



City of Melville

# Modified Reserves (Karrakatta Soils) Strategic Management Plan

2020-2025

June 2020

## Executive Summary

The Modified Reserves (Karrakatta soils) are located in multiple suburbs on the western side of the City of Melville. The five reserves (Art Wright Reserve, Arthur Kay Reserve, Harold Field Reserve, Olding Park and William Reynolds Park) include 3.05 hectares of bushland that has been moderately isolated from other terrestrial bushland remnants for approximately 50-70 years.

These reserves were rated lowest in terms of their overall ecological value in the NAAMP due to their small size and modified condition, however they still hold significant conservation values for the Karrakatta South and Central vegetation complex, individual species and for ecological linkages across the City of Melville.

Of the assets targeted for monitoring and management, the 2 assets of regional, state and/or national significance were:

- 1 ecological community
  - Karrakatta Vegetation Complex – Central and South
- 1 bird species
  - *Calyptorhynchus banksii naso*, Forest red-tailed Black Cockatoo

The 42 native plant species recorded onsite represent approximately 9% of the species recorded in the City of Melville:

- three tree species are at very high risk of local extinction:
  - *Banksia prionotes* (1 plant at Arthur Kay)
  - *Banksia attenuata* (1 plant at Arthur Kay)
  - *Banksia menziesii* (5 plants at Arthur Kay)
- one species is significant on site and at medium risk of extinction:
  - *Xanthorrhoea preissii*

The 15 native animal species (3 reptiles, 10 bird and 2 mammal species) recorded onsite represent 6% of species recorded in the City of Melville. Of these:

- 1 bird (*Calyptorhynchus banksii naso*, Forest red-tailed Black Cockatoo) is listed as vulnerable and of national significance that utilises the Modified Reserves (Karrakatta soils) for feeding, and as a linkage between larger remnants, but unlikely for breeding
- 2 birds (*Pardalotus striatus* Striated Pardalote and *Smicromis brevirostris* Weebill) persist on site. These species are bushland dependent and sensitive to habitat loss and fragmentation. These species have been identified as at risk within the City of Melville as they persist in few reserves or in low numbers across our natural areas.
- 1 mammal (*Chalinolobus gouldii* Gould's Wattled Bat) is sensitive to habitat loss and fragmentation and has been identified as at risk within the City of Melville as they persist in few reserves or in low numbers across our natural areas.

Of the threats considered for targeted monitoring and management, the high impact threats directly affecting the reserves were:

- 3 weed species/categories
  - *Asparagus asparagoides*, Bridal Creeper
  - *Corymbia citriodora*, very large tree weeds
  - 22 Woody weed species
- 1 plant pathogen
  - *Phytophthora cinnamomi*, Dieback
- 2 weather events
  - High Temperatures
  - Low Rainfall





The major priorities for management should be:

- Increasing the *Banksia* species populations in low numbers and at risk of local extinction
- Maintaining Karrakatta South and Central vegetation complex
- Maintaining of significant *Xanthorrhoea preissii* species on site
- Maintaining canopy and large habitat trees for persistence of significant bat and bird species
- Managing the impacts of *Phytophthora cinnamomi*, at Olding Park by continuing Phosphite applications to maintain populations of Dieback-susceptible species
- Removal of one occurrence of Bridal Creeper, 2 very large weed trees and 22 woody weeds identified
- Addressing physical disturbance threats on site including informal bike track building and illegal dumping



## Recommended Reference

The recommended reference for this document is:

Fowler, K (2020) *Modified Reserves (Karrakatta Soils) Strategic Management Plan 2020-2025*, City of Melville, Perth.

## Acknowledgements

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## Acronyms and Definitions

ANZECC	Australian and New Zealand Environment and Conservation Council
DBH	Diameter at Breast Height
DEC	(WA) Department of Environment and Conservation
DEP	(WA) Department of Environmental Protection
DPaW	(WA) Department of Parks and Wildlife
EPBC Act	Environment Protection and Biodiversity Conservation Act
FCT	Floristic Community Type
ha	hectares
Melville	City (rather than suburb) unless specifically stated otherwise
NAAMP	Natural Areas Asset Management Plan
PEC	Priority Ecological Community (as defined and listed by DPaW)
WAPC	Western Australian Planning Commission



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# 1. Introduction

## 1.1. Background

The City of Melville's *Natural Areas Asset Management Plan* (NAAMP) provides a framework for:

- consistently prioritising assets and threats;
- a format for plans; and
- community involvement in managing specific reserves:
  - the community can assist during the preparation of strategic reserve plans in:
    - the identification and benchmarking of assets and threats; and
    - quantifying objectives for threats and goals for assets (e.g. specific number of very high value plants of a species to be established onsite).
- the community can assist during the life of strategic plans in:
  - the identification and delineation of additional assets (including revegetation sites) and threats;
  - the monitoring of assets and threats; and
- on-ground works in the context of specific and measurable goals.

In accordance with the NAAMP framework, the Strategic Reserve Plans form part of the integrated set of documents. The Strategic Reserve Plan is structured with the major headings of assets and threats, whereby assets are maintained or enhanced by the management of threats (using the strategies and guidelines). Please refer to the NAAMP 2019 for figures summarising the strategic framework and how these documents work together to manage our natural areas and reserves.



## 1.2. Objectives

Under the framework of the NAAMP, the objectives of this and all City of Melville Strategic Reserve Plan/s are to:

- document:
  - the extent and/or abundance and condition of assets;
  - the present and potential level and extent of impacts of threats;
  - any changes evident in the assets and threats over time;
  - reserve-specific risk-based management priorities;
  - management strategies relevant to the specific reserve; and
- discuss:
  - reserve specific application of strategies and make reserve specific recommendations regarding the implementation of strategies.

## 1.3. Scope

The scope of this report was the bushland and native tree portions (totalling 3.05 hectares) of:

- Art Wright Reserve
- Arthur Kay Reserve
- Harold Field Reserve
- Olding Park
- William Reynolds Park

These reserves are all highly modified natural areas, located on Karrakatta soils on the east side of the City of Melville, as shown in **Figure 1**.



**Figure 1** Location of Reserves included in Plan



## 2. Assets

### 2.1. Overview

The City of Melville has committed to a strategic goal to 'contribute to the maintenance and enhancement of biodiversity for the preservation of our natural flora and fauna'.

The values of assets are reviewed periodically as they will occasionally change (e.g. the significance of an occurrence of a species may be downgraded if it is recorded in more reserves over time with additional targeted surveys). A change in the value of an asset is applicable to that asset in all natural areas in the City of Melville, including in reserves with current endorsed strategic reserve management plans.

### 2.2. Reserve Assets

#### 2.2.1. Bush Forever

Bush Forever Sites are properties listed as containing regionally significant bushland by the Government of Western Australia (2000). Bush Forever is not subject to ongoing revision and therefore the Bush Forever status of reserves is expected to remain unchanged for the foreseeable future. However under the NAAMP, Bush Forever status is considered in terms of:

- prioritising management resources between reserves, and
- managing sites and species within reserves to ensure reserves continue to meet the Bush Forever criteria for which they were listed.

None of the Modified Reserves (Karrakatta Soils) were listed as Bush Forever Sites

#### 2.2.2. Ecological Linkages

Ecological linkages can increase the effective size of flora populations, and increase available habitat for individual animals, and help maintain genetic diversity for animals and plants by providing connections between groups of animals and plants in isolated bushland remnants.

None of the Modified Reserves (Karrakatta Soils) were included in:

- Regional Linkages in Bush Forever (Government of Western Australia, 2000); or
- Perth Biodiversity Plan Regional Linkages; or
- Regional Greenways (Alan Tingay and Associates, 1998).
- NAAMP Ecological Linkages (City of Melville, 2019)

The bushland of the Modified Reserves (Karrakatta Soils) has been moderately isolated from other terrestrial bushland remnants for at least 50 years, in most cases up to 70 years. This long time since isolation has modified their condition from remnant, however also indicates the significant age of some of the individual species still present. Aerial photography between 1953 and 2020 is shown in [Figure 2](#) and [Figure 4](#).







Figure 2 Remnant Vegetation in 1953



Figure 3 Remnant Vegetation in 1974



Figure 4 Remnant Vegetation in 2020



## 2.3. Site Assets

### 2.3.1. Ecological Communities

Assets are prioritised on the basis of their highest level of significance when they are assessed against multiple datasets. The significance of vegetation can be assessed in terms of several classifications:

- **Vegetation Complexes** are a regional classification for the Swan Coastal Plain, Darling Scarp and Darling Plateau mapped by Heddle *et al.* (1980) on the basis of combinations of plants communities, soils and landforms. Plant communities may occur in more than one soil-landform combination but the relative proportions of plant communities vary between these (Government of Western Australia, 2000).
- **Floristic Community Types** (FCTs) are a regional classification for the Swan Coastal Plain and Darling Scarp defined in terms of groups of co-occurring plants by Gibson *et al.* (1995) and the DEP (1996). Whilst FCTs are distributed in more of a mosaic than vegetation complexes, the classifications are equivalent in dividing the region into a roughly equal number of classes. There are some associations between FCTs and vegetation complexes (i.e. some FCTs tend to occur in particular complexes), but there is **no** hierarchical relationship between them. No FCTs were inferred for the Modified Reserves because there were no detailed reference sites or species inventories to compare species presence/absence between vegetation associations.
- **Vegetation Types** are a local classification in the City of Melville mapped by Ecoscape (2018) in terms of dominant overstorey species. The general descriptions of vegetation types were applied to avoid issues with minor discrepancies in interpretation of boundaries.

The vegetation is regionally significant, with less than 5% of the Karrakatta Central and South vegetation complex remaining uncleared compared to pre-European extent (Zelinova, 2014). City of Melville is high urbanised and with little native vegetation represented overall, this increases the significance of even small areas of remnant vegetation.

The modified reserves are small and have little remnant vegetation remaining, therefore distinct ecological community types were hard to identify and extents were not recorded. The vegetation types recorded in each reserve are listed in Table 1.

**Table 1 Vegetation Types across Modified Reserves (Karrakatta Soils)**

Associations	Dominant / Typical / Indicative species	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds	Total
<i>Banksia</i> woodland	<i>Banksia menziesii</i> <i>Corymbia calophylla</i> <i>Eucalyptus marginata</i>				0.72		0.72 ha
<i>Eucalyptus</i> woodland	<i>Eucalyptus marginata</i> <i>Corymbia calophylla</i> <i>Xanthorrhoea preissii</i>	0.38	0.47				0.85 ha
<i>Eucalyptus</i> woodland	<i>Eucalyptus marginata</i> <i>Corymbia calophylla</i> <i>Banksia menziesii</i>			1.34			1.34 ha
Scattered <i>Eucalyptus</i>	<i>Eucalyptus marginata</i>					0.14	0.14 ha
<b>Total</b>		<b>0.38 ha</b>	<b>0.47 ha</b>	<b>1.34 ha</b>	<b>0.72 ha</b>	<b>0.14 ha</b>	<b>3.05 ha</b>

The vegetation does not meet the criteria of a Matter of National Environmental Significance (MNES) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) as the *Banksia* Woodlands occurrences

are less than 1 hectare in size and not in 'Pristine' condition or 'Excellent' condition.

The ecological communities for which objectives apply in the Modified Reserves (Karrakatta soils) are listed in [Table 2](#).

**Table 2 Ecological Community Sites**

Vegetation Association	Vegetation Complex	Floristic Community Types	Vegetation Types
<i>Banksia attenuata</i> / <i>Banksia menziesii</i> woodland	Karrakatta Central and South  <b>High Significance</b> Less than 5% pre-European extent remaining	Not Determined	Eucalyptus and Banksia species on upland areas  <b>Low Significance</b> Multiple occurrences in Melville

### 2.3.2. Fauna Habitat

Very large trees are important habitat sites for a number of resident and migratory birds and bats onsite:

- many birds rely on tree hollows (Birdlife Australia, 2013);
- roost sites (in tree hollows and under flaking/rough bark) are a critical habitat requirement for bats (Hosken, 1996); and
- The size of trees is one of the critical factors in determining the likelihood of hollow formation in trees (Gibbons & Lindenmayer, 2002).

The density of very large trees in bushland areas in the Modified Reserves is compared to other reserves in Melville in Table 3. The density of habitat trees in the Modified Reserves was low compared to other reserves in the City of Melville.

