*

*supercilliosus* (Western Spinebill) is also a resident of the Common and forms part of its emblem. The Western Spinebill is also the fauna emblem of the City of Armadale.

### 3.6.4 Frogs

The records of the WA Museum have identified 14 different species having previously occurred in the Common and its surrounds. These frogs are from 7 separate genera, and include tree frogs, burrowing frogs and humming frogs. Generally frogs will capture and eat any suitably sized invertebrate and their population numbers are controlled by predation by birds and snakes or by climatic factors such as rainfall, drought and temperature extremes. Habitat is provided by a number of sources including dense stream vegetation, rocks, timber and leaf litter or by the soil in the case of the burrowing frogs.

Of the 14 species of frog expected to occur in the Common, two species have been opportunistically sighted, *Litoria moorei* (Western Green Frog) and *Crinia georgiana* (Red-thighed Froglet) (Tizard, 2000).

### 3.6.5 Reptiles

Reptiles can be found throughout the Common, mainly consisting of snakes, skinks and geckos. The majority of the reptile species are predators, including snakes and the mainly insectivorous skinks and geckos of the Common. Skinks and Geckos are sometimes found in homes surrounding the reserve attracted to moths and other insects around lights. Over 49 species potentially occur within the Common with opportunistic sightings of six species recorded. These are three species of skink: *Cryptoblepharus plagiocephalus* (Fence Lizard); *Tiliqua occipitalis* (Blue-tongue); and *T. rugosus* (Bobtail). One species of monitor; *Varanus tristis* (Black-tailed Monitor); and two species of snake: *Acanthopis antarcticus* (Common Death-adder); and *Pseudonaja affinis* (Dugite).

### 3.6.6 Invertebrates

Armadale Settlers Common supports a large and diverse range of invertebrate fauna. There are several species of butterfly, dragonfly, and damselfly. Spiders, grasshoppers and flying insects are also a common sight. The leaf litter provides habitat for many of the invertebrates of the Common including several types of millipede, centipede, scorpion, earthworm and other detritivorous insects. Data from the Department of Agriculture and the WA Museum confirm that Bedforddale has a varied and diverse invertebrate population. The estimated number of insect species in the Northern Jarrah Forest is shown in Table 3.9

**Table 3.9 Estimated Number of Insect Species in the Northern Jarrah Forest**

Biota Type	Number of Species	Est. No. of Insect Taxa
Plants	318	1389
Mammals	29	8579
Birds	59	8898

Adapted from Abbott (1995)

The number of insects in the Northern Jarrah Forest was estimated using a number of formula based on either the number of plant species, the number of mammals or the number of birds in the area of interest (Tizard, 2000). These figures vary considerably, reflecting the paucity of information on the relationship between the different components of an ecosystem. However these estimates indicate a significant number of insect species reside in the Common.

Invertebrates have an important role within the ecosystem of Common. Many species have a vital role to play either as a source of food, recyclers of biomass or as predators themselves. Invertebrate diversity is susceptible to fire, with insect diversity being reduced for at least three years following a burn (Koch and Majer, 1980).

### **3.6.7 Feral Animals**

Feral animals are a significant problem in the management of native fauna populations. Competition and land degradation by feral rabbits, and predation by feral cats and the European Red Fox (*Vulpes vulpes*) identified as Key Threatening Processes by the Commonwealth *Environment and Biodiversity Conservation Act, 1999*:

The Commonwealth Government has prepared a number of Threat Abatement Plans to reduce the effects of these pests on our native fauna. Reports of wild pigs in the Common have not been confirmed for over ten years, however rabbits, foxes and cats have been located within the reserve in recent times.

## 4.0 Social Environment

### Armadale Settlers Common Strategic Directions

#### 4.1 History

Over one hundred years ago, the Colony of Western Australia established a series of Commons within its borders. Reserve 4127 was gazetted on 18 June 1897 for the purposes of "Commonage". The region was not accurately surveyed and was said to be approximately 700 acres. The remaining land that is now part of the Common was privately owned at that time and was predominantly used for grazing.

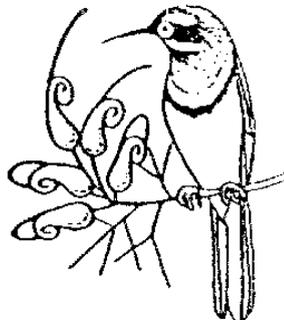
Reserve 4127 (officially named the Armadale Common) was vested in the Armadale-Kelmscott Road Board on 2 August 1912 and the purpose amended to "Common and Timber for Settlers". The Road Board officially accepted control of the Common at the next meeting dated 28 August 1912.

During World War II, part of the Common (then in private ownership) was used for charcoal production. It is from this that Charcoal Hill, located in the north-western corner of the Common was given its name. From 1922 until 1971 sections of the Common were also used for gravel mining and evidence of these gravel pits can still be seen.

In 1981, the purpose of the reserve was changed to "Parks and Recreation" and the previously removed sections were incorporated into the Common. It was then was revested in the Armadale City Council on 8 May 1981. The reserve also lost its official name at this time.

In 1988, the Armadale City Council began discussions as to the formation of a Committee to develop a strategy for the Common. The Advisory Committee first met on 12 April 1989 and has had regular monthly meetings since that date. Margaret Peroni, a well known wildlife artist, was commissioned to design a logo for the reserve in 1989. The design incorporates both of the floral and faunal emblems of the Common, Wilson's Grevillea (*Grevillea wilsonii*) and the Western Spinebill (*Acanthorhynchus superciliosus*). These emblems represent the interconnection of the biota of the Common. The use of a bird pollinator highlights the importance of vertebrate pollinators in the Northern Jarrah Forest. This symbol is shown below in Figure 4.1.

**Figure 4.1 Logo for Armadale Settlers Common**



In 1990, the first Management Plan was published following extensive public consultation and the Armadale Settlers Common Field Study Centre was open in early 1993. Since that time the building has grown into a complex of buildings and is used by environmental and community groups throughout the year. The year 1993 also marked the release of the Darling Range Regional Park Proposal.

Following investigations and community consultation, the City of Armadale adopted the Western Spinebill as the faunal emblem for the municipality in 1994. The Department of Planning and Urban Development (now the Department of Planning and Infrastructure), signed a ten year lease for the Common with the Armadale City Council. Implementation of the Management Plan was one of the conditions of the lease.

A major birthday party and the planting of 100 trees in the Settlers Grove commemorated the Centenary of the Common in 1997. Many of the Friends of Armadale Settlers Common and distinguished guests were invited to plant a tree within the Grove.

In early 1997, Main Roads WA began work on the widening of the Albany Highway through Bedforddale. This construction would have meant the destruction of the former Plymouth Brethren Meeting Hall known as Willow Heights, a building listed in the City of Armadale's Municipal Heritage Inventory. To avoid destruction of this heritage building, it was transported to the Field Study Centre Complex on 4<sup>th</sup> October 1997. The next 18 months were spent restoring the building including reroofing, rewiring and painting (Tizard, 2000).

In 1988, the Armadale City Council began discussions as to the formation of a Committee to develop a Management Plan for the Common. The Department of Planning and Urban Development (now the Department of Planning and Infrastructure), was approached about amalgamating land it owned adjoining Reserve 4127 to form a park as recommended in the System Six Report and the MPRS. The Advisory Committee was intended to have broad community representation and participation. On 21 November 1988, the Council resolved to invite a number of organizations to nominate people to serve on the Committee. The first Committee meeting was held on 12 April 1989. Under the Local Government Act 1995 all members of Management Committees are appointed by Council for terms of up to two years, or until the next ordinary elections day, whichever comes sooner.

The Armadale Settlers Common Management Committee and other management groups are further described in Section 6.1, Planning and Management Structure.

## **4.2 Cultural Heritage**

### **4.2.1 Aboriginal Heritage**

A search of the Aboriginal Sites Register database revealed a registered aboriginal heritage site in the vicinity of the Armadale Settlers Common. Information on the whereabouts of Registered Aboriginal Heritage Sites should not be made public, therefore information regarding the whereabouts of sites in the vicinity of the Common have been placed in Appendix Seven. This appendix will not be included in public versions of this Document.

Before work is conducted in the vicinity of any of these sites, certain obligations are required. These are outlined in Section 6.10; Cultural Heritage Management.

### **4.2.2 Non-indigenous Cultural Heritage**

#### ***Register of National Estate***

Extensive community consultation undertaken as part of the Comprehensive Regional Assessment process of the Regional Forest Agreement (RFA) identified over 600 sites in south west WA nominated as having high community attachment. Of these 600 sites, only 95 met the threshold for the Register of the National Estate as having significant

social heritage value and the Common was amongst those which were recommended for listing on the Register. Consultants were subsequently commissioned to undertake a study of the aesthetic values of the RFA area and it was concluded that the Common met the aesthetic value threshold and should be listed on the Register of the National Estate.

### ***Municipal Heritage Inventory***

Relocation of the former Plymouth Brethren Meeting Hall known as 'Willow Heights' was undertaken following the widening of the Albany Highway through Bedforddale in 1997. This building is listed in the City of Armadale's Municipal Heritage Inventory and has been restored after its relocation to the Field Study Centre Complex.

Management of non-indigenous cultural heritage is described in Section 6.10.

## **4.3 Economic Environment**

### **4.3.1 Aesthetic and Landscape Values**

As an integral part of the Darling Scarp, the Common contributes significantly to the amenity value of the district as it forms a significant part of the backdrop to the Armadale City Centre and is part of the Heritage Country Tourist Drive. Much of the bush is in good condition, and while there are no 'official' walk trails in the Common, people make use of the firebreaks for recreation.

The City of Armadale Rural Strategy assessed a large section of the Common as having secondary landscape quality, and an area adjacent to the Common, along Locke View, as having primary landscape quality (City of Armadale, 1998). Landscape degradation in these areas are to be minimised through planning control.

### **4.3.2 Ecotourism**

The potential for ecotourism activities, particularly based on bushland walks and interpretation, is high in Armadale Settlers Common.

In the past a brochure has been published and distributed through the Armadale Tourist Centre, and other local tourist agencies including the Heritage Country Tourist Association, however it appears that the brochure is currently out of print.

An annual event called "Walk the Common" is coordinated by the Recreation Department of the City of Armadale. The event consists of a series of walks through the Common with temporary interpretive signage erected along the walks which are detailed on a map provided to participants by the event organisers. The event attracts approximately 100 people each year and in previous years there has been a sausage sizzle and entertainment offered in the afternoon. A shuttle bus transferring participants from the bottom of the scarp to the top has also been offered in the past. A gold coin donation was requested to help cover costs.

The event is advertised in the local community newspapers, school newsletters and in radio community service announcements. In addition information is circulated among the bushwalking clubs around Perth. In the past promotion of forthcoming events has been achieved by bookmarks indicating upcoming events and distributed through the local libraries.

Education, Interpretation and Ecotourism management is described in Section 6.12.

## 4.4 Access and Recreation

Armadale Settlers Common has high value as a recreational resource for the community. Individuals and community groups take advantage of the facilities provided by the Common and its closeness to the metropolitan area to undertake passive recreational activities. Activities that are frequently undertaken include walking, orienteering, nature appreciation, picnicking and nature photography.

There are many access points to the Common. While this allows easy access to passive recreation it also makes it difficult to control the access of activities that have the potential to impact negatively on the bushland environment such as four-wheel driving and horse-riding. Four-wheel drive enthusiasts were encountered during a site reconnaissance and signs of horse riding activity have previously been seen in the area.

While there are no official walking tracks within the Common, the area is popular for bushwalking using the network of well-maintained fire access tracks in the area. Obvious access for bushwalkers is not apparent and few options exist for car-parking. The 'Street smart' Street directory (Department of Land Administration, 2001) indicates two car-parking areas: one on Canns Road between Settlers Road and Carradine Road, and another along Carradine Road. Parking is also available at the Field Study Centre. The location of car parks and fire access tracks is shown in Figure 4.2. Management of Access and Recreation is described in Section 6.11.

## 4.5 Infrastructure and Amenities

Most of the Infrastructure and amenities of the Common are located at the Field Study Centre Complex. The location of infrastructure and assets in Armadale Settlers Common is shown in Figure 4.2. Management of Infrastructure and Amenities is described in Section 6.13.

### ***Buildings***

There are two buildings at this location, the Field Study Centre and the old Willow Heights building. Both buildings are intended for education purposes and are used occasionally by the Armadale Scout Group, Armadale City Council, School groups and field naturalist clubs.

### ***Toilets***

There are toilets at the Field Study Centre however there are no public toilets elsewhere within the Common.

### ***Signage***

The location of signage in the Armadale Settlers Common is shown in Figure 4.2. Signs in the Common generally include the following information:

- Name (Armadale Settlers Common)
- Rules and guidelines (written and symbolised)

### ***Fences and Gates***

There is generally very little fencing around the Common. Some boundary fences are present where the Common is adjacent to private land, however these are of varying quality. There is little fencing between the Common and the roads bordering the Common and consequently unauthorised access is not difficult, particularly along Canns Road where the vegetation is relatively sparse.

Few gates have been erected in the Common. There is a single gate at the end of Locke View, however this is generally kept open. Attempts have been made to block access with large logs at the entrances to firebreaks on Canns Road and Carradine Road. These are ineffective as a deterrent to determined individuals with four wheel drive vehicles (see Figure 4.3).

In addition there are several additional gates proposed for Armadale Settlers Common. These are shown in Figure 4.2.

**Figure 4.2 Damage to surrounding vegetation from access restrictions**



### **Barbecue/Picnic Facilities**

A barbecue/picnic area has been set aside near the Field Study Centre. An electric barbecue, two picnic tables and lighting has been established here.

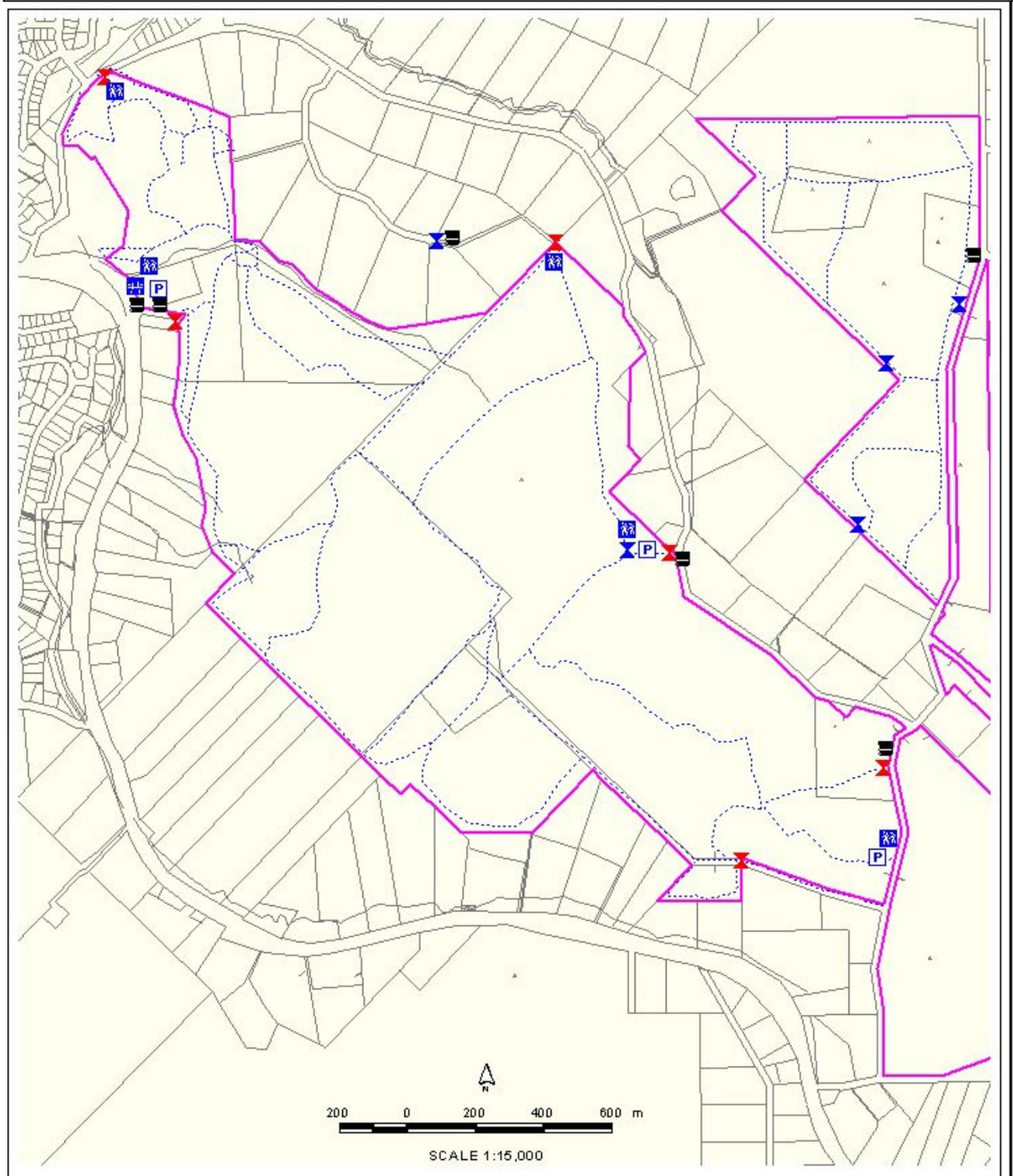
### **Rubbish Bins**

There are rubbish bins provided at the barbecue area near the Field Study Centre. No other bins are provided within the Common.

### **Seating**

There are numerous benches located near the Field study centre and at the overlook located approximately 100 m east of the Field Study Centre. Other benches are located at various locations between the overlook and the Field Study Centre. Some of these are in very poor condition.

Figure 4.3 Location of Assets in Armadale Settlers Common



- |  |  |  |
|--|--|--|
|  EXISTING GATES |  CARPARKS     |  CADASTRE   |
|  PROPOSED GATES |  TRAIL HEADS  |  TRACKS     |
|  SIGNS          |  BBQ / PICNIC |  STUDY AREA |

Location of assets in Armadale Settlers' Common	CLIENT	CITY OF ARMADALE	
	PROJECT:	1037	
	JOB NO:	1037-4.1	
	DATE:	06-08-03	

## 5.0 Stakeholder Consultation

### Armadale Settlers Common Strategic Directions

Stakeholder and community consultation was undertaken with the following groups and organisations. Representatives of each group were contacted and the current issues and needs, future plans and visions were discussed. Consultation was undertaken with representatives from the following departments and organisations:

- Friends of Armadale Settlers Common;
- Armadale Settlers Common Management Committee;
- Armadale Scout Group;
- Armadale Primary School;
- Orienteering WA;
- Armadale Tourist Information Centre;
- Australian Heritage Commission;
- Department of Conservation and Land Management;

### 5.1 Friends of Armadale Settlers Common

The Friends of Armadale Settlers Common have recently been established and currently comprise approximately 30 people. Areas the group focus on include the following:

- The creation of safe areas for passive recreation that can be utilised by people of all ages;
- bushland regeneration; and
- weed control.

Actions the group are currently undertaking or planning to undertake are:

- constructing a nature trail that is suitable for all age groups through the Common;
- attending the APACE bushland regeneration course;
- regenerating the land adjacent to Canns Road with assistance from Churchman's Brook Estate; and
- undertaking other projects outlined in this Document.

### 5.2 Armadale Settlers Common Management Committee

The Armadale Settlers Common Management Committee (ASCMC) is a standing committee of Council responsible for management decisions within the Common and has an advisory role to council. Specific points raised in reference to the ASCMC are as follows:

- There is a need to make the Committee more sustainable. People bring into and develop skills and knowledge which is often lost when they move on. There needs to be a mechanism to ensure that these skills are retained as far as possible when people move on.
- The ASCMC sees its role as identifying and coordinating projects for improvements to the Common and providing a link between Friends Groups including people willing to 'lend a hand' and the council and BEAC.

### **5.3 Armadale Scout Group**

The Armadale Settlers Common is a useful resource for Scout groups and is occasionally used by the Armadale Scout Group for wide games and navigation exercises. The Scout Group regard the Common as an important asset and meets their needs in its current form.

### **5.4 Orienteering WA**

Orienteering WA have a set course for Armadale Settlers Common that is occasionally used. The Common has been host to the group's state championships and is regularly used for the 'Introduction to Orienteering' course. The Common appears to meet their needs at this time.

### **5.5 Armadale Primary School**

Armadale Primary School regard Armadale Settlers Common as a very valuable resource. It is used extensively for cross country runs and as an orienteering training ground. Additionally it is used for art classes / sketching and environmental studies including identification of plants, trees, animals and birds. The Common is used most often in terms 2 and 3 as there is a higher risk of snake activity during the summer months.

A suggested improvement to the Common is the establishment of a nature trail with interpretive signage that will assist with flora and fauna identification. This would be particularly beneficial for teachers and supervisors with few skills in bushland interpretation but would like to promote awareness of the natural environment among their students.

### **5.6 Armadale Tourist Information Centre**

The Armadale Tourist Information centre had little information on Armadale Settlers Common. A pamphlet had been produced for the area but there were no copies left. It would be good if these were again available.

