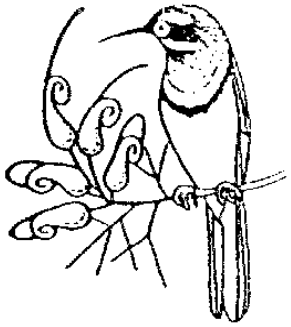
ARMADALE SETTLERS COMMON MANAGEMENT PLAN

CITY OF ARMADALE



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REPORT FOR THE CITY OF ARMADALE

ARMADALE SETTLERS COMMON MANAGEMENT PLAN
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Table of Contents

Armadale Settlers Common Management Plan 2003

LIST OF TABLES

LIST OF FIGURES

Acknowledgments

Armadale Settlers Common Management Plan 2003

There are many people who contributed to the development of this management plan.

First and foremost Brett Tizzard 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 management plan.

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

From the Armadale Settlers Common Management Committee Bob Tizzard and Shirley Hobday should be acknowledged for their contributions.

Other stakeholders that contributed to the Management Plan 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.

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.

While the greater part 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 casued by inappropriate access. Threatening processes include:

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

Due to its size and location, restricting access is difficult. 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 bulbillifera,* pose a large risk to the integrity of the bushland if they are not controlled at an early stage.

From an educational and recreational 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. 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.

Study Area

The Armadale Settlers' Common is located in Bedfordale, 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 Ministry for Planning, as part of its Metropolitan Region Scheme (MRS) reserve acquisition program and currently leased to the City of Armadale.

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 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 reidleii)* 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).

There are also 145 vertebrate fauna species 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 a registered Aboriginal heritage site associated with Armadale Settles 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.

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	Responsibility	Cost	Key Performance Indicator
1.1	Amalgamate FOASC with FSC Inc.	1	FOASC / ASCMC	Operational	Incorporated friends group created.
1.2	Establish a formal instrument of appointment for the Armadale Settlers Common Management Committee.	1	ASCMC	Operational	Formal instrument of appointment established.
1.3	Investigate the feasibility of transferring vesting and ownership of the part of ASC currently owned by the WAPC to the City of Armadale.	3	Plan Srv / WAPC	Operational	Feasibility investigation completed and acted upon.
1.4	Seek funding to carry out restoration projects annually.	1	FOASC / ASCMC / BEAC	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	Responsibility	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	Env Srv / P&R Srv	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	Env Srv / consultant	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	Responsibility	Cost	Key Performance Indicator
3.1	Dumped rubbish should be removed as soon as possible after it has been found	1	P&R Srv	Operational	Annual reduction in rubbish dumping incidents
3.2	Gradually close and rehabilitate all tracks not depicted in Figure 4.2. Prioritise tracks susceptible to erosion or within dieback-free areas.	2	P&R Srv / FOASC	$6,000 / annum	1,000 m^2 tracks rehabilitated per annum
3.3	Undertake weekend patrols of ASC perimeter during summer and holidays.	1	Ranger Srv	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	Ranger Srv / P&R Srv	$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 by 2005	4	Env Srv / P&R Srv	$1,000	Initial increase followed by annual reduction in reports of prohibited activities
3.6	Encourage local residents to report illegal activities through enhacing reserve custodian program with a focus on ASC by raising awareness with leaflets and website updates	4	Env Srv / BEAC / ASCMC	$1,500	Initial increase followed by annual reduction in reports of prohibited activities
3.7	Control introduced bee hives when found	1	Env Srv / P&R Srv	Operational	Reduction in number of bee hives in the Common

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	Responsibility	Cost	Key Performance Indicator
4.1	Undertake Bushland Condition mapping of ASC.	1	Env Srv / consultant	$2,000	Bushland condition map including serious weed infestations
4.2	Undertake annual best practice weed control activities based on the methods and priorities outlined in this Management Plan, Map 3.3 and bushland condition map once completed.	1	Env Srv / P&R Srv / FOASC / contractor	$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	Env Srv / consultant	$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	Env Srv / FOASC / consultant	$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	Responsibility	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	Env Srv / P&R Srv / FOASC	$1 / m^2 / annum	10% of ASC bushland has improved category after 5 years
5.2	Carry out reconstruction / revegetation in areas indicated by Figure 3.3 and in *Poor* and *Very Poor* Condition areas based on bushland condition mapping.	3	FOASC	$5 / m^2 / annum	10% of ASC bushland has improved category after 5 years
5.3	Monitor the success of individual restoration projects using quadrats	4	Env Srv / FOASC / consultant	$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	Responsibility	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	Ranger Srv / Env Srv / Bush Fire Brigade	$4,000	Reduction in severity of fire incidents (reviewed annually)
6.2	Continue maintenance of firebreaks within the Common	1	Ranger Srv	Operational	Reduction in severity of fire incidents (reviewed annually)
6.3	Undertake hazard reduction through control of grassy weeds.	2	Env Srv / P&R Srv / contractor	$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	Ranger Srv / Bush Fire Brigade	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	Ranger Srv / Bush Fire Brigade / Env Srv	Operational	Database of fire history for ASC continually updated
6.6	Following completion of the Fire Management Plan undertake research to determine the effects of burn regime in the Common to maintain biodiversity and the ecological values.	3	FOASC/ University	N/A	No net decrease in floral diversity as a result of hazard reduction burns. Monitered 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	Ranger Srv / Volunteer Fire Brigades	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	Responsibility	Cost	Key Performance Indicator
7.1	Investigate the feasibility of applying phosphite to susceptible vegetation in a 10 m buffer around known dieback free areas. Prioritise with other known dieback-free areas in the CoA.	2	Env Srv / contractor	Operational	no annual reduction in area of treated dieback-free areas beyond natural rate of expression (1 m / yr)
7.2	Train revegetation and maintenance personnel in dieback hygiene measures	2	Env Srv / P&R Srv / FOASC	$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	Env Srv / consultant	$2,000	Dieback mapping on CoA GIS
7.4	Upgrade drainage along Settlers Road to prevent dieback spores infecting dieback-free area by 2005	2	Eng Srv	$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.	3	Env Srv	$2,500	Boot scrub facilities and signage installed on completion of one trail per annum.

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	Responsibility	Cost	Key Performance Indicator
8.1	Undertake further earthworks to restore natural stream contours at the old dam site by 2007.	3	Env Srv / Eng Srv	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 by 2007	5	Env Srv / Eng Srv	$1,000	culvert operating effectively
8.3	Undertake further works to reduce erosion initiated as a result of the installation of culverts under Triton Crescent.	1	Eng Srv	$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	Desirable Start Year	Responsibility	Cost	Key Performance Indicator
9.1	Undertake habitat supplementation such as nesting boxes and raptor platforms and monitor their use	4	FOASC	$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 by 2006	4	Env Srv	Operational	Needs analysis completed and acted upon by 2006
9.3	Investigate the feasibility of Armadale Settlers Common participating in species recovery programs by 2006	4	Env Srv / CALM / WA Zoo	Operational	Feasibility investigated by 2004
9.4	Investigate the location and protection of ecological linkages to other conservation areas.	2	Plan Srv/ ASCMC	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	Responsibility	Cost	Key Performance Indicator
10.1	Investigate and consider renomination of Armadale Settlers Common for inclusion on the Register of National Estate	1	Plan Srv / ASCMC	Operational	ASC included or rejected in register for National Estate
10.2	Facilitate further research on the identification of cultural heritage values	5	Plan Srv / ASCMC / University	$1,000	Report on cultural heritage values compiled by 2005

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	Responsibility	Cost	Key Performance Indicator
11.1	Audit potential walking tracks for standards to AS 1256 and determine upgrade requirements and cost	1	Rec Srv / contractor	$2,500	Report completed by 2004
11.2	Undertake a comprehensive safety audit of public access areas within ASC	2	Rec Srv / contractor	$1,500	Report completed by 2004
11.3	Establish signposted, named walking trails in the Common with informative signage at trail heads as indicated in Figure 6.5	2	Env Srv / P&R Srv / Rec Srv / ASCMC / FOASC	approx $1,000 per trail head plus	One trail completed per annum
11.4	Continue to promote and hold the annual 'Walk the Common' event	1	Rec Srv	$3,000	increasing numbers of participants annually
11.5	Update and redistribute ASC brochure,	2	Rec Srv	$2,000	Increased number of visitors to ASC
11.6	Monitor visitor numbers annually	3	Rec Srv / consultant	$1,000	Increased number of visitors to ASC
11.7	Explore implications and investigate methods for the control of access from private property	1	Env Srv	operational	Report on access completed 2004

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	Desirable Start Year	Responsibility	Cost	Key Performance Indicator
12.1	Provide potable water to Field Study Centre by 2005	1	Rec Srv / Eng. Srv / Prop Serv	$6,000	Level of use for Field Study Centre increases annually
12.2	Monitor use of the field study centre	1	Rec Srv / Env Srv	Operational	Level of use for Field Study Centre increases annually
12.3	Annually update relevant internet web pages upon adoption of this management plan. Include 'counter' to monitor site visitors	2	Env Srv	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	Responsibility	Cost	Key Performance Indicator
13.1	Audit and ensure signage consistent and complies with AS 2156	1	Rc Srv	$250 / sign	inconsistent signage replaced by 2005
13.2	Provide disabled access to Field Study Centre and toilet facilities to AS 1428 by 2006.	2	Eng. Srv/ Cty Dvt	$12,000	Increased annual use of Field Study Centre
13.3	Provide sewerage infrastructure to Field Study Centre by 2006.	2	Rec Srv / Eng. Srv / Prop Srv	$15,000	Increased annual use of Field Study Centre
13.4	Investigate the feasibility of providing a walk trail suitable for disabled access	5	Eng Srv/ Cty Dvt	Operational	Feasibility study completed by 2008
13.5	Reopen car park on Carradine Road redesigned with reduced area to discourage antisocial behaviour.	4	Eng Srv / P&R Srv	$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	Rec Srv / Env Srv / contractor	$8,100	One shelter erected per annum
13.7	Construct an additional electric BBQ at the Field Study Centre complex	5	Rec Srv / P&R Srv	$2,400	Barbecue installed by 2008

1.0 Introduction

Armadale Settlers Common Management Plan 2003

1.1 General Description

The Armadale Settlers Common is located in Bedfordale, 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 the Management Plan, 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 Management Plan 2003

2.1 Duration of the Management Plan

This Management Plan is intended to be used for a period of 10 years from its adoption by the City of Armadale (2004 – 2014) with a review to be undertaken in five years time (2009).