**Table 3 Numbers of Very Large Trees per Hectare in Modified Reserves**

Species	Modified Reserves	South-Eastern (uninfested) Reserves (2 reserves)	South-Eastern (Infested) Reserves (8 reserves)#	Eastern Reserves (3 reserves)	Bullcreek Reserves (7 reserves)	North-West Reserves (3 reserves)	Estuarine Reserves+ (4 reserves)	Heathcote Reserve (1 reserve)	Wireless Reserve (1 reserve)	Piney Lakes Reserve (1 reserve)	Quenda (1 reserve)	Central (modified) (2 reserves)	Central (2 reserves)
Live Native	<1	2	8	6	12	17	18	4	3	1	2	5	6
Dead	<1	0	1	<1	0	2	3	0	<1	0	0	0	<1
<b>Total</b>	<b>&lt;1</b>	<b>2</b>	<b>9</b>	<b>6</b>	<b>13</b>	<b>19</b>	<b>21</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>5</b>	<b>6</b>

The fauna habitat for which objectives apply are listed in [Table 4](#), which reflects that the number of very large trees was not previously benchmarked for the Modified Reserves, and that it is assumed they have been maintained.



**Table 4 Fauna Habitat Sites Indices**

Values	Habitat Sites	Trees / Hectare 2014	Trees / Hectare 2019	Assets 2014-2019
<b>Medium</b> Very Large Trees	Live Native Tree	No Data	<1	Maintained (assumed unchanged)
	Dead Tree		<1	

The locations of the very large dead trees and live native trees (trunk diameter at breast height greater than 60 cm) are shown in [Appendix 3](#).

The numbers of very large trees by species are listed in [Table 5](#).

**Table 5 Numbers of Very Large Native Trees by Species**

Reserve (Karrakatta)		Art Wright Reserve	Arthur Kay Reserve	Harold Field Reserve	Olding Park	William Reynolds Park	Species Total Count
Species							
Native Trees	<i>Banksia attenuata</i>			1			<b>1</b>
	<i>Corymbia calophylla</i>		2	8			<b>10</b>
	<i>Eucalyptus</i> sp.*		1	1			<b>2</b>
	<i>Eucalyptus marginata</i>	3	4	35	6	4	<b>52</b>
	<b>Total Native Trees</b>	<b>3</b>	<b>7</b>	<b>45</b>	<b>6</b>	<b>4</b>	<b>65</b>
	Dead Trees						<b>0</b>
Weed Trees	<i>Corymbia citriodora</i>				2		
	<b>Total Weed Trees</b>				<b>2</b>		<b>2</b>
	<b>Species Total Count</b>	<b>3</b>	<b>7</b>	<b>45</b>	<b>8</b>	<b>4</b>	<b>67</b>

\*Not necessarily locally native species



### 2.3.3. Wetlands

Wetlands are defined in Schedule 5 of the *Environmental Protection Act 1986* as areas 'of seasonally, intermittently or permanently waterlogged or inundated land, whether natural or otherwise, and includes a lake, swamp, marsh, spring, dampland, tidal flat or estuary'.

There are no wetland indices for the Modified Reserves (Karrakatta Soils). The reserves contain no wetland sites identified in the DPaW's *Geomorphic Wetlands Swan Coastal Plain* dataset, based on the mapping of Hill *et al.* (1996).

### 2.3.4. Heritage

There are no heritage indices for the Modified Reserves (Karrakatta Soils) as there were no heritage sites listed on:

- The National Heritage List;
- WA Aboriginal Sites Register;
- the WA Heritage Register; or
- the City of Melville's Municipal Heritage Inventory.



### 2.3.5. Community Interest

Revegetation sites can be a focus for community interest as these are visible manifestations of natural area management, and the public is often directly involved in their proposal or implementation. Interest has been expressed by a resident to form a group at Harold Field Reserve, Kardinya, with the aim to undertake revegetation works and maintenance. However there are currently no active revegetation sites in any of the modified reserves (Karrakatta soils). There was one bird box located at Harold Field Reserve.

There is also significant community interest in the modified reserves in terms of the areas being used for active recreational activities such as off road biking. This issue is currently being investigated to determine whether there are suitable alternative locations for these activities as they do not align with the values of these reserves, which are to be managed for conservation. More information on the locations of informal bike tracks can be found in [Appendix 3](#).

**Table 6 Community Interest Sites**

Community Interest Sites	Art Wright Reserve	Arthur Kay Reserve	Harold Field Reserve	Olding Park	William Reynolds Park	Total
Local Native Plantings						0
Closed Tracks						0
Bird / Bat Boxes			1			1

The community interest sites for which objectives apply are listed in [Table 7](#).

**Table 7 Community Interest Site Indices**

Values	Community Interest Sites	Completion Criteria Met 2008-2017	Completion Criteria Met 2017-2020	Assets 2017-2020
<b>Medium</b> Revegetation Sites <b>Medium</b>	Local Native Plantings	No plantings	No plantings	Change Not Assessable
	Bird/Bat Boxes	No data	1	Change Not Assessable

### 2.3.6. Reference

Reference sites provide opportunities for long-term monitoring and research. There are no reference indices for the Modified Reserves (Karrakatta Soils) as no reference sites have been established.



## 2.4. Species

### 2.4.1. Native Flora

The Modified Reserves (Karrakatta soils) support 42 native plants, approximately 9% of species recorded in natural area reserves in the City of Melville. In the 2017 surveys the flora inventory for each reserve was:

- 13 species in Art Wright
- 15 species in Arthur Kay
- 27 species in Harold Field
- 24 species in Olding Park
- 2 species in William Reynolds

The flora inventory is included in [Table 34](#) in [Appendix 1](#).

Plants in the Modified Reserves (Karrakatta soils) are to be managed as similar but independent populations due to the highly fragmented nature and distance between reserves (assuming a lack of interbreeding through dispersal of seed or pollen). Reserves within 5-20km of each could be considered part of a meta-population (Young, Broadhurst, Byrne, Coastes, & Yates, 2005) and be managed for overall viability of the species across those reserves, with sub-populations on each site also requiring monitoring.

The indices for plants are listed in [Table 8](#)

**Table 8 Plant Indices**

Values	Plants	Status 2008	Status 2017	Assets 2008-2017
<b>Medium</b> Present in many Melville reserves, but in low abundance or decline	<i>Banksia prionotes</i>	Assumed Present	15 plants	4 species Maintained
	<i>Banksia attenuata</i>		25 plants	
	<i>Banksia menziesii</i>		51 plants	
	<i>Xanthorrhoea preissii</i>		No data	

### Plants at High Risk of Local Extinction

*Banksia* trees ([Table 9](#) below):

- *Banksia prionotes*, Acorn Banksia:
  - Only one individual recorded in Arthur Kay Reserve
- *Banksia attenuata*, Candle-stick Banksia:
  - Only 1 individual recorded in Arthur Kay Reserve
- *Banksia menziesii*, Firewood Banksia:
  - Only 5 individuals recorded in Arthur Kay Reserve, although more highly represented across other reserves within the Modified Reserves (Karrakatta soils).





Table 9 Number of Banksia Trees in City of Melville Reserves

Species	Art Wright Reserve	Arthur Kay Reserve	Harold Field Reserve	Olding Park	William Reynolds Park	Total Species Count
<i>Banksia attenuata</i>		1	24			25
<i>Banksia grandis</i>						0
<i>Banksia ilicifolia</i>						0
<i>Banksia menziesii</i>	11	5	20	15		51
<i>Banksia prionotes</i>		1		14		15
<b>Total Species Count</b>	<b>11</b>	<b>7</b>	<b>44</b>	<b>29</b>	<b>0</b>	<b>91</b>

The Modified Reserves (Karrakatta soils) support a small proportion of Banksia trees compared with other City of Melville reserves, with the exception of Harold Field Park. See below for a comparison to other City of Melville reserves in Table 10.

Table 10 Number of Banksia Trees in City of Melville Reserves

Species	South-Eastern (uninfested) Reserves (2 reserves)	South-Eastern (Infested) Reserves (8 reserves)#	Eastern Reserves (3 reserves)	Bullcreek Reserves (7 reserves)	North-West Reserves (3 reserves)	Estuarine Reserves+ (4 reserves)	Heathcote Reserve (1 reserve)	Wireless Reserve (1 reserve)	Piney Lakes Reserve (1 reserve)	Quenda (1 reserve)	Modified Reserves (11 reserves)	Central (2 reserves)	Total (35 reserves)
<i>Banksia attenuata</i>	16	578	28	22	>26*	98	7	2218	110	10	68	207	3388
<i>Banksia grandis</i>	5	6	0	5	13	1	0	7	24	3	1	4	69
<i>Banksia ilicifolia</i>	6	138	16	22	1	0	0	4	0	0	5	1	193
<i>Banksia littoralis</i>	0	23	0	0	0	4^	0	0	91	140	0	0	258
<i>Banksia menziesii</i>	48	694	152	78	>74*	177	40	1529	202	20	141	180	3335
<i>Banksia prionotes</i>	0	0	52^	0	0	168	0	0	0	0	15	0	235
<b>Total</b>	<b>75</b>	<b>1439</b>	<b>248</b>	<b>127</b>	<b>114</b>	<b>448</b>	<b>47</b>	<b>3758</b>	<b>427</b>	<b>173</b>	<b>230</b>	<b>392</b>	<b>7478</b>

All trees counted except where \* indicates only trees with trunk >30 cm diameter counted

^assumed planted

### Plants at Moderate Risk of Local Extinction or Significant on site

- *Xanthorrhoea preissii*, Grass tree:
  - Many very large, old individuals present in Art Wright, Arthur Kay and Harold Field Reserves
  - In Art Wright and Arthur Kay, *Xanthorrhoea* forms part of the dominant vegetation present on site
  - Little natural recruitment present due to threats on site

### Plants Extinct or Not Confirmed Onsite

No plants were confirmed extinct. The focus of the 2017 flora survey was increasing the flora inventory as many of these reserves had not previously been comprehensively surveyed.



### Native Species to be Managed as Weeds

A number of species native to Western Australia have been planted, some of which do not naturally occur onsite. Detailed planting records were not available and a comprehensive audit of plantings was not conducted, but it is noted that introducing different forms of species, as well as non-local species, can also result in negative impacts in terms of hybridization and competition, especially for significant isolated populations of native species targeted for monitoring and management.

The species that naturally occur on the Swan Coastal Plain, but could possibly be introduced as plantings into the Modified Reserves (Bassendean soils) is listed in **Table 11**.

**Table 11 Native Coastal Plain Plants possibly introduced/of dubious origin to Reserves**

Species	Arthur Kay	Harold Field	Olding Park
<i>Acacia acuminata</i>	1	1	
<i>Agonis flexuosa</i>	1		1
<i>Banksia lindleyana</i>			
<i>Calothamnus quadrifidus</i>		1	1
<i>Eucalyptus orthostemon</i>	1		
<i>Eucalyptus stoatei</i>	1		
<i>Hakea laurina</i>	1		
<i>Hibbertia cuneiformis</i>		1	
<i>Scholtzia laxiflora</i>			1
<b>9</b>	<b>5</b>	<b>3</b>	<b>3</b>



## 2.4.2. Native Fauna

The 15 native animal species (3 reptiles, 10 bird and 2 mammal species) recorded onsite represent 6% of species recorded in the City of Melville. The fauna recorded in 2017 in the Modified Reserves (Karrakatta soils) is listed in [Appendix 2](#).

### Mammals

Two native mammals (both bat species) were confirmed in the Modified Reserves (Karrakatta soils) in 2017. 1 mammal indicator species is listed in [Table 12](#) below and requires ongoing monitoring.

Table 12 Mammal Indices

Values	Birds	Status Pre-2017	Status 2017	Assets 2017
<b>Low</b> Bushland dependent species recorded in more than 2 Melville reserves	<i>Chalinolobus gouldii</i> Gould's Wattled Bat	Assumed Present	Confirmed Present	1 species Maintained

### Reptiles and Amphibians

Each reserve is a separate management and monitoring unit for reptiles and amphibians. Each reserve is likely to support independent resident populations without the potential for unassisted re-colonisation if extinction occurs in an individual reserve. Most reptile species are sedentary and of low mobility, suggesting that they may have limited capacity to move between patches of habitat isolated by clearing or land-use (Wilson & Valentine, 2009).

Only 3 native reptile species were confirmed in the Modified Reserves (Karrakatta soils) in 2017, all of which are skinks. Skinks are relatively persistent in urban bushland as they are the only reptiles whose diversity is not correlated with the size of remnants on the Swan Coastal Plain (How & Dell, 2000).

There are no reptile indicator species that require ongoing targeted monitoring.

### Birds

The Modified Reserves (Karrakatta soils) are spatially distant from one another, however will be treated as a single management and monitoring unit for birds. In urban environments with areas of low overall habitat cover, the degree of connectivity may influence species richness to a greater extent than small differences in patch size, and species persistence may depend upon the occurrence of several populations and dispersal between them (Wilson & Valentine, 2009).

Of the 10 native bird species confirmed in the Modified Reserves (Karrakatta soils), 3 are listed as indicator species in [Table 13](#).