### **5.7 Australian Heritage Council**

As noted in Section 4.2.2 above Armadale Settlers Common has previously been nominated for inclusion to the Register of National Estate, however it was no longer being considered for nomination for unknown reasons. Nominations are now possible under the current legislation.

### **5.8 Department of Conservation and Land Management**

The Department of Conservation and Land Management (CALM) are responsible for the management of the Darling Range Regional Park of which Armadale Settlers Common is a part. The Darling Range Regional Park Management Plan is expected to include strategies for liaison and resource sharing between Local Government Authorities and the Department. Coordination of activities such as fire response and management are also likely to be addressed in the forthcoming management plan.

## 6.0 Plan for Management

### Armadale Settlers Common Strategic Directions

## 6.1 Planning and Management Structure

### 6.1.1 Objectives

The objectives of the Planning and Management Structure are to:

- Create an effective management structure with identified roles and responsibilities.
- Management of the Common becomes the responsibility of a single administrative body to achieve coordinated management within five years.

### 6.1.2 Background and Strategy

#### ***Management Groups***

The current management framework involves the Armadale Settlers Common Management Committee (ASCMC) and friends groups including the Field Study Centre Inc. and the Friends of Armadale Settlers Common (FOASC). The Field Study Centre Inc. (FSC Inc) currently does not have any active members, however its framework still exists. As an incorporated body, the FSC Inc. is in a position to apply for external funding as:

- Organisations that administer grants and funds for bushland management and restoration generally require that a friends group is incorporated; and
- Funding organisations generally also require that friends groups are not associated with Local Government.

#### ***Vesting and Ownership***

The Armadale Settlers Common comprises two parts in terms of vesting and ownership. (see Figure 2.1).

For effective management to take place it would be preferable if vesting is transferred to a single entity enabling the entire Common to be managed as a single unit and also allow a greater security of tenure for the purposes of conservation.

### 6.1.3 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
1.1	Investigate the feasibility of transferring vesting and ownership of the part of ASC currently owned by the City of Armadale to the Conservation Commission.	1	Operational	Feasibility investigation completed and acted upon.
1.2	Seek funding to carry out restoration projects annually.	1	Operational	Funding acquired from external sources increases annually

## 6.2 Management Zones

### 6.2.1 Objectives

The objectives of management zones are to:

- divide the Common into relatively homogenous areas that have a uniform basis for management;
- manage the Common in relation to their purpose of Special Conservation, Conservation, Buffer and Education.

### 6.2.2 Background and Strategy

Armadale Settlers Common has been divided into Management Zones based on the network of fire access tracks and patterns of controlled burning. Each management zone is burnt at a different time depending on fuel loads (see section 6.6). Figure 6.1 shows the Management Zones in Armadale Settlers Common, based on fire access tracks. Dieback free areas are also shown. Zones 8, 11, 14 and 15 and 17 have dieback free areas within them and should be managed in accordance with recommendations given in Section 6.7, Dieback Management. Basing management zones on boundaries of dieback-free areas was considered but rejected as dieback boundaries:

- can move by natural rate of expression; and
- are difficult to identify on the ground unlike tracks.

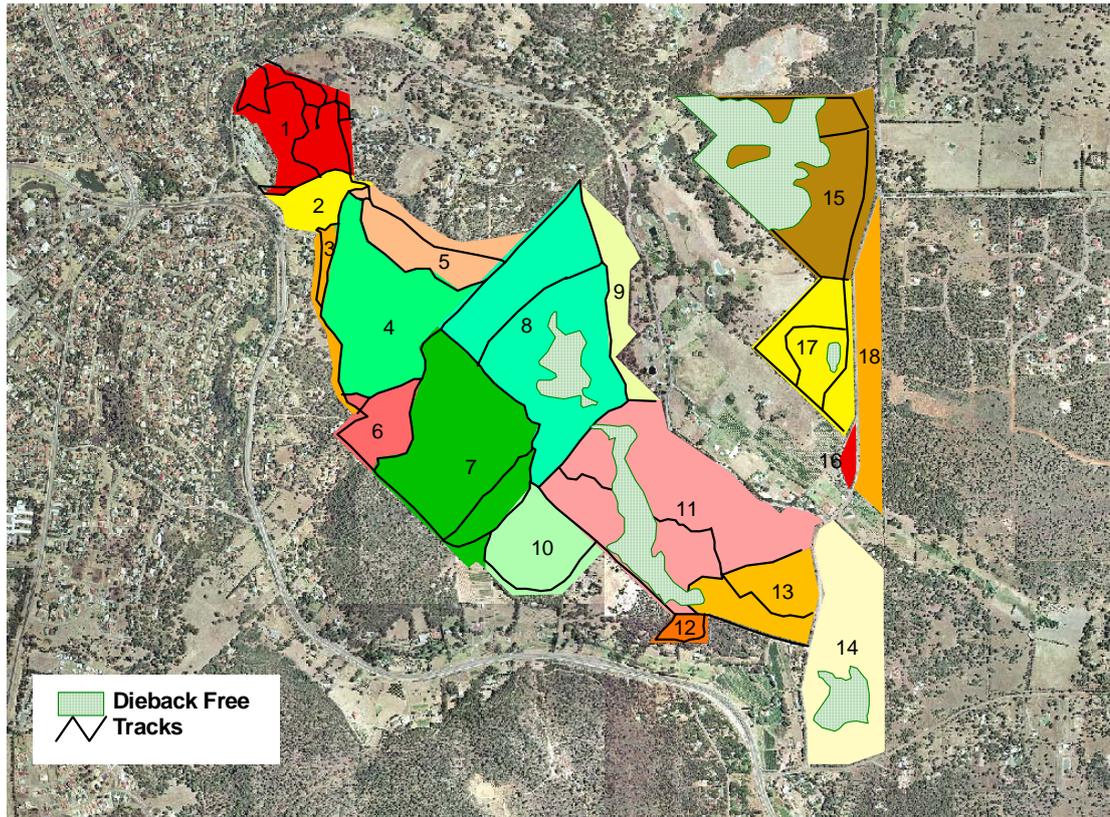
Management categories have been used to define the purpose and the acceptable uses that can be carried out within each zone. The categories are: Special Conservation; Conservation; Buffer and Education. Management Zones are shown in Figure 6.2. Table 6.1 defines the purpose and acceptable uses within each category.

#### ***Special Conservation***

The Special Conservation Category has been applied to Management Zones that have significant flora and fauna or have substantial dieback-free areas within them. While passive recreation is permitted in this area, it will be kept to established tracks outside of mapped dieback-free areas. Management access into these areas outside of established walking tracks will need to undergo hygiene procedures prior to entering. Fuel reduction burns are permitted in these areas (see Section 6.6) apart from within Management Zone 15 which may have Significant Flora (See Appendix Six). If this is found to be no longer the case, fire management should extend to this Zone.

Rehabilitation undertaken in these areas will also need hygiene procedures for all equipment and personnel prior to entering. All other activities are cognisant with the Conservation Management Category.

**Figure 6.1 Armadale Settlers Common Management Zones**



### **Conservation**

This Management Category is primarily associated with conservation including rehabilitation and weed control activities. Passive recreation is permitted in these areas confined to established walking tracks.

### **Buffer**

This category has been created to delineate buffer areas for the protection of life and property in neighbouring areas where fire management is not undertaken adjacent to the old pasture areas of the Common. In this area fire management can take precedence over conservation, however where possible conservation values should be retained.

### **Education**

This area contains the Field Study Centre and associated areas including old gardens and remnants of pastoral activities historically undertaken in the Common. This zone also contains a barbecue and picnic area.

Figure 6.2 Armadale Settlers Common Management Categories

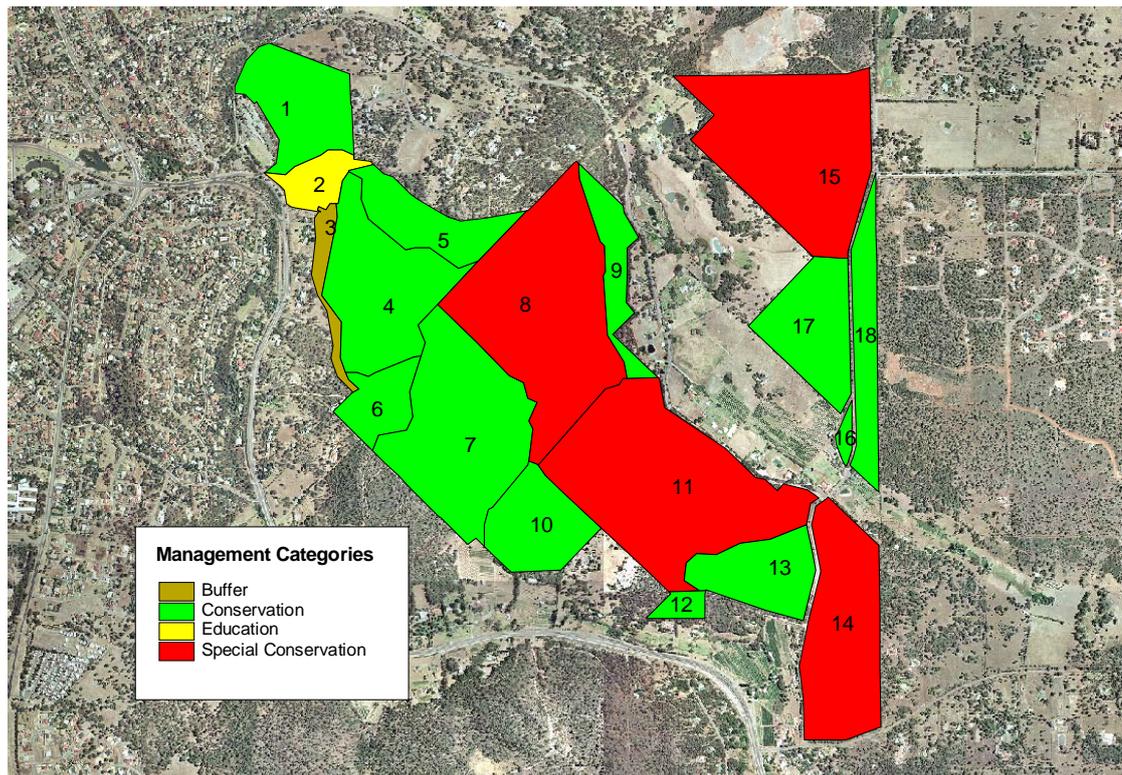


Table 6.1 Management Categories, Purpose and Acceptable Uses

Category	Management Zones	Purpose	Acceptable Uses
Special Conservation	8, 11, 14, 15	<ul style="list-style-type: none"> <li>Protection of flora and fauna of high conservation value.</li> <li>Retaining dieback-free areas</li> <li>Passive recreation</li> </ul>	<ul style="list-style-type: none"> <li>Conservation activities</li> <li>Dieback control activities.</li> <li>Hygiene measures for management access.</li> <li>Public access limited to pedestrian traffic away from dieback areas</li> </ul>
Conservation	1, 4, 5, 6, 7, 9, 10, 12, 13, 16, 17, 18.	<ul style="list-style-type: none"> <li>Conservation.</li> <li>Landscape quality maintenance and enhancement</li> <li>Passive recreation</li> </ul>	<ul style="list-style-type: none"> <li>Passive recreation.</li> <li>Walk trails.</li> <li>Public access limited to pedestrian traffic.</li> </ul>
Buffer	3	<ul style="list-style-type: none"> <li>Protection of other land uses from fire</li> <li>Protection of the Common from other land uses (e.g. weed invasion).</li> </ul>	<ul style="list-style-type: none"> <li>Protection of the Common.</li> <li>Protection of land surrounding the Common.</li> </ul>
Education	2	<ul style="list-style-type: none"> <li>Education (Field Study Centre Complex).</li> <li>Recreation (picnic and barbeque facilities).</li> </ul>	<ul style="list-style-type: none"> <li>Field Study Centre.</li> <li>Meetings.</li> <li>Educational activities.</li> <li>barbecues / picnics</li> </ul>

### 6.2.3 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
2.1	Public access to the Special Conservation Category Zones should be restricted by directing pedestrian traffic onto formalised paths.	2	N/A	Measurable decrease in area of Dieback-free areas of no more than 5% per annum
2.2	Zone boundaries and categories should be periodically reassessed every five years.	5	inclusive w / EMP review	Purpose and acceptable uses are appropriate to management zones

## 6.3 Disturbance Management

### 6.3.1 Objectives

The objectives for disturbance management within Armadale Settlers Common are to:

- minimise disturbance to natural bushland within Armadale Settlers Common; and
- limit and reduce activities that contribute to disturbance and degradation of natural areas.

### 6.3.2 Background

#### ***Rubbish Dumping***

Rubbish dumping is a recognised problem in the Common and one which has the potential to increase as additional housing development is undertaken in areas surrounding the Common. Piles of rubbish including car bodies, household and domestic rubbish was frequently encountered in the area bordered by Settlers Road, Canns Road and Carradine Road.

Access to these areas is provided by firebreaks and a network of trails throughout this area. Rubbish was dumped indiscriminately in these areas. Figure 6.3 shows a typical rubbish dump within the Common.

**Figure 6.3 Rubbish dumping in Armadale Settlers Common**



Rubbish dumping should be removed as soon as possible so that further dumping is not encouraged. Enforcement of council policy should also be undertaken where possible. Greater ranger presence and law enforcement is a priority and residents close to the Common should be encouraged to report suspicious activity to the City.

### **Timber Cutting and Removal**

The destruction of trees or the removal of fallen branches or trees is not permitted within the Common. The retention of large trees is essential as they provide habitat and nesting sites for many bird and mammal species.

Dead trees should not be felled unless they are within 3 m of a walk trail and pose a hazard. The remains of such trees should be left in the Common to provide fauna habitat. Illegal removal of trees for firewood should be discouraged by providing greater Ranger presence in the area and encouraging nearby residents to report suspicious activity.

### **Beekeeping**

In the past, CALM has issued apiary licences for the Common, however the use of reserve for beekeeping is inconsistent with its conservation purposes and there are no beekeeping activities currently being undertaken in the Common. The introduced honeybee competes with native bee species and does not pollinate as diverse a range of flora. The long term effects of this practice will reduce the number of species in the reserve and compromise the Common's biodiversity. Introduced bees can also construct its hives in tree hollows that may otherwise be used by native fauna. This should be monitored and control measures implemented if this is widespread. If the City of Armadale is consulted regarding the issuing of beekeeping licences in its reserves it should have a policy of opposition.

### **Horses, Dogs and Bicycles**

The use of the Common for horse riding has the potential to conflict with the objectives for minimising disturbance. The presence of horses and other hooved animals can accelerate erosion, cause soil compaction, spread weeds, increase soil nutrient levels and spread *Phytophthora* spores in bushland areas.

There are a number of horse riding enthusiasts living in the City of Armadale and many rural and semi-rural activities including stabling and agistment. Consequently the level of horse ownership is high leading to a demand for recreational facilities for horse-riding including bridle-trails, such as exists in Bungedore Park.

Clearly, while there is a demand for horseriding facilities within the Common there is little information about the potential impacts from different levels of horse riding use for the particular soil and vegetation types in the Common. The following list illustrates the types of impacts that may arise from horse riding in the Common, some of which are difficult or impossible to reverse without significant funds:

- Horseriding on steep sections of the Common, such as along the scarp face, has a high potential to cause erosion and exacerbate existing erosion. Horseriding in these areas is undoubtedly likely to cause unacceptable land degradation and damage to the natural environment.
- Horseriding has been shown to cause compaction of the soil, weed spread and can change the composition of native vegetation communities (Landsberg *et al.*, 2001, Whinam and Comfort, 1995)
- Horseriding in dieback free areas is highly likely to spread dieback from surrounding affected areas. There are a number of areas within the Common that are dieback free (Figure 3.4) and horseriding in these areas would need to be prohibited.

Furthermore the following considerations mitigate against recommending horse riding as an acceptable activity in the Common:

- Maintenance of adequate tracks to facilitate horseriding is expensive, particularly in steep or wet areas (estimates are around \$10,000/km to upgrade existing tracks and around \$1,000/km/yr to maintain existing tracks (Landsberg et al. 2001).
- Horseriding and walking activities are incompatible due to safety hazards (trampling) and health hazards (dung).
- There is a potential for conflict between horseriders and walkers.
- It is difficult to exclude horseriding from sensitive areas. Fencing, signage and enforcement costs are significant.

In light of the above, and the existence of an adequate Bridle Trail at Bungedore Park horse riding is to be excluded from Armadale Settlers' Common.

Under the City's Local Government Property Law 2002, a permit is required to ride a horse in the Common and horse riding may be permitted on reserves if appropriate signage is installed by Council. However, no permits have been issued, and it is no permits should be issued.

Similarly mountain-bikes ridden on the steeper sections of the Common may increase erosion of tracks and firebreaks. Cycling may also contribute to soil compaction and weed spread. There is also a high potential for conflict between cyclists and pedestrians.

Currently dogs are not permitted in the Common except on a leash. Dogs have the potential to increase nutrification of soil through faeces, and if not on a leash impact on native fauna and conflict with other walkers. Currently there are few facilities such as dog-poo bags, signage and bins; however this could be revisited in the future.

To discourage horses, roaming dogs and bicycles within Armadale Settlers Common, regulatory signs should be posted at track heads and regular patrols undertaken by Rangers. Closure and rehabilitation of excess tracks should also be undertaken to limit access and associated impacts by horses, dogs and bicycles.

### **Off-road Vehicles**

Four wheel drive vehicles and trail bikes inflict significant environmental damage in the Common and the unauthorised use of these vehicles in should be discouraged. High rates of erosion in the existing tracks and firebreaks is evident from the use of these vehicles, particularly in winter on steep and muddy tracks.

As well as accelerating erosion, vehicles within the Common can spread weed seed and *Phytophthora* spores. They can also damage or destroy existing vegetation and endanger other recreational users. Faulty exhausts in bushland areas can also increase the likelihood of fire during the summer months, and the network of tracks created will facilitate future rubbish dumping. Conflict with other recreational users is highly likely through high levels of noise, and reduction in the quality of tracks and surrounding vegetation.

City of Armadale rangers have the authority to administer fines for such activities under the *Control of Vehicles (Off Road Areas) Act, 1978*. Regular patrols of Armadale Settlers Common should be undertaken by the City's Rangers and on-the-spot fines issued to offenders. Local residents should also be encouraged to report off-road activity to the City and complaints responded to as quickly as possible. Closure and rehabilitation of excess tracks should also be undertaken to reduce the extent of impacts by off-road vehicles.

### 6.3.3 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
3.1	Dumped rubbish should be removed as soon as possible after it has been found	1	Operational	Annual reduction in rubbish dumping incidents
3.2	Gradually close and rehabilitate all tracks not depicted in Figure 4.2 and any other tracks agreed by all relevant parties including community groups and the Fire Brigade. Prioritise tracks susceptible to erosion or within dieback-free areas.	2	\$6,000 / annum <sup>1</sup>	1,000 m <sup>2</sup> tracks rehabilitated per annum
3.3	Undertake weekend patrols of ASC perimeter during summer and holidays.	1	Operational	Increase in number of infringement notices given in first year followed by decreasing numbers annually thereafter
3.4	Block all access points not gated with minor earthworks	1	\$200 per access point	Initial increase followed by annual reduction in reports of off-road activity
3.5	Erect regulatory signs at trail heads to advise of prohibited activities	4	\$1,000 <sup>2</sup>	Initial increase followed by annual reduction in reports of prohibited activities
3.6	Encourage local residents to report illegal activities through enhancing reserve custodian program with a focus on ASC by raising awareness with leaflets and website updates	2	\$1,500	Initial increase followed by annual reduction in reports of prohibited activities
3.7	Control of feral bee hives when found	1	Operational	Reduction in number of bee hives in the Common
3.8	Permits for horse riding on the Common should not be issued.	1	Operational	None

## 6.4 Weed Control

### 6.4.1 Objectives

The objectives for weed control within Armadale Settlers Common 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 areas;
- Minimise any detrimental effects of the weed control programme on the native biota; and
- Integrate the weed control programme with bushland restoration programmes.

### 6.4.2 Background

The existing extent of weeds in Armadale Settlers Common are described in Section 3.3.3.

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:

<sup>1</sup> Assumes \$6.00 / m<sup>2</sup> to rehabilitate and maintain.

<sup>2</sup> Assumes 5 trail heads at \$200 per sign.

- resource competition, as weeds often out-compete native species;
- prevention of seedling recruitment of native species;
- alteration to geomorphologic 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 is a primary cause of the degradation of bushland and loss of understorey species. Shrubs, herbs and sedges are gradually replaced by weed species, notably grassy weeds as fire frequency increases. Grassy weeds have characteristics that enable them respond quickly to fires and create situations of high fire risk. Some of the contributing factors to the fire-weed cycle are:

1. Weed species are often advantaged by the burst of nutrients available immediately after a fire.
2. Weed species, particularly grassy weed species, accumulate biomass rapidly, increasing fuel loads to levels that will sustain fires.
3. High growth rates of weed species allow them to out-compete native species.
4. Grassy weeds, and many other weed species, are able to set seed within a single year.
5. 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.
6. Native seeder species require time between fires not only to set seed but also to replenish its seed stocks. This may take several years. A rule of thumb is to allow twice the interval for the species with the longest seed set before burning. Frequent fires deplete seed stocks, rapidly eliminating these species from the species assemblage.
7. Native resprouting species (i.e. species that have an underground lignotuber) can also succumb to frequent fires if fire recurs before the new growth has had time to harden.