2.2 Land Tenure and Vesting

The Armadale Settlers Common comprises land reserved for Parks and Recreation vested in the City of Armadale, and land leased by the City of Armadale from 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 Department for Planning and Infrastructure and currently leased to the City of Armadale. Freehold land leased by the City of Armadale and land vested in the City is shown in Figure 2.1.

Recommendations for Land Tenure and Vesting are described in Section 6.1, Planning and Mangaement Structure.

2.3 Management Framework and Stakeholders

2.3.1 City of Armadale

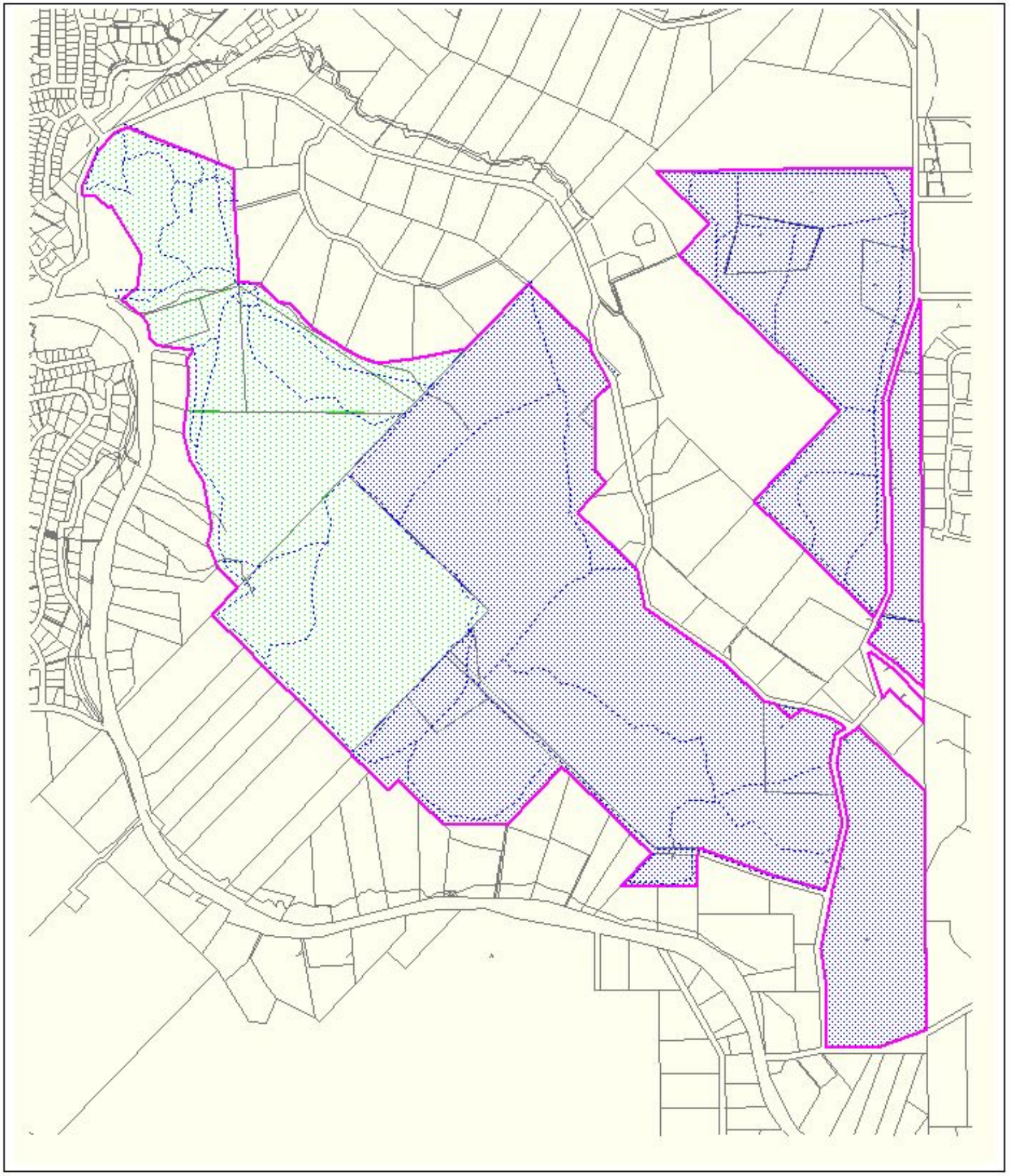
The following Council Directorates are involved in the management of Common:

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 in regard to management plan preparation. The Environmental Officer is also responsible for monitoring the implementation of Management Plan recommendations.



LEGEND

STUDY AREA

CROWN RESERVES
Vested in Local Government

FREEHOLD LAND

CADASTRE

TRACKS

N

200 0 200 400 600 m

SCALE 1:17,500

Vesting of Armadale Settlers Common

CLIENT	CITY OF ARMADALE
PROJECT:	1037
JOB NO:	1037-2.1
DATE:	06-08-03

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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.

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.

2.3.2 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.

2.3.3 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.

2.3.4 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.

2.3.5 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.

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2.3.6 Commonwealth and State Government Agencies

Department of Planning and Infrastructure

The Department for Planning and Infrastructure provides statutory, consultative and co-ordination services to the WA Planning Commission (DPI, 2003).

Western Australian Planning Commission

The Western Australian Planning Commission (WAPC) is the agency responsible for landuse zoning at a regional scale (Metropolitan Region Scheme or MRS). They are also responsible for administering Planning Through the Town Planning and Development Act. Amendments to the MRS such as from Urban to Parks and Recreation are administered by the WAPC. Freehold land forming part of the Common is owned by the WAPC and this is leased to the City of Armadale.

Australian Heritage Commission

The Australian Heritage Commission is an independent statutory agency within the Federal Department of the Environment and Heritage. Is roles include performing statutory responsibilities under the *Australian Heritage Commission Act, 1975.* Listing in the Register of National Estate gives heritage places some protection through the obligation of Commonwealth agencies under the act. Armadale Settlers Common was nominated for listing 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.

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 and the Department of Conservation and Land Management is required to ensure consistency in management objectives for the Regional Park.

2.3.7 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.

2.3.8 Key to Stakeholder Abbreviations

The following are abbreviations used throughout the management plan 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

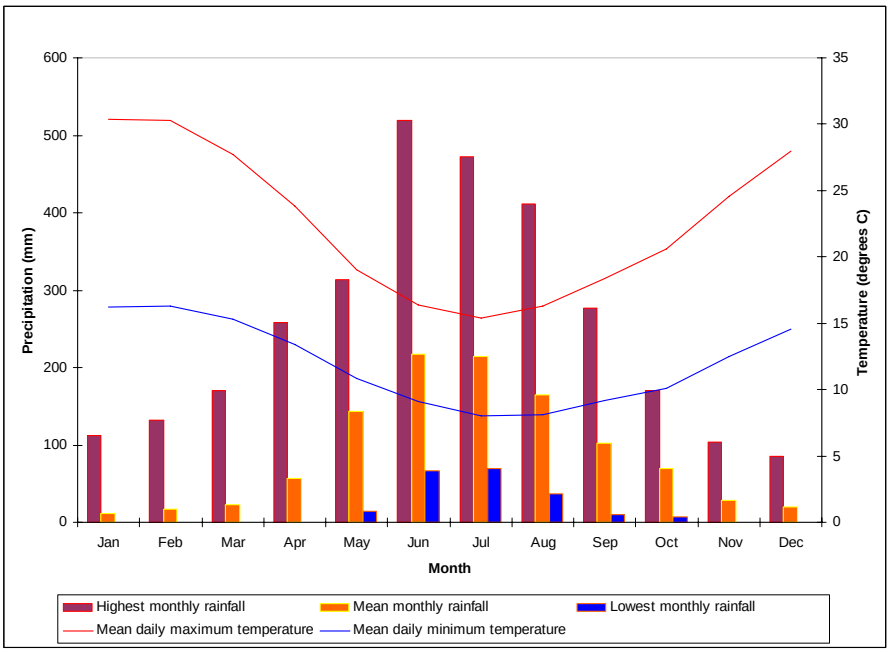
Other

Priv	Private Landholders

3.1 Climate

The Common has a Mediterranean climate characterised by warm, dry summers and cool, wet winters. Bedfordale 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 Meterology