Table 13 Bird Indices

Values	Birds	Status Pre-2017	Status 2017	Assets 2017
<b>Very High</b> Matter of National Environmental Significance under EPBC Act 1999 (vulnerable)	<i>Calyptorhynchus banksii naso</i> Forest Red-tailed Black-Cockatoo	Assumed Present	Confirmed Present	1 species Maintained
<b>Low</b> Bushland dependent species recorded in more than 2 Melville reserves	<i>Smicrornis brevirostris</i> Weebill	Assumed Present	Confirmed Present	2 species Maintained
	<i>Pardalotus striatus</i> Striated Pardalote	Assumed Present	Confirmed Present	

Striated Pardalote and Weebill are both bushland dependent birds that have been identified as being at risk within the City of Melville, due to being recorded in few reserves or in low numbers across the City. These two species are dependent on large habitat trees and adequate canopy cover in order to persist (Pizzey & Knight, 2012).

*Calyptorhynchus banksii naso*, Forest red-tailed Black-Cockatoo, is listed as vulnerable, and evidence of these birds utilising the Modified Reserves (Karrakatta soils) for feeding, and as a linkage between larger remnants was confirmed.

- Sites such as these may form part of a valuable network of habitat remnants providing food resources, especially given the potential for removal of historical pines throughout Melville. It may also be important for the survival of the Cockatoos that reserves are not only retained, but also that native vegetation is maintained in good condition (Gole, 2003).
- Non-breeding feeding habitat is particularly important within 6 km of roost sites (DEC, 2012) and there are confirmed roost sites at Wireless Hill (Ardross), Piney Lakes (Winthrop) and Shirley Strickland Oval (Ardross).
- These birds are granivores, so a dominant overstorey of Eucalypts, Banksia and Sheoaks represents a significant food source; and
- Movement corridors with breaks of less than 4 km between other foraging, breeding and roosting sites are important to allow the birds to move between these areas. (Department of Sustainability, Environment, Water, Population and Communities, 2013).

The critical habitats for birds to be considered in revegetation are summarised in Table 14.

Table 14 Bird Habitat Considerations for Revegetation

Bird	Habitat				Diet		
	Breeds Onsite	Trees Only	Hollows	Bushland	Seed/Plants	Invertebrates	Vertebrates
<i>Calyptorhynchus banksii naso</i> Forest Red-tailed Black-Cockatoo	N		X	X	X		
<i>Smicrornis brevirostris</i> Weebill	?			X		X	
<i>Pardalotus striatus</i> Striated Pardalote	?		X	X		X	

? = Possibly but no existing records to confirm nesting



### **Invertebrates**

There have been no systematic surveys for invertebrates in bushland in the City of Melville, and no records exist for invertebrates in the Modified Reserves (Karrakatta soils).



## 3. Threats

### 3.1. Overview

The NAAMP identified the ten most significant threats to natural areas in the City of Melville and details the impacts they can have. These threats (with the exception of stormwater and reticulation which are specific to small bushland remnants in an urban environment) align with major biodiversity threatening processes.

The significance of threats can be assessed in a similar manner to that used for assets as indicated in **Figure 5**.

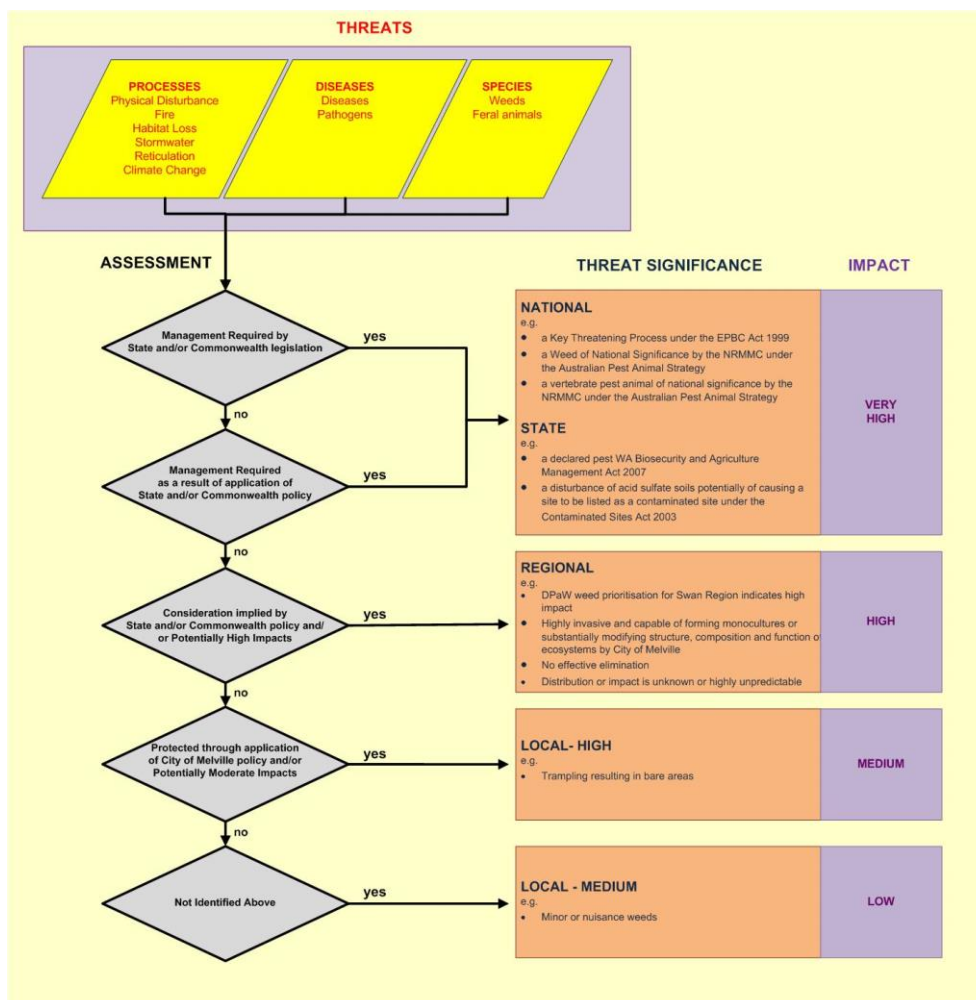


Figure 5 Assessment of Threats in Natural Areas

### 3.2. Physical Disturbance

There is no data for physical disturbance available, but there was little evidence of any disturbances onsite in 2017 for most indices, so an assumption that it was minimal for 2017-2020 is reflected in Table 15. There is evidence of regular informal bike track building in Art Wright Reserve, garden and other rubbish dumping occurrences, and informal tracks at several reserves.

Table 15 Physical Disturbance Indices

Impacts	Physical Disturbance	Disturbances 2008-2017	Disturbances 2017-2020	Threats
<b>High</b> Potential to substantially change ecosystem structure, composition or function	Clearing for utilities	No Data	Minimal	1 Threat Contained
<b>Medium</b> Potential to moderately change ecosystem structure, composition or function	Trampling		Moderate	2 Threats Contained
	Sediment/Erosion		Minimal	
	Rubbish Dumping		Moderate	3 Threats Managed
	Tree Poisoning, Illegal Clearing, Firewood Collection		Minimal	
<b>Medium</b> Potentially costly remediation	Vandalism		Moderate	

### 3.3. Fire

An individual fire may not necessarily be a threat to the biodiversity, as the flora and fauna of the region has evolved in the context of, adapted to, and in part depends upon, fire. However modified fire regimes (characterised in terms of intensity, frequency, season and scale), especially in the context of external factors such as habitat fragmentation and climate change can lead to the decline and/or local extinction of species.

The two fire scenarios that were identified in the NAAMP as potential triggers for local extinctions of vulnerable species were:

- Large Fires (a fire burning more than one third of a reserve); and
- Repeat Fires (fires burning the same portions of a reserve within eight years).

Table 16 reflects that there was no evidence of large or repeat fires from 2017-2020.

Table 16 Fire Indices

Impacts	Fires	Extent of Fires 2008-2017	Extent of Fires 2017-2020	Threats
<b>High</b> Potential for local extinctions of ground dwelling species	Large fires	No data	0 ha	2 Threats Prevented
<b>High</b> Potential for local extinctions of trees and shrubs that regenerate only from seed stored on the plant	Repeated fires		0 ha	



### 3.4. Weeds

The 47 weed species recorded in the Modified Reserves (Karrakatta Soils) are listed in [Appendix 1](#). Most of the very high impact weeds have been prevented or contained, with the exception of one individual Bridal Creeper plant located at Olding Park. The most widespread weeds were annual and perennial clumping grasses, perennial running grasses and other annual weeds.

The extents of weeds in 2017 (based on presence at 51 reference points in a grid with 30 metre spacing) are listed in [Table 17](#), with distributions mapped in [Appendix 4](#). The following assumptions were made in terms of trends:

- weeds were prevented if not observed in 2017 survey;
- weeds were contained if localised (< 50% of grid points in 2017 survey); and
- weeds were not assessable if widespread (>50% of grid points in 2017 survey).

**Table 17 Weed Indices**

Impact	Weeds	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds	Total	Threats
Very High	Arum Lily Blackberry Golden Dodder Lantana Madeira Vine Narrowleaf Cottonbush One Leaf Cape Tulip Tamarisk Willows Asparagus Fern Paterson's Curse Soldiers Brazilian Pepper	0%						13 weeds Prevented
	Very Large Trees				<50%		Localised	2 weeds Contained
	Bridal Creeper				<50%			
	Perennial Clumping Grass	>50%	>50%	>50%	>50%		Widespread	1 weed Not assessable
High	Giant Grasses	0%						1 weed prevented
	Annual Clumping Grass	>50%	<50%	>50%	>50%		Widespread	2 weeds Not assessable
	Perennial Running Grass	>50%		>50%	>50%			
	Clumping Geophytes	<50%	<50%	<50%			Localised	2 weeds Contained
	Shrubs and Trees	<50%	<50%	<50%	<50%		Localised	
Medium	Perennial Weeds	>50%	<50%	<50%	<50%		Localised	1 reserve Not Assessable 3 reserves Contained
Low	Annual Weeds	>50%	>50%	>50%	>50%		Widespread	1 weed Not Assessable



A site-based approach should be applied to prioritising woody weeds for removal with a focus on shrub and tree weeds removal as these were in relatively low numbers. The number of individual weed plants of selected weeds is indicated in **Table 18**.

**Table 18 Number of Plants in 2016 of Selected Weeds**

Impact	Weeds	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds	Total
Very High	Brazilian Pepper						0
High	Very Large Trees				2		2
High	Shrubs and Trees	7	5	6	4		22
	<b>Total</b>	<b>7</b>	<b>5</b>	<b>6</b>	<b>6</b>	<b>0</b>	<b>24</b>

### 3.5. Habitat Loss

Habitat loss has been mapped in two ways, based on weed coverage and percentage bare ground. This method has been used instead of bushland condition rating as it is more quantitative in its assessment.

The extent of weed coverage is indicated in **Table 19**. The distribution of total weed cover at each grid point is shown in **Figure 19**.

**Table 19 Cover of All Weeds Combined**

Category	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds
0%	0%	0%	0%	0%	No Data
1-5%	0%	100%	30%	0%	
6-25%	0%	0%	25%	36%	
26-100%	100%	0%	45%	64%	
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	

The extent of bare ground is categorised in **Table 20**. The distribution of total bare ground is shown in **Figure 20**.

**Table 20 Bare Ground Cover**

Category	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds
0%	0%	0%	0%	0%	No Data
1-5%	0%	10%	5%	0%	
6-25%	86%	40%	85%	57%	
26-100%	14%	50%	10%	43%	
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	

The habitat loss indices are listed in **Table 21**. Art Wright weed coverage was of high priority, as all grid points fell into the >25% weed coverage category.

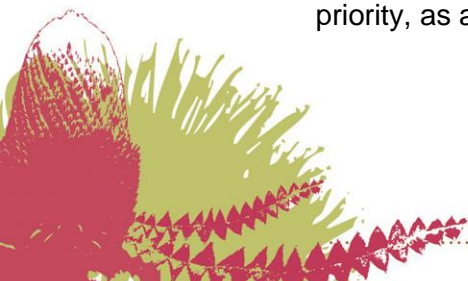


Table 21 Habitat Loss Indices

Impact	Habitat Loss	% of Reserve Pre-2017	% of Reserve 2017	Threat Pre 2017-2017
<b>Medium</b> Process of moderate ecosystem function modification <ul style="list-style-type: none"> <li>• Reduced natural regeneration</li> <li>• Increased fire or erosion risk</li> </ul>	Weed Cover > 25%	No Data	52%	Change Not Assessable
<b>Low</b> Process of low ecosystem function modification <ul style="list-style-type: none"> <li>• Reduced natural regeneration</li> <li>• Increased fire or erosion risk</li> </ul>	Bare Ground > 25%		29%	





Figure 19 Cover of All Weeds Combined for each reserve





Figure 20 Cover of Bare Ground for each reserve



### 3.6. Feral Animals

Feral animal populations are not surveys for abundance but presence/absence can be determined based on sightings or evidence through the City's feral animal control program and surveys, as indicated in Table 22.