A policy of annual or biannual burning was previously adhered to in the old pasture areas of Armadale Settlers Common previous to the release of the 1990-2000 Management Plan. This policy has now ceased, instead two firebreaks were placed around the perimeter of the area creating a buffer strip to protect the Common fires in neighbouring properties and vice versa. There has since been a reduction in the amount of *Avena fatua* (Wild Oats) as well as an associated increase in native plant species (Tizard, 1995).

The processes that have spread weeds within Armadale Settlers Common include:

- historic clearing for pasture;
- increased fire frequency since European settlement;
- trampling;
- off-road vehicles;
- rubbish dumping; and
- movement of weed seed, especially by vectors along the numerous tracks in the area, and along the boundaries of roads and adjacent private property.

Generally the remnant bushland of the Armadale Settlers Common is in very good condition with few weeds present in the remnant vegetation. There are some minor

infestations of weeds within these areas that need to be controlled. Locations of weed infestations are shown in Figure 6.3. The old pasture area is infested with many grassy weeds including *Eragrostis curvula* (Love Grass) and *Briza maxima* (Blowfly Grass). In places weeds are the dominant vegetation type, however some incursion of native species can be seen on the margins of remnant bushland.

The Field Study Centre Gardens also contain many introduced species and remnants of previous gardens. These may cause a problem if they escape into the bushland areas.

### 6.4.3 Strategy

Control options for environmental weeds within Armadale Settlers Common include:

- control of degrading processes;
- manual control;
- herbicides; and
- fire management.

The City of Armadale directs funds for weed control and management into the protection good and better condition bushland. In general revegetation / rehabilitation is not funded by the City unless the works are critical to protecting an area of good (or better) condition bushland or if they are undertaken by a Friends Group.

#### ***Control of Degrading Processes***

Controlling degradation processes that increase ecosystem vulnerability to weeds is often the most effective way to control weeds in the long term. Recommendations for the control of degrading process are outlined in Section 6.3 Disturbance Management, Section 6.6 Fire Management and Section **Error! Reference source not found.** 6.8 Erosion 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 (Appendix Five) 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 in many cases should be given priority over herbicide spraying. This method should not be used in high erosion risk areas.

#### ***Herbicide Control***

Herbicide application is often the most cost effective method for the control of weeds and a wide range of herbicides are available to control different species of weeds. 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 8 cm intervals at a 45° angle and 4-5 cm long to penetrate the sapwood beneath the bark, or drill at 45° angle with holes 5 cm apart. If the plant is multi-stemmed, treat all stems at chest height. Use a special injector calibrated to deliver the right amount or use a syringe; and
- Cut Stump Application – when the plant is actively growing, cut the stump almost to ground level and apply the herbicide immediately using a paint brush.
- 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 (e.g. 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 monocot-selective herbicide that is effective on most grassy weeds and does not affect native dicots. It may however impact on native monocots such as orchids and native grasses, rushes and sedges. A dye should be added to the herbicide to mark areas sprayed. Herbicides should not be sprayed in creeklines, 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 also available for use near watercourses.

### ***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). A bushland condition map is very useful when determining a weed control strategy.

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 (Appendix Six). Essentially, this method involves assisted natural regeneration of native plants from seed banks, rather than the use of replanting programmes

## **Approaches to Weed Control**

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

- species-led control;
- site-led control;
- resource-led control;
- cause-led control; and
- threatened species and communities led control.

The approach to weed control within Armadale Settlers Common should focus on the first four approaches listed above. Cause-led control is a preventative measure which aims to reduce the impact of factors that aid the spread and establishment of weeds.

### Species-led Control

Species-led control is a proactive strategy to prevent introduction, establishment, survival, reproduction and dispersal of a weed species before it becomes a major problem. 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:

- prevention of the dumping of garden waste and soil in the Common;
- rapid removal of any garden waste or soil dumped; and
- application of good hygiene practices, 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 should be 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.

These weed species should be tackled on a weed by weed basis, using the guiding principles described in Section 6.4.4.

Weeds that have the highest priority for control within Armadale Settlers Common are all weeds within the reserve with a High priority rating according to the *Environmental Weed Strategy for Western Australia* (EWSWA) (CALM, 1999). Control of these weeds should be followed by control of weeds rated as Moderate in EWSWA that are widespread throughout the Common.

High priority weed species are as follows:

- *Zantedeschia aethiopica* (Arum Lily)
- *Watsonia bulbifera* (Watsonia)

Moderate priority widespread weed species are as follows:

- *Avena fatua* (Wild Oats)
- *Eragrostis curvula* (Love Grass)
- *Briza maxima* (Blowfly Grass)

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.

#### Site-led Control

Site-led control focuses on identifying areas that require weed control to maintain their ecological and commercial values. Site-led control is appropriate for old pasture and localised, disturbed areas within Armadale Settlers Common. Generally, it is recommended that site-led control be undertaken after control of weeds recommended for species-led control. Weed species should be 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.

Site-led control should also be undertaken at highly visible sites such as entrances and areas that have recently been burnt. Weeds in these areas are highly visible and can significantly reduce visual amenity of the bushland.

#### 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 resource-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. Contractors should be used where spraying or machinery is required.

#### Threatened Species-led Control

Threatened species-led control is undertaken where there are known populations of threatened fauna at risk from weed invasion. It is possible a Declared Rare Flora occurs in the Common (See Appendix Six) and these populations exist, weed control should be undertaken as a priority if they are seen as posing a potential threat. Threatened species-led weed control should only be undertaken by qualified personnel that are familiar with both bushland weed control and the protection of threatened species.

### **General Weed Control Action Plan.**

A general weed control action plan based on the above information is shown in Table 6.2.

**Table 6.2 General weed control action plan**

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

### **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:

1. If the fire occurs in early summer, weed control should be carried out three months after a fire.
2. 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 identification of emergent weed species should also be undertaken at this stage to determine appropriate control methods.

3. The affected area should be monitored and if necessary a follow-up treatment should be applied.
4. 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.

### ***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.

#### Monitoring

When monitoring site specific projects within the park, monitoring quadrats should be established in areas subject to weed control programmes.

- *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.
- *Site-led control* – establish monitoring quadrats and survey and record annually.
- *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.

Weed mapping is also important for monitoring the extent of weeds within the Common. This is generally undertaken by establishing GPS-located grid points throughout the Common and recording the cover-abundance of weed species at these points.

#### 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:

- eradication of a set number of priority weed species from the Common 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 park by 5% over 5 years.

### **6.4.4 Recommendations**

No.	Recommendation	Priority	Cost	Key Performance Indicator
4.1	Undertake Bushland Condition mapping of ASC.	1	\$2,000	Bushland condition map including serious weed infestations

No.	Recommendation	Priority	Cost	Key Performance Indicator
4.2	Undertake annual best practice weed control activities based on the methods and priorities outlined in this Document, Map 3.3 and bushland condition map once completed.	1	\$800 - \$1,000 / ha	2 ha weeds controlled per annum
4.3	Monitor success of overall weed control activities by repeating bushland condition mapping every 5 years	5	\$2000	10% of ASC bushland has improved category after 5 years <sup>3</sup>
4.4	Monitor success of individual weed control sites using quadrats that are checked annually.	2	\$300 / quadrat	90% reduction in weed cover at each quadrat

## 6.5 Bushland Restoration

### 6.5.1 Objectives

The objectives for ecological restoration within Armadale Settlers Common are to:

- reinstate indigenous flora and vegetation communities, where they have been disturbed and/or depleted;
- 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 Common; and
- ensure that vegetation communities are self-sustaining and are capable of natural regeneration.

### 6.5.2 Background

Native flora and vegetation in Armadale Settlers Common is described in Section 3.3.1. Background information for bushland restoration is described in Section 3.3.4.

Ecological restoration involves restoring the vegetation and habitats by 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 areas in need of restoration in the Common can be divided into 3 different categories:

1. small minor disturbances contained within healthy bushland on the upper slopes and crests;
2. specific sites that require restoration within generally healthy bushland such as old gravel pits; and
3. the lower slopes of former pasture

Generally, the majority of bushland on the crest and upper slopes of the Common are in excellent condition with small areas of poorer condition bushland where there has been high levels of disturbance such as old gravel pits and an old dam. The large area of former pasture on the lower slopes of the scarp is in poor condition and will therefore require large amounts of resources and a long period of time to restore.

<sup>3</sup> E.g. *Good* condition bushland increases to *Very Good – Excellent*

### **6.5.3 Strategy**

A bushland condition map can be used to develop a strategic approach to bushland restoration. The restoration of the vegetation should aim to maintain the resilience of good condition bushland, while restoring disturbed areas of the site. The restoration plan should follow three basic principals of bush regeneration known as the Bradley method (Appendix Five). 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:

1. 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.
2. 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.
3. 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.

#### ***Assisted Natural Regeneration***

This method is used where the native vegetation is in good or 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.

Assisted natural regeneration following the Bradley method should be undertaken in good condition bushland. Methods for weed control in these areas are outlined in detail in Section 6.4.

There are several areas within the Common that have been subjected to degrading processes where assisted natural regeneration is the most suitable. These areas are generally isolated pockets of disturbance surrounded by healthy and vigorous bushland. The removal of the disturbance should allow the natural regeneration processes to occur. These areas will require monitoring to ensure that the regeneration process is assisted if required and some of these areas will require the removal of weed species which will require control.

#### ***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. Replanting and reconstruction should only occur where the exclusion of disturbance will not by itself lead to regeneration.

The City of Armadale directs funds for weed control and management into the protection good and better condition bushland. In general revegetation/ rehabilitation is not funded unless critical to protecting an area of good (or better) condition bushland or it is undertaken by a Friends Group. A number of restoration projects have therefore been identified as suitable for the Friends of Armadale Settlers Common. These areas are shown in Figure 3.3 and are described as follows. Bushland condition mapping of Armadale Settlers Common should highlight additional areas for reconstruction.

Costs provided are for materials only as volunteer labour will be used. Costs for seedling plantings assume three plants per square metre and include tubestock, tree guards (incl. stakes), weed mats and native fertiliser tablet. Costs for direct seeding include seed and mulch (50mm deep). Annual weed control costs for each site are also given.

Restoration Areas No. 1a & 1bArea 1a

Location:	MGA 410734 E: 6442668 N
Area:	3,630 m <sup>2</sup>
Establishment Cost (planting):	\$26,680
Establishment Cost (direct seeding)	\$12,700
Annual Weed Control:	\$550

Area 1a

Location:	MGA 410643 E: 6442290 N
Area:	7,767 m <sup>2</sup>
Establishment Cost (planting):	\$57,090
Establishment Cost (direct seeding)	\$27,180
Annual Weed Control:	\$1,170

Restoration Areas No. 1a & 1b are located near the intersection of Canns Rd and Churchman's Brook Rd. These areas were formerly gravel pits that are in need of restoration and consequently should be undertaken at the same time. There is a significant grassy and woody weed infestation including several large Tagasaste plants in Area 1a and both have been used as landfill sites. As this area is located on the edge of the Special Conservation Zone, disturbance must be kept to a minimum. These sites have been mapped as dieback infested. Care must be taken to disinfect all equipment upon leaving the area.

Restoration Area No. 2

Location:	MGA 410246 E: 6442743 N
Area:	1,560 m <sup>2</sup>
Establishment Cost (planting):	\$11,470
Establishment Cost (direct seeding)	\$5,460
Annual Weed Control:	\$250

Work being carried out in Restoration Area No 2 needs to be undertaken with extreme care. Located in the centre of the Conservation & Protection Zone, the surrounding bush is dieback free and contains rare flora. All activities within Management Zone 15 need to be in compliance with the management objectives of this area to minimise further degradation. This area has been mapped as containing dieback while the surrounding area is dieback free. Tools, equipment and footwear must therefore be disinfected prior to entering the dieback -ree area and also prior to leaving the rehabilitation area.

Restoration Area No. 3

Location:	MGA 410151 E: 6442672 N
Area:	8,010 m <sup>2</sup>
Establishment Cost (planting):	\$58,870
Establishment Cost (direct seeding)	\$28,040
Annual Weed Control:	\$1,200

Restoration Area No 3 has previously been used for rubbish dumping on a number of occasions. Contour reinstatement has occurred on at least one occasion with the rubbish being buried rather than removed. Located on the edge of Management Zone 15, all activities in the area need to be in compliance with the management objectives of this area to minimise further degradation.

Restoration Area No. 4

Location:	MGA 410801 E: 6442353 N
Area:	16,930 m <sup>2</sup>

Establishment Cost (planting):	\$124,440
Establishment Cost (direct seeding)	\$59,260
Annual Weed Control:	\$2,550

Restoration Area No 4 is located on the south-eastern corner of Canns Rd and Churchman's Brook Rd that has had some gravel removed from it. The area is surrounded by bush but is on a very narrow strip of land and is subject to high "edge effects". It is visible from Canns Rd and has been subject to limited floral reinstatement. However the bulldozing of the area following the replanting hampered these restoration efforts. Funding for this area has been made available from the Churchman's Brook Estate for restoration.

Restoration Area No. 5

Location:	MGA 410765 E: 6441625 N
Area:	6,790 m <sup>2</sup>
Annual Weed Control:	\$1,000

Restoration Area No 5, which was affected by the realignment of Canns Road, has been the focus of previous restoration work which has been quite successful. The site is therefore used as a teaching tool for urban bushland managers and has featured in several field trips by State Government departments. Surrounded by healthy bushland, there has been significant natural regeneration following the revegetation work conducted in 1993. Ongoing weed control and some revegetation will still be required.

Restoration Area No. 6

Location:	MGA 409289 E: 6441345 N
Area:	7,910 m <sup>2</sup>
Establishment Cost (planting):	\$58,140
Establishment Cost (direct seeding)	\$27,690
Annual Weed Control:	\$1,200

Restoration Area No 6 is the largest former gravel pit in the Common. It has had road fill dumped in an attempt to reinstate contours, however the process of contour reinstatement has not been completed, as the road fill has not been smoothed out. The area also contains large amounts of weeds including significant numbers of *Echium plantagineum* (Paterson's Curse). This weed, and any other significant weeds in the area, should be controlled prior to revegetation. Care should be taken in this area as the firebreak, formerly part of Settlers Road, borders a Dieback free area.

General Restoration Area (Former Pasture Land)

The former pasture land that forms the bulk of the lower slopes on the eastern side of the Common is severely degraded and conventional methods of bushland restoration will require substantial resources and time. The highest management priority is to restrict fire in the area so that it does not return to the previous cycle of fire encouraging the growth of grassy weeds leading to conditions of high fire risk.

Bushland restoration in this area should be focussed on highly visible areas such as near the Field Study Centre, along Canns Road near Armadale Primary School. Previous revegetation on Charcoal Hill could also be a site for ongoing bushland restoration.

**Restoration Techniques**

A detailed design plan should be developed for each area requiring reconstruction. Specific techniques to be used in the rehabilitation and reconstruction of the bushland include seedling planting, direct seeding and seed collection. These 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) in square plastic pots (75 x 75 x 100 mm) 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. Most importantly the seedlings should be derived from local provenance seed and/or cuttings.

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 or a weed mat may be used. 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 is a useful technique in reconstruction areas. It has numerous benefits in that it is cheaper and can often use a wider range of species, however the results are generally less consistent. 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 3.5 - 5 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.

### **Monitoring**

Bushland condition can be used to measure the success of ecological restoration, as it can be used to demonstrate changes in condition 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 increases in condition are required over a set time. 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.

### Local Provenance

Local Provenance is an important biological concept that has important applications in bushland restoration. Regional and local differences in the genotypes of plants of the same species often have significant effects on the phenotype of an organism. Differences in leaf shape, flower colour and flowering times are obvious visual differences but important nonvisual differences can also occur such as disease resistance and drought tolerance. These may factors can be restricted to distinct populations of flora within an area. The introduction of individuals of the same species, but from a different population will be adapted to its local conditions and therefore may not respond well to new conditions. Another, more serious outcome of using genetic material from different populations, is that it may lead to genetic ‘pollution’, where the plants from introduced populations breed with the local populations producing offspring that have reduced vigour. The effects of this can be quite serious reducing the vigour of the entire population.

There are specific policies associated with the removal of flora for local provenance. These rules and guidelines should be adhered to when collecting seed and plant material for the purposes of revegetation.

The *Wildlife Conservation Act* prohibits the removal or taking of native flora without a licence. Such a licence can be obtained from the Department of Conservation and Land Management.

City of Armadale policy regarding the removal of native flora is as follows (City of Armadale, 2003):

1. *“Material not being sourced from vegetation of regional significance namely vegetation between Southern River/Wungong Brook and the base of the Darling Scarp, vegetation on Forrestdale Lake bushland Reserve 21675 Forrestdale and vegetation on Gibbs Road Reserve 32635 unless:
 
  - For research by State Government agencies or accredited dieback interpreters, university staff or a Friends Group; or
  - There is no other source of material for revegetation works that meets provenance criteria;*
2. *The taking of flora, cuttings or seed for revegetation projects being supervised by a person or organization with prior experience in successful revegetation projects.*
3. *Where groups of students are required to make up herbaria, cooperation occurs between students so that the number of cuttings required is minimised;*
4. *Determination that the site will not be adversely impacted from cumulative operations that involve the taking of native flora;*
5. *If it is proposed to take flora from a reserve, a valid licence must be held; and*
6. *Requests for taking introduced plants shall be approved in writing where the taking is likely to result in increased invasion of weeds into natural areas.”*

### 6.5.4 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
5.1	Carry out assisted natural regeneration in Good condition areas following the principles of the Bradley method based on bushland condition mapping.	1	\$1 / m <sup>2</sup> / annum	Area of bushland that has improved its category from bushland condition survey <sup>4</sup>

<sup>4</sup> E.g. Good condition bushland increases to Very Good – Excellent

No.	Recommendation	Priority	Cost	Key Performance Indicator
5.2	Carry out reconstruction / revegetation in areas indicated by Figure 3.3 and in <i>Poor</i> and <i>Very Poor</i> Condition areas based on bushland condition mapping.	3	\$5 / m <sup>2</sup> / annum	Area of bushland that has been regenerated with local vegetation to a weed free status equivalent to good condition vegetation.
5.3	Monitor the success of individual restoration projects using quadrats	4	\$300 / quadrat	90% Survivability of planted seedlings / 40% germination from seed

## 6.6 Fire Management

### 6.6.1 Objectives

The prioritised objectives for fire management for the Armadale Settlers Common are to ensure:

1. protection of human life;
2. protection of property; and
3. protection of ecological integrity and biological values.

### 6.6.2 Background

#### ***Impact of Fires on the Biological Environment***

Both the immediate and cumulative impact of fires on biological values is 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 as it forms a highly flammable fine-textured fuel and produces a high annual fuel load depending on climate and growth rate. Grassy weeds can also form a continuous fuel bed, permitting a fire to spread quickly and creating a very hot fire at ground level. Native plants usually have gaps between them which act to slow down the spread of fire. They also generally take much longer to reach the same fuel levels. 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 on natural communities is profound and can quickly lead to a greatly reduced diversity of flora and fauna.

#### ***Fire Management***

Fire is a management tool that involves many complex interactions and should therefore be used with caution. Some components of the ecosystem survive and thrive after fire, whilst other components are slow to recover. Fragmented bushland containing weeds is less resilient to fire and weeds can become firmly established in areas of high fire frequency. A number of species require several years prior to recovering in full from the effects of fire.

There is little known about the fire history of the Common and records do not date back past 1977. The entire Reserve was control burned in 1986 and pre 1977. Both times the burnings occurred after the first rains and before the start of winter. It was the practice of the local Fire Brigade at that time to undertake a hazard reduction burn every 7 – 10 years (Tizard, 1990). The current regime of controlled burns is dictated by fuel loads and these are conducted when the fuel load exceeds 8.5 tonnes per hectare.

The Common has been divided into Management Zones (see Section 6.2) which are burnt at different times. This mosaic pattern of burning allows native fauna to move away from the fire and seek cover in unburnt areas of the reserve. It also helps establish native colonising species in the burnt areas by providing 'reservoirs' from which flora and fauna stock can be recruited (Bamford & Dunlop, 1983). In addition it provides the public with access to unburnt regions of the reserve at all times.

Fire should be excluded from the old pasture areas on the scarp at all times and in management zone 15 (special conservation zone) between April and December, unless it is established that this area no longer has significant flora (See Appendix Six). This will necessitate allowing these areas to reach higher fuel loads than is currently permissible. In order to achieve this while still meeting the objective of protecting life and property, buffer zones have been established between these areas and private property (see Section 6.2).