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 *Eucalyptus marginata – Corymbia calophylla.*
Yarragil	Minor Valleys	Open forest of *E. marginata – C. calophylla*
Murray	Major Valleys Combining Slopes and Floors	Open forest of *E. marginata – C. calophylla* with some *E. patens* on slopes to fringing woodland of *E. rudis – Melaleuca rhaphiophylla* 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 E. wandoo with *E. laeliae* in the north, *E. haematoxylon* in the south and *C. calophylla* 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 *Eucalyptus wandoo* woodland over low heath/dwarf shrub on mid-upper -Scarp face and valley slopes.	66.9.±8.9
1b	*Eucalyptus wandoo – Corymbia calophylla* woodlands on winter wet deep loamy clays on creek flats and adjacent to granites and/or dolerite.	69.1±5.2
9	*Eucalyptus marginata* forest and woodland on lateritic upper slopes and upland Darling Plateau.	68.7±12.3
10	*Corymbia calophylla* woodland on deep loams of upland valley slopes. Species poor.	25.5±5.5

Adapted from Markey (1997)

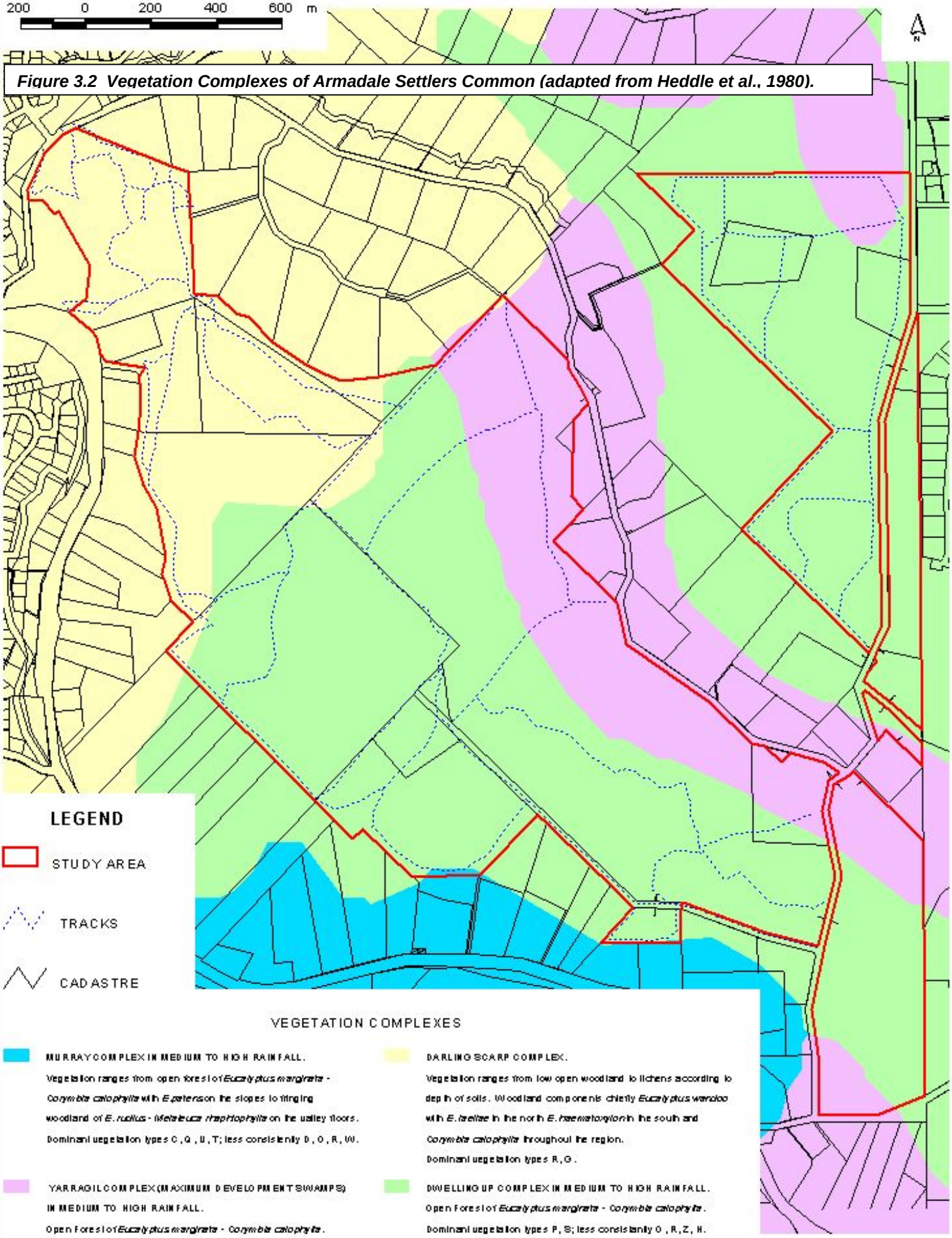


Figure 3.2 Vegetation Complexes of Armadale Settlers Common (adapted from Heddle et al., 1980).

Vegetation Complexes of Armadale Settlers Common
(Adapted from Heddle et al., 1980)

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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.

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	Ranunulaceae	1	1
Dasypogonaceae	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			
			Total	**162**	**318**

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 reidleii)* 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

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

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 been 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
Lupinus cosentinii	Sandplain Lupin	High
Watsonia bulbillifera	Watsonia, Bugle Lily	High
Zantedeschia aethiopica	Arum Lily	High
Freesia sp	Freesia	High
Cerastium glomeratum	Mouse Ear Chickweed	Low
Cicendia filiformis	Slender Cicendia	Low
Cytisus proliferus	Tree Lucerne, Tagasaste	Low
Linum trigynum	French Flax	Low
Lolium multiflorum	Rye Grass	Low
Lotus angustissimus	Narrow leafed Trefoil	Low
Tolpis fatua	Yellow Hawkhead	Low
Ipomoea indica	Morning Glory	Mild
Poa annua	Winter Grass	Mild
Raphanus raphanistrum	Wild Radish	Mild
Trifolium scabrum	Rough Clover	Mild
Aira caryophyllaea	Silvery Hairgrass	Moderate
Anagallis arvensis	Scarlet or Blue Pimpernel	Moderate
Avena fatua	Wild Oats	Moderate
Bellardia trixago	Bellardia	Moderate
Briza maxima	Blowfly Grass	Moderate
Briza minor	Shivery Grass	Moderate
Centaurium erythraea	Common Centaury	Moderate
Cyperus tenellus	Tiny Flat Sedge	Moderate
Hypochaeris glabra	Smooth Catsear	Moderate
Juncus capitatus		Moderate
Lantana camara	Lantana	Moderate
Monadenia bracteata	Brown Fingure Orchid	Moderate
Orobanche minor	Lesser Broomrape	Moderate
Parentucellia latifolia	Common Bartsia	Moderate
Parentucellia viscosa	Sticky Bartsia	Moderate
Senecio diaschides	Fireweed	Moderate
Solanum nigrum	Backberry Nightshade	Moderate
Sonchus oleraceus	Common Sow Thistle	Moderate
Trifolium campestre	Hop Clover	Moderate
Trifolium dubium	Suckling Clover	Moderate
Ursinia anthemoides	Ursinia	Moderate
Vulpia bromoides	Squirrel Tail Fescue	Moderate
Vulpia myuros	Rat's Tail Fescue	Moderate
Echium plantagineum	Paterson's Curse	Unrated
Freesia affin leichtlinii	Freesia	Unrated
Rhynchelytrum repens	Red Natal Grass	Unrated
Romulea rosea var australis	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 since1990 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 bulbillifera)* 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 bulbillifera* (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.