Table 22 Feral Animal Records

Feral Animal		Status 2017	Status 2020
Mammals	<i>Oryctolagus cuniculus</i> , Rabbits	Not Present	Assumed Not Present
	<i>Vulpes vulpes</i> , Foxes		
	<i>Felis catus</i> , Feral Cats		
	<i>Mus musculus</i> , House Mice		
	<i>Rattus norvegicus</i> , Brown Rat		
	<i>Rattus rattus</i> , Black Rat		
Birds	<i>Streptopelia chinensis</i> , Spotted Dove	Confirmed Present	Assumed Present
	<i>Trichoglossus haematodus</i> , Rainbow Lorikeet		
Insects	<i>Apis mellifera</i> , Feral Honeybee	Not Present	Assumed Not Present

*Oryctolagus cuniculus*, rabbits, were not recorded in 2017. *Vulpes vulpes*, foxes, are assumed absent although foxes could pass through these reserves, but they are likely too small to utilise for creation of dens. *Felis catus*, cats, were not recorded although there is possibility of domestic cats using local reserves.

The indices for feral animals are only for those species for which some control is practical and effective. The indices are listed in Table 23, with an occurrence defined as specific sightings of dens, warrens, hives or animals.

Table 23 Feral Animal Indices

Impact	Feral Animal	Occurrences 2008-2017	Occurrences 2017 - 2020	Threat 2017-2020
<b>Very High</b> Key Threatening Process under the EPBC Act 1999	<i>Oryctolagus cuniculus</i> , Rabbit	No Data	Absent	Assumed Prevented
	<i>Vulpes vulpes</i> , Fox			
	<i>Felis catus</i> , Feral Cat			
<b>High</b> Competition with native birds for hollows and food (impact level variable)	<i>Apis mellifera</i> , Honeybee			

### 3.7. Diseases and Pathogens

*Phytophthora cinnamomi*, Dieback, is a microscopic water mould that weakens or kills the plants by reducing or stopping the movement of water and nutrients within the plant (Dieback Working Group, 2000), and 'is one of the major threats to the biodiversity of Western Australia's ecosystems' (DEC, 2010).

The presence of *Phytophthora cinnamomi* was confirmed at Olding Park in 2018 by Terratree, noting the following:

- Olding Park:**

The southern vegetated portion of Olding Park is uninfested with a healthy overstorey of *Eucalyptus marginata* trees as well as *Banksia attenuata*, *B. menziesii* and *Xanthorrhoea preissii*, comprising 0.19ha. The northern half of vegetated area within the park is degraded and infested with multiple infested indicator species including *E. marginata*, *B. attenuata*, *B. menziesii* and *Xanthorrhoea preissii* and little or no understorey species remaining, comprising 0.37ha. There is a clear delineation between the infested northern portion and the uninfested southern portion of the Park.

The remaining reserves have not recently been formally surveyed, but were deemed to be 'Unprotectable' by Glevan Consulting (2010), and it was recommended they be managed as if they were infested (on the basis that either the vegetation was severely degraded or contained no Dieback disease indicating species).

Disease occurrence mapping for Olding Park indicates a partial infestation of *Phytophthora cinnamomi*, Dieback, as shown in [Figure 21](#).

*Armillaria luteobubalina*, Honey Fungus, is an indigenous parasitic mushroom that is widespread in south west Western Australia that causes decay in roots and stems that can result in the death of the host plant (Shearer, 1994). Whilst no targeted surveys have been undertaken it is assumed to be absent from the Modified Reserves (Karrakatta soils):

- no occurrences of *Armillaria luteobubalina* have been documented in the City;
- there were also no opportunistic observations of patches of dead susceptible plants, or the parasitic mushroom itself; and
- it occurs most frequently in coastal dunes, and forests east of the Darling Scarp, and rarely occurs in the acidic sands of the Bassendean Dune system (Shearer, 1994).

The diseases and pathogens for which objectives apply are listed in [Table 24](#).

**Table 24 Disease and Pathogen Indices**

Impact	Diseases and Pathogens	Extent 2010	Extent 2018	Threat 2018-2020
<b>Very High</b> Key Threatening Process under the EPBC Act 1999	<i>Phytophthora cinnamomi</i> Dieback	Assumed present	Olding Park- 47% Infested	Assumed Contained
<b>Medium</b> Native species capable of moderate modification of structure and composition of flora by killing multiple species	<i>Armillaria luteobubalina</i> Honey Fungus	No Data	Assumed Absent	Assumed Prevented







Figure 21 Interpretation of Extent of Dieback Infestation in 2018

### 3.8. Stormwater

There are no stormwater discharge points into the reserves.

There are no water quality indices for which objectives apply in the Modified Reserves (Karrakatta soils) as these only apply in bushland where the stormwater is discharged into an open waterbody. Any erosion/sedimentation associated with the stormwater outlets is monitored as a physical disturbance and would be discussed in [Section 3.2](#) if applicable.

### 3.9. Reticulation

There is reticulated lawn adjacent to bushland in Art Wright, Olding Park and William Reynolds however there have been no reported instances of additional water being applied to the bushland. The indices for reticulation are listed in [Table 25](#), with an occurrence defined as specific sightings of excessive drift or leaking.

**Table 25 Reticulation Indices**

Impact	Water Sources	Occurrences 2008 - 2017	Occurrences 2017 - 2020	Threat 2017-2020
<b>Low</b> Alteration of Surface Water Flows	Overspray / leakages from reticulation	No Data	No Data	Assumed Contained

### 3.10. Acid Sulfate Soils

Acid Sulfate Soil (ASS) reactions can potentially occur where:

- excavations are dug below the minimum level of the watertable; and/or
- groundwater extraction results in oxidation of soils previously permanently saturated by lowering the minimum level of the watertable.

The Modified Reserves (Karrakatta soils) fall into low risk category for the occurrence of ASS (NAAMP, 2019).

There is no evidence of any ASS reactions previously occurring in the Modified Reserves (Karrakatta soils), and no documented excavations or groundwater extraction has occurred, as reflected in [Table 26](#).

**Table 26 Acid Sulfate Soil Indices**

Impact	Potential Initiation of ASS Reactions	Occurrences 2008 - 2017	Occurrences 2017 - 2020	Threat 2017-2020
<b>Very High</b> An occurrence of could result in the reserve being listed as a contaminated site under the Contaminated Sites Act 2003	Excavations below the minimum level of the watertable	No Data	0	Assumed Prevented
	Groundwater extraction resulting in lowering of minimum level watertable		No Data	



### 3.11. Climate Change

The climate trend is for hotter and drier weather. During the period 2008-2019 average annual rainfall has shown to be decreasing and mean annual temperature has shown to be increasing for nearby Perth Airport, as shown in **Table 27** (Bureau of Meteorology 2020).

In 2017 when the surveys were undertaken, August and September were wetter than in 2008 and 2019 years, however April, May and Jun were particularly dry months compared to other years, which may have had an impact on the flora species recorded in the surveys.

**Table 27 Perth Airport Climate Data**

Climate Data- Perth Airport (9021)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual total
<b>Rainfall</b>													
Monthly Total 2008	0.0	39.6	16.2	135.0	59.8	170.0	213.6	19.0	66.8	33.8	69.0	5.4	828.2
Monthly Total 2017	39.8	89.8	19.8	0.0	57.0	54.8	181.8	149.2	81.2	26.0	1.8	28.2	729.4
Monthly Total 2019	5.8	0.8	4.8	35.2	12.4	175.0	101.0	117.2	31.8	23.4	15.0	2.2	524.6
<b>Temperature</b>													
Monthly mean 2008	33.8	32.7	30.0	24.3	22.7	19.7	17.9	19.4	20.5	24.1	23.9	28.6	24.8
Monthly mean 2017	32.0	30.3	28.3	27.5	22.9	21.5	18.1	18.8	20.8	23.2	30.0	30.6	25.3
Monthly mean 2019	31.3	32.2	31.0	26.0	22.5	19.6	19.3	20.2	23.1	24.7	29.8	33.9	26.1

No objectives apply to containing or preventing climate change as extreme weather events as the threat can only be addressed indirectly through management of impacts to assets.





## 4. Management

### 4.1. Review of Management 2008-2020

#### 4.1.1. Key Performance Indicators

On-ground works were undertaken including maintenance, weed control, plantings and removal of illegal dumpings. There was no previous management plan for Modified Reserves (Karrakatta soils), so no audit of these works was undertaken.

### 4.2. Management Objectives 2020-2025

#### 4.2.1. Leading Indicators

Leading indicators are associated with changes in the density / abundance / extent / occurrences of threats. The levels of acceptable changes are determined in the framework established in the NAAMP as summarised in Table 28 and applied in Table 29 and Table 30.

Table 28 Tiered Objectives for Threats and Associated Leading Indicators

Objective	Leading Indicator	Applicable When
<b>Prevent</b>	<ul style="list-style-type: none"> <li>Prevent introduction to or occurrence of</li> </ul>	<ul style="list-style-type: none"> <li>Threat absent from reserve</li> <li>Unplanned Introduction Possible</li> </ul>
<b>Eliminate</b>	<ul style="list-style-type: none"> <li>reduce rate of density / abundance / extent (Eventual complete removal, but in short term may only reduction of numbers or prevention of seed set onsite)</li> </ul>	<ul style="list-style-type: none"> <li>Large discrepancy between current and potential impact</li> <li>Potential impact high</li> <li>Elimination feasible</li> </ul>
<b>Contain</b>	<ul style="list-style-type: none"> <li>Stop, restrict, or reduce rate of spread or frequency of occurrence</li> </ul>	<ul style="list-style-type: none"> <li>Moderate discrepancy between current and potential impact</li> <li>Potential but not current impact high</li> <li>Elimination not feasible</li> </ul>
<b>Manage</b>	<ul style="list-style-type: none"> <li>Limit negative impacts on assets</li> </ul>	<ul style="list-style-type: none"> <li>Small discrepancy between current and potential impact</li> <li>Threat “naturalised” or near maximum extent</li> <li>No information on density/abundance/extent</li> </ul>
<b>None</b>	<ul style="list-style-type: none"> <li>Not Applicable</li> </ul>	<ul style="list-style-type: none"> <li>Threat absent from reserve</li> <li>Only Planned Introduction Possible</li> </ul>

Table 29 Objectives for Weed Species

Objective	Impact	Weed Species / Group	2017 Extent	Comments
<b>Prevent</b>	Very High	Arum Lily Blackberry Golden Dodder Lantana Madeira Vine Narrowleaf Cottonbush One Leaf Cape Tulip Tamarisk Willows Asparagus Fern Paterson's Curse Soldiers Brazilian Pepper	0%	Not Present Onsite
	High	Giant Grasses		
<b>Eliminate</b>	Very High	Bridal Creeper Very Large Trees	<50%	1 occurrence Bridal Creeper and 2 <i>Corymbia citriodora</i> trees in Olding Park
	High	Trees and Shrubs	22	Eliminate 22 woody weeds: Olding Park <ul style="list-style-type: none"> <li><i>Acacia iteaphylla</i></li> <li><i>Acacia longifolia</i></li> </ul>

				<ul style="list-style-type: none"> <li>• <i>Olea europaea</i></li> </ul> Harold Field <ul style="list-style-type: none"> <li>• <i>Acacia iteaphylla</i></li> <li>• <i>Brachychiton populneus</i></li> </ul> Arthur Kay <ul style="list-style-type: none"> <li>• <i>Acacia longifolia</i></li> <li>• <i>Nerium oleander</i></li> <li>• <i>Olea europaea</i></li> </ul> Art Wright <ul style="list-style-type: none"> <li>• <i>Acacia iteaphylla</i></li> <li>• <i>Acacia podalyriifolia</i></li> <li>• <i>Agave Americana</i></li> <li>• <i>Lavandula stoechas</i></li> <li>• <i>Nerium oleander</i></li> <li>• <i>Olea europaea</i></li> </ul> (Maps of locations in Appendix 4)
	Low	Natives of Dubious Origin	11	Eliminate planted species to be managed as weeds on site (listed in section 2.4.1)
<b>Contain</b>	Very High	Perennial Clumping Grasses	>50%	Elimination not feasible in short to medium term
	High	Annual Clumping Grasses	>50%	
		Perennial Running Grass	>50%	
		Clumping Geophytes	<50%	
<b>Manage</b>	Medium	All other perennial weeds	<50%	Focus in terms of asset protection – revegetation sites
	Low	All other annual weeds	>50%	