This concept of a core area that is burnt to ecological requirements and a surrounding zone that is burnt according to fuel loads, means that although life and property are protected, firefighting techniques cannot be applied to a substantial portion of the Common. In order to apply this concept, additional firebreaks would need to be constructed. Consideration would therefore need to be given as to the costs and benefits of creating additional tracks compared with continuation of the existing fire management regime. This could be investigated during the preparation of the Fire Management Plan.

### **6.6.3 Strategy**

#### ***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 park and fuel levels can be reduced through manual removal of fuel or controlled burns.

#### ***Incidence of Ignition***

By far the greatest cause of fires in urban bushland is arson. A review of bushfire records from Kings Park for the period 1944 – 1983 found that 42% of all bushfires were deliberately lit (Wycherley and Robley, 1983). Unfortunately, arson is difficult to police and offenders are rarely caught. The most effective method of preventing arson within Armadale Settlers Common is to control private vehicle access into the park. Ideally the external boundaries of the Common should be securely fenced, with locked access gates for service vehicles and access points for pedestrians and cyclists. This is not however a feasible option given the large boundary of the Common and the limited resources available. Vehicular access should be restricted by limiting entry points as far as practicable. Regular ranger patrols of the Common should also be undertaken. If practical this should also include patrols at times of highest risk for fire ignition such as after school and between 8pm – 12pm during the summer months.

Access is one of the most important factors in determining ignition locations for both deliberately lit and accidentally lit fires. Another factor to consider is the time of ignition. By concentrating ranger patrols at times when fire ignition risk is highest, the incidence and severity of deliberately lit fires can be reduced. Fire and Rescue Service (FRS) incident statistics from 1996/97 and 1997/98 indicate that ignition of grass, scrub, bush

and rubbish (GSBR fires) peak in December and January (FRS, 1997; FRS, 1998). Ignitions are lower in February and March, although fuel moisture levels are lowest at these times of the year. December and January correspond to school holidays. Anecdotal information suggests that during the summer school holidays there are two peaks in fire ignition, with the first three to five days after holidays commence, and the second one week before the holidays end.

Bushfires are sometimes a result of accidental ignition. Common causes include escapes from burning rubbish, barbeques and campfires, cigarette butts, escapes from controlled burns, faulty powerlines and the operation of plant and machinery. Fires can also be started by lightning strikes during storms. A community education programme highlighting activities that could lead to accidentally lit bushfires could reduce the incidence of bushfires within the Common, especially near areas where the number of visitors is greatest.

#### Fuel Reduction

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 (Wycherley and Robley, 1983). The main approach to fuel reduction in the Common should be through weed control, especially on road verges surrounding the Common and next to major tracks throughout the area. Verges are one of the most common sites of ignition.

Prescribed burns are currently undertaken when fuel loads reach 8.5 tonnes per hectare. While prescribed burns can be a useful tool for fuel load reduction and the regeneration of some plant species, this needs to be carefully managed to ensure that it does not contribute to increased weed loads and reduced recruitment of native species. Patterns of fuel load build-up should be investigated and ongoing monitoring undertaken to determine whether controlled burning is a suitable fire management technique for Armadale Settler's Common.

The pattern of controlled burns related to fuel loads is acceptable as long as the minimum fire frequency to maintain all ecological functions of the Common is maintained. Controlled burns within an urban environment can be placed in some context by examining the fire history of Kings Park, which contains approximately 270 ha of bushland in the centre of Perth. A comparison of the prescribed block burning program (1954 – 1962) with fire suppression regimes revealed that the area burnt by wildfire did not vary significantly but that the total area burnt decreased dramatically when prescribed burns were not conducted. Kings Park would have to be burnt every 3 to 4 years to ensure fuel levels are kept below 8 tonnes per hectare, and burning at this frequency has been shown to exacerbate the fire hazard by facilitating the replacement of native understorey with grass weeds such as Veld Grass. (Dixon, 1995)

To ensure that all species have adequate time to build up a seed bank between fires Burrows and Wardell-Johnson (2002) recommend that fire regimes have a fire frequency twice the period required for the slowest maturing species at a site to set seed. Without comprehensive information it is worth noting that Jarrah and Marri do not flower for approximately 4 years following intense fires that cause crown damage; the ability of Jarrah, Marri and Tuart to resprout also declines with age and *Banksia attenuata* (Candle Banksia) takes up to 10 years to flower from seed (George, 1996).

Occasional fires at closer intervals will not necessarily lead to the demise of species but regular and frequent burning will lead to the increase of short-lived herbs and some grasses at the expense of obligate-seeding species.

Another method of fuel reduction is the construction of low fuel zones. Fire access tracks have been established around the Management Units throughout the Common. These

tracks serve a dual role by providing low fuel buffer areas, preventing the spread of low and moderate intensity fires, and also as fire access trails permitting access by fire suppression vehicles. The Fire access tracks in the Common also function as walking tracks for passive recreation. Firebreak notices are issued by the City of Armadale and are enforceable under the *Bush Fires Act 1954* and the *Local Government Act 1995* (FESA, 2000). Private landholders adjacent to the Common are also required to construct and maintain firebreaks under the Act.

#### Public Education

A community education programme should be developed for the Common and other bushland areas in the City of Armadale. 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 Common.

#### **Fire Suppression**

Fire suppression involves the application of fire-fighting techniques 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. The chances of success in this respect can be greatly enhanced if nearby residents are encouraged to participate in a 'Fire-watch' programme.

Fire suppression requires trained, experienced staff and volunteers, with suitable equipment, who are available within a short response time to fight fires. Armadale Settlers Common is within the Bedfordale Fire District and first response is undertaken by the Bedfordale Fire Brigade. 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 and must be integrated with effective ignition and fuel reduction programmes.

#### **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 an 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, while 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 within the Common, 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 steep areas of the Common with high pedestrian use, foot access should be limited to limestone-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 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 and weed control measures will need to be implemented within the Common 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. Implementation of weed control in the post-fire environment should follow the strategy outlined in Section 5.3.

Fire fighting operations also 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 park 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***

An Urban Bushland Fire Plan should be developed for the Armadale Settler's Common in consultation with the Fire and Emergency Service Authority (FESA), volunteer bushfire brigades, stakeholders and the City of Armadale Rangers. The Plan should incorporate response and recovery strategies, list key contacts and map the locations of hydrants, fire access tracks, infrastructure, nearby dwellings and biodiversity assets (such as populations of rare flora).

### ***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. For every bushfire the following should be recorded and mapped using GIS to enable a database of fire history to be compiled:

1. location of ignition;
2. cause of ignition (if known);
3. season/date and time of ignition;
4. fire perimeter/extent; and
5. 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.

## 6.6.4 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
6.1	Prepare and implement a Fire Control Management Plan for the Armadale Settlers Common using FESA guidelines that includes investigation of the mosaic burning and areas with different fire frequencies.	1	\$4,000	Reduction in severity of fire incidents (reviewed annually)
6.2	Continue maintenance of firebreaks within the Common	1	Operational	Reduction in severity of fire incidents (reviewed annually)
6.3	Undertake hazard reduction through physical removal of grassy weeds on the Common boundaries.	2	\$1,000 per Ha	Reduction in number of bushfire incidents (reviewed annually)
6.4	Continue mosaic hazard reduction burning once fuel loading has reached 8T/Ha	N/A	Operational	No increase in number of bushfire incidents or severity (reviewed annually)
6.5	Engage in post-fire recovery and incident analysis following a bushfire event.	N/A	Operational	Database of fire history for ASC continually updated
6.6	Facilitate research to determine the effects of burn regime in the Common to maintain biodiversity and the ecological values.	3	N/A	No net decrease in floral diversity as a result of hazard reduction burns. Monitored using vegetation survey conducted every five years.
6.7	Develop, and encourage nearby residents to participate in, a 'Fire Watch' programme for early response using signage and leaflets	1	Operational	Reduction in number of bushfire incidents (reviewed annually)

## 6.7 Dieback Management

### 6.7.1 Objectives

The objectives for dieback management are to:

- prevent the spread of dieback into uninfected areas beyond its natural rate of expression
- educate bushland regenerators and the community about dieback and ways to limit its spread

### 6.7.2 Background

Dieback in Armadale Settlers Common is described in Section 3.5.

Dieback is very prevalent with nearly 90% of the Common exhibiting signs of dieback. There are a few patches that do not show evidence of dieback expression which total approximately 39 ha.

Dieback expression in the Common is likely to be due to uncontrolled vehicle access and high frequency of use with uncontrolled levels of hygiene (Glevan, 2000). The dieback in the Common also shows an expression pattern typical of many infected areas in that there are high levels of recolonisation of dieback susceptible plants. Once these reach maturity the progeny may also become infected and die during years with conditions are suitable for dieback, such as in years with heavy rainfall and warm conditions. This cycle can continue for several decades (Glevan, 2000).

In some infestations, trees that could be considered significant based on their size or other key characteristics are still healthy, but may die the next time conditions are suitable for dieback unless they are injected with phosphite. Injection of significant trees could save such specimens.

Of note also is the presence of a relatively large 'dieback-free' area within management zone 15 (special conservation zone). This area has other important biological values and every effort should be taken to restrict further spread of dieback in this area.

*Phytophthora* related dieback generally has a slow natural rate of movement, however the rate of spread can be increased considerably by vehicle and foot movement. A history of uncontrolled vehicle access in the Common is likely to be the primary factor behind the extensive areas of dieback expression currently observed (Glevan, 2000).

Factors that may also contribute to the spread of dieback are as follows:

- uncontrolled vehicle access, particularly off formed tracks;
- pedestrian access in dieback-free areas;
- machinery and works undertaken in dieback free areas without appropriate hygiene measures;
- movement of soil;
- wet conditions;
- sticky soils (high clay or humus content); and
- low lying areas.

All of the areas where there is little or no dieback expression are on the higher parts of the Common characterised by the Dwellingup soil unit. This unit is composed of sandy gravels and laterite on the uplands and therefore has little moisture-holding capacity. The slopes and scarp face characterised by the Darling Scarp unit have higher moisture and moisture-holding capacity and all areas of this unit show dieback expression.

### 6.7.3 Strategy

As there is no cure for dieback, prevention of infection is the primary means of defence. This involves preventing movement of dieback infected soil, plant matter and water into uninfected areas, and careful placement of tracks so that they do not cross between dieback infested and uninfected areas. Any soil or plant material used for bushland restoration or landscaping in dieback-free areas should be certified as *Phytophthora*-free.

Dieback hygiene measures should be undertaken when conducting bushland restoration works in dieback infested and dieback free areas. Equipment, boots and machinery should be disinfected prior to entering dieback-free zones. The following should also be undertaken when conducting restoration works (adapted from Dieback Working Group, 1999):

1. Manually removed weeds should be placed in a container so soil is not spread.
2. Revegetation activities should generally be avoided in areas that are disease-free, however if revegetation is required then the following should be considered:
  - Use of direct seeding in preference to planting seedlings;
  - dieback resistant plants selected;
  - complete works when soil is moist but not wet;
  - introduced soil should be certified dieback free (including purchased seedlings);
  - use only composted mulch; and
  - watering should be from scheme sources or sterilised.

Relevant guidelines for local government are detailed in *Managing Phytophthora Dieback – Guidelines for Local Government* (Dieback Working Group, 2000).

Restriction of access in dieback free areas is of the highest importance and movement between dieback infected and dieback free areas should be regulated as much as possible. Particular attention should be made to restricting access from the lower parts of the Common, specifically tracks that can be entered from the Field Study Centre, Armadale Primary School, Carawatha Avenue and Locke View. These wetter, low lying areas provide good conditions for the spread of *Phytophthora* which, if carried to the higher parts of the Common, may spread dieback into uninfected areas. Published, guided or signposted walks that incorporate both the scarp and uplands should also start from the upland areas.

Short-term protection of individual plants can be achieved using phosphite, which is injected or sprayed onto individual trees. However it is recommended that this be restricted to application in buffers around dieback-free areas as it is relatively expensive due to the intensive labour requirements, and can only be effectively used on small or isolated occurrences of dieback. Glevan (2000) outlines site specific procedures for phosphite application in each dieback-free area. A brief description of dieback free areas is given below. Locations of dieback-free areas are shown in Figure 3.4.

#### Area 1

This area is located in the north-eastern end of the Common and is approximately 15 ha within Management Zone 15. There is a dieback infested area within this zone situated on the old gravel pit. Restricting the spread to dieback in this area is important as there are high conservation values associated with this zone. Management of this area should focus closing non-essential vehicle tracks and restricting access, particularly during the winter months. Dieback is moving downhill into the dieback free zone along the eastern boundary of this area, which should be treated as a priority.

#### Area 2

This is a small area (0.5 ha) west of Canns Road and south of Area 1 in Management Zone 17.

#### Area 3

This area is located on the corner of Canns Road and Waterwheel Road in Management Zone 14. It is approximately 6 hectares in area. Expression in this area is greatest along the northern and eastern edges with potential rapid movement of the eastern edge.

#### Area 4

This large area is located along Settlers Road and extends north. While Glevan (2000) suggests that tracks do not cross the dieback-free area, updated mapping conducted by Ranger Services confirms a track does indeed pass through this area. This track is currently maintained as a fire access track, so closure may be inappropriate. As well as treating with phosphite Glevan (2000) recommends:

- upgrading drainage control along Settlers Road so runoff cannot flow into the area or exacerbate existing roadside infection;
- closing and rehabilitating track running north east from Settlers Road; and
- treating susceptible vegetation with phosphite in a 10 m buffer on either side of the fire access track where it crosses the dieback free area.

#### Area 5

This area is located north of Area 4 and is approximately 4 hectares in area. Interpretation of this area was difficult (Glevan, 2000), however samples taken did not detect *Phytophthora* in this area.

## 6.7.4 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
7.1	Apply phosphite to the eastern boundary of Area 1, and consider phosphite applications to other parts of the Common in the broader context of other City reserves.	1	Operational	Length of dieback front treated and re-treated every four years.
7.2	Train revegetation and maintenance personnel in dieback hygiene measures	1	\$300 per person	no annual reduction in area of treated dieback-free areas beyond natural rate of expression (1 m / yr)
7.3	Monitor dieback-free areas by mapping every 5 years	1	\$2,000	Dieback mapping on CoA GIS
7.4	Upgrade drainage along Settlers Road to prevent dieback spores infecting dieback-free area	2	\$15,000	no annual reduction in area of Area 4 beyond natural rate of expression (1 m / yr)
7.5	Include information about dieback hygiene in interpretive signage and provide boot-scrub facilities at trail heads.	2	\$2,500 <sup>5</sup>	Boot scrub facilities and signage installed on completion of one trail per annum.
7.6	Inject individual significant trees susceptible to dieback.	1	N/A	Individual trees identified compared with the number protected by phosphite (in the last four years).

## 6.8 Erosion Control

### 6.8.1 Objectives

The objectives for erosion control within Armadale Settlers Common are to:

- Control the causes of erosion and rehabilitate existing eroded areas;
- Prevent erosion caused by inappropriately placed tracks; and
- Prevent erosion after weeds have been removed.

### 6.8.2 Background

While much of the Common is not susceptible to erosion, it can be a problem on the slopes and gullies of the north-western section characterised by the Darling Scarp soil unit. Erosion in the Common is generally associated with steep tracks running up the face of the scarp. There is also significant erosion at the spring where the old dam has been infilled.

Steep tracks, particularly those running parallel to Locke View along the border of the Common, are often perceived as a challenge to four-wheel drive enthusiasts. This can be particularly damaging during the winter months when high rainfall exacerbates the damage.

Major earthworks near the site of the old dam has also resulted in high erosion. The dam is fed by an underground spring (B. Tizard pers. comm.) and the area is very boggy. Heavy erosion can be seen where underground water has seeped to the surface and flows into a nearby stream.

<sup>5</sup> Cost estimated as \$500 per boot-scrub per trail head (5). Signage inclusive with interpretational signage and information shelters.

### 6.8.3 Strategy

Erosion, once started, is often difficult to control. Once vegetation has been removed and the surface soil disturbed, erosion will continue until active measures are put in place to prevent further erosion. This would include as a minimum:

1. prevention of further erosion-causing processes
2. revegetation using local species.

Mulching or other ground cover may also be necessary to prevent further erosion.

Restricting vehicle access to the Common is the best strategy for minimising further erosion. The need for steep fire access tracks running up the face of the scarp should also be investigated and closed if these are found to be unnecessary. Revegetation should then be undertaken to prevent further erosion.

Additional earthworks may be required for erosion located at the old dam. This will involve reinstatement of the original contours as far as possible to redirect the flow of surface water to its natural state. This should be undertaken using specialist advice.

Water erosion on tracks can be controlled by 'cross falling' whereby they are constructed at an angle to allow water to flow off one or both sides of the track, rather than coursing down the middle of the track. This may need to be done in association with drains to remove the water that sheds off the track.

### 6.8.4 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
8.1	Undertake further earthworks to restore natural stream contours at the old dam site.	3	approx. \$20,000	Reduction in water turbidity 100 m downstream by 50% after rainfall event.
8.2	Construct culvert where track crosses stream fed by old dam spring	2	\$1,000	culvert operating effectively

## 6.9 Fauna Management

### 6.9.1 Objectives

The objectives for fauna management within Armadale Settlers Common are to:

- preserve and improve fauna habitat;
- control feral animals within the Common where possible and appropriate;
- 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 that currently roam within the Common.

### 6.9.2 Background

Fauna in the Armadale Settlers Common is described in Section 3.6. Fauna species that may potentially occur in the Common are listed in Appendix Three.

### ***Native Fauna***

The Armadale Settlers Common is of a sufficient size to potentially support most fauna species that naturally occur in the region. This is confirmed by repeated sightings of Western Grey Kangaroo within the Common. These animals have large home ranges and therefore generally do not occur in small, isolated reserves.

Armadale Settlers Common is situated near several other large reserves including Bungendore Park to the south, and large areas of undeveloped freehold land and State Forest to the east. The presence of these large areas of nearby bush increases the potential for fauna species to utilise Armadale Settlers Common. While the full range of bird species and large mammals can be expected, roads, developed areas and pasture can prove significant obstacles for smaller and more cryptic fauna. It is therefore important to try and establish and maintain wildlife corridors and other linkages to these areas of bushland.

There is also the potential to improve habitat quality within the Common. While this is primarily related to appropriate bushland management, particularly in the area of fire management and weed control, supplementing habitat components that have been lost through a combination of historical logging and the fragmented nature of the landscape is also appropriate.

### ***Feral and Domestic Animals***

Many feral animals pose a serious threat to small native animals. Many species have become extinct as a direct result of predation or competition by feral animals while many others are at risk.

Rabbits, foxes and cats have a significant impact in the Common. Rabbits graze on the native vegetation limiting food sources for native grazers while foxes and cats predate directly on small mammals, reptiles, birds and amphibians.

The City of Armadale has undertaken a number of measures aimed at reducing the numbers of roaming cats including:

- Preparation of an informative brochure on responsible cat ownership in conjunction with the Cat Sterilisation Society
- Establishment of a 'Cat free zone' at Churchman's Brook Estate
- Undertaking research in collaboration with the Department of Conservation and Land Management and Murdoch University that will help determine if local cat laws, would be effective, particularly in reducing predation on fauna. This research is partly funded by the Perth Biodiversity Project.

In many large conservation reserves, foxes are controlled by baiting with 1080 poison. While this is yet to be undertaken in urban areas, nearby State Forest area are regularly baited as part of the Department of Conservation and Land Management's Western Shield program. Fox baiting in urban areas is controversial as domestic dogs can be at risk if they are not adequately controlled. Fox trapping is instead sometimes undertaken in urban areas. Rabbits can also be controlled with special 1080 baits or Pindone<sup>®</sup> as is more often used in urban areas.

The feasibility of baiting for foxes and rabbits should be investigated. The current rural setting of Armadale Settlers Common suggests that baiting may be an appropriate management response to the presence of feral animals in Armadale Settlers Common. If this is initiated it will need to be ongoing as reinvasion of feral animals will occur once baiting has ceased.

As well as naturalised animals generally recognised as having a direct impact on local fauna through predation such as foxes and cats, other naturalised animals in Perth also impact on local populations through competition for resources and habitat requirements. Animals such as Kookaburras, Rainbow Lorikeets, Galahs, Honeybees etc. have arrived in the area through either natural range extensions or human influences. Some local animals can also proliferate to the detriment of other species when certain conditions are met. While it is rarely possible, or even desirable to reduce numbers of these species, the presence of these animals should be taken into account when managing local species. For example the provision of habitat for a rare local species may simply benefit a common naturalised species.

### **6.9.3 Strategy**

The most effective way of ensuring viable local fauna populations is by the maintenance of habitat. Weed control and bushland restoration indirectly benefit fauna by improvements to habitat. Other measures including minimising clearing, appropriate fencing, control of feral animals and reducing the incidence of disturbance factors will also result in more diverse and viable fauna assemblages.

In addition to strategies that incidentally improve fauna habitat, specific strategies to benefit native fauna can be undertaken. This includes habitat supplementation, recovery programs and the creation and maintenance of linkages / wildlife corridors.