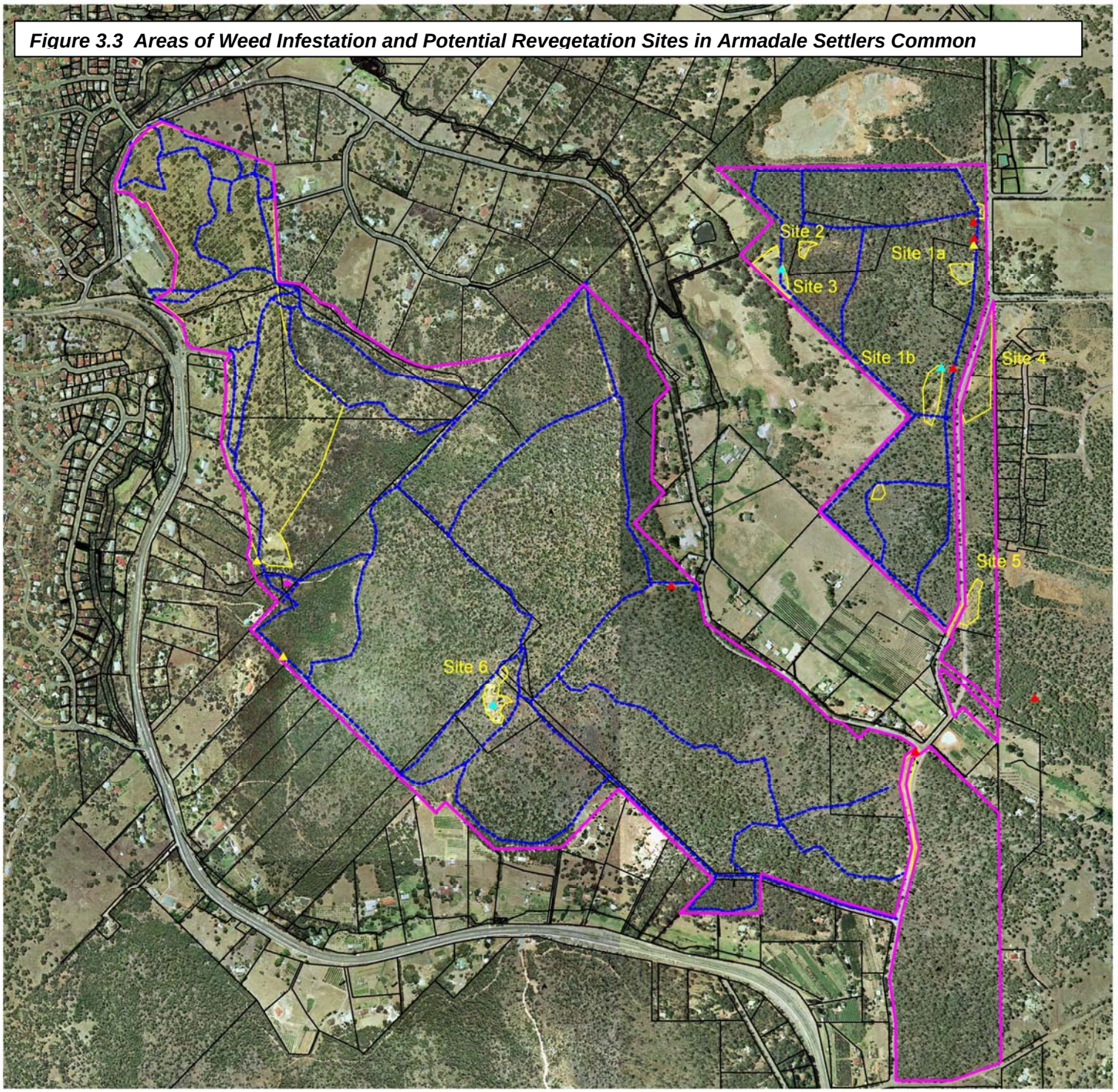
Weed Infestations found within Armadale Settlers Common as part of this management plan are shown in Figure 3.3. Management of Weeds within Armadale Settlers Common is described in Section 6.4.

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 (Tizzard, 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 siginificant revegetation are shown in Figure 3.3.

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

N

200 0 200 400 600 m

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

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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.

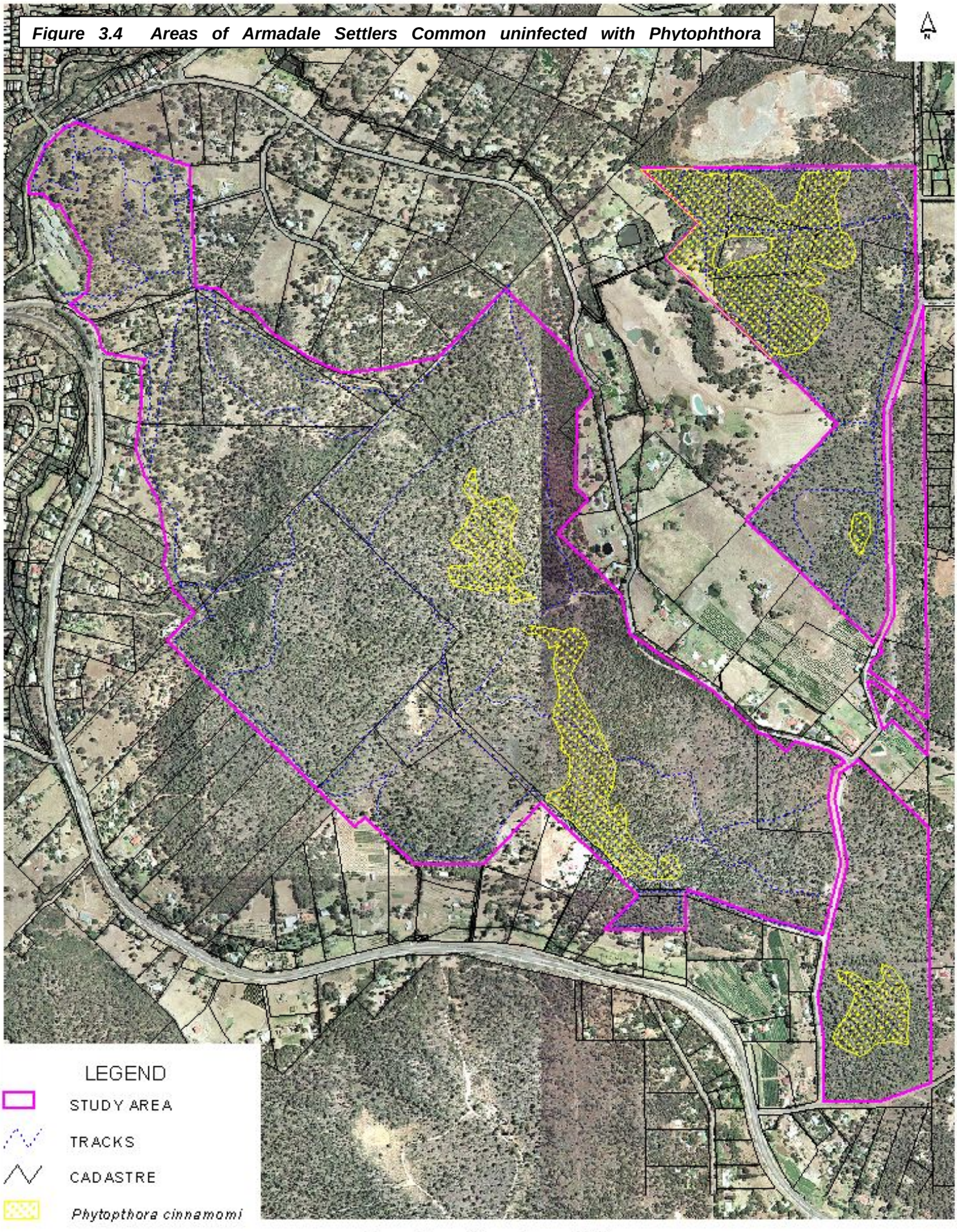
Dieback disease requires three factors: the pathogen (*Phytophthora cinnamomi*), a host, and suitable environmental conditions. *Phytophthora* has a very wide host range, with possibly up to one third or more of all Western Australian plant species susceptible to infestation. Generally, the indigenous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

Figure 3.4 Areas of Armadale Settlers Common uninfected with Phytophthora



Areas of Armadale Settlers Common' uninfected with *Phytopthora cinnamomi*.

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DATE:	06-08-03

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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.

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)
Calyptorhynchus baudinii	Baudin's Cockatoo	Vulnerable	Threatened (Vulnerable)
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered	Threatened (Endangered)
Calyptorhynchus banksii	Forest Redtailed Cockatoo	Not Listed	Priority 3
Dasyurus geofffroii	Chuditch	Vulnerable	Vulnerable
Phascogale tapoatafa	Brush-tailed Phascogale	Not Listed	Priority 3
Hydromys chrysogaster	Water Rat	Not Listed	Priority 4
Isoodon obesulus fusciventer	Quenda	Not Listed	Priority 4 / Conservation Dependant
Macropus irma	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 (Tizzard, 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 superciliosus* (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) (Tizzard, 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: *Acanthophis 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 Bedfordale 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 (Tizzard, 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.

4.1 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.

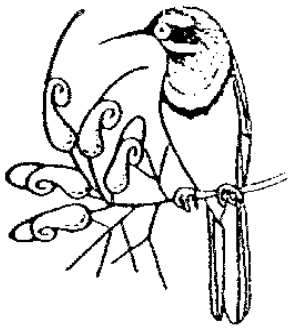
Reserve 4127 (officially named the Armadale Common) was vested in the Armadale-Kelmscott Road Board on 2 August 1912 and the purpose amended to "Common and Timber for Settlers". The Road Board officially accepted control of the Common at the next meeting dated 28 August 1912.

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 Management Plan 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 staff 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 Bedfordale. 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 4th October 1997. The next 18 months were spent restoring the building including reroofing, rewiring and painting (Tizzard, 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 Management Plan.