Table 30 Objectives for all other Threats

Objective	Impact	Threat	Comments
Prevent	Very High	Acid Sulfate Soil	Monitoring required as groundwater extraction proposed
		Ferals (Foxes)	Absent - occasional incursion may occur and remove/eliminate with 10 working days of observations, before they permanently establish
		Ferals (Rabbits)	Absent - occasional incursion may occur and remove/eliminate with 10 working days of observations, before they permanently establish
		Ferals (Cats)	Absent - occasional incursion may occur and remove/eliminate with 10 working days of observations, before they permanently establish Also manage threat indirectly through revegetation - increase vegetation cover to aid small vertebrates evade predation
	High	Fires (large and repeat)	Prevent fires that burn more than one third of bushland or in the same portion of bushland, in consultation with Department of Fire and Emergency Services
	High	Ferals (Bees)	Absent – remove/eliminate with 10 working days of observations, before they permanently establish
	Medium	Diseases and Pathogens (Honey Fungus)	Assumed absent - never recorded in the City of Melville Apply appropriate hygiene standards for on-ground works to prevent introduction
Contain	Very High	Habitat Loss	Limit fragmentation of bushland (e.g. by paths, trampling, informal bike tracks) within reserves and increase native vegetation cover
	Medium	Physical Disturbance	Manage public access and trampling through the provision of paths and use of soft barriers (such as plantings) and hard barriers (such as fences). Remove disturbance activities such as informal tracks and illegal dumping.
Manage	Very High	Diseases and Pathogens (Dieback)	Manage impacts directly through Phosphite applications, signage, public education and revegetation with non-susceptible species as required.
		Climate Change	Manage through: <ul style="list-style-type: none"> <li>• revegetation if mass plant deaths occur or are likely.</li> <li>• prioritisation of removal of high water use weeds (especially weed trees and shrubs)</li> <li>• maintenance of soil moisture through maintenance of canopy and thick leaf litter</li> </ul>
	High	Ferals (Birds)	Monitor population numbers and record impacts. Install only bird and bat boxes that limit use by ferals
	Low	Ferals (Mice)	Assumed absent but could be present in adjacent urban areas. Manage indirectly through revegetation to offset seed predation
		Reticulation	Manage through maintenance and operation of reticulation to avoid drift or leaks into bushland



## 4.2.2. Lagging Indicators

Lagging indicators are associated with changes in the density / abundance / extent / occurrences of assets. The levels of acceptable change are determined in the framework established in the NAAMP as summarised in Table 31 and applied in Table 32 and Table 33.

Table 31 Tiered Goals for Assets and Associated Lagging Indicators

Goal	Lagging Indicator	Applicable When
<b>Enhance</b>	Increase in either <ul style="list-style-type: none"> <li>• extent</li> <li>• density</li> <li>• numbers or</li> <li>• occurrences</li> </ul>	Asset can be enhanced and <ul style="list-style-type: none"> <li>• occurs in only one reserve and/or</li> <li>• at risk of local extinction and/or</li> <li>• minimal cost (e.g. incorporated in revegetation program) and/or</li> <li>• reduces operational costs (e.g. reduces requirements for on-going for threat management)</li> </ul>
<b>Maintain</b>	No decrease in either <ul style="list-style-type: none"> <li>• extent</li> <li>• density</li> <li>• numbers or</li> <li>• occurrences</li> </ul>	Asset can be maintained and <ul style="list-style-type: none"> <li>• the asset occurs in a number of reserves and/or</li> <li>• not a risk of local extinction and/or</li> <li>• occurs in only one reserve but insufficient knowledge/resources to enhance</li> </ul>
<b>Confirm</b>	Decrease in: <ul style="list-style-type: none"> <li>• number of assets for which their presence is uncertain</li> </ul>	Asset significant and <ul style="list-style-type: none"> <li>• historic but no recent records in reserve and/or</li> <li>• potential to be in reserve based on habitat and/or proximity of other records</li> </ul>
<b>Monitor</b>	No indices for management effectiveness	Assets that cannot be maintained by actions within City of Melville boundaries or for which no quantifiable indices exist and: <ul style="list-style-type: none"> <li>• for which reserves are not critical component of habitat (e.g. highly mobile/wide roaming and/or infrequent/irregular visitors to the City of Melville)</li> <li>• there is a risk of local extinction from processes that cannot be mitigated by the City of Melville (e.g. climate change, some pathogens)</li> </ul>

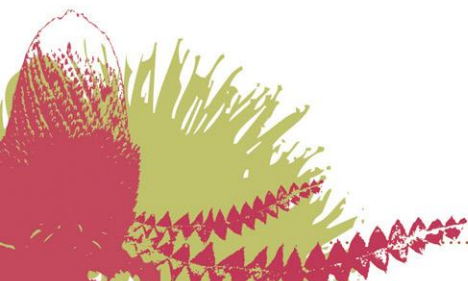




Table 32 Goals for Species

Goal	Priority	Asset	Comments
Enhance	Medium	<i>Banksia prionotes</i>	Increase the population from 1 to 10 plants in Arthur Kay
		<i>Banksia attenuata</i>	Increase the population from 1 to 10 plants in Arthur Kay
		<i>Banksia menzeisii</i>	Increase the population from 5 to 10 plants in Arthur Kay
	Low	<i>Banksia grandis</i>	Opportunity to reintroduce this species across all reserves, increase population to 5 in each reserve
		<i>Banksia ilicifolia</i>	Opportunity to reintroduce this species across all reserves, increase population to 5 in each reserve
Maintain	Medium	<i>Xanthorrhoea preissii</i>	Maintain the population of old, significant grass trees on site at Art Wright, Arthur Kay and Harold Field Reserves
	Low	<i>Banksia prionotes</i>	Trees susceptible to dieback, and likely requires Phosphite treatments to be retained onsite in Olding Park with active dieback infestation.
		<i>Banksia menziesii</i>	
		<i>Banksia attenuata</i>	Maintain the population of 24 plants in Harold Field
		<i>Chalinolobus gouldii</i>	Resident bat. Maintain habitat in the form of very large habitat trees and insect attracting vegetation.
		<i>Pardalotus striatus</i>	Resident birds requiring tree hollows for breeding. Maintain habitat in the form of very large habitat trees.
		<i>Smicrornis brevirostris</i>	Resident birds not requiring tree hollows for breeding. Maintain habitat in the form of overstorey/canopy cover.
Monitor	High	<i>Calyptrorhynchus banksii naso</i>	Bird species utilising the site for feeding. Maintain habitat in the form of food tree species.
Confirm	Low	<i>Christinus marmoratus</i>	Confirm whether marbled gecko is present on site
		<i>Platycercus zonarius</i>	Confirm whether Ringneck Parrot is present on site

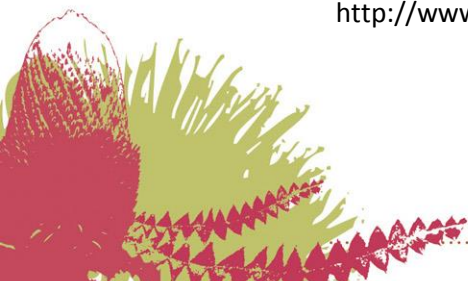
Table 33 Goals for Sites

Goal	Priority	Asset	Comments
Enhance	High	Karrakatta – Central and South Vegetation Complex	Enhance vegetation complex (less than 5% pre-European extent remaining in City of Melville) by managing threats and enhancing Banksia species as above.
Maintain	Medium	Revegetation Sites – existing plantings	Maintain revegetation and community interest sites across reserves
		Habitat Sites - very large live native trees	Assets that are expected to persist onsite if standard threat management procedures and guidelines are effective and implemented.
Monitor	Low	Nest box- Harold Field	Monitor nest box for signs of breeding by native parrots



## References

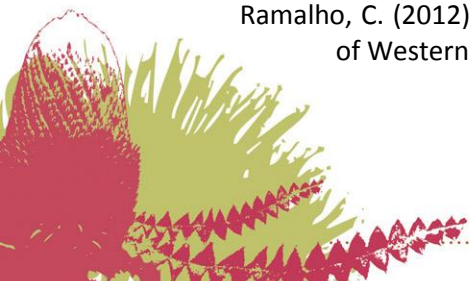
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# Appendix 1 Flora Inventory

Table 34 Native Flora Inventory

Species	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds
<i>Acacia cyclops</i>				1	
<i>Acacia lasiocarpa</i>	1				
<i>Acacia pulchella</i>			1	1	
<i>Acacia saligna</i>	1		1	1	
<i>Allocasuarina fraseriana</i>			1	1	
<i>Allocasuarina humilis</i>			1	1	
<i>Banksia attenuata</i>			1	1	
<i>Banksia menziesii</i>	1	1	1	1	
<i>Banksia prionotes</i>		1		1	
<i>Banksia sessilis</i>				1	
<i>Bossiaea eriocarpa</i>		1			
<i>Conostylis candicans</i>				1	
<i>Conostylis</i> sp.			1		
<i>Corymbia calophylla</i>	1	1	1	1	
<i>Desmocladius flexuosus</i>			1		
<i>Dianella revoluta</i>	1	1	1		
<i>Eucalyptus gomphocephala</i>				1	
<i>Eucalyptus marginata</i>	1	1	1	1	1
<i>Hakea prostrata</i>			1	1	
<i>Hardenbergia comptoniana</i>		1	1	1	
<i>Hibbertia hypericoides</i>			1		
<i>Hypocalymma robustum</i>			1	1	
<i>Jacksonia furcellata</i>	1	1	1	1	
<i>Jacksonia sternbergiana</i>	1			1	
<i>Kunzea glabrescens</i>				1	
<i>Lepidosperma calcicola?</i> (could be squamatum)		1	1		
<i>Lepidosperma pubisquameum</i>			1		
<i>Leucopogon propinquus</i>			1		
<i>Lomandra suaveolens</i>	1				
<i>Macrozamia fraseri</i>	1	1	1	1	
<i>Melaleuca systema</i>		1		1	
<i>Melaleuca viminea</i>		1			
<i>Mesomelaena pseudostygia</i>	1	1	1		
<i>Nuytsia floribunda</i>				1	
<i>Paraserianthes lophantha</i>			1		
<i>Patersonia occidentalis</i>	1				
<i>Petrophile linearis</i>		1			
<i>Pimelea rosea</i>			1		
<i>Sowerbaea laxiflora</i>			1		
<i>Tetraria octandra</i>			1		
<i>Xanthorrhoea brunonis</i>			1	1	
<i>Xanthorrhoea preissii</i>	1	1	1	1	1
<b>42</b>	<b>13</b>	<b>15</b>	<b>27</b>	<b>24</b>	<b>2</b>

Table 35 Weed Inventory

Species	Common Name	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds
<i>Acacia iteaphylla</i>	Flinders Range Wattle	1		1	1	
<i>Acacia longifolia</i>	Sydney golden wattle		1		1	
<i>Acacia podalyriifolia</i>	Queensland silver wattle	1				
<i>Agave americana</i>	Century Plant	1				
<i>Aira cupaniana</i>	Silvery Hairgrass	1				
<i>Asphodelus fistulosus</i>	Onion Weed			1		
<i>Avena barbata</i>	Bearded Oat	1	1	1	1	
<i>Brachychiton populneus</i>	Kurrajong			1		
<i>Brassica tournefortii</i>	Mediterranean Turnip	1				
<i>Briza maxima</i>	Blowfly Grass		1	1	1	
<i>Bromus diandrus</i>	Great Brome	1		1	1	
<i>Cenchrus clandestinus</i>	Kikuyu Grass	1	1		1	
<i>Commelina benghalensis</i>	Benghal dayflower	1				
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	1	1			
<i>Corymbia citriodora</i>	Lemon Scented Gum		1		1	
<i>Cynodon dactylon</i>	Couch	1		1		
<i>Ehrharta calycina</i>	Perennial Veldt Grass	1	1	1	1	
<i>Ehrharta longiflora</i>	Annual Veldt Grass	1	1	1	1	
<i>Eragrostis curvula</i>	African Lovegrass	1			1	
<i>Eucalyptus botryoides</i>	Southern Mahogany		1			
<i>Eucalyptus cladocalyx</i>	Sugar Gum	1	1			
<i>Eucalyptus erythrocorys</i>	Illyarrie				1	
<i>Eucalyptus orthostemon</i>			1			
<i>Eucalyptus stoatei</i>	Scarlet Pear Gum		1			
<i>Euphorbia peplus</i>	Petty Spurge	1	1			
<i>Euphorbia terracina</i>	Geraldton Carnation Weed	1		1		
<i>Fumaria capreolata</i>	Whiteflower Fumitory	1		1	1	
<i>Gladiolus undulatus</i>	Wild Gladiolus		1	1		
<i>Hakea laurina</i>	Pincushion Hakea		1			
<i>Hordeum leporinum</i>	Barley Grass		1	1		
<i>Hypochaeris glabra</i>	Smooth Catsear	1	1	1	1	
<i>Lactuca serriola</i>	Prickly Lettuce	1	1	1	1	
<i>Lagurus ovatus</i>	Hare's Tail Grass	1				
<i>Lavandula stoechas</i>	Italian Lavender	1				
<i>Lolium multiflorum</i>	Italian Ryegrass	1		1	1	
<i>Nerium oleander</i>	Oleander	1	1			
<i>Nothoscordum gracile</i>		1				
<i>Olea europaea</i>	Olive	1	1		1	
<i>Orobancha minor</i>	Lesser Broomrape			1	1	
<i>Oxalis caprina</i>		1				
<i>Oxalis pes-caprae</i>	Soursob			1	1	
<i>Pelargonium capitatum</i>	Rose Pelargonium	1				
<i>Polygala myrtifolia</i>	Myrtleleaf Milkwort			1		
<i>Sonchus oleraceus</i>	Common Sowthistle	1	1	1	1	
<i>Trifolium angustifolium</i>	Narrowleaf Clover	1				