#### ***Habitat Supplementation***

It has been recognised that most, if not all, of the Jarrah Forest in the metropolitan area has been subjected to logging which has seen the removal of many of the older, larger trees. Unfortunately this has resulted in the loss of a substantial amount of nesting and breeding sites within the hollows of the old trees.

Although the cessation of selective logging in the Northern Jarrah Forest will eventually provide more of these nesting hollows, there is presently a shortage of this habitat component. Trees need to be more than 130 years old to have the hollows suitable for use by fauna as habitat (City of Armadale, 2000). In order to redress the problem in the short to medium term a program of habitat supplementation should be undertaken in the form of nesting boxes. Preliminary research has shown that there is a great deal of information on the types, shapes and construction of nesting boxes designed to meet the needs of specific species, it should be noted however that non-local species of birds and other animals can also inhabit nesting boxes including honeybees. This can be a major problem and nesting boxes need to be regularly monitored. Raptor platforms are also a method of recreating tall dead stags that have been removed from logging operations.

Logging is not permitted in the Common and the City of Armadale Tree Policy (Policy 2.1.15) states that tree *“lopping be undertaken only when boughs constitute a danger or the tree has a history of falling limbs or has developed a condition which could make it hazardous in the foreseeable future.”* Trees that are felled for whatever reason should be left on the ground away from access tracks to provide additional fauna habitat.

#### ***Recovery Programs***

Threatened fauna species are often the focus of recovery plans undertaken by the Department of Conservation and Land Management, often in conjunction with Perth Zoo. Recovery plans often involve captive breeding and release into suitable bushland. Intensive fox and cat control should be undertaken in conjunction with the release of captive-bred animals back into the wild.

The Common may have an important role to play in the recovery of threatened species. As a large reserve it has the ability to contribute to the Recovery Plans of the State and Commonwealth agencies. Wherever possible the Common should be considered for these programs

### ***Linkages and Wildlife Corridors***

While Armadale Settlers Common is a large reserve surrounded by other large patches of remnant bushland, there are limited linkages between them. The City of Armadale's Town Planning Scheme No. 4 Special Control Area Map No. 1 identifies key ecological linkages to be maintained between the Common and other bushland as "Green Links with Remnant Vegetation - Outside of Parks and Recreation Reservations". It is not intended to purchase these areas but ensure that existing remnant vegetation is retained and enhanced where possible.

The largest section of Armadale Settlers Common is completely bordered by roads and there are also extensive areas of cleared land bordering the Common. These are significant barriers to the movement of animals as this cleared open land does not provide adequate cover through which animals can move. The adequacy of the key ecological linkages identified in Town Planning Scheme No. 4 is unknown, but more linkages would be desirable.

It is therefore important to provide areas of adequate cover through which animals can move. While the best linkages consist of remnant vegetation, it is sometimes possible to create areas through which some animals can move. For example, fauna underpasses are often constructed where major roads intersect significant areas of remnant vegetation, and brushing can sometimes be used to provide cover over short distances.

Important areas of remnant vegetation surrounding the Common should be protected as much as is possible and taken into account when making planning decisions. Access to these linkages should also be facilitated by revegetation if necessary and the provision of cover such as brush and logs. Landowners around Armadale Settlers Common should be made aware of the value of their land for fauna and encouraged to participate in bushland restoration and habitat supplementation, particularly in 'closing the gaps' between vegetated areas. Landholders participating in this may also be eligible for certain schemes such as 'Land for Wildlife' and conservation covenanting programs that offer financial assistance and benefits.

#### **6.9.4 Recommendations**

<b>No.</b>	<b>Recommendation</b>	<b>Priority</b>	<b>Cost</b>	<b>Key Performance Indicator</b>
9.1	Undertake habitat supplementation such as nesting boxes and raptor platforms and monitor their use	4	\$2,500 <sup>6</sup>	Habitat supplementation being used by native species
9.2	Assess the need to prepare and adopt a Local Law and/or Planning Policy to control cats near reserves	4	Operational	Needs analysis completed and acted upon
9.3	Investigate the feasibility of Armadale Settlers Common participating in species recovery programs	4	Operational	Feasibility investigated
9.4	Investigate the location and protection of ecological linkages to other conservation areas.	2	Operational	Town Planning Scheme No. 4 identifies and protects linkages.

<sup>6</sup> Estimate \$1,500 for raptor platform and 5 nesting boxes @ \$200 each

## 6.10 Cultural Heritage Management

### 6.10.1 Objectives

The objectives for the cultural heritage management within the Common are:

- to prevent damage to cultural heritage values;
- to maintain European and Aboriginal cultural heritage values, structures and artefacts; and
- to promote awareness of cultural values through education.

### 6.10.2 Background

The Common has many features which are important to the Community and add to the cultural heritage of Armadale Settlers Common. The management of factors affecting these values should be guided by the Australian Natural Heritage Charter and its associated social counterpart, the Burra Charter.

Specific details on the location and nature of Aboriginal heritage sites should not be made public and have therefore appeared in Appendix Seven which will not be included in public versions of this document.

#### ***Aboriginal Heritage Sites***

Aboriginal Sites, regardless of whether they are registered or not, are protected under the *Aboriginal Heritage Act, 1972*:

- **Section 5** defines sites as places of importance where objects connected with traditional life have been left, stored or taken from; ceremonies have been conducted; some ethnographic interest;
- **Section 15** requires that findings be reported;
- **Section 17** makes it an offence to excavate, destroy, damage, conceal or in any way alter any Aboriginal site; and
- **Section 18** establishes the conditions for certain uses of land unaffected by the Act.

All proposed development and management of the study area needs to be undertaken in the context of the legislative requirements. While the Common contains at least one registered site, further surveying may be required to precisely demarcate this site and ensure that any other sites are located. Depending upon the outcome of the survey and proposed works the following situations may arise:

- If works may impact on a known site, then a determination as to whether the works are within the scope of any prior Ministerial consent issued under Section 18 of the Act should be made;
- If the works are assessed to be beyond the scope of previous consent then fresh consent will be required to permit the works to proceed; and
- If no consent has been previously issued, permission will need to be sought and obtained under Section 18 prior to any works proceeding.

#### ***European Heritage***

The Armadale Settlers Common has been identified as having high community attachment and aesthetic value and has been previously nominated for inclusion on the Register of National Estate. The Common is no longer being considered for nomination and steps should be taken to initiate the process to list Armadale Settlers Common as a site with National Heritage value under the *Environment Protection and Biodiversity Conservation Act 1999*.

The National Heritage criteria for a place are any or all of the following:

- (a) the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history;
- (b) the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;
- (c) the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;
- (d) the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of:
  - (i) a class of Australia's natural or cultural places; or
  - (ii) a class of Australia's natural or cultural environments;
- (e) the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- (f) the place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period;
- (g) the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- (h) the place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history;
- (i) the place has outstanding heritage value to the nation because of the place's importance as part of Indigenous tradition.

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The Willow Heights building also retains cultural heritage and is listed on the Municipal Heritage Inventory.

### 6.10.3 Strategy

The strategy for cultural heritage management includes:

1. identification of cultural heritage values;
2. assessment of values in a legislative context;
3. appropriate management to preserve cultural heritage values; and
4. education.

#### ***Identification of Cultural Heritage***

The identification of cultural heritage values is a necessary first step to subsequent management and preservation. Once these values have been identified then an appropriate management framework can be established. Identification of heritage sites may involve:

- collation of existing historical material relevant to the Common;
- conducting ethnographic surveys, particularly prior to any development works in the Common;
- conducting desktop reviews of the historical significance of the Common and associated components;
- collating oral histories from interviews with people that have a living memory of the Common and its use. This is important to be able to put recorded history in the context of everyday life.

The identification of cultural values can be initiated by the City of Armadale by encouraging interested people to undertake research. This could be achieved in a number of ways including sponsoring university projects or local residents interested in History. Genealogical societies can also be a useful source of both information and people interested in discovering the context in which their ancestors lived.

### **Assessment of Values**

The assessment of identified values should then be undertaken in a legislative context. Any Aboriginal Heritage sites discovered through ethnographic surveys should be nominated for inclusion on the Aboriginal Heritage Sites register at the Department of Indigenous Affairs. The Common itself has also been found to meet the criteria for inclusion in the Register of National Estate and should therefore be again nominated for inclusion.

### **Cultural Heritage Management**

The management of cultural heritage sites and artefacts should focus on preservation. While some values may be viewed or are resilient enough to be used, other values should be preserved by restricting access to them.

### **Education**

Education is itself a means of preserving cultural heritage. Armadale Settlers Common is in a unique position to facilitate education through the Field Study Centre. While this is currently focussed on the natural values of the Common, education centred on cultural heritage values may also be included. This may involve:

- Use of the Field Study Centre for meetings by clubs and societies associated with the preservation of cultural heritage e.g. historical societies, genealogical societies etc; or
- public workshops to learn about local aboriginal heritage and history.
- encouraging the use of the Field Study Centre and the Common by schools.

#### **6.10.4 Recommendations**

<b>No.</b>	<b>Recommendation</b>	<b>Priority</b>	<b>Cost</b>	<b>Key Performance Indicator</b>
10.1	Investigate and consider renomination of Armadale Settlers Common for inclusion on the Register of National Estate	1	Operational	ASC included or rejected in register for National Estate
10.2	Facilitate further research on the identification of cultural heritage values	5	\$1,000	Report on cultural heritage values compiled

## **6.11 Access and Recreation**

### **6.11.1 Objectives**

The objectives for access and recreation management are to:

- provide an appropriate level of access to minimise recreational conflicts and preserve the ecological and cultural values of Armadale Settlers Common;
- facilitate appropriate recreational activities by providing suitable resources and infrastructure; and
- provide a safe environment for passive recreation.

## 6.11.2 Background

Existing access and recreation in Armadale Settlers Common is described in Section 4.4.

### Access

Public vehicular access to the Common is restricted to the Car parks. Vehicle access to the interior of the Common is restricted to Management and Emergency Vehicles only. Firebreaks are to be kept to useable standard at all times. Vehicle access to the Special Conservation Zone is prohibited except for the management of the Zone.

Pedestrian access should be facilitated in all areas of Armadale Settlers' Common except dieback free areas (Figure 3.4) and within Management Zone 15 (Special Conservation Category – see Section 6.2)

### Recreation

Passive use is the main recreational activity encouraged in the Common. The network of fire access tracks that demarcate the management zones of the Common can be used for passive recreation. In addition there has recently been a walking track established that bypasses a steep and unsafe section of a fire access track.

The publication of books and pamphlets such as *Country Trails – Bushwalks and Trails in Perth's "Heritage Country"* provide information to the wider community of the passive recreation resources available at the Common. The annual 'Walk the Common' event also highlights the utility of the area for passive recreation and the event is now an integral part of the annual community events calendar. This highly successful family day brings new people into the reserve and provides old friends with the opportunity to share the secrets of the park. Participants are bussed to the start of the 5km walk and are treated to a spectacle of wildflowers until their return to the Field Study Centre. Interpretive Guides are located throughout the walk to assist in the enjoyment of the bush experience. There are generally about 150 participants in the event.

A pamphlet has been prepared that provides information about Armadale Settlers Common, however this is no longer available from the Armadale Tourist Information Centre. The pamphlet should be updated, printed and distributed to the Tourist Information Centre, the City of Armadale Library and Council buildings, bushwalking clubs and other organisations.

## 6.11.3 Visitor Safety

Using the bush for any recreational activity has some elements of risk. Visitors to the Common need to be aware of safety hazards in the Common including both the site specific risks and those found in any bushland. Additionally there is a duty of care by the City of Armadale to recreational users of the Common. As such tracks should be maintained to a state suitable for safe pedestrian access. Hazards should also be identified and reduced as far as possible.

## 6.11.4 Strategy

### Access

Pedestrian access to the Common should be formalised and signposted. A series of tracks such as those shown below in Figure 6.4, can direct pedestrian traffic into scenic, manageable areas, and away from dieback infected areas. Some possible walking tracks are given below. These are of varying length and difficulty and offer scenic views and/or good condition bushland. Trail heads should have informative signage detailing the length, return time and difficulty of the walks as well as information on the sights that

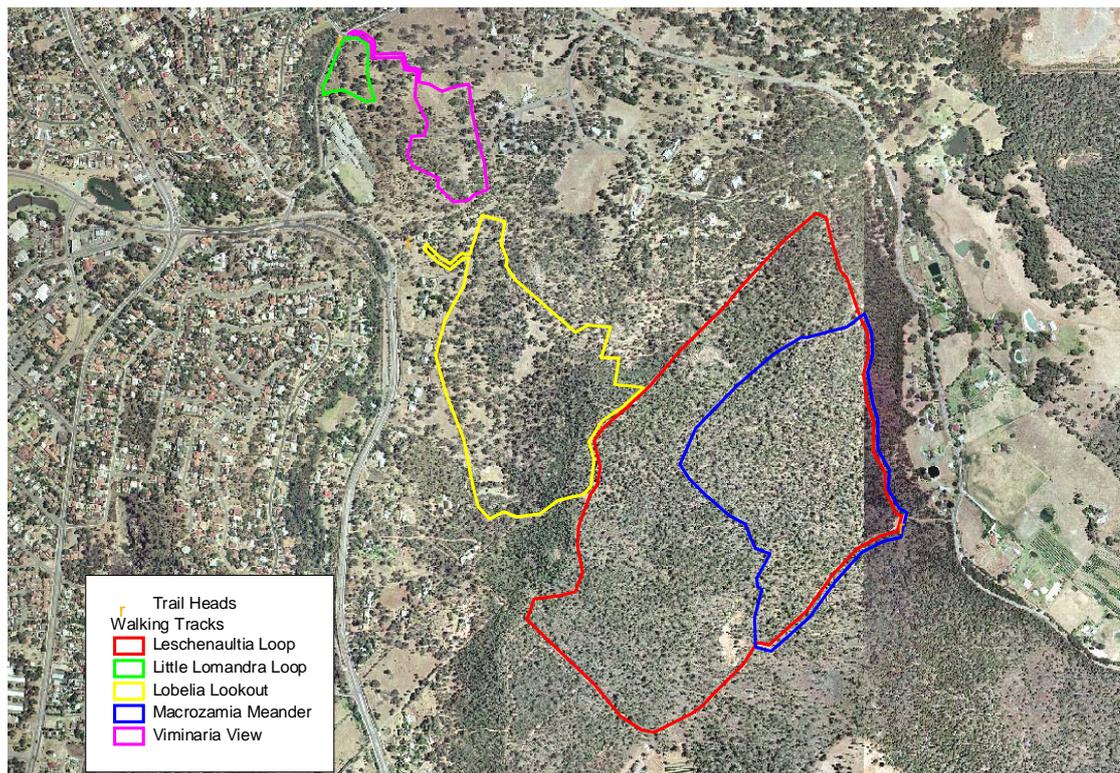
are likely to be encountered on the way. Where tracks divide, markers should be placed to aid navigation.

Tracks and associated signage and infrastructure should comply with Australian Standards AS 2156.1-2001 Walking Tracks – Classification and Signage and AS 1256.2-2001 Walking Tracks Infrastructure Design

Vehicular access should be limited to management vehicles. Management personnel should be aware of all issues and procedures associated with the Common, particularly in minimising the spread of weeds and dieback and minimising erosion. Exclusion of vehicles in the Common will be achieved by a combination of barriers/gates to entry, routine patrols of the perimeter and occasional patrols of the interior. Inspections should also be carried out for breaks in fences, barriers and gates which should be repaired as soon as possible after they are discovered. Special attention should be given to the Special Conservation Zones in this respect.

Access to the common via private property has been identified as a potential threat to the biodiversity conservation objectives of the common. Uncontrolled access from adjacent private land has the potential to spread dieback and weeds. The implications of uncontrolled access from private property into the Common should be investigated, and methods for control of this access identified and implemented.

**Figure 6.4 Potential Walking Trails in Armadale Settlers Common**



### **Recreation**

Maintaining recreational facilities such as tracks and suitable access points for passive recreation is a priority. Consideration could be given to a short, signposted nature trail in the Common that interprets the natural and cultural values of the Common. There is also a need for specific walks to be determined, assessed and named. The large size of the Common means that walks of different lengths and grades can be created using the

existing network of tracks. Most should be of a circuit design so that people can return to their cars, however as there is parking at several points in the Common several trail heads can be established (see figure 6.5).

Also of high priority is the provision of information about the types of activities encouraged in the Common. This can be done through print media such as books, and pamphlets as well as the electronic media. This aspect is explored in more detail in Section 6.11.

### 6.11.5 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
11.1	Audit potential walking tracks for standards to AS 1256 and determine upgrade requirements and cost	1	\$2,500	Report completed
11.2	Undertake a comprehensive safety audit of public access areas within ASC	1	\$1,500	Report completed
11.3	Establish signposted, named walking trails in the Common with informative signage at trail heads as indicated in Figure 6.5	2	approx \$1,000 per trail head plus	Number of trails completed
11.4	Continue to promote and hold the annual 'Walk the Common' event	1	\$3,000	Increasing numbers of participants annually
11.5	Update and redistribute ASC brochure,	2	\$2,000	Increased number of visitors to ASC
11.6	Monitor visitor numbers annually	5	\$1,000	Increased number of visitors to ASC
11.7	Explore implications and investigate methods for the control of access from private property	1	operational	Report on access completed

## 6.12 Education, Interpretation and Ecotourism

### 6.12.1 Objectives

The objectives for interpretation and education-based activities within Armadale Settlers Common are to:

- inform and educate visitors on the natural and cultural values of the Common;
- develop opportunities for ecotourism with minimal impact on the environment;
- increase the level and quality of information available to the community on the flora, vegetation and fauna of the park; and
- increase knowledge of Armadale Settlers Common's environmental, local and regional significance.

### 6.12.2 Background

Ecotourism within the Common is described in Section 4.3.2. Ecotourism can be described as nature based-tourism which develops an empathy for the environment and an appreciation of conservation in the individuals who experience it. This involves awareness of the biological, physical, and cultural features that are promoted through interpretive programmes. Ecotourism should have minimal impact on the environment and should maintain the biological diversity and other resources of the area. The provision of local and regional benefits in the form of employment, revenue, status and facilities are some of the advantages of ecotourism.

Armadale Settlers Common is a valuable ecotourism and educational resource that is currently not being used to its full potential. The combination of a relatively large expanse of bushland with an educational venue (Field Study Centre) within the Perth Metropolitan Area provides a unique opportunity for education and interpretation.

Currently there is a policy of non-exclusive use of the Field Study Centre and it is available for environmental and education groups. Groups and organisations that may benefit from the Field Study Centre include:

- Greening Western Australia;
- Armadale Settlers Common Management Committee;
- Armadale Settlers Common Field Study Centre Inc.;
- Friends of Armadale Settlers Common;
- Armadale Bushcare and Environmental Advisory Committee;
- Bungendore Park Management Committee; and
- Upper Canning Southern Wungong Catchment Management Team.

Armadale Primary School also use the Common quite extensively and regard it as an important resource for the school. As well as cross country and orienteering activities, classes, particularly Environmental Studies Groups, have used the Field Study Centre and surrounding bushland for plant, animal and bird identification.

There is some literature and printed material available for the Common, as well as web pages on the City of Armadale's website. A brochure of the Common has been produced, however there are no available copies left.

The Armadale Settlers' Common Field Study Centre internet site is an online resource that allows visitors to access data about the Common. The site features information about the reserve including flowering times of plant species and which fauna may be encountered in the Common.

The Web Site contains information needed to maximise enjoyment of the Common. It is an effective way to reach people all over the globe and provide local schools with an important environmental resource. For example schools can obtain access to information about the Common prior to a visit, come and see the wildflowers and wildlife and then do further investigations back in the classroom. Information on the website can also easily be updated to reflect new information, upcoming events and changes.

The Web Site covers three main topics; Conservation, Education and Recreation. Visitors to the site can find out about the importance of Biodiversity and the contribution of the Common's diverse range of flora and fauna. Flora and fauna lists and information on management of the Common is also included.

The Armadale Settlers' Common Web Site is currently located at: [http://www.armadale.wa.gov.au/government/Settlers/index\\_armadale\\_settlers.htm](http://www.armadale.wa.gov.au/government/Settlers/index_armadale_settlers.htm)

### **6.12.3 Strategy**

#### ***Field Study Centre***

The Field Study Centre is an important resource that has the capacity for more use than it currently receives. Some maintenance work needs to be undertaken, and the provision of potable water at the Field Study Centre will increase its utility by a large extent. Environmental education groups will then need to be made aware of the upgraded nature of the Centre and procedures for gaining access. These groups should be encouraged to add to the material already present in the Common and make the results of any studies undertaken available to the Field Study Centre.

## **Information and Interpretation**

### Literature

The unique values of the Armadale Settlers Common should be published as widely as possible to increase awareness of the resource. Workshops and studies held at the Field Study Centre should be publicised before and after the event in print and electronic media to different target audiences.

The Bushland Management Library in the Field Study Centre should be added to as frequently as possible and environmental groups using the Centre should be encouraged to donate materials relevant to studies they are doing or general bushland management techniques.