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 Bedfordale 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)

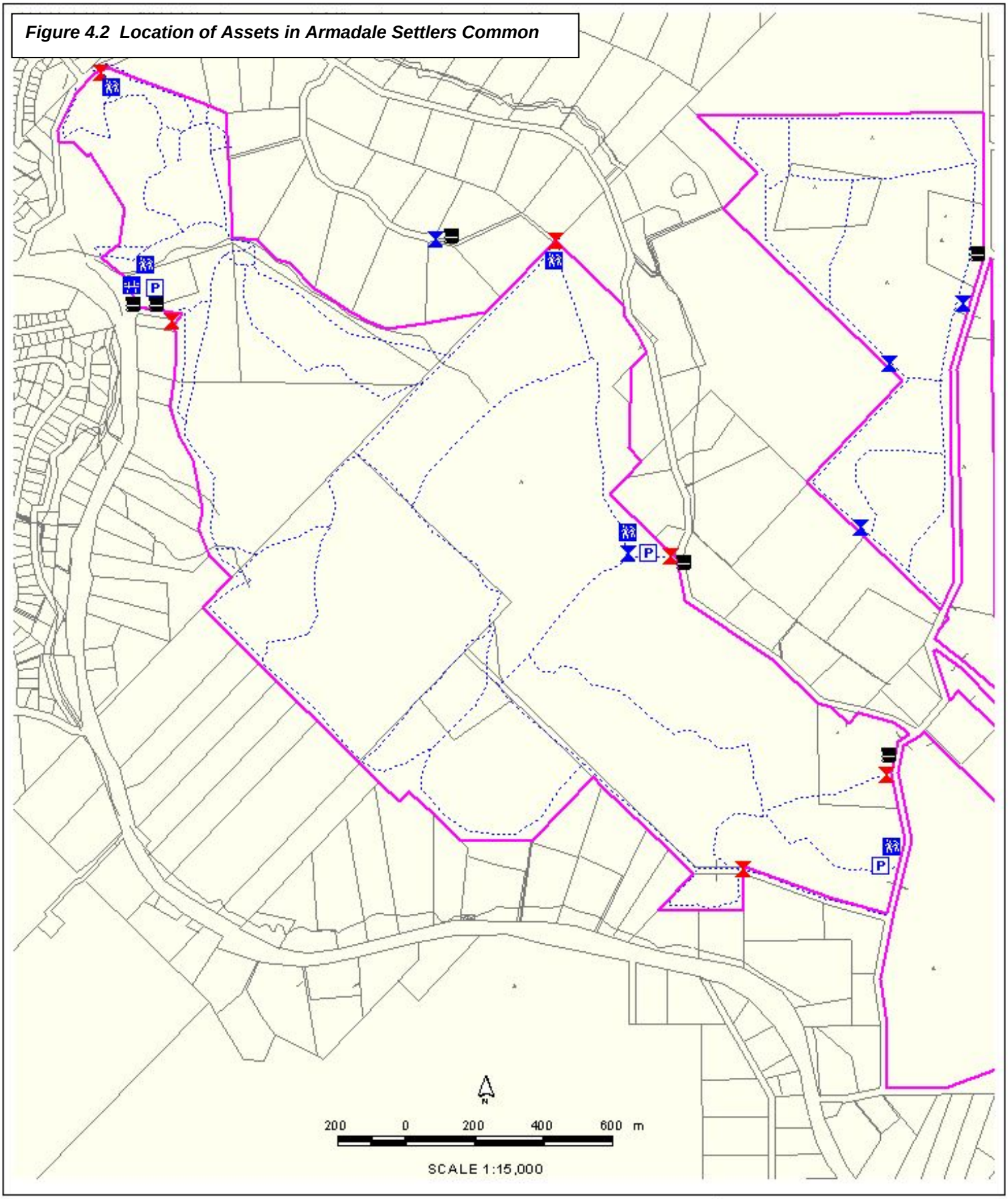
Fences and Gates

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 Location of Assets in Armadale Settlers Common



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

Location of assets in Armadale Settlers' Common

CLIENT	CITY OF ARMADALE
PROJECT:	1037
JOB NO:	1037-4.1
DATE:	06-08-03

ecoscape

Figure 4.3 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.

5.0 Stakeholder Consultation

Armadale Settlers Common Management Plan 2003

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 Management Plan.

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 Setters 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 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 Commission

The Australian Heritage Commission verified that Armadale Settlers Common had previously been nominated for inclusion to the Register of National Estate, however it was no longer being considered for nomination for unknown reasons. The AHC representative provided forms for renomination of Armadale Settlers Common.

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 release of the Darling Range Regional Park Management Plan will 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 Management Plan 2003

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 Bushcare and Environmental Advisory Committee (BEAC), 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.

The Friends of Armadale Settlers Common should either become an incorporated body or adopt the name and structure of the Field Study Centre Inc. Investigations should be undertaken to determine whether the existing structure and constitution of the FSC Inc. is compatible with the aims and objectives of FOASC before amalgamation is considered.

Vesting and Ownership

The Armadale Settlers Common comprises two parts in terms of vesting and ownership. The largest part is vested in, and managed by the City of Armadale, while a portion is owned by the Western Australian Planning Commission (WAPC) and is leased and managed by the City of Armadale (see Figure 2.1).

For effective management to take place it would be preferable if vesting is transferred to the City of Armadale enabling the entire Common to be managed as a single unit and also allow a greater security of tenure for the purposes of conservation. It is currently an opportune time to investigate the feasibility of this transfer as the lease has recently expired (B. Tizzard, pers. comm.).

6.1.3 Recommendations

No.	Recommendation	Priority	Responsibility	Cost	Key Performance Indicator
1.1	Amalgamate FOASC with FSC Inc.	1	FOASC / ASCMC	Operational	Incorporated friends group created.
1.2	Establish a formal instrument of appointment for the Armadale Settlers Common Management Committee.	1	ASCMC	Operational	Formal instrument of appointment established.
1.3	Investigate the feasibility of transferring vesting and ownership of the part of ASC currently owned by the WAPC to the City of Armadale.	3	Plan Srv / WAPC	Operational	Feasibility investigation completed and acted upon.
1.4	Seek funding to carry out restoration projects annually.	1	FOASC / ASCMC / BEAC	Operational	Funding acquired from external sources increases annually

6.2 Management Zones

6.2.1 Objectives

The objectives of management zones are to:

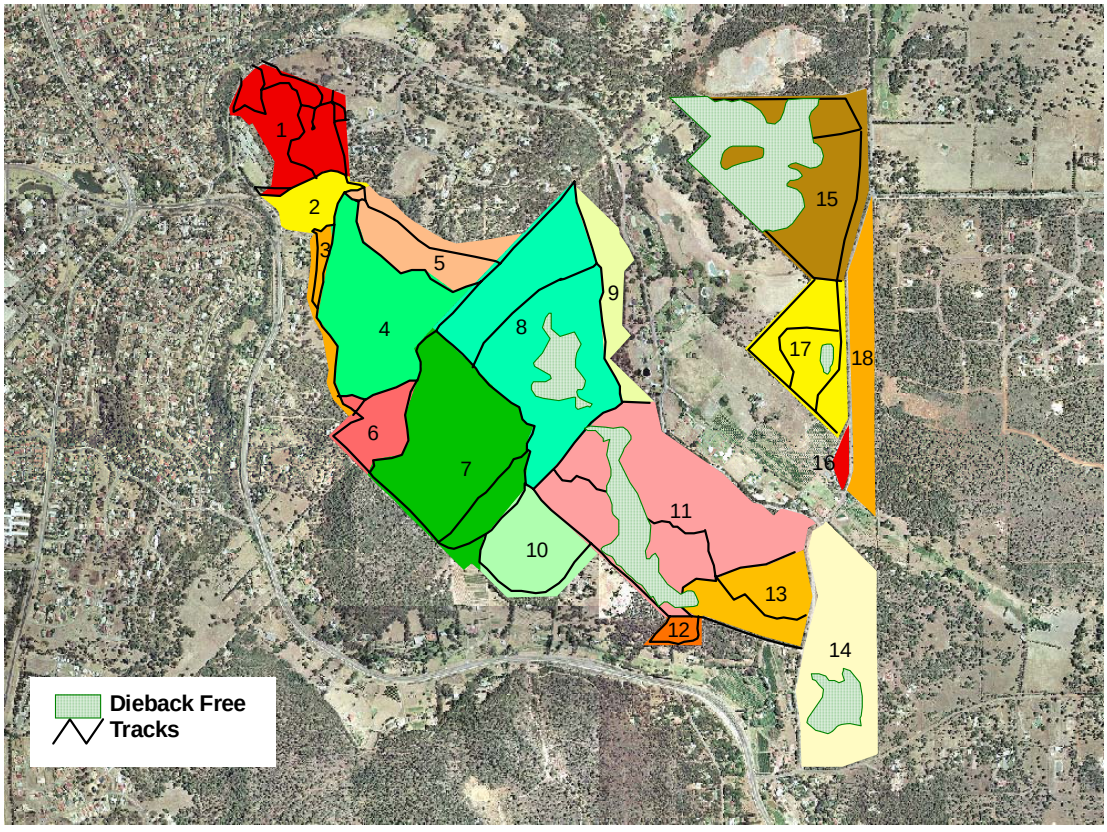
- divide the Common into relatively homogenous areas that have a uniform basis for management;
- manage the Common in relation to their purpose of Special Conservation, Conservation, Buffer and Education.

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.

Figure 6.1 Armadale Settlers Common Management Zones



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 trakcs 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.