Species	Common Name	Art Wright	Arthur Kay	Harold Field	Olding Park	William Reynolds
<i>Trifolium</i> sp.	Clover	1		1	1	
<i>Tropaeolum majus</i>	Garden Nasturtium				1	
<b>47</b>		<b>31</b>	<b>21</b>	<b>21</b>	<b>21</b>	<b>0</b>





## Appendix 2 Fauna Inventory

Occurrence code	Description
1	Observed - species was observed, number shows how many individuals were observed
S	Sign-positive evidence of species recorded at site (e.g. chewed nuts, scats, burrows)
R	Recorded - species was recorded on acoustic device and identified from call signature
L	Likely - the species is known to occur in the area and, based on habitat and connectivity to surrounding habitat, is expected to be present at times in the reserve
P	Possible - the species is known to occur in the region, however, no current records exist for the immediate area and/or habitat available is poor or poorly connected to other areas
U	Unlikely - no current records for the area, or a total lack of suitable habitat. Species may be recorded as being locally extinct
Pr EN VU	Conservation Status as per State or National Listings Priority Fauna (WA) Endangered Vulnerable
*	Pest Species
#	Species at risk of localised extinction within City of Melville or identified in few reserves
Species occurrence information compiled from the Department of Biodiversity, Conservation and Attractions NatureMap service, Atlas of Living Australia, local management plans and Ecoscape experience	

Table 36 Native Fauna Inventory

		COM Status	Conservation Status	Art Wright Reserve	Arthur Kay Reserve	Harold Field Reserve	Olding Park	William Reynolds Park
Family	Species							
Birds	Threskiornithidae	Australian White Ibis <i>Threskiornis moluccus</i>			P	P	P	P
	Columbidae	Spotted Turtle-Dove <i>Spilopelia chinensis</i>	*		L	L	L	1
		Laughing Turtle-Dove <i>Spilopelia senegalensis</i>	*		1	L	1	1
	Alcedinidae	Laughing Kookaburra <i>Dacelo novaeguineae</i>	*		L	L	L	L
	Cacatuidae	Forest Red-tailed Black Cockatoo	#	VU	S	S	S	S
		<i>Calyptrorhynchus banksii naso</i>			L	L	L	L
		Galah <i>Cacatua roseicapilla</i>			L	L	L	L
	Psittacidae	Little Corella <i>Cacatua sanguinea</i>	*		L	L	L	13
		Rainbow Lorikeet <i>Trichoglossus moluccanus</i>	*		4	11	7	2
	Meliphagidae	Brown Honeyeater <i>Lichmera indistincta</i>			3	L	1	L
		New Holland Honeyeater <i>Phylidonyris novaehollandiae</i>	#		U	U	U	P
		Red Wattlebird <i>Anthochaera carunculata</i>			L	2	5	4
		Singing Honeyeater <i>Gavicalis virescens</i>			L	1	L	L

	<b>Pardalotidae</b>	Striated Pardalote <i>Pardalotus striatus</i>	#		P	L	L	1	U
	<b>Acanthizidae</b>	Weebill <i>Smicrornis brevirostris</i>	#		L	L	1	L	P
	<b>Cracticidae</b>	Grey Butcherbird <i>Cracticus torquatus</i>			P	P	L	P	P
		Australian Magpie <i>Cracticus tibicen</i>			4	2	3	3	2
	<b>Rhipiduridae</b>	Willie Wagtail <i>Rhipidura leucophrys</i>			L	1	L	L	1
	<b>Monarchidae</b>	Magpie-lark <i>Grallina cyanoleuca</i>			L	1	L	L	L
	<b>Corvidae</b>	Australian Raven <i>Corvus coronoides</i>			L	L	1	L	L
<b>Reptiles</b>	<b>Scincidae</b>	Buchanan's Snake-eyed Skink <i>Cryptoblepharus buchananii</i>			1	L	1	1	L
		Two-toed Earless Skink <i>Hemiergis quadrilineata</i>			2	3	4	1	L
		Common Dwarf Skink <i>Menetia greyii</i>			L	L	1	L	L
<b>Mammals</b>	<b>Vespertilionidae</b>	Gould's Wattled Bat <i>Chalinolobus gouldii</i>	#		R	R	R	R	P
	<b>Molossidae</b>	White-striped Free-tailed Bat <i>Austronomus australis</i>			R	R	R	R	P





## Appendix 3 Reserve Mapping

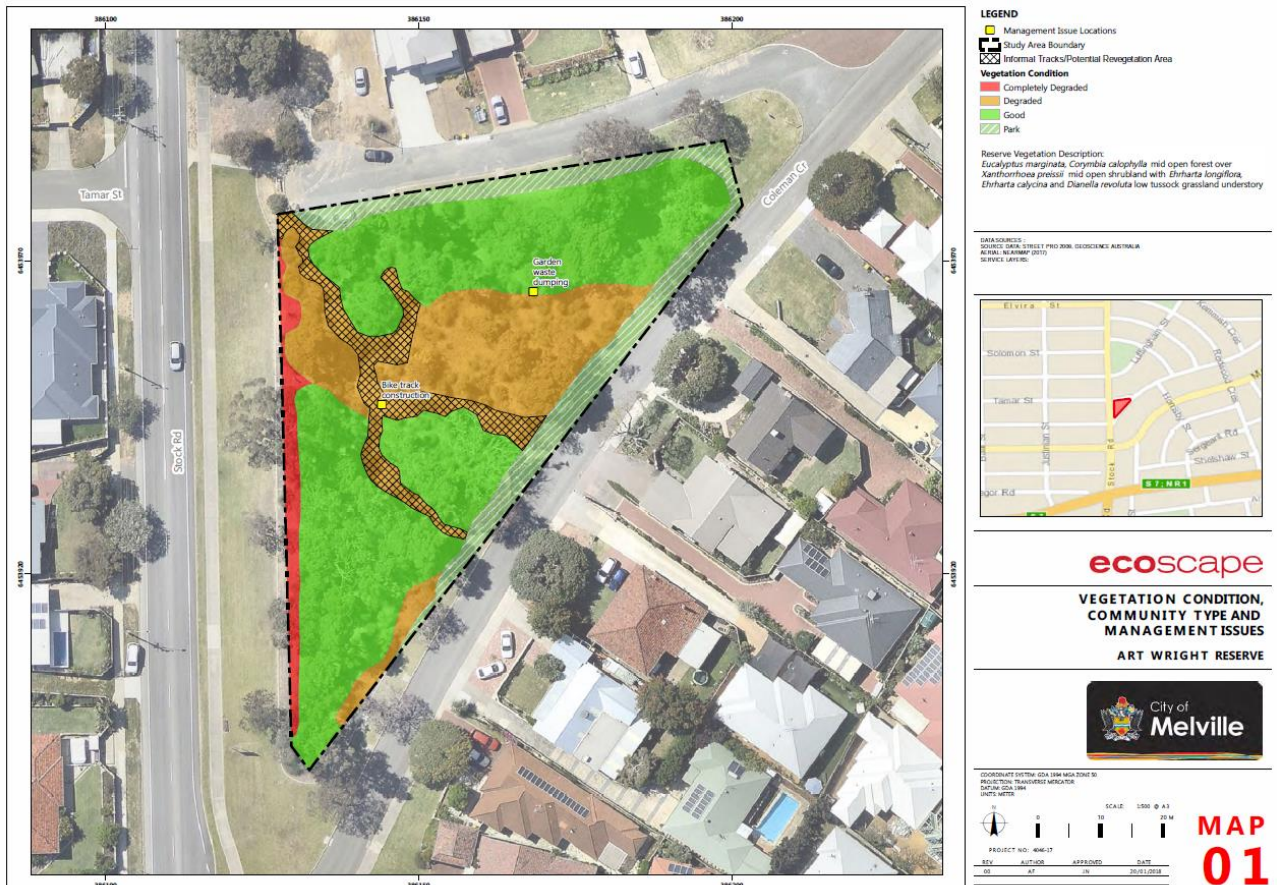


Figure 22 Vegetation condition, Revegetation Areas and Management Issues- Art Wright Reserve



Figure 23 Vegetation condition, Revegetation Areas and Management Issues- Arthur Kay Reserve



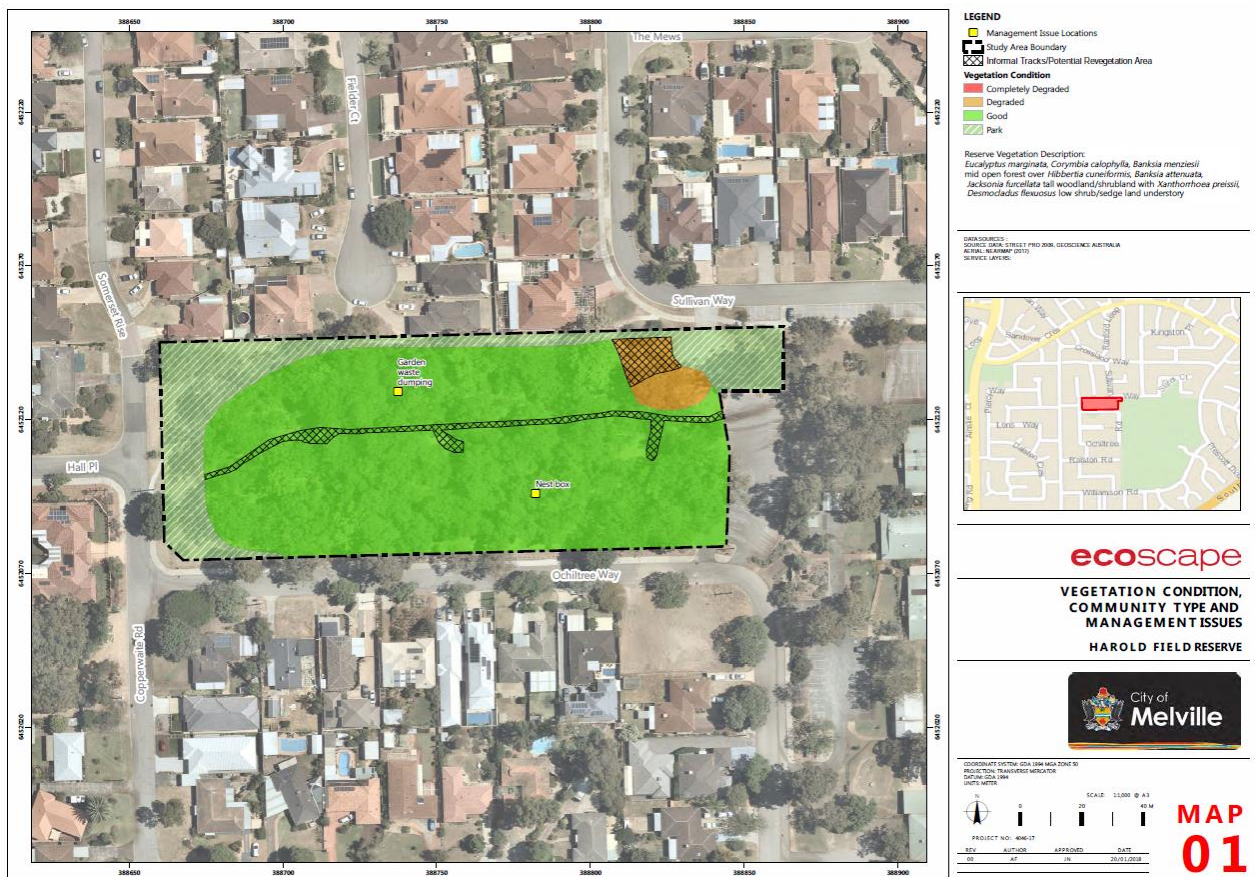


Figure 24 Vegetation condition, Revegetation Areas and Management Issues- Harold Field Reserve