### Internet and Electronic Media

The internet is a valuable educational resource and needs to be continually updated to reflect changes, new information and upcoming events. Other aspects can be included such as virtual walk trails that can show images of aspects of the Common such as different views, flowers etc. Different walks and routes can also be posted with information about the length, time and degree of difficulty of the walk, as well as features of the walk to look out for and information about the flora and fauna likely to be encountered.

## **6.12.4 Recommendations**

<b>No.</b>	<b>Recommendation</b>	<b>Priority</b>	<b>Cost</b>	<b>Key Performance Indicator</b>
12.1	Provide potable water to Field Study Centre	1	\$6,000	Level of use for Field Study Centre increases annually
12.2	Monitor use of the field study centre	1	Operational	Level of use for Field Study Centre increases annually
12.3	Annually update relevant internet web pages. Include 'counter' to monitor site visitors	2	Operational	Increased number of 'hits' on website annually

## **6.13 Infrastructure and Amenities**

### **6.13.1 Objectives**

The objectives for the management of infrastructure and amenities in Armadale Settlers Common are to:

- provide a level of amenities to aid the enjoyment and function of the reserve;
- provide security for the biophysical values in the Common; and
- maintain the existing infrastructure and amenities to an acceptable standard.

### **6.13.2 Background and Strategy**

Existing infrastructure and amenities in Armadale Settlers Common are described in Section 4.5.

#### ***Buildings***

Buildings in Armadale Settlers Common consist of the Field Study Centre and "Willow Heights" Building. These buildings are well maintained and relatively free from

vandalism. These buildings should continue to be maintained and disabled access to the Field Study Centre and toilet facilities provided according to Australian Standards AS 1428.

### **Toilets**

Currently the only toilets are within the Field Study Centre. If this area is to be further developed to accommodate passive recreation, a public toilet may need to be constructed. Once formalised walking trails have been developed, monitoring should be undertaken to determine the utilisation of the walking tracks and assess whether a public toilet is needed and the most effective location. This would most effectively be achieved through a visitor survey at trail heads and information shelters.

### **Fences**

There is minimal fencing around and within the Common, the majority of fencing situated between the Common and private property. This is of generally poor condition and mostly needs replacing. While fencing of the entire perimeter of the Common is unfeasible, some level of fencing is required, particularly between private property and the Common, to demarcate tenure. Fencing can also be useful to deter inappropriate access, however as fences can often easily be cut, other methods such as boulder placement, deep gutters along roads and minor earthworks at access points may be more appropriate in many areas of the Common such as along Canns Road and Waterwheel Road.

### **Tracks and Walk Trails**

There is 23.5 km of fire access tracks within the Common as well as numerous unofficial tracks. Official tracks, walk trails and fire access tracks need to be maintained to appropriate standards and extraneous tracks closed and rehabilitated. Many of these tracks serve dual functions (e.g. fire access tracks and walking tracks) and therefore minimum standards for both must be maintained. For example fire access tracks must be of a minimum width and be cleared of vegetation while walking tracks should be of an appropriate grade and be reasonably free of trip hazards and dangerous areas. Tracks should be maintained to Australian Standards AS2156 (2003).

The Recreation Strategic Plan (City of Armadale, 2003a) proposes the following strategies associated with the provision of walking trails in the City of Armadale:

*“Investigate and report to Council on opportunities to establish additional walk and/or bridle trails in bushland reserves and trails which link bushland reserves” (Strategy 26);*  
and

*“Develop and promote a system of walking paths along the ridge and face of Darling Scarp” (Strategy 57).*

Walk trails consisting of circuits of different lengths and difficulty should be designed and named.

Additionally a nature trail close to Armadale Primary School and the Field Study Centre would also be highly beneficial to teachers, students and the general public. The trail should have interpretive signage identifying the natural and historical features of the Common. The establishment of defined circuit trails will indicate where it is most critical that track maintenance be of an appropriate standard.

There is also scope for the establishment of a trail for the disabled. The upper parts of the Common are relatively flat and potentially suitable for wheelchair access. Some of the requirements for disabled access are:

- paths should be at least 1200 mm wide
- uninterrupted slopes should not exceed 1 in 33;
- surfaces should be slip resistant with adequate drainage;

Adequate disabled parking should also be made available at the start of the trail.

### ***Rubbish Bins***

Rubbish bins are available at the Field Study Centre complex. There are no other bins elsewhere in the Common. CALM has a policy of not providing rubbish bins as an incentive for visitors to take their rubbish home with them. This approach should be adopted by the City and reinforced by providing information shelters at trail heads (Section 6.11.4). Rubbish bins should therefore not be provided except at the barbecue area.

### ***Car Parks***

There are three official car parks in the Common, although there are many other places where parking is possible. The locations of car parks are shown in Figure 4.2. None of the car parks have defined bays and this is unlikely to be necessary most of the time. Most of the car park on Carradine Road has been barricaded due to inappropriate behaviour being carried out there.

This car park should be redesigned to discourage antisocial behaviour and reopened. Additionally provision should be made for disabled parking where tracks are able to be negotiated in a wheelchair. This should comply with Australian Standards AS 1428

### ***BBQ and Picnic Facilities***

There are currently barbecue and picnic facilities at the Field Study Centre. This consists of one electric barbecue and two barbecues. While these cater for most needs, an additional barbecue would be beneficial during peak times of use (spring and early summer).

### ***Seating***

There is little outdoor seating at the Armadale Settlers Common, with the only existing seating situated at the Field Study Centre Complex. Once walking trails have been defined, signposted and named, seating should be placed at key locations along the trails. Consideration of suitable resting places, particularly in scenic or tranquil spots should be given when determining seat placement.

### ***Signage***

The City's Recreation Strategic Plan (City of Armadale, 2003a) recommends that the City "Develop a common pathway signing system for the City's strategic walking trails" (Strategy 55).

While there are a number of signs at Armadale Settlers Common, they are often inconsistent. Older signs should be replaced with newer signs. There should also be additional signs at defined car parks and access points that inform visitors about walk trails, acceptable and prohibited activities. Disabled access, where possible, should also be signposted where provision has been made for this.

An information shelter would be highly beneficial at key areas of the Common, particularly at trail heads. Information shelters convey a lot of information including details of what can and cannot be done in the reserve, safety information, a map with the routes, times and distances of walk trails, and information on the flora, fauna and cultural heritage that are likely to be encountered.

### 6.13.3 Recommendations

No.	Recommendation	Priority	Cost	Key Performance Indicator
13.1	Audit and ensure signage consistent and complies with AS 2156	1	\$250 / sign	inconsistent signage replaced
13.2	Provide disabled access to Field Study Centre and toilet facilities to AS 1428.	2	\$12,000	Increased annual use of Field Study Centre
13.3	Provide sewerage infrastructure to Field Study Centre.	2	\$15,000	Increased annual use of Field Study Centre
13.4	Investigate the feasibility of providing a walk trail suitable for disabled access	5	Operational	Feasibility study completed
13.5	Reopen car park on Carradine Road redesigned with reduced area to discourage antisocial behaviour.	4	\$4,000	No more than 10 complaints of antisocial behaviour per annum
13.6	Construct information shelters at trail head indicated in Figure 6.5	3	\$8,100 <sup>7</sup>	One shelter erected per annum
13.7	Construct an additional electric BBQ at the Field Study Centre complex	5	\$2,400	Barbecue installed

## 6.14 Monitoring & Evaluation

Monitoring and evaluation should be undertaken. This should include:

- Bushland condition mapping undertaken every four years to provide an indication of the success of weed control and revegetation activities.
- Dieback monitoring every four years to determine the rate of dieback spread
- Recreational use assessments to determine where and how the Common is used.

### 6.14.1 Monitoring

The Armadale Settlers' Common flora and fauna databases comply with the nationally accepted standards for data collection. This includes the "Biological Data Core Attributes" and "Quality Control and Validation" protocols established by Environment Australia. These protocols are used by all of the major environmental agencies and organisations for the collection of biological information.

In order to obtain a more precise picture of the native vegetation within the Common, more work needs to be carried out, including the identification and distribution of the native species. Biological surveys should therefore be encouraged within the reserve and the results of surveys maintained at the Field Study Centre. Similarly research undertaken by the Armadale Settlers Common Management Committee should be documented and collated for use in management decisions.

<sup>7</sup> Three shelters at \$2,700 each

### **6.14.2 Evaluation**

Evaluation of the management of natural areas is an essential component in determining the extent to which objectives for the reserve are being met.

Evaluation programs for the reserve should include development of clear management objectives with articulated criteria against which performance can be measured, the establishment of programs of monitoring and reporting which increase the likelihood of informed evaluation and the provision of feedback so that management practices can be progressively improved. Evaluation allows provides a link to public accountability and can demonstrate outcomes for expenditure for funding agencies. (Jones, 2000)

## 7.0 | References

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# Appendix One: Flora Species List

## Armadale Settlers Common Strategic Directions

This table combines data from various sources including Markey 1997, CALM DRF records, site visits from botanists as well as the initial species list from the ASC Amalgamated Data Set. All names have been corrected as per FloraBase.

Adiantaceae	<i>Cheilanthes austrotenuifolia</i>	Rock Fern
Amaranthaceae	<i>Ptilotus manglesii</i>	Rose Tipped Mulla-Mulla
Anthericaceae	<i>Agrostocrinum scabrum</i>	False Blind Grass
	<i>Arthropodium capillipes</i>	Nodding Lily
	<i>Borya sphaerocephala</i>	Pincushion Plant
	<i>Caesia microrantha</i>	Pale Grass Lily
	<i>Chamaescilla corymbosa</i>	Blue Squill
	<i>Laxmannia squarrosa</i>	False Borya
	<i>Sowerbaea laxiflora</i>	Purple Tassles
	<i>Thysanotus asper</i>	Hairy Fringed Lily
	<i>Thysanotus dichotomus</i>	Branching Fringed Lily
	<i>Thysanotus fastigratus</i>	Fringed Lily
	<i>Thysanotus manglesianus</i>	Fringed Lily
	<i>Thysanotus multiflorus</i>	Many Flowered Fringed Lily
	<i>Thysanotus sparteus</i>	Broom Fringed Lily
	<i>Thysanotus tenellus</i>	Dwarf Fringed Lily
	<i>Thysanotus thyrsoides</i>	Fringed Lily
	<i>Tricoryne elatior</i>	Yellow Autumn Lily
Apiaceae	<i>Actinotus leucocephalus</i>	Flannel Flower
	<i>Homalosciadium homalocarpum</i>	
	<i>Hydrocotyle callicarpa</i>	Small Pennywort
	<i>Pentapeltis peltigera</i>	
	<i>Trachymene pilosa</i>	Native Parsnip
	<i>Xanthosia candida</i>	
	<i>Xanthosia huegelii</i>	
Araceae	* <i>Zantedeschia aethiopica</i>	Arum Lily
Asteraceae	<i>Asteridea pulverulenta</i>	
	<i>Brachycome iberidifolia</i>	Swan River Daisy
	<i>Craspedia</i> sp.	Billybutton
	<i>Craspedia variabilis</i>	Billybutton
	<i>Helipterum cotula</i>	Daisy
	<i>Helipterum spicatum</i>	Daisy
	<i>Hyalosperma cotula</i>	Everlasting
	* <i>Hypochaeris glabra</i>	Smooth Catsear
	<i>Lagenifera huegelii</i>	
	<i>Millotia tenuifolia</i> var <i>tenuifolia</i>	
	<i>Olearia paucidentata</i>	Autumn Scrub Daisy
	<i>Podolepis gracilis</i>	
	<i>Pterochaeta paniculata</i>	Dwarf Daisy
	<i>Quinetia urvillei</i>	Daisy
	* <i>Senecio diaschides</i>	Fireweed
	* <i>Sonchus oleraceus</i>	Common Sow Thistle
	* <i>Tolpis fatua</i>	Yellow Hawkhead

	<i>Tricholine spathulata</i>	Native Gerbera
	* <i>Ursinia anthemoides</i>	Ursinia
Boraginaceae	* <i>Echium plantagineum</i>	Paterson's Curse
Brassicaceae	* <i>Raphanus raphanistrum</i>	Wild Radish
Caesalpiniaceae	<i>Labichea punctata</i>	
Campanulaceae	<i>Wahlenbergia preissii</i>	
Caryophyllaceae	* <i>Cerastium glomeratum</i>	Mouse Ear Chickweed
Casuarinaceae	<i>Allocasuarina fraseriana</i>	Fraser's Sheoak
	<i>Allocasuarina humilis</i>	Dwarf Sheoak
Centrolepidaceae	<i>Centrolepis aristata</i>	Dwarf Sedge
	<i>Centrolepis drummondiana</i>	Dwarf Sedge
Colchicaceae	<i>Burchardia umbellata</i>	Milkmaids
Convolvulaceae	* <i>Ipomoea indica</i>	Morning Glory
Cyperaceae	<i>Chorizandra enodis</i>	Black Bristle-rush
	* <i>Cyperus tenellus</i>	Tiny Flat Sedge
	<i>Isolepis marginata</i>	Club Rush
	<i>Lepidosperma angustatum</i>	Square Sedge
	<i>Lepidosperma ?scabrum</i>	Sword Sedge
	<i>Lepidosperma sp A</i>	Sword Sedge
	<i>Lepidosperma sp B aff squamatum</i>	Sword Sedge
	<i>Lepidosperma sp type I</i>	Sword Sedge
	<i>Lepidosperma sp type J</i>	Sword Sedge
	<i>Lepidosperma sp type N</i>	Sword Sedge
	<i>Mesomelaena pseudostygia</i>	Sedge
	<i>Mesomelaena tetragona</i>	Semaphore Sedge
	<i>Schoenus grammatophylla</i>	
	<i>Schoenus nanus</i>	Tiny Bog Rush
	<i>Schoenus odontocarpus</i>	
	<i>Tetraria capillaris</i>	Hair Sedge
	<i>Tetraria octandra</i>	Eight Anthered Sedge
Dasyogonaceae	<i>Kingia australis</i>	Kingia
	<i>Lomandra brittanii</i>	Grass Mat Rush
	<i>Lomandra caespitosa</i>	Tuffed Mat Rush
	<i>Lomandra hermaphrodita</i>	Curly leafed Mat Rush
	<i>Lomandra micrantha</i>	Small Flower Mat Rush
	<i>Lomandra nigricans</i>	Mat Rush
	<i>Lomandra orora</i>	Tiered Mat Rush
	<i>Lomandra preissii</i>	Preiss's Mat Rush
	<i>Lomandra suaveolens</i>	Mat Rush
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken Fern
Dilleniaceae	<i>Hibbertia acerosa</i>	Needle Leafed Guinea Flower
	<i>Hibbertia aff glomerata</i>	Buttercup
	<i>Hibbertia amplexicaulis</i>	Buttercup
	<i>Hibbertia aurea</i>	Golden Buttercup
	<i>Hibbertia commutata</i>	Buttercup
	<i>Hibbertia huegelii</i>	Buttercup
	<i>Hibbertia hypercoides</i>	Yellow Buttercup
	<i>Hibbertia ovata</i>	Buttercup

Droseraceae	<i>Drosera erythrorhiza</i> <i>Drosera macrantha</i> <i>Drosera menziesii</i> <i>Drosera microphylla</i> <i>Drosera pallida</i>	Red Ink Sundew Bridal Rainbow Pink Rainbow Golden Rainbow Pale Rainbow
Epacridaceae	<i>Andersonia lehmanniana</i> <i>Astroloma ciliatum</i> <i>Astroloma pallidum</i> <i>Leucopogon capitellatus</i> <i>Leucopogon gracillimus</i> <i>Leucopogon pulchellus</i> <i>Styphelia tenuiflora</i>	Moss-leaved Heath Kickbush Fluffy Flowers Heath Beard Heath Common Pin Heath
Euphorbiaceae	<i>Phyllanthus calycinus</i>	False Boronia
Gentianaceae	* <i>Centaurium erythraea</i> * <i>Cicendia filiformis</i>	Common Centaury Slender Cicendia
Goodeniaceae	<i>Dampiera alata</i> <i>Dampiera coronata</i> <i>Dampiera linearis</i> <i>Goodenia caerulea</i> <i>Lechenaultia biloba</i> <i>Scaevola calliptera</i> <i>Scaevola pilosa</i> <i>Scaevola platyphylla</i>	Winged-stem Damperia  Common Dampiera  Blue Leschenaultia Royal Robe  Fan Flower
Haemodoraceae	<i>Angiozanthos manglesii</i>  <i>Conostylis aculeata</i> <i>Conostylis aculeata subsp preissii</i> <i>Conostylis candicans</i> <i>Conostylis setigera subsp setigera</i> <i>Conostylis setosa</i> <i>Haemodorum discolor</i> <i>Haemodorum laxum</i> <i>Haemodorum paniculatum</i> <i>Haemodorum simplex</i> <i>Tribonanthes sp</i>	Red and Green Kangaroo Paw  Prickly Conostylis Cats Paws Grey Cottonhead Bristly Cottonhead White Cottonhead Bloodroot Broad leafed Haemodorum Strap leafed Haemodorum Scented Haemodorum White Trionanthes
Haloragaceae	<i>Gonocarpus cordiger</i>	
Hypoxidaceae	<i>Hypoxis occidentalis</i>	Yellow Star
Iridaceae	* <i>Freesia affin leichtlinii</i> * <i>Freesia sp</i> <i>Orthrosanthus laxus</i> <i>Patersonia juncea</i> <i>Patersonia occidentalis</i> <i>Patersonia pygmaea</i> * <i>Romulea rosea var australis</i> * <i>Watsonia bulbifera</i>	Freesia Freesia Morning Iris Rush Leafed Patersonia Purple Flag Dwarf Patersonia Guildford Grass Watsonia, Bugle Lily
Juncaginaceae	<i>Juncus bufonius</i> * <i>Juncus capitatus</i> <i>Luzula meridionalis</i>	Toad Rush  Field Woodrush
Lamiaceae	<i>Hemigenia ramosissima</i> <i>Cassytha pomiformis</i> <i>Cassytha racemosa</i>	 Dodder Laurel Dodder Laurel
Linaceae	* <i>Linum trigynum</i>	French Flax

Lobeliaceae	<i>Isotoma hypocraetiformis</i> <i>Lobelia heterophylla</i> <i>Lobelia rhombifolia</i>	Woodbridge Poison
Loranthaceae	<i>Amyema miquelii</i> <i>Nuytsia florabunda</i>	Stalked Mistletoe Christmas Tree
Mimosaceae	<i>Acacia barbinervis</i> <i>Acacia dentifera</i> <i>Acacia lateritcola</i> <i>Acacia pulchella</i> <i>Acacia pulchella var pulchella</i> <i>Acacia teretifolia</i> <i>Acacia urophylla</i>	Wattle Toothed Wattle Wattle Prickly Moses Prickly Moses Wattle Net leafed Wattle
Myrtaceae	<i>Baeckea camphorosmae</i> <i>Calothamnus quadrifidus</i> <i>Calothamnus rupestris</i> <i>Darwinia citriodora</i> <i>Corymbia calophylla</i> <i>Eucalyptus marginata</i> <i>Eucalyptus rudis</i> <i>Eucalyptus wandoo</i> <i>Hypocalymma angustifolium</i> <i>Hypocalymma robustum</i> <i>Leptospermum erubescens</i> <i>Melaleuca lateritia</i> <i>Melaleuca radula</i> <i>Melaleuca raphiophylla</i> <i>Melaleuca scabra</i>	Camphor Myrtle One Sided Bottlebrush Mouse Ears Lemon Scented Darwinia Marri Jarrah Flooded Gum Wandoo Myrtle Swan River Myrtle Roadside Tea Tree Robin Redbreast Bush Graceful Honeymyrtle Swamp Paperbark Rough Honeymyrtle
Orchidaceae	<i>Burnettia nigricans</i> <i>Caladenia deformis</i> <i>Caladenia flava</i> <i>Caladenia flava subsp flava</i> <i>Caladenia longicauda</i>  <i>Caladenia longicauda subsp longicauda</i> <i>Caladenia longiclavata</i> <i>Caladenia marginata</i> <i>Cyanicula sericea</i> <i>Diuris corymbosa</i> <i>Diuris longifolia</i> <i>Elythranthera brunonis</i> <i>Lyperanthus serratus</i> <i>Microtis alba</i> <i>*Monadenia bracteata</i> <i>Prasophyllum brownii</i> <i>Prasophyllum elatum</i> <i>Pterostylis fatua</i> <i>Pterostylis recurva</i> <i>Pterostylis sauguinea</i> <i>Thelymitra crinita</i> <i>Thelymitra stellata</i>	Red Beaks Blue Fairy Orchid Cowslip Orchid Cowslip Orchid Common White Spider Orchid Common White Spider Orchid Clubbed Spider Orchid White Fairy Orchid Silky Blue Orchid Common Donkey Orchid Donkey Orchid Purple Enamel Orchid Rattle Beak Orchid White Mignonette Brown Fingure Orchid Brown's Leek Orchid Tall Leek Orchid Bird Orchid Jug Orchid Dark Banded Greenhood Blue Lady Orchid Sun Orchid
Orobanchaceae	* <i>Orobanche minor</i>	Lesser Broomrape
Oxalidaceae	<i>Oxalis perennans</i>	
Papilionaceae	<i>Bossiaea ornata</i> <i>Bossiaea pulchella</i>	Broad Leafed Brown Pea