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 neaighbouring areas where fire management is not undertaken adjacent to the old pasture areas of the Common. In this area fire management can take precendence 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

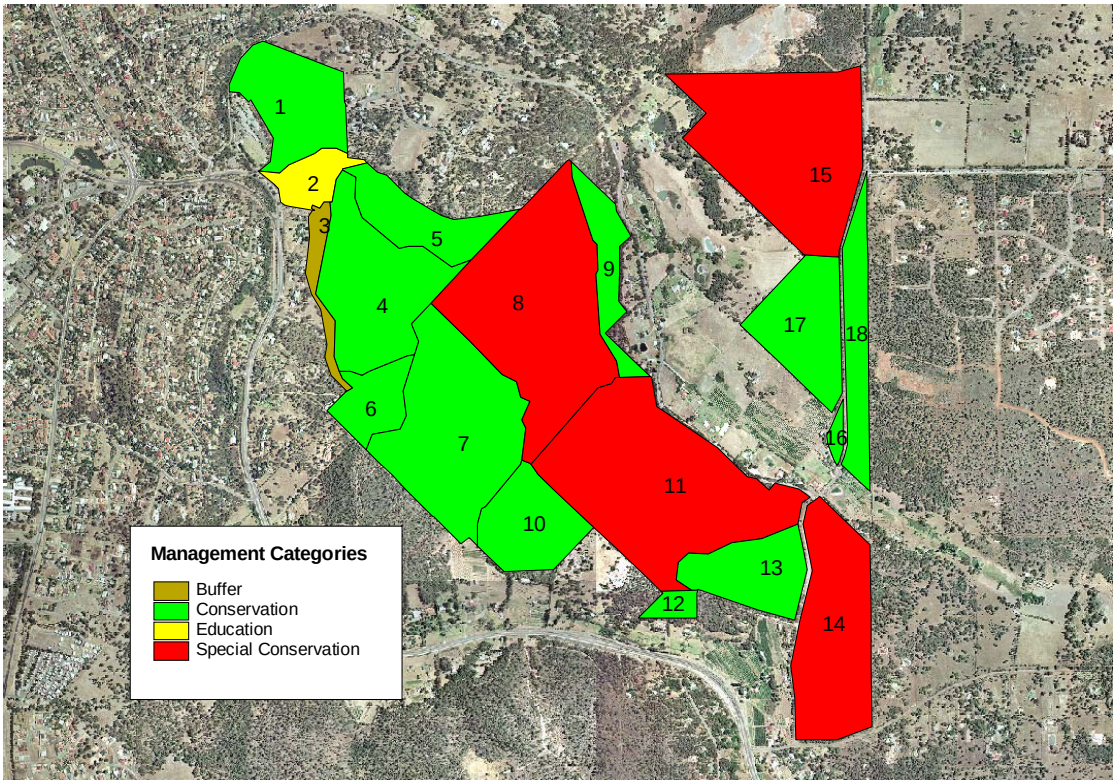


Table 6.1 Management Categories, Purpose and Acceptable Uses

Category	Management Zones	Purpose	Acceptable Uses
Special Conservation	8, 11, 14, 15	• Protection of flora and fauna of high conservation value. • Retaining dieback-free areas • Passive recreation	• Conservation activities • Dieback control activities. • Hygeine measures for management access. • Public access limited to pedestrian traffic away from dieback areas
Conservation	1, 4, 5, 6, 7, 9, 10, 12, 13, 16, 17, 18.	• Conservation. • Landscape quality maintenance and enhancement • Passive recreation	• Passive recreation. • Walk trails. • Public access limited to pedestrian traffic.
Buffer	3	• Protection of other land uses from fire • Protection of the Common from other land uses (e.g. weed invasion).	• Protection of the Common. • Protection of land surrounding the Common.
Education	2	• Education (Field Study Centre Complex). • Recreation (picnic and barbeque facilities).	• Field Study Centre. • Meetings. • Educational activities. • barbecues / picnics

6.2.3 Recommendations

No.	Recommendation	Priority	Responsibility	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	Env Srv / P&R Srv	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	Env Srv / consultant	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 hoofed 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 horesriding enthusiasts living in the City of Armadale and the Town Planning Scheme encompasses 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, the potential for degradation to the natural environment is high. Specifically the following needs to be considered:

1. 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 likely to cause unacceptable land degradation and damage to the natural environment.
2. 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)
3. 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 needs to be prohibited
4. 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).
5. Horseriding and walking activities are incompatible due to safety hazards (trampling) and health hazards (dung).

6. There is a potential for conflict between horeriders and walkers.
7. 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, it is recommended that horseriding be excluded from Armadale Settlers' Common. A proposal for a bridle trail through part of the Common may only be considered if all of the following is provided:

- all costs of planning, construction and maintenance of the trail are borne by the proponent;
- existing tracks are upgraded and maintained by the proponent;
- the proposal is compatible with recommendations in this Management Plan;
- all management issues mentioned above must be considered and strategies employed to mitigate environmental damage.

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. Dogs have the potential to increase nutrification of soil through faeces, impact on native fauna and conflict with other recreational activities, particularly walking. Currently there are inadequate facilites such as dog-poo bags, signage and bins to allow dogs within the Common; however given the likely demand for dog-walking areas, this topic should be revisited during the Management Plan review in 2009.

To discourage horses, 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	Responsibility	Cost	Key Performance Indicator
3.1	Dumped rubbish should be removed as soon as possible after it has been found	1	P&R Srv	Operational	Annual reduction in rubbish dumping incidents
3.2	Gradually close and rehabilitate all tracks not depicted in Figure 4.2. Prioritise tracks susceptible to erosion or within dieback-free areas.	2	P&R Srv / FOASC	$6,000 / annum[1]	1,000 m^2 tracks rehabilitated per annum
3.3	Undertake weekend patrols of ASC perimeter during summer and holidays.	1	Ranger Srv	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	Ranger Srv / P&R Srv	$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 by 2005	4	Env Srv / P&R Srv	$1,000[2]	Initial increase followed by annual reduction in reports of prohibited activities
3.6	Encourage local residents to report illegal activities through enhacing reserve custodian program with a focus on ASC by raising awareness with leaflets and website updates	4	Env Srv / BEAC / ASCMC	$1,500	Initial increase followed by annual reduction in reports of prohibited activities
3.7	Control introduced bee hives when found	1	Env Srv / P&R Srv	Operational	Reduction in number of bee hives in the Common

[1] Assumes $6.00 / m^2 to rehabilitate and maintain.

[2] Assumes 5 trail heads at $200 per sign.

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 Armadael 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:

- 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 places 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 (Tizzard, 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 Section6.3 Disturbance Management, Section 6.6 Fire Management and Section 06.8 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 Six) 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 axle to make cuts at 8 cm intervals at a 45^{o} angle and 4-5 cm long to penetrate the sapwood beneath the bark, or drill at 45^{o} 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 bulbillifera* (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.

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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

Priority	General Recommendations
Priority 1 **Start with species-led control**	***Species-led control:*** 1. Select weeds for control on a species basis according to time of year and available resources. 2. For each weed species, use bushland condition maps to: • Start control efforts in *Very Good-Excellent* condition bushland • Move to *Good-Fair* condition bushland • Move to *Poor* condition bushland The above represents primary weed control. Secondary weed control and long-term monitoring of weed populations will also need to be undertaken.
Priority 2 **Move to site-led control**	***Site-led control:*** 1. Select sites suitable for site-based control. 2. Use bushland condition and weed distribution maps to: • Start control efforts in *Very Good-Excellent* condition bushland • Move to *Good-Fair* condition bushland • Move to *Poor* condition bushland 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.
Priority 3 **Move to resource-led control**	***Resource-led control:*** 1. Select sites suitable for resource-based control. 2. Use bushland condition and weed distribution maps to: • Start control efforts in *Very Good-Excellent* condition bushland • Move to *Good-Fair* condition bushland • Move to *Poor* condition bushland Again, the above represents primary weed control. Secondary weed control and long-term monitoring of weed populations will also need to be undertaken.

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	Responsibility	Cost	Key Performance Indicator
4.1	Undertake Bushland Condition mapping of ASC.	1	Env Srv / consultant	$2,000	Bushland condition map including serious weed infestations
4.2	Undertake annual best practice weed control activities based on the methods and priorities outlined in this Management Plan, Map 3.3 and bushland condition map once completed.	1	Env Srv / P&R Srv / FOASC / contractor	$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	Env Srv / consultant	$2000	10% of ASC bushland has improved category after 5 years[3]
4.4	Monitor success of individual weed control sites using quadrats that are checked annually.	2	Env Srv / FOASC / consultant	$300 / quadrat	90% reduction in weed cover at each quadrat

[3] E.g. *Good* condition bushland increases to *Very Good – Excellent*

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 Settelrs 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.

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 gaurds (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 & 1b

Area 1a

Location:	MGA 410734 E: 6442668 N
Area:	3,630 m^2
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^2
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^2
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^2
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^2
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^2
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^2
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 required 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 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	Responsibility	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	Env Srv / P&R Srv / FOASC	\$1 / m^2 / annum	10% of ASC bushland has improved category after 5 years[4]
5.2	Carry out reconstruction / revegetation in areas indicated by Figure 3.3 and in *Poor* and *Very Poor* Condition areas based on bushland condition mapping.	3	FOASC	\$5 / m^2 / annum	10% of ASC bushland has improved category after 5 years
5.3	Monitor the success of individual restoration projects using quadrats	4	Env Srv / FOASC / consultant	\$300 / quadrat	90% Survivability of planted seedlings / 40% germination from seed

[4] E.g. *Good* condition bushland increases to *Very Good – Excellent*

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 (Tizzard, 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, additionaly 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	Responsibility	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	Ranger Srv / Env Srv / Bush Fire Brigade	$4,000	Reduction in severity of fire incidents (reviewed annually)
6.2	Continue maintenance of firebreaks within the Common	1	Ranger Srv	Operational	Reduction in severity of fire incidents (reviewed annually)
6.3	Undertake hazard reduction through control of grassy weeds.	2	Env Srv / P&R Srv / contractor	$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	Ranger Srv / Bush Fire Brigade	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	Ranger Srv / Bush Fire Brigade / Env Srv	Operational	Database of fire history for ASC continually updated
6.6	Following completion of the Fire Management Plan undertake research to determine the effects of burn regime in the Common to maintain biodiversity and the ecological values.	3	FOASC/ University	N/A	No net decrease in floral diversity as a result of hazard reduction burns. Monitered 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	Ranger Srv / Volunteer Fire Brigades	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 or are subject to heavy inundation the progeny may also become infected and die. This cycle can continue for several decades (Glevan, 2000). 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 area 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.