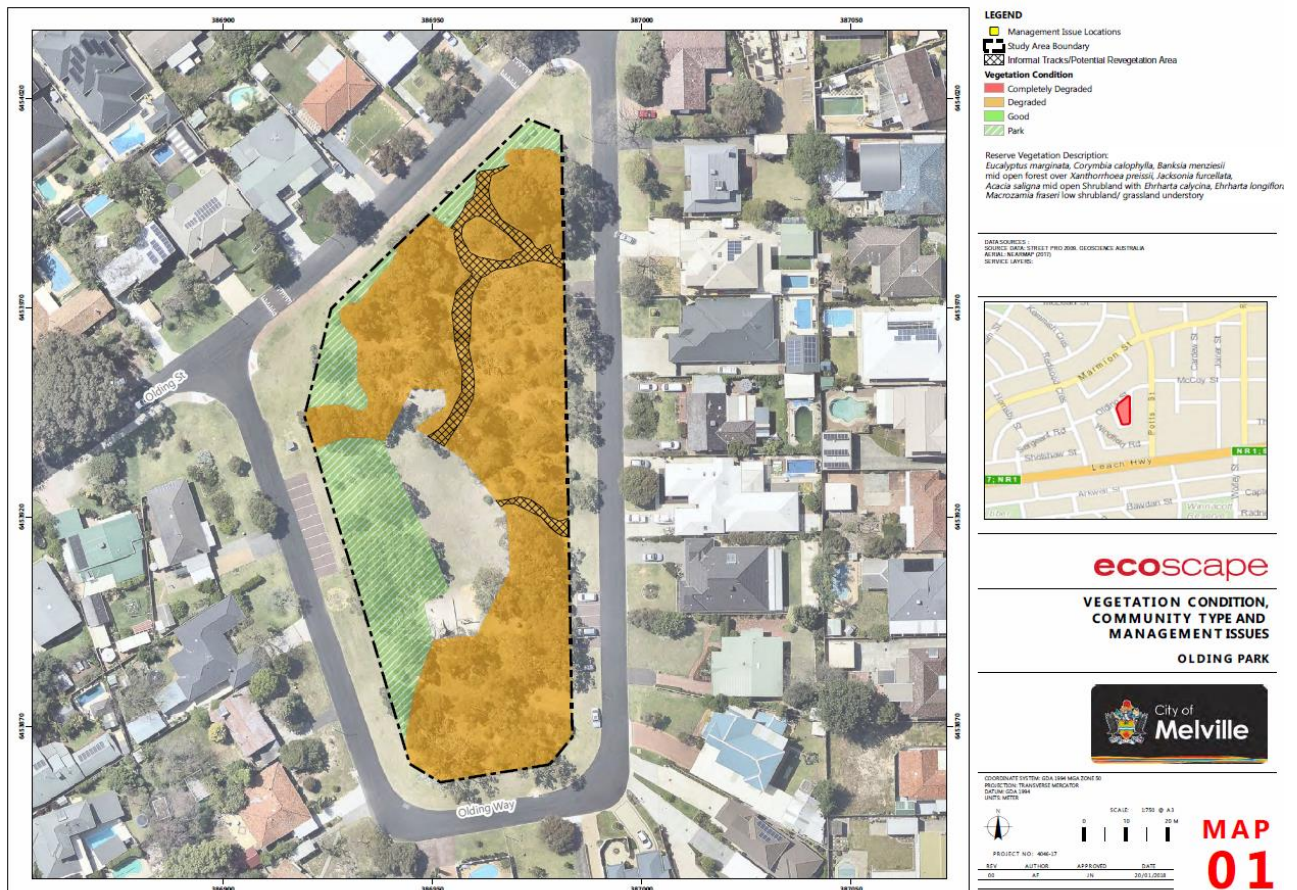


Figure 25 Vegetation condition, Revegetation Areas and Management Issues- Olding Park



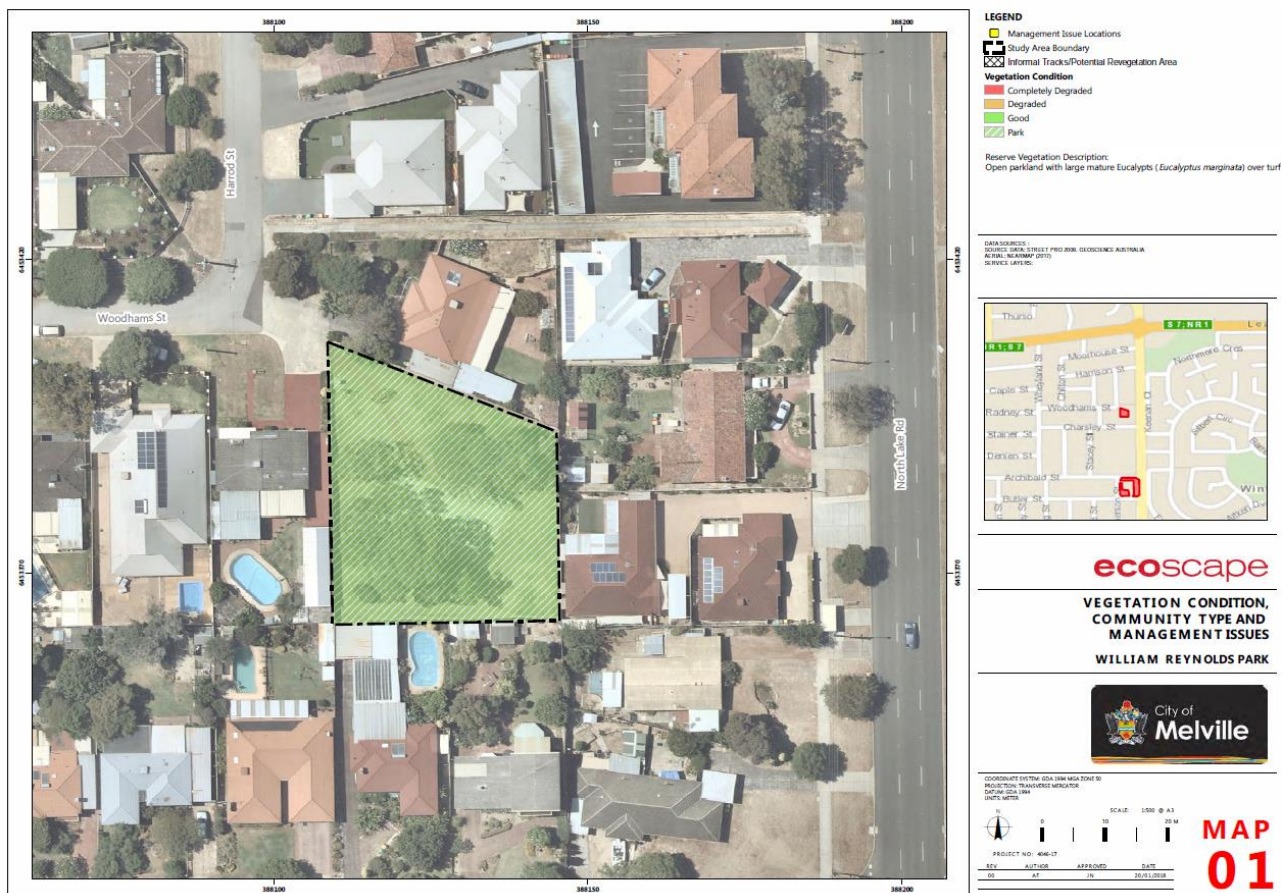


Figure 26 Vegetation condition, Revegetation Areas and Management Issues- William Reynolds