	<i>Bossiaea</i> sp Wandoo	
	<i>Chorizema dicksonii</i>	Yellow eyed Flame Pea
	* <i>Cytisus proliferus</i>	Tree Lucerne, Tagasaste
	<i>Daviesia decurrens</i>	Prickly Bitter Pea
	<i>Daviesia horrida</i>	
	<i>Daviesia preissii</i>	
	<i>Daviesia rhombifolia</i>	
	<i>Gastrolobium spinosum</i>	Prickly Poison
	<i>Gompholobium knightianum</i>	
	<i>Gompholobium marginatum</i>	
	<i>Gompholobium polymorphum</i>	Variable Gompholobium
	<i>Gompholobium preissii</i>	
	<i>Hovea chorizemifolia</i>	Holly leafed Hovea
	<i>Jacksonia alata</i>	
	<i>Jacksonia condensata</i>	
	<i>Kennedia coccinea</i>	Coral Vine
	<i>Kennedia prostrata</i>	Red Runner, Running Postman
	* <i>Lotus angustissimus</i>	Narrow leafed Trefoil
	* <i>Lupinus cosentinii</i>	Sandplain Lupin
	<i>Nemcia capitata</i>	Bacon and Eggs
	<i>Sphaerolobium medium</i>	
	* <i>Trifolium campestre</i>	Hop Clover
	* <i>Trifolium dubium</i>	Suckling Clover
	* <i>Trifolium scabrum</i>	Rough Clover
	<i>Viminaria juncea</i>	Native Broom, Swish Bush
Philydraceae	<i>Philydrella pygmaea</i> subsp <i>pygmaea</i>	Butterfly Plant
Phormiaceae	<i>Dianella revoluta</i>	Spreading Flax-lily
	<i>Stypandra gluaca</i>	Blind Grass
Pittosporaceae	<i>Pronaya fraseri</i>	Elegant Pronaya
Poaceae	<i>Agrostis avenacea</i>	Blowngrass
	* <i>Aira caryophyllaea</i>	Silvery Hairgrass
	<i>Amphipogon strictus</i>	Greybeard Grass
	<i>Amphipogon turbinatus</i>	
	<i>Austrodanthonia occidentalis</i>	Wallaby Grass
	<i>Austrodanthonia setacea</i>	Smallflower Wallaby Grass
	<i>Austrostipa campylachne</i>	Speargrass
	<i>Austrostipa compressa</i>	Compact Needle Grass
	* <i>Avena fatua</i>	Wild Oats
	* <i>Briza maxima</i>	Blowfly Grass
	* <i>Briza minor</i>	Shivery Grass
	* <i>Lolium multiflorum</i>	Rye Grass
	<i>Microlaena stipoides</i>	Weeping Grass
	<i>Neurachne alopecurodea</i>	Foxtail Mulga Grass
	* <i>Poa annua</i>	Winter Grass
	<i>Poa drummondiana</i>	Knotted Poa
	* <i>Rhynchelytrum repens</i>	Red Natal Grass
	<i>Tetrarrhena laevis</i>	Forest Rice Grass
	* <i>Vulpia bromoides</i>	Squirrel Tail Fescue
	* <i>Vulpia myuros</i>	Rat's Tail Fescue
Polygalaceae	<i>Comesperma calymega</i>	Blue-spike Milkwort
	<i>Comesperma ciliatum</i>	Love Creeper
	<i>Comesperma virgatum</i>	Milkwort
Primulaceae	* <i>Anagallis arvensis</i>	Scarlet or Blue Pimpernel
Proteaceae	<i>Adenanthos barbigerus</i>	Hairy Jug Flower
	<i>Banksia grandis</i>	Bull Banksia

	<i>Conospermum stoechadis</i>	Common Smokebush
	<i>Dryandra bipinnatifida</i>	Ground Grevillia
	<i>Dryandra lindleyana</i>	
	<i>Dryandra lindleyana var lindleyana</i>	
	<i>Dryandra nivea</i>	Couch Honeypot
	<i>Dryandra pilulifera</i>	
	<i>Dryandra praemorsa</i>	Holly Leaf Dryandra
	<i>Dryandra sessilis</i>	Parrot Bush
	<i>Dryandra synapheae</i>	
	<i>Grevillea bipinnatifida</i>	Fushsia Grevillea
	<i>Grevillea quercifolia</i>	Oak leaved Grevillia
	<i>Grevillea synapheae</i>	Grevillea
	<i>Grevillea wilsonii</i>	Wilson's Grevillea
	<i>Hakea amplexicaulis</i>	Prickly Hakea
	<i>Hakea cristata</i>	Snail Hakea
	<i>Hakea erinacea</i>	Hedgehog Hakea
	<i>Hakea lissocarpa</i>	Honey Bush
	<i>Hakea stenocarpa</i>	Narrow Fruited Hakea
	<i>Hakea trifurcata</i>	Hakea
	<i>Hakea undulata</i>	Cut Leaf Hakea
	<i>Isopogon dubius</i>	Isopogon
	<i>Isopogon sphaerocephalus</i>	Drumstick Isopogon
	<i>Persoonia elliptica</i>	Spreading Snottygooble
	<i>Persoonia longifolia</i>	Snottygooble
	<i>Petrophile striata</i>	
	<i>Synaphea gracillima</i>	
	<i>Synaphea petiolaris</i>	Synaphea
Ranunculaceae	<i>Clematis pubescens</i>	Western Clematis
Restionaceae	<i>Desmocladus asper</i>	
Rhamnaceae	<i>Cryptandra arbutiflora</i>	
	<i>Trymalium ledifolium</i>	Trymalium
	<i>Trymalium leditolum var rosmanifolium</i>	
Rubiaceae	<i>Opercularia apiciflora</i>	
	<i>Opercularia echinocephala</i>	Bristle Headed Stinkweed
	<i>Opercularia vaginata</i>	Dog Weed
Rutaceae	<i>Eriostemon spicatus</i>	Pepper and Salt
Scrophulariaceae	* <i>Bellardia trixago</i>	Bellardia
	* <i>Parentucellia latifolia</i>	Common Bartsia
	* <i>Parentucellia viscosa</i>	Sticky Bartsia
Solanaceae	* <i>Solanum nigrum</i>	Backberry Nightshade
Stackhousiaceae	<i>Tripterococcus brunonis</i>	Yellow Candles
Sterculiaceae	<i>Thomasia foliosa</i>	
Stylidiaceae	<i>Levenhookia pusilla</i>	Midget Stylewort
	<i>Levenhookia stipitata</i>	Common Stylewort
	<i>Stylidium amoenum</i>	Lovely Triggerplant
	<i>Stylidium breviscapum</i>	Boomerang Triggerplant
	<i>Stylidium brunonianum</i>	Pink Fountain Triggerplant
	<i>Stylidium bulbiferum</i>	Circus Triggerplant
	<i>Stylidium calcaratum</i>	Book Triggerplant
	<i>Stylidium dichotimum</i>	Pins and Needles
	<i>Stylidium diuroides</i>	Donkey Triggerplant
	<i>Stylidium elongatum</i>	Tall Triggerplant
	<i>Stylidium hispidum</i>	White Butterfly Triggerplant

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	<i>Stylidium juncea</i>	Reed Triggerplant
	<i>Stylidium piliferum</i>	Common Butterfly Triggerplant
	<i>Stylidium pycnostachyum</i>	Downy Triggerplant
	<i>Stylidium rigidifolium</i>	Stiff-leaved Triggerplant
	<i>Stylidium shoenooides</i>	Cow Kicks
Thymelaeaceae	<i>Pimelea ciliata</i>	White Banjine
	<i>Pimelea imbricata var piligera</i>	Banjine
	<i>Pimelea suaveolens</i>	Scented Banjine
Tremandraceae	<i>Tetradthea hirsute</i>	Black Eyed Susan
	<i>Tetradthea setigera</i>	
Verbenaceae	* <i>Lantana camara</i>	Lantana
Violaceae	<i>Hybanthus calycinus</i>	Wild Violet
Xanthorrhoeaceae	<i>Xanthorrhoea gracilis</i>	Slender Blackboy
	<i>Xanthorrhoea preissii</i>	Blackboy, Grass Tree, Balga
Zamiaceae	<i>Macrozamia riedlei</i>	Zamia Palm



# Appendix Two: Fungi Species List

## Armadale Settlers Common Strategic Directions

Fungus	Habitat	Life Mode
<i>Amanita umbrinella</i>	litter/ground	M
<i>Amanita xanthocephala</i>	litter/ground	M
<i>Agaricus sp. A (unidentified)</i>	litter/ground	S
<i>Amanita sp. B (unidentified)</i>	litter/ground	M
<i>Amanita sp. C (unidentified)</i>	litter/ground	M
<i>Boletellus obscurecoccineus</i>	litter/ground	M
<i>Boletus prolinus group</i>	litter/ground	M
<i>Boletus sp.</i>	Litter/ground	M
<i>Calocera sp.</i>	Dead wood	S
<i>Coltriciella dependans</i>	dead wood	S
<i>Cortinarius basirubescens</i>	litter/ground	M
<i>Cortinarius sp (lilac stem, subgenus Phlegmacium)</i>	litter/ground	M
<i>Cup fungi on faeces</i>	faecal pellets	S
<i>Galerina unicolor</i>	litter/ground/moss	S
<i>Hebeloma westraliense</i>	litter/ground	M
<i>Heterotextus peziziformis</i>	dead wood	S
<i>Lepiota sp.</i>	Litter/ground	S
<i>Leptonia incana</i>	litter/ground	S
<i>Lycoperdon sp.</i>	Litter/ground	S
<i>Mycena sp.</i>	Dead wood	S
<i>Pisolithus sp. (yellow peridium, small size)</i>	litter/ground	M
<i>Pycnoporus coccineus</i>	dead wood	M
<i>Ramaria ochraceosalmonicolor</i>	litter/ground	M
<i>Ramaria sp. (white)</i>	litter/ground	M
<i>Ramaria sp. (yellow)</i>	litter/ground	M
<i>Russula flocktonae</i>	litter/ground	M
<i>Sepedonium parasitising a Boletus</i>	other fungi	P
<i>Trametes lilacino-gilva</i>	dead wood	S
<i>Tricholoma eucalypticum</i>	litter/ground	M
<i>Tricholoma eucalypticum</i>	litter/ground	M
<i>Tricholoma sp.</i>	Litter/ground	M
<i>Truffle species A (unidentified)</i>	litter/ground	M
<i>Truffle species B (unidentified)</i>	litter/ground	M

S = saprotrophic (decomposer); M = mycorrhizal; P = parasitic

The fungi table was collated from information from Dr Neale Bougher, CSIRO. Fungi were collected from the Armadale Settlers Common on 20th June 1999. Sampling was undertaken at AMG 409750E 6441500N

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# Appendix Three: Fauna Species List

## Armadale Settlers Common Strategic Directions

### Phylum Arthropoda

Class	Order	Family	Scientific Name	Common Name	
Insecta	Coleoptera	Carabidae	<i>Notonomus mediosulcatus</i>		
		Chrysomelidae	<i>Ditropidus fugitivus</i> <i>Paropsis semifumata</i>		
		Cleridae	<i>Eleale aulicodes</i>		
		Coccinellidae	<i>Harmonia conformis</i>		
		Curculionidae	<i>Ethemaia sellata</i> <i>Meriphys sp</i> <i>Otirhynchus cribricollis</i> <i>Rhinoplethes foveatus</i>		
		Dermestidae	<i>Orphinus sp</i>		
		Dytiscidae	<i>Necterosoma sp</i> <i>Platynectes decempunctatus</i> <i>Platynectes sp</i> <i>Rhantus suturalis</i> <i>Sternopriscus browni</i>		
		Elateridae	<i>Crepidomenus sp</i>		
		Geotrupidae	<i>Stenaspidius nigricornis</i>		
		Histeridae	<i>Saprinus australis</i>		
		Hydrophilidae	<i>Hydratotrepes sp</i>		
		Lucanidae	<i>Lamprima varians</i>		
		Scarabaeidae	<i>Aphodius frenchi</i> <i>Onthophagus haagi</i> <i>Phyllotocus ustulatus</i>		
		Silphidae	<i>Ptomaphila lachrymosa</i>		
		Tenebrionidae	<i>Helaeus perforatus</i> <i>Lagria aneoviolaecae</i>		
		Diptera	Bibionidae	<i>Dilophus tricuspidatus</i>	
			Drosophilidae	<i>Drosophila sp</i>	
			Tephritidae	<i>Ceratitus capitata</i> <i>Dacus newmani</i>	
			Asilidae	<i>Mauropteron pelago</i> <i>Neosaropogon sp</i> <i>Neoscleropogon sp</i> <i>Stenopogon sp</i>	
			Tababidae	<i>Polychaeta sp</i> <i>Scaptia gemina</i> <i>Scaptia singularis</i> <i>Sturmia convergens</i>	
	Cuicidae		<i>Aedeo alboannulatus</i> <i>Culex quinquefasciatus</i>		
	Hemiptera		Corixidae	<i>Agraptocorixa sp</i> <i>Diaprepotis personata</i>	
		Gelastocoridae	<i>Mononyx tuberculatus</i>		
		Gerridae	<i>Limnogonus fossarum skusei</i> <i>Limnogonus sp</i>		
		Lygaeidae	<i>Spilostethus pacificus</i>		
		Pentatomidae	<i>Kapunda sp</i> <i>Poecilmetis lineatus</i>		

Class	Order	Family	Scientific Name	Common Name
		Reduviidae	<i>Gminatus sp</i> <i>Ptilocnemus lineatus</i>	
	Homoptera	Cicadellidae	<i>Putoniessa sordida</i>	
		Cicadidae	<i>Cicadetta sp</i>	
	Hymenoptera	Colletidae	<i>Leioproctus sp</i>	
		Encyrtidae	<i>Litomastic truncatellus</i>	
		Scoliidae	<i>Scolia anthracina</i>	
		Braconidae	<i>Cotesia ruficrus</i> <i>Rogas sp</i>	
		Halictidae	<i>Lasioglossum mirandum</i> <i>Lasioglossum sp</i>	
		Ichneumonidae	<i>Ichneumon sp</i> <i>Netelia sp</i>	
		Sphecidae	<i>Ammophila instabilis</i>	
		Vespidae	<i>Paralator sp</i>	
	Lepidoptera	Hesperiidae	<i>Anisynta sphenosema</i> <i>Antipodia dactyliota anaces</i> <i>Antipodia dactyliota anapus</i> <i>Croitana croites</i> <i>Exometoeca nycteris</i> <i>Hesperilla chrysotricha chrysotricha</i> <i>Hesperilla donnyssa albina</i> <i>Mesodina cyanophracta</i> <i>Motasingha dirphia</i> <i>Motasingha trimaculata occidentalis</i> <i>Taractrocera papyria papyria</i> <i>Trapezites argenteoornatus argenteoornatus</i> <i>Trapezites sciron sciron</i>	Wedge Skipper  Croites Skipper Western Flat Golden Haired Skipper Donnyssa Skipper Cyanophracta Skipper Dirphia Skipper Western Three-spotted Skipper Western Grass Dart Silver-spotted Skipper Sciron Skipper
		Lycaenidae	<i>Acrodipsas brisbanensis brisbanensis</i> <i>Candalides acastus</i> <i>Candalides cyprotus cyprotus</i> <i>Candalides heathi heathi</i> <i>Candalides hyacinthinus simplex</i> <i>Hypochrysops halyaetus</i> <i>Jalmenus icilius</i> <i>Jalmenus inous</i> <i>Lampides boeticus</i> <i>Nacaduba biocellata biocellata</i> <i>Neolucia agricola occidens</i> <i>Ogyris amaryllis meridionalis</i> <i>Ogyris idmo idmo</i> <i>Ogyris oroetes apiculata</i> <i>Theclinestes hisperia hisperia</i> <i>Theclinestes miskini miskini</i> <i>Theclinestes serpentata serpentata</i> <i>Zizina labradus labradus</i>	Large Ant-blue Blotched Blue Cyprotus Blue Rayed Blue Common Dusky Blue Western Jewel Icilius Blue Inous Blue Pea Blue Double Spotted Lineblue Fringed Blue Amaryllis Azure Large Brown Azure Silky Azure Western Blue Miskin's Blue Chequered Blue Common Grass Blue
		Nymphalidae	<i>Danaus chrysippus petilia</i> <i>*Danaus plexippus plexippus</i> <i>Geitoneura minyas</i> <i>Heteronympha merope duboulayi</i> <i>Heteronympha merope duboulayi</i> <i>Junonia villida calybe</i> <i>Vanessa itea</i> <i>Vanessa kershawi</i>	Lesser Wanderer Wanderer Western Xenica  Western Brown Meadow Argus Australian Admiral Australian Painted Lady
		Papilionidae	<i>Papilio demoleus sthenelus</i>	Chequered Swallowtail
		Pieridae	<i>Anapheris java</i> <i>Delius aganippe</i> <i>Eurema smilax</i> <i>*Pieris rapae rapae</i>	Caper White Wood White Small Grass Yellow Cabbage White
	Odonata	Aeshnidae	<i>Acanthaeschna anacatha</i>	
		Libellulidae	<i>Diplacodes bipunctata</i> <i>Orthetrum caledonicum</i>	
		Margarodidae	<i>Callipappus australe</i>	
		Megapodagrionidae	<i>Argiolestes minimus</i>	

## Appendix Three

Class	Order	Family	Scientific Name	Common Name
	Orthoptera	Acrididae	<i>Acrida conica</i> <i>Cirphulia carbonaria</i> <i>Gastrimargus musicus</i> <i>Goniaea sp</i> <i>Locusta migratoria</i>	
		Blattellidae	<i>Ellipsidon occidentalum</i>	
		Blattidae	<i>Cutilia concolora</i> <i>Platyzozeria morosa</i>	

## Phylum Chordata (Vertebrata)

Class	Order	Family	Scientific Name	Common Name	Status	
Amphibia	Salienta	Hylidae	<i>Litoria adelaidensis</i>	Tree Frog	+P	
			<i>Litoria moorei</i>	Tree Frog	@P	
		Myobatrachidae	<i>Crinia georgiana</i>	Red-Thighed Froglet	@P	
			<i>Crinia glauerti</i>	Glauert's Froglet	+P	
			<i>Crinia pseudinsignifera</i>	Granite Froglet	+P	
			<i>Geocrinia leai</i>	Green-Bellied Froglet	+P	
			<i>Heleioporus albopunctatus</i>	Spotted Burrowing Frog	+P	
			<i>Heleioporus barycragus</i>	Yellow Flanked Burrowing Frog	+P	
			<i>Heleioporus eyrei</i>		+P	
			<i>Heleioporus inornatus</i>		+P	
			<i>Heleioporus psammophilus</i>	Marbled Burrowing Frog	+P	
			<i>Limnodynastes dorsalis</i>	Western Banjo Frog, Pobblebonk	+P	
			<i>Neobatrachus pelobatoides</i>	Humming Frog	+P	
		<i>Pseudophryne guentheri</i>	Guenther's Toadlet	+P		
	Aves	Accipitriformes	Falconidae	<i>Falco berigora</i>	Brown Falcon	+P
				<i>Falco hypoleucos</i>	Grey Falcon	+P
		Anseriformes	Anatidae	<i>Anas castanea</i>	Chestnut Teal	+P
<i>Anas gibberifrons</i>				Grey Teal	+P	
<i>Tadorna tadornoides</i>				Australian Shelduck	+P	
Ardeiformes		Ardeidae	<i>Ardea novaehollandiae</i>	White-faced Heron	@P	
Columbiformes		Columbidae	<i>Phaps elegans</i>	Brush Bronzewing	+P	
Coraciiformes		Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	@P	
			<i>Halcyon sancta</i>	Sacred Kingfisher	@P	
Cuculiformes		Cuculidae	<i>Cacomantis pyrrhopterus</i>		+P	
			<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo	@P	
			<i>Chrysococcyx malayanus</i>	Little Bronze-Cuckoo	@P	
			<i>Cuculus pallidus</i>	Pallid Cuckoo	@P	
			<i>Lamprococcyx plagosus</i>		+P	
Gruiformes		Rallidae	<i>Porzana tabuensis</i>	Spotless Crake	+P	
Passeriformes		Acanthizidae	<i>Acanthiza apicalis</i>	Inland Thornbill		
			<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	+P	
			<i>Acanthiza inornata</i>	Western Thornbill		
			<i>Gerygone fusca</i>	Western Gerygone		
			<i>Smicrornis brevirostris</i>	Weebill	@P	
			Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	@P
			Corvidae	<i>Corvus coronoides</i>	Australian Raven	@P
			Cracticidae	<i>Cracticus torquatus</i>	Grey Butcherbird	@P
				<i>Gymnorhina tibicen</i>	Australian Magpie	@P
			Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	@P
			Grallinidae	<i>Grallina cyanoleuca</i>	Australian Magpie Lark	@P
			Maluridae	<i>Malurus elegans</i>	Red-winged Wren	+P
				<i>Malurus splendens</i>	Splendid Wren	@P
			Meliphagidae	<i>Acanthorhynchus superciliosus</i>	Western Spinebill	@P
				<i>Anthochaera carunculata</i>	Red Wattlebird	@P
			<i>Anthochaera chrysoptera</i>	Little Wattlebird	@P	
			<i>Melithreptus lunatus</i>	White-naped Honeyeater	+P	
		<i>Phylidonyris albifrons</i>	White-fronted Honeyeater	@P		
		<i>Phylidonyris nigra</i>	White-cheeked Honeyeater	@P		
		<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	@P		