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	Responsibility	Cost	Key Performance Indicator
7.1	Investigate the feasibility of applying phosphite to susceptible vegetation in a 10 m buffer around known dieback free areas. Prioritise with other known dieback-free areas in the CoA.	2	Env Srv / contractor	Operational	no annual reduction in area of treated dieback-free areas beyond natural rate of expression (1 m / yr)
7.2	Train revegetation and maintenance personnel in dieback hygiene measures	2	Env Srv / P&R Srv / FOASC	$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	2	Env Srv / consultant	$2,000	Dieback mapping on CoA GIS
7.4	Upgrade drainage along Settlers Road to prevent dieback spores infecting dieback-free area by 2005	2	Eng Srv	$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.	3	Env Srv	$2,500[5]	Boot scrub facilities and signage installed on completion of one trail per annum.

[5] Cost estimated as $500 per boot-scrub per trail head (5). Signage inclusive with interpretational signage and information shelters.

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. Tizzard 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 (Figure 6.4).

The recent installation of a culvert also appears to have resulted in significant erosion at the end of Triton Crescent near the Field Study Centre. While this does not appear to be threatening environmental values, it is unsightly and may contribute to the spread of dieback. Further earthworks may need to be undertaken to rectify this.

Figure 6.4 Erosion at dam and Field Study Centre

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 and culverts placed at Triton Crescent. 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	Responsibility	Cost	Key Performance Indicator
8.1	Undertake further earthworks to restore natural stream contours at the old dam site by 2007.	3	Env Srv / Eng Srv	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 by 2007	5	Env Srv / Eng Srv	$1,000	culvert operating effectively
8.3	Undertake further works to reduce erosion initiated as a result of the installation of culverts under Triton Crescent.	1	Eng Srv	$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® 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 incendence 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 met 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 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.

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

No.	Recommendation	Priority	Responsibility	Cost	Key Performance Indicator
9.1	Undertake habitat supplementation such as nesting boxes and raptor platforms and monitor their use	4	FOASC	$2,500[6]	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 by 2006	4	Env Srv	Operational	Needs analysis completed and acted upon by 2006
9.3	Investigate the feasibility of Armadale Settlers Common participating in species recovery programs by 2006	4	Env Srv / CALM / WA Zoo	Operational	Feasibility investigated by 2004
9.4	Investigate the location and protection of ecological linkages to other conservation areas.	2	Plan Srv/ ASCMC	Operational	Town Planning Scheme No. 4 identifies and protects linkages.

[6] 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 publis and have therefore appeared in Appendix Seven which will not be included in publis versions of this document.

Aboriginal Heritage Sites

Aboriginal Sites, regardless of whether they are 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 reinitiate the process.

Entry in the register of national estate:

- recognises that a place has met the criteria for national estate significance and therefore has heritage value;
- gives planners and decision makers objective information about the national estate values of the place which can be taken into consideration during the decision-making process;
- provides researchers and scientists with information about Australia's national estate; and
- obliges the Commonwealth Government, under S30 of the *Australian Heritage Commission Act 1975,* to avoid damaging national estate places, unless there are no feasible and prudent alternatives, and to consult with the commission before taking any action which could harm or affect a registered place.

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

No.	Recommendation	Priority	Responsibility	Cost	Key Performance Indicator
10.1	Investigate and consider renomination of Armadale Settlers Common for inclusion on the Register of National Estate	1	Plan Srv / ASCMC	Operational	ASC included or rejected in register for National Estate
10.2	Facilitate further research on the identification of cultural heritage values	5	Plan Srv / ASCMC / University	$1,000	Report on cultural heritage values compiled by 2005

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.

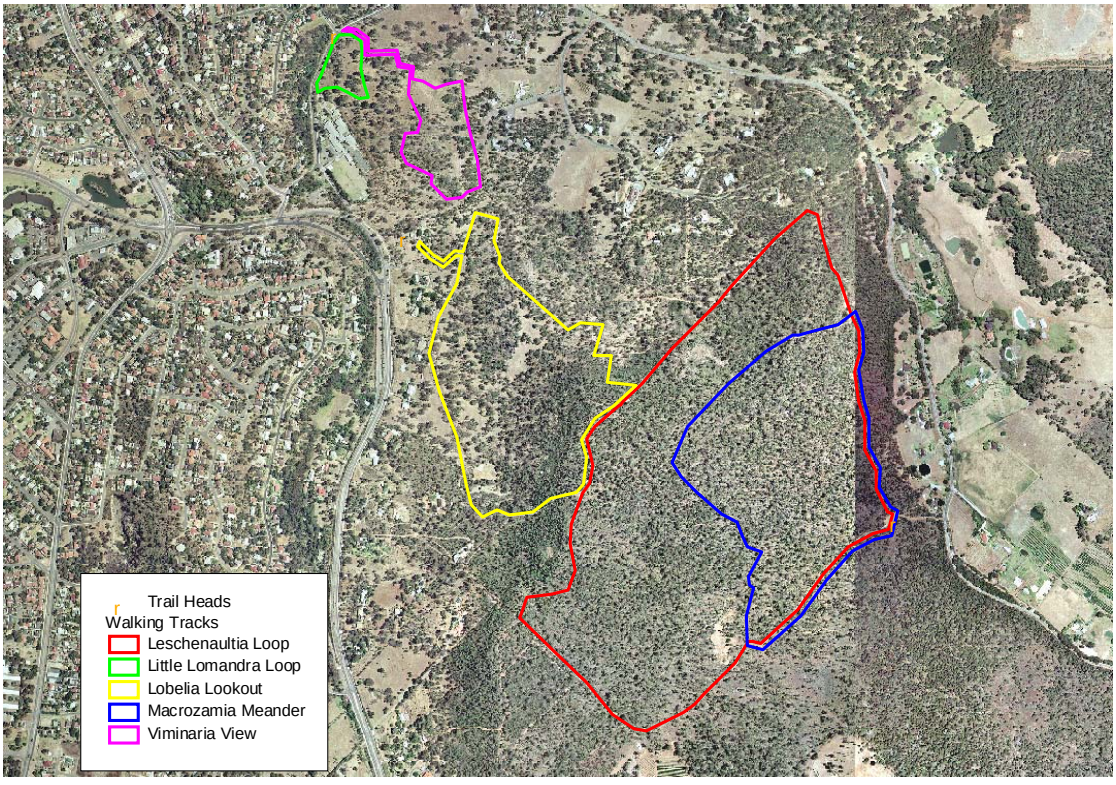
6.11.4 Strategy

Access

Pedestrian access to the Common should be formalised and signposted. A series of tracks such as those shown below in Figure 6.5, 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

Figure 6.5 Potential Walking Trails in Armadale Settlers Common



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.

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	Responsibility	Cost	Key Performance Indicator
11.1	Audit potential walking tracks for standards to AS 1256 and determine upgrade requirements and cost	1	Rec Srv / contractor	$2,500	Report completed by 2004
11.2	Undertake a comprehensive safety audit of public access areas within ASC	2	Rec Srv / contractor	$1,500	Report completed by 2004
11.3	Establish signposted, named walking trails in the Common with informative signage at trail heads as indicated in Figure 6.5	2	Env Srv / P&R Srv / Rec Srv / ASCMC / FOASC	approx $1,000 per trail head plus	One trail completed per annum
11.4	Continue to promote and hold the annual 'Walk the Common' event	1	Rec Srv	$3,000	Increasing numbers of participants annually
11.5	Update and redistribute ASC brochure,	2	Rec Srv	$2,000	Increased number of visitors to ASC
11.6	Monitor visitor numbers annually	3	Rec Srv / consultant	$1,000	Increased number of visitors to ASC

11.7	Explore implications and investigate methods for the control of access from private property	1	Env Srv	operational	Report on access completed 2004

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

Ecotoursim wihin 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 Setters' 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

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

No.	Recommendation	Priority	Responsibility	Cost	Key Performance Indicator
12.1	Provide potable water to Field Study Centre by 2005	1	Rec Srv / Eng. Srv / Prop Srv	$6,000	Level of use for Field Study Centre increases annually
12.2	Monitor use of the field study centre	1	Rec Srv / Env Srv	Operational	Level of use for Field Study Centre increases annually
12.3	Annually update relevant internet web pages upon adoption of this management plan. Include 'counter' to monitor site visitors	2	Env Srv	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. These should
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 (see Figure 6.6). Older signs (right) should be replaced with newer signs (left). 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.

Figure 6.6 Inconsistent Signage at Armadale Settlers Common

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. Examples of informative signage are shown in Figure 6.7.