Class	Order	Family	Scientific Name	Common Name	Status
		Pachycephalidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin	+P
			<i>Eopsaltria griseogularis</i>	Western Yellow Robin	@P
			<i>Pachycephala pectoralis</i>	Golden Whistler	@P
			<i>Pachycephala rufiventris</i>	Rufous Whistler	@P
			<i>Petroica goodenovii</i>	Red-capped Robin	@P
			<i>Petroica multicolor</i>	Scarlet Robin	@P
			<i>Rhipidura fuliginosa</i>	Grey Fantail	@P
			<i>Rhipidura leucophrys</i>	Willie Wagtail	@P
		Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	@P
			<i>Pardalotus striatus</i>	Striated Pardalote	@P
			<i>Pardalotus substriatus</i>	Pardalote	+P
		Passeridae	<i>Zonaeginthus ocellatus</i>		+P
		Ploceidae	<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin	@P
		Zosteropidae	<i>Zosterops lateralis</i>	Silvereeye	@P
	Psittaciformes	Psittacidae	<i>Barnardius zonarius</i>	Port Lincoln Ringneck	@P
			<i>Cacatua roseicapilla</i>	Galah	@P
			<i>Calyptorhynchus banksii</i>	Forest Redtailed Black Cockatoo	@P4
			<i>Calyptorhynchus baudinii</i>	White-tailed Black-Cockatoo	@T
			<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	@T
			<i>Neophema elegans</i>	Elegant Parrot	@P
			<i>Platycercus icterotis</i>	Western Rosella	@P
			<i>Purpurecephalus spurius</i>	Red-capped Parrot	@P
	Strigiformes	Strigidae	<i>Ninox connivens</i>	Barking Owl	@P
Mammalia	Carnivora	Canidae	* <i>Canis familiaris</i>	Feral Dog	+P
			* <i>Vulpes vulpes</i>	Fox	+F
		Felidae	* <i>Felis catus</i>	Cat	+F
	Lagomorpha	Leporidae	* <i>Oryctolagus cuniculus</i>	Rabbit	@F
	Rodentia	Muridae	<i>Hydromys chrysogaster</i>	Water Rat	+P4
			* <i>Mus musculus</i>	House Mouse	+F
			* <i>Rattus rattus</i>	Black Rat	+F
	Chiroptera	Molossidae	<i>Mormopterus planiceps</i>	Little Mastiff-bat	+P
			<i>Nyctinomus australis</i>	Mastiff Bat	+P
		Vespertilionidae	<i>Vespertilio regulus</i>	Bat	+P
	Diprotodonta	Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo	@P
			<i>Macropus irma</i>	Western Brush Wallaby	@P4
			<i>Setonix brachyurus</i>	Quokka	-T
		Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	@P
		Tarsipedidae	<i>Tarsipes rostratus</i>	Honey Possum	@P
	Polyprotodonta	Dasyuridae	<i>Antechinus flavipes</i>	Mardo	@P
			<i>Dasyurus geoffroi</i>	Western Quoll	+T
			<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	+P3
			<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart	+P
			<i>Sminthopsis gilberti</i>	Gilbert's Dunnart	+P
			<i>Sminthopsis murina</i>	Common Dunnart	@P
		Myrmecobiidae	<i>Myrmecobius fasciatus</i>	Numbat	-T
		Peramelidae	<i>Isodon obesulus fusciventer</i>	Quenda	@P4
	Monotremata	Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	@P
Reptilia	Chelonia	Chelidae	<i>Chelodina oblonga</i>		+P
	Squamata	Agamidae	<i>Ctenophorus ornatus</i>	Ornate Crevice Dragon	+P
			<i>Pogona minor</i>	Western Bearded Dragon	+P
		Gekkonidae	<i>Crenadactylus ocellatus</i>	Gecko	+P
			<i>Diplodactylus granariensis</i>	Gecko	+P
			<i>Diplodactylus polyophthalmus</i>	Gecko	+P
			<i>Gehyra variegata</i>	Gecko	+P
			<i>Oedura reticulata</i>	Gecko	+P
			<i>Strophurus spinigerus</i>	South-Western Spiny Tailed Gecko	+P
			<i>Underwoodisaurus milii</i>	Gecko	+P
		Pygopodidae	<i>Aprasia pulchella</i>	Western Granite Worm Lizard	+P

## Appendix Three

Class	Order	Family	Scientific Name	Common Name	Status
			<i>Aprasia repens</i>	Lizard	+P
			<i>Lialis burtonis</i>	Burton's Legless Lizard	+P
		Scincidae	<i>Acritoscincus trilineatum</i>		+P
			<i>Bassiana trilineata</i>	South-Western Cool Skink	+P
			<i>Cryptoblepharus plagiocephalus</i>	Fence Lizard, Sun Lizard	@P
			<i>Ctenotus delli</i>	Darling Range Heath Ctenotus	+P
			<i>Ctenotus fallens</i>		+P
			<i>Ctenotus impar</i>	SouthWestern Odd Striped Ctenotus	+P
			<i>Ctenotus labillardieri</i>	Red-Legged Ctenotus	+P
			<i>Egernia kingii</i>	King's Skink	+P
			<i>Egernia napoleonis</i>	Soth-Western Crevice Egernia	+P
			<i>Hemiergis initialis</i>	Southern Five-Toed Earless Skink	+P
			<i>Hemiergis quadrilineata</i>	Two Toed Earless Skink	+P
			<i>Lerista distinguenda</i>	South-Western Four-Toed Lerista	+P
			<i>Lerista lineata</i>		+P
			<i>Menetia greyii</i>	Common Dwarf Skink	+P
			<i>Morethia lineocellata</i>		+P
			<i>Morethia obscura</i>	Southern Pale-Flecked Morethia	+P
			<i>Tiliqua occipitalis</i>	Blue Tongue	@P
			<i>Tiliqua rugosus</i>	Bobtail Shingleback Sleepy Lizard	@P
		Varanidae	<i>Varanus tristis</i>	Black Tailed Monitor	@P
		Boidae	<i>Antaresia stimsoni stimsoni</i>	Stimson's Python	+P
			<i>Morelia spilota</i>	Southern Carpet Python	+P
		Elapidae	<i>Acanthophis antarcticus</i>	Common Death Adder	@P
			<i>Neelaps bimaculatus</i>		+P
			<i>Notechis scutatus</i>	Western Tiger Snake	+P
			<i>Parasuta gouldii</i>		+P
			<i>Parasuta nigriceps</i>		+P
			<i>Pseudechis australis</i>		+P
			<i>Pseudonaja affinis</i>	Dugite, Spotted Brown Snake	@P
			<i>Rhinoplocephalus gouldii</i>	Gould's Hooded Snake	+P
			<i>Rhinoplocephalus nigriceps</i>	Black-Banded Snake	+P
			<i>Simoselaps bertholdi</i>		+P
			<i>Simoselaps semifasciatus</i>	Southern Half-Girdled Snake	+P
		Typhlopidae	<i>Ramphotyphlops australis</i>	Southern Blind Snake	+P
			<i>Ramphotyphlops bituberculatus</i>	Blind Shake	+P
			<i>Ramphotyphlops pinguis</i>	Fat Blind Snake	+P
			<i>Ramphotyphlops waitii</i>	Beaked Blind Snake	+P

The fauna tables have been compiled using information from the records of the WA Museum, WA Dept of Agriculture, Environment Australia, selected publications on regional fauna and confirmed species identification by trapping or other observations.

The records of the WA Museum are © WA Museum 2000

### Key to Status

@	Recorded in the Common
T	Threatened
+	Northern Jarrah Forest Species
P	Protected (includes Priority Species)
-	NJF Species (locally extinct)
F	Feral/Introduced



# Appendix Four: Management Calander

## Armadale Settlers Common Strategic Directions

Month	Management Items	Fire Season	Wildflower Season
January	Planning Meeting Prepare Annual Report		
February	NHT Funding Closes (via BEAC) Review Web Site		
March	Release Annual Report		
April	Site Preparation for Winter Planting		
May	Site Preparation for Winter Planting Reappoint members of ASCMC (Biannually)		
June	New Councillor Tour (Biannually) Prepare Ecotourism event		
July	CoA Budget Announced (July/August) Winter Planting (Seedlings)		
August	Discuss Fire Management requirements (Invite FRS/BVFB) Announce Ecotourism event		
September	Guided Walks (Ecotourism event)		
October	ASCMC to determine Budget Requirements Walk the Common		
November	Submit Budget to Council		
December	BEAC Xmas Meeting		



# Appendix Five: Bradley Method of Weed Control

## Armadale Settlers Common Strategic Directions

The aim of bush regeneration by the Bradley method (Bradley, 1971, 1988) is the systematic removal of weeds to allow native plants to re-establish themselves when and where they choose. This method does not involve replanting – simply the gradual removal of weeds so that no large openings are made. This makes the Bradley method ideal for many situations, such as where native plants are able to colonise the site by seeds or vegetative means, areas sensitive to erosion and areas likely to be over-used.

### UNDERLYING PRINCIPLES

**1. Always work from areas with native plants towards weed-infested areas.**

This makes good ecological sense. If you are relying on natural regeneration then choose areas that will contain the maximum number of existing native plants and native plant seeds, and minimal weed seeds and vegetative reproductive organs of weeds.

**2. Make minimal disturbance.**

Application of this principal depends on the native species to regenerate. Many plant communities (both weeds and native) need disturbed and sunlit soil for successful regeneration. However, by following the 1<sup>st</sup> principle above, any weed regeneration should be minimised. Any soil that is disturbed should be returned in its original layers, thus ensuring that any native seed stored in the soil will still be on top. This principle also applies to the application of natural plant mulch in the work area – where a gap is left as a result of weeding, it is recommended that mulch from surrounding areas be added to the gap. This helps to minimise weed regeneration.

**3. Let native plant regeneration dictate the rate of weed removal.**

The ability to follow this principle may depend on the amount of time and money committed to a particular project. If few weeds and many native plants regenerate, or if the ground remains weed free, little time will need to be spent re-weeding a site, allowing time to be spent on other sites. If masses of weeds regenerate then a lot of time will be required re-weeding so that regenerating native plants can flourish.

### DEVELOPING WORK PLANS

**1. Prevent deterioration of good areas.**

Start by removing weeds scattered through otherwise clean bush. Practically no follow up work will be needed, but it should be checked once or twice a year.

**2. Improve the next best area.**

Once you are confident you have prevented deterioration of better condition bush, you can start work on thicker patches of weed. Choose a place you can visit easily and often, where thick native growth is pushing up against weeds, preferably no worse than one weed species to every two native plant species. Start with a strip approximately 12 feet wide and no longer than can be managed with monthly weeding days. If the area to be cleared of weeds runs up a slope which may erode, clear a number of smaller patches instead.

**3. Hold the advantage gained.**

Resist the temptation to push deeper into the weeds before regenerating natives have stabilised each cleared area. The natives do not need to be very tall, but they usually need to form an almost complete ground cover. Weeds will always nearly keep germinating until this is achieved. These newly regenerated areas are most vulnerable to weed reinvasion and so must be re-weeded as required. If weeding occurs adjacent to the regenerating area prior to sufficient new cover light from adjacent cleared patches can affect the regeneration of natives.

**4. Cautiously move into the really bad areas.**

When new growth coming up consists almost entirely of native plants with only a few weeds among them, it is safe to move deeper into the weeds. Keep working along the regeneration boundary, making new clearings smaller as the weeds get more dense.

**WEEDING TECHNIQUES****1. Disturb the soil as little as possible.**

All tools used for weeding programmes should be small, such as a broad boning knife, trowels, secateurs, pliers (for pulling roots), loppers, hatchet and small saws. This recommendation is based on the belief that using small tools will cause minimum soil disturbance and minimal damage to the roots and shoots of nearby native plants.

**2. Sweep back the mulch surface.**

Any weeding will disturb the ground litter and soil will be exposed. Repair the damage as you go, by pushing back as much mulch as possible. It is often helpful to sweep aside mulch prior to removing large plants, so that it can easily be redistributed when you have finished removing the plant.

**3. Mulch with the weeds themselves.**

Weeds removed can be used to add to existing mulch. In dry areas leaving the weed with its roots exposed will be sufficient to kill it. In moist areas, hanging the weeds on nearby native vegetation will allow them to dry out and die. Some items are unsuitable for mulch, and these are removed from the site. Such items include bulbs and tubers, plants that root at every node and free-seeders with ripe seed.

**4. Watch where you put your feet.**

Be careful how you move through the bush. A small weeding party moving through thick bush single file can open up a track. Efforts should be made to not walk on the same paths all the time, and to watch where you walk to ensure you are not trampling native vegetation.

# **Appendix Six: Management of Rare Flora**

**Armadale Settlers Common Strategic Directions**

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# Appendix Seven: Aboriginal Heritage Sites

## Armadale Settlers Common Strategic Directions

A search of the Aboriginal Sites Register database revealed a registered aboriginal heritage site in the vicinity of the Armadale Settlers Common. This site is Neerigen Brook Camping Area Site No. S2215 (site ID 3715). Neerigen Brook Camping area is located in the angle formed by the bend of Albany Highway as it turns south opposite Triton Crescent. There is the potential for part of this site to occur on or near the Field Study Centre.

A number of Aboriginal families including the Harts and the Nannups lived at the camp from the 1930's to the 1970's, the remains of which can still be seen. The residents moved following a death in the camp and there is a belief among local aborigines that a malignant spirit haunts the western end of the Pioneer Village Complex (O'Conner *et al.*, 1989).

Other Aboriginal Heritage Sites nearby include Neerigen Brook (Site No. S2214) which flows west through Armadale and joins the Wungong Brook less than 100 m south of Armadale Road to form the Southern River. According to legend, Neerigen Brook was formed by the creative actions of the Waugal or Rainbow Serpent, who still inhabits it and sustains flow of water to the brook (O'Conner *et al.*, 1989). It should be noted that the upper reaches of Neerigen Brook flow through the Armadale Settlers Common.

Before work is conducted in the vicinity of any of these sites, certain obligations are required. These are outlined in Section 6.10.3

The Department of Indigenous affairs do not wish the locations of Registered Aboriginal Heritage Sites to be made public without specific approval. This appendix should not be included in public versions of this Management Plan.

# Appendix Eight: Linkages and Wildlife Corridors

## Armadale Settlers Common Strategic Directions

This section has been removed from the public document pending the completion of revisions to the Town Planning Scheme for the City of Armadale (TPS 4). Upon completion of this scheme it should be reinserted into the Fauna Management Section of the Report.

### ***Linkages and Wildlife Corridors***

While Armadale Settlers Common is a large reserve surrounded by other large patches of remnant bushland, there are limited linkages between them. The largest section of Armadale Settlers Common is completely bordered by roads and there are also extensive areas of cleared land bordering the Common. These are significant barriers to the movement of animals as this cleared open land does not provide adequate cover through which animals can move. The Common can essentially be regarded as an island in this respect.

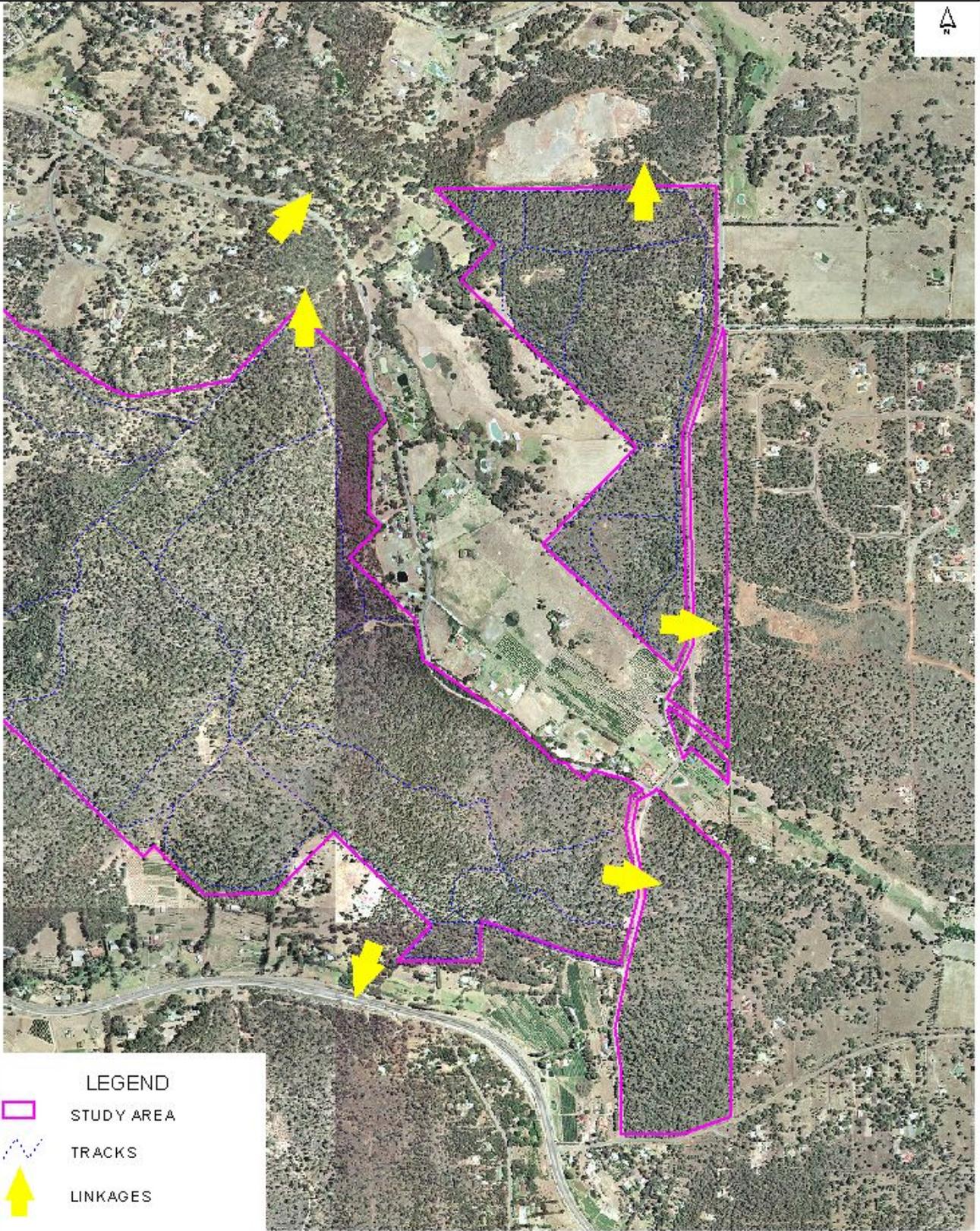
It is therefore important to provide areas of adequate cover through which animals can move. While the best linkages consist of remnant vegetation, it is sometimes possible to create areas through which some animals can move. For example, fauna underpasses are often constructed where major roads intersect significant areas of remnant vegetation, and brushing can sometimes be used to provide cover over short distances.

There are presently limited opportunities for wildlife movement in and out of the Common, although there are some potential areas for wildlife movement (See map next page). These areas are:

- two blocks of relatively uncleared private land linking Armadale Settlers Common with Bungendore Park with subsequent unbroken linkages to the Wungong Reservoir Catchment Area and State Forest;
- across Canns Road below its intersection with Carradine Road to a large area of undeveloped private land; and
- across Canns Road above its intersection with Carradine Road to a large extent of undeveloped private land with subsequent unbroken linkages to the Churchman Brook Catchment Area and State Forest.

These identified areas should be protected as much as is possible and taken into account when making planning decisions affecting these linkages. Access to these linkages should also be facilitated as much as is possible by revegetation if necessary and the provision of cover such as brush and logs. Landowners of habitat linkages around Armadale Settlers Common should be made aware of the value of their land for fauna and encouraged to participate in bushland restoration and habitat supplementation, particularly in 'closing the gaps' between vegetated areas. Landholders participating in this may also be eligible for certain schemes such as 'Land for Wildlife' and conservation covenanting programs that offer financial assistance and benefits.

**Existing Fauna Linkages of Armadale Settlers Common**



- LEGEND**
- STUDY AREA
  - ~ TRACKS
  - ➔ LINKAGES

SCALE 1:15,000

Existing fauna linkages of Armadale Settlers' Common	CLIENT	CITY OF ARMADALE
	PROJECT:	1037
	JOB NO:	1037-3.3
	DATE:	06-08-03