Figure 6.7 Examples of Informative Signage

6.13.3 Recommendations

No.	Recommendation	Priority	Responsibility	Cost	Key Performance Indicator
13.1	Audit and ensure signage consistent and complies with AS 2156	1	Rc Srv	$250 / sign	inconsistent signage replaced by 2005
13.2	Provide disabled access to Field Study Centre and toilet facilities to AS 1428 by 2006.	2	Eng. Srv/ Cty Dvt / Prop Srv	$12,000	Increased annual use of Field Study Centre
13.3	Provide sewerage infrastructure to Field Study Centre by 2006.	2	Rec Srv / Eng. Srv / Prop Srv	$15,000	Increased annual use of Field Study Centre
13.4	Investigate the feasibility of providing a walk trail suitable for disabled access	5	Eng Srv/ Cty Dvt / P&R Srv	Operational	Feasibility study completed by 2008
13.5	Reopen car park on Carradine Road redesigned with reduced area to discourage antisocial behaviour.	4	Eng Srv / P&R Srv	$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	Rec Srv / Env Srv / contractor	$8,100[7]	One shelter erected per annum
13.7	Construct an additional electric BBQ at the Field Study Centre complex	5	Rec Srv / P&R Srv	$2,400	Barbecue installed by 2008

[7] Three shelters at $2,700 each

6.14 Monitoring & Evaluation

Monitoring and evaluation need to be undertaken to ensure that management recommendations are being implemented and measures implemented are effective. This should include:

- Bushland condition mapping undertaken every two years can 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.

Yearly evaluation of the status of management recommendations should also be done annually culminating in a management plan review in five years time.

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.

6.14.2 Evaluation

Evaluation of the management of natural areas is an essential component in determining the effectiveness achieving the desired outcomes. The purpose of management of a reserve is to achieve a set of predetermined objectives. The principle measure of management performance is the extent to which the management objectives are achieved. Any evaluations that seek to demonstrate performance against management objectives should focus primarily on outcomes. (Jones, 2000)

The integration of evaluation programs into a Management Plan offers significant benefits for the reserve including the 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 Management Plan 2003

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

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

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

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

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

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

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

Appendix Two:
Fungi Species List

Armadale Settlers Common Management Plan 2003

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

Appendix Three: Fauna Species List

Armadale Settlers Common Management Plan 2003

Phylum Arthropoda

Class	Order	Family	Scientific Name	Common Name
Insecta	Coleoptera	Carabidae	*Notonomus mediosulcatus*	
		Chrysomelidae	*Ditropidus fugitivus*	
			Paropsis semifumata	
		Cleridae	*Eleale aulicodes*	
		Coccinellidae	*Harmonia conformis*	
		Curculionidae	*Ethemaia sellata*	
			Meriphus sp	
			Otirhynchus cribricollis	
			Rhinoplethes foveatus	
		Dermestidae	*Orphinus sp*	
		Dytiscidae	*Necterosoma sp*	
			Platynectes decempunctatus	
			Platynectes sp	
			Rhantus suturalis	
			Sternopriscus browni	
		Elateridae	*Crepidomenus sp*	
		Geotrupidae	*Stenaspidius nigricornis*	
		Histeridae	*Saprinus australis*	
		Hydrophilidae	*Hydratotrephes sp*	
		Lucanidae	*Lamprima varians*	
		Scarabaeidae	*Aphodius frenchi*	
			Onthophagus haagi	
			Phyllotocus ustulatus	
		Silphidae	*Ptomaphila lachrymosa*	
		Tenebrionidae	*Helaeus perforatus*	
			Lagria aneoviolacae	
	Diptera	Bibionidae	*Dilophus tricuspidatus*	
		Drosophilidae	*Drosophila sp*	
		Tephritidae	*Ceratitus capitata*	
			Dacus newmani	
		Asilidae	*Mauropteron pelago*	
			Neosaropogon sp	
			Neoscleropogon sp	
			Stenopogon sp	
		Tababidae	*Polychaeta sp*	
			Scaptia gemina	
			Scaptia singularis	
			Sturmia convergens	
		Cuilicidae	*Aedea alboannulatus*	
			Culex quinquefascitaus	
	Hemiptera	Corixidae	*Agraptocorixa sp*	
			Diaprepotis personata	
		Gelastrocoridae	*Mononyx tuberculatus*	
		Gerridae	*Limnogonus fossarum skusei*	
			Limnogonus sp	

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

Class	Order	Family	Scientific Name	Common Name
		Margarodidae	*Callipappus australe*	
		Megapodagrionidae	*Argiolestes minimus*	
	Orthoptera	Acrididae	*Acrida conica*	
			Cirphulia carbonaria	
			Gastrimargus musicus	
			Goniaea sp	
			Locusta migratoria	
		Blattellidae	*Ellipsidon occidentalum*	
		Blattidae	*Cutilia concolora*	
			Platyzosteria morosa	

Phylum Chordata (Vertebrata)

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

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

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

Key to Status

@ Recorded in the Commmon
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 Management Plan 2003

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 Management Plan 2003

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 1st 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 Management Plan 2003

Not for publication.

Appendix Seven: Aboriginal Heritage Sites

Armadale Settlers Common Management Plan 2003

Not for publication.

Appendix Eight: Linkages and Wildlife Corridors

Armadale Settlers Common Management Plan 2003

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

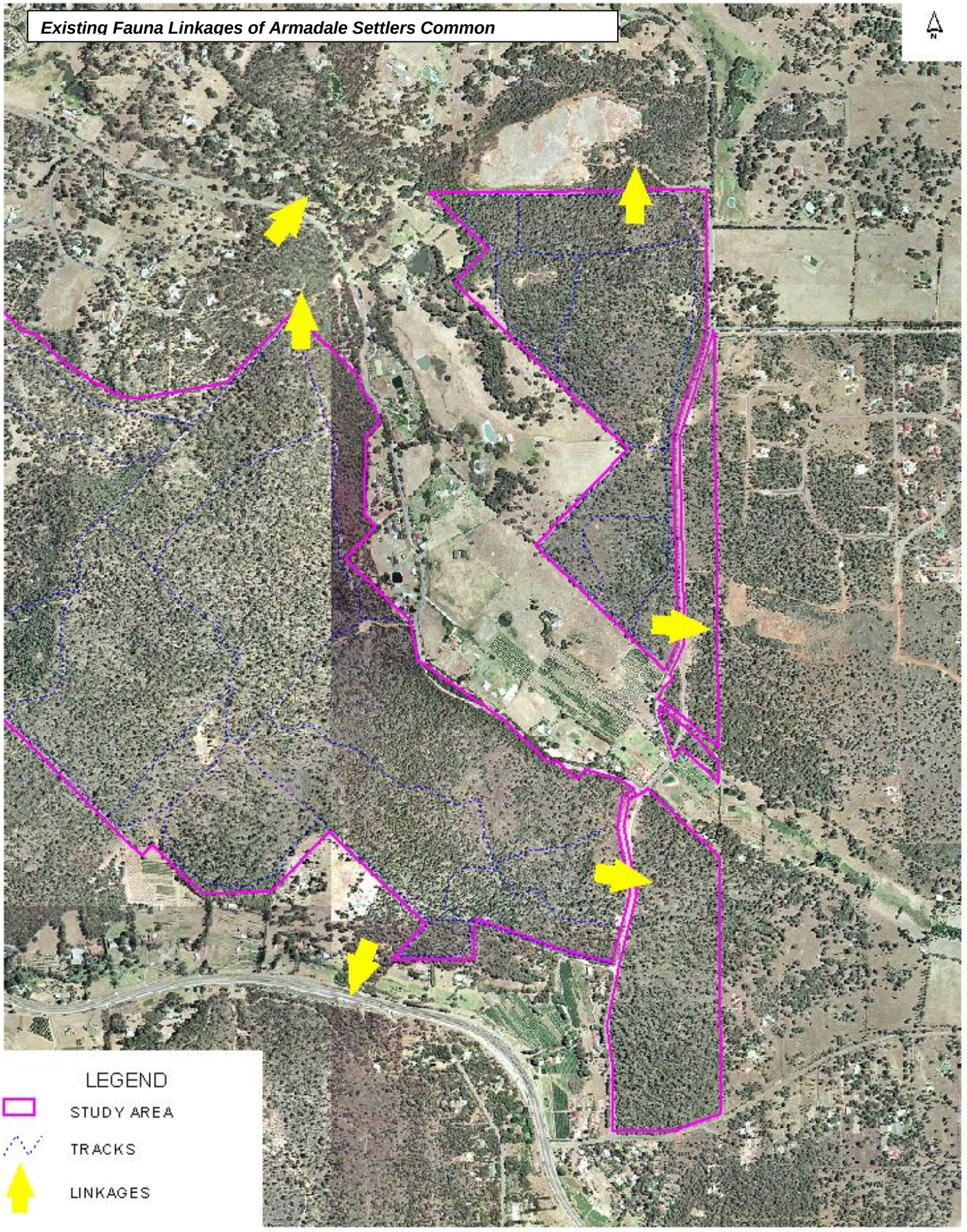
While Armadale Settlers Common is a large reserve surrounded by other large patches of remnant bushland, there are limited linkages between them. The largest section of Armadale Settlers Common is completely bordered by roads and there are also extensive areas of cleared land bordering the Common. These 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

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