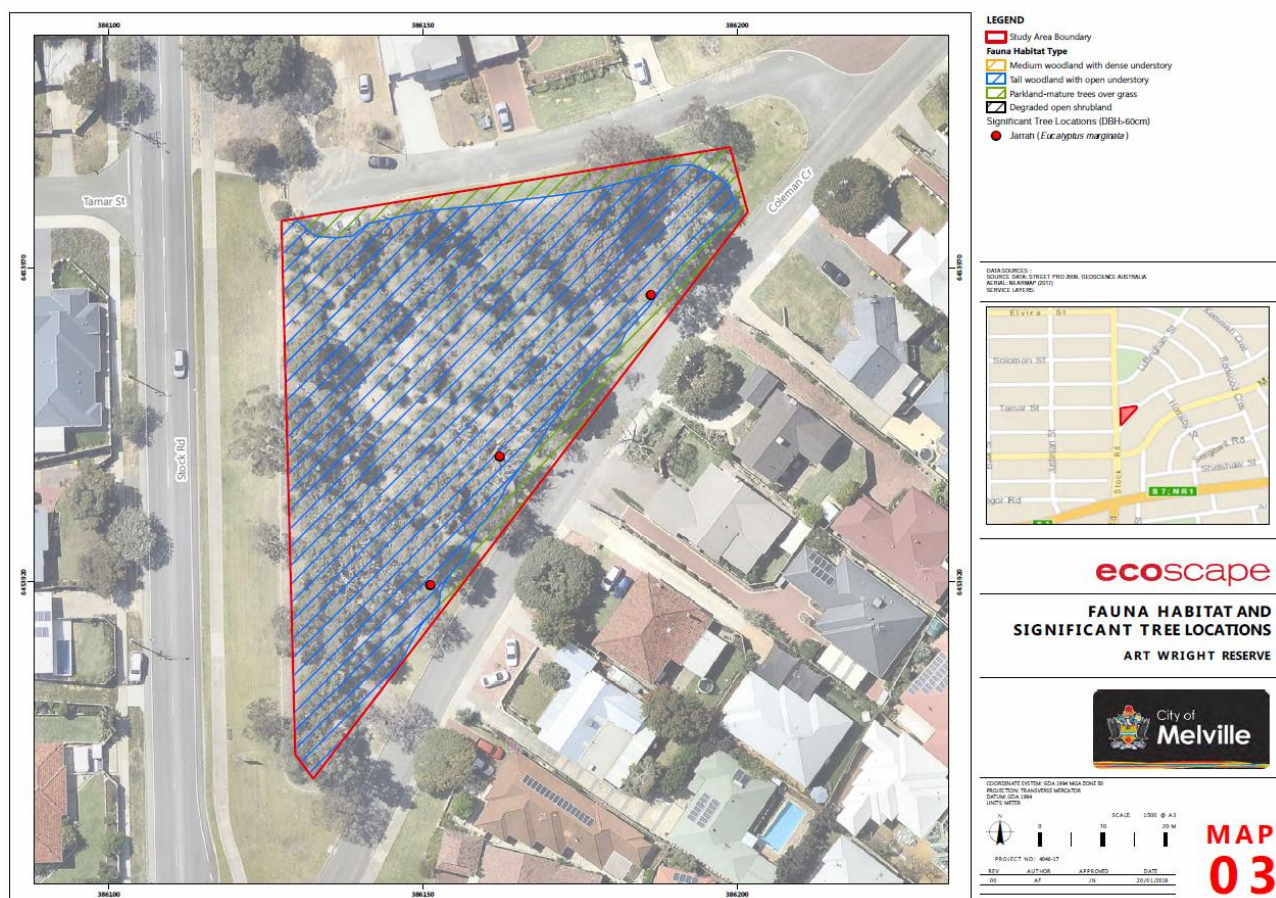


Figure 27 Significant Trees- Art Wright Reserve



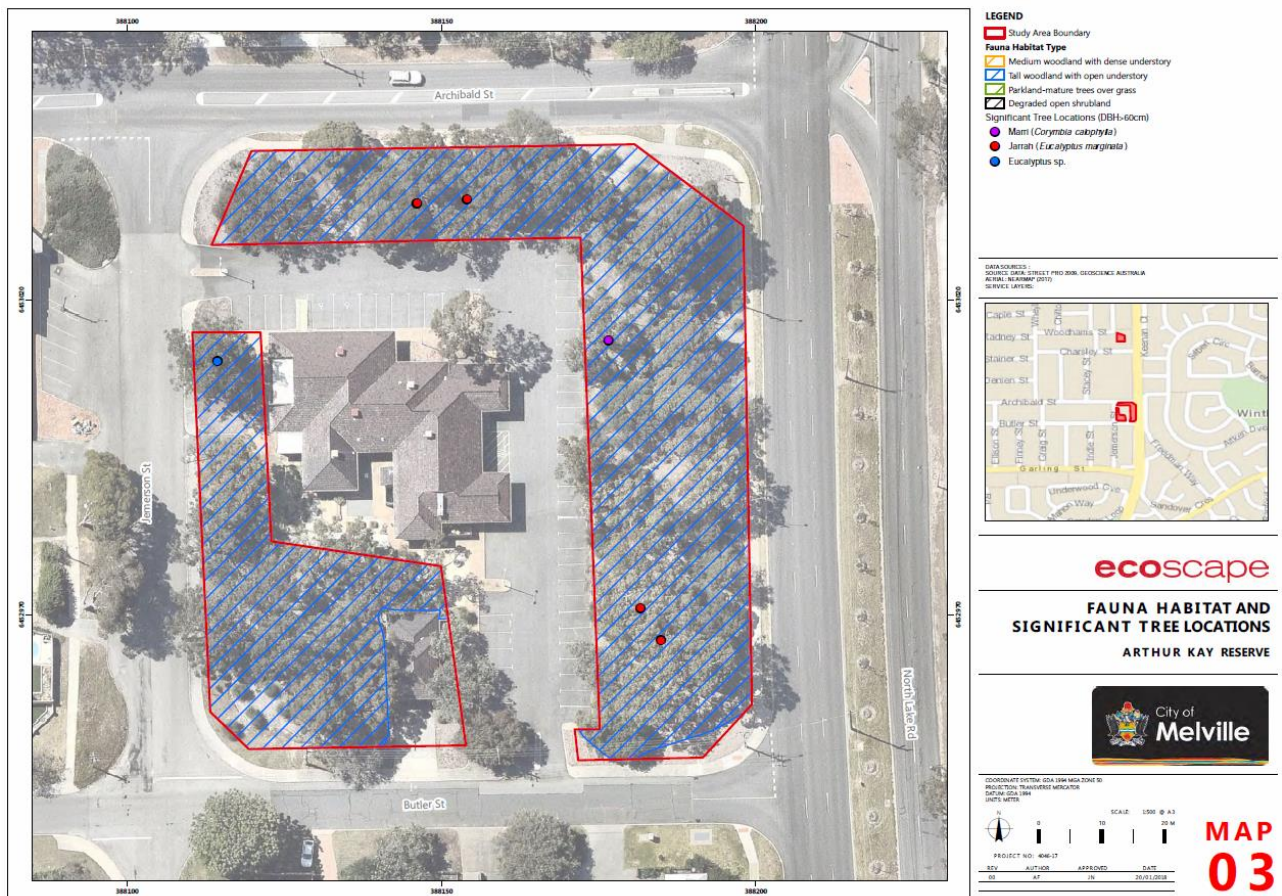


Figure 28 Significant Trees- Arthur Kay Reserve

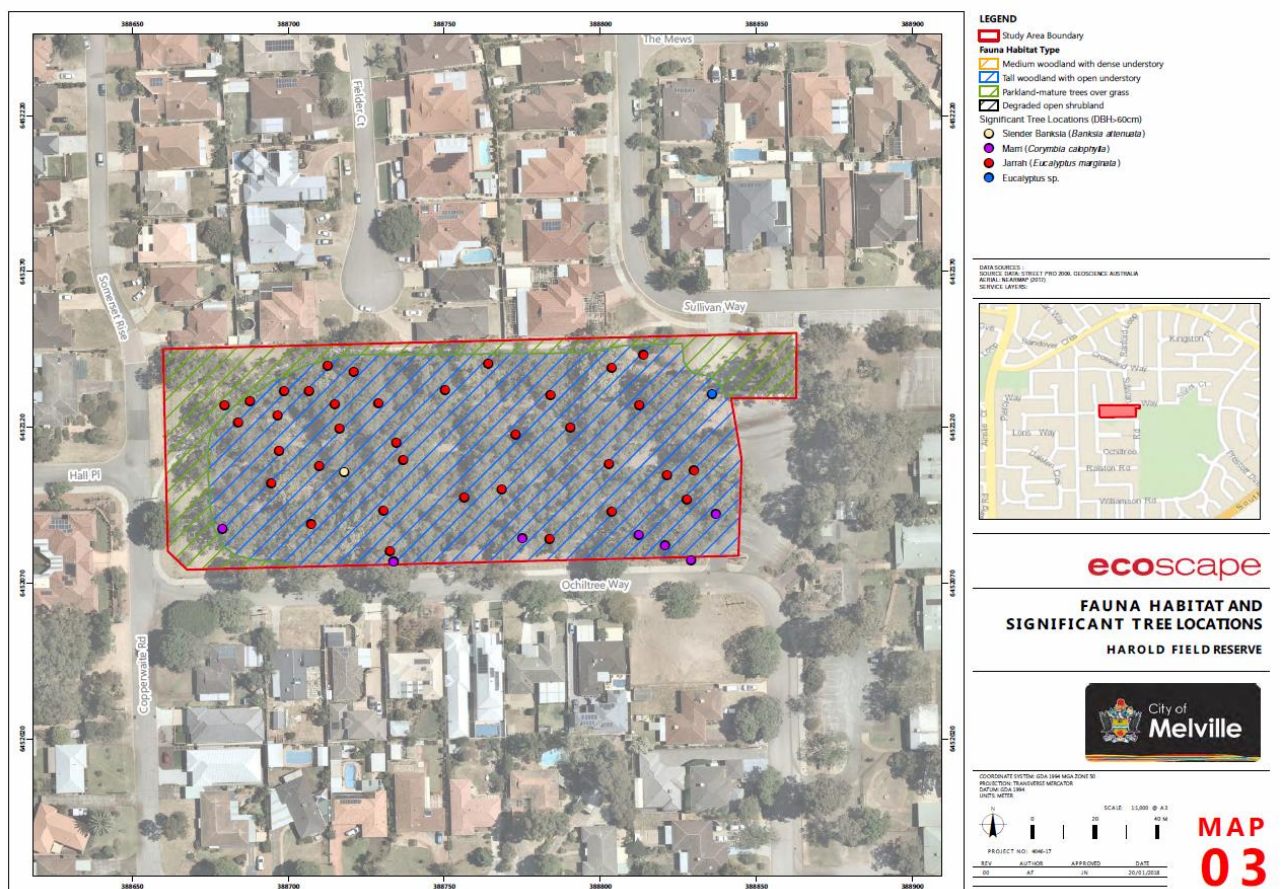


Figure 29 Significant Trees- Harold Field Reserve



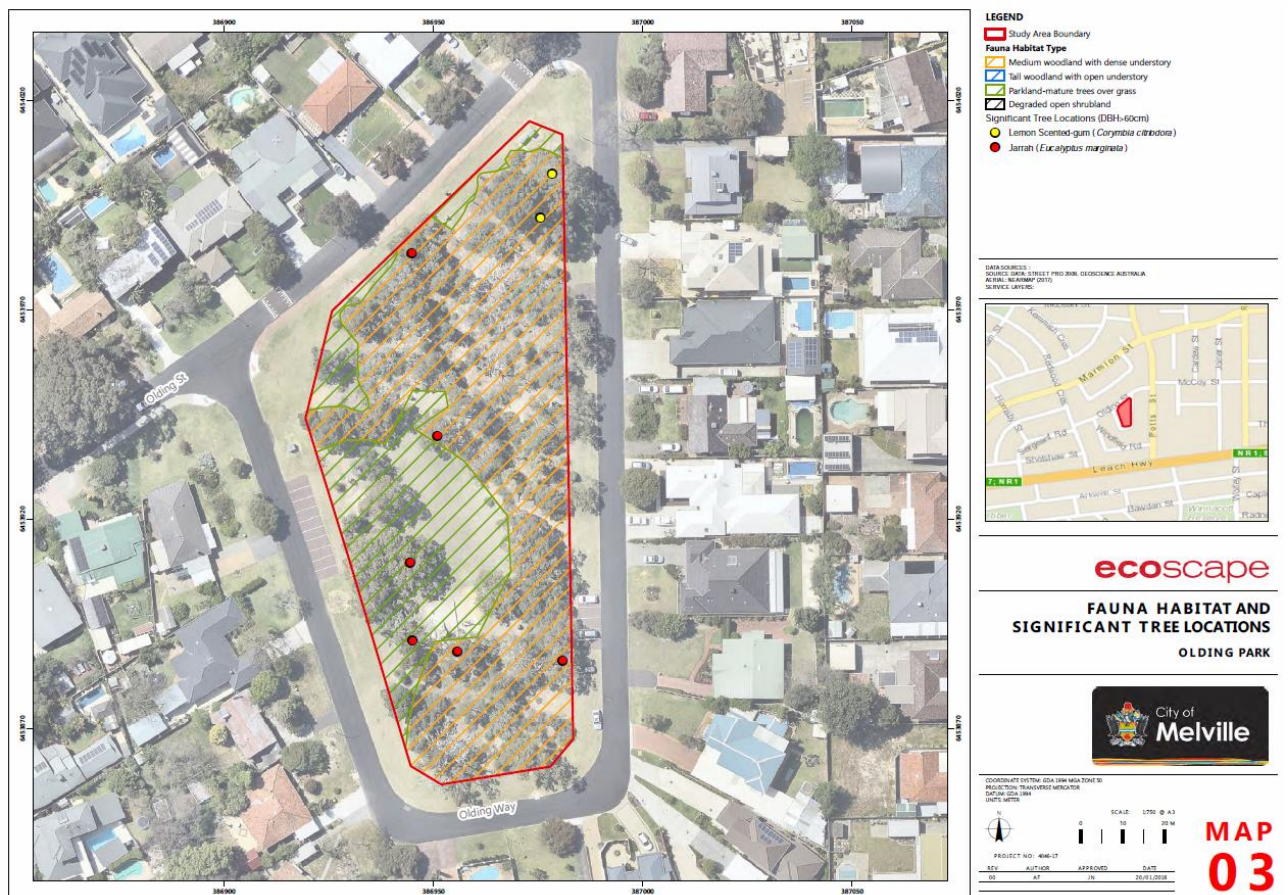


Figure 30 Significant Trees- Olding Park

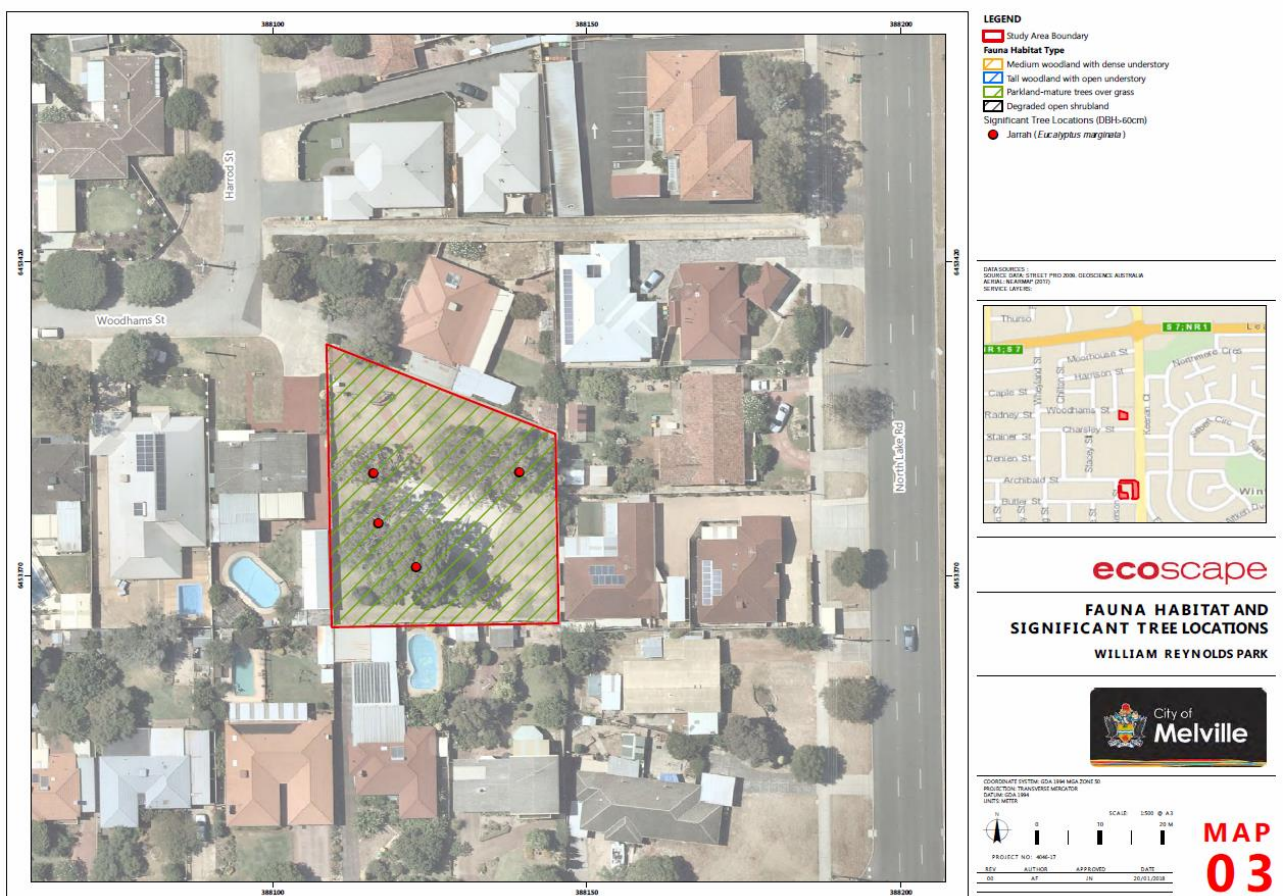


Figure 31 Significant Trees- William Reynolds Park



# Appendix 4 Weed Distributions



Figure 32 Woody Weeds- Art Wright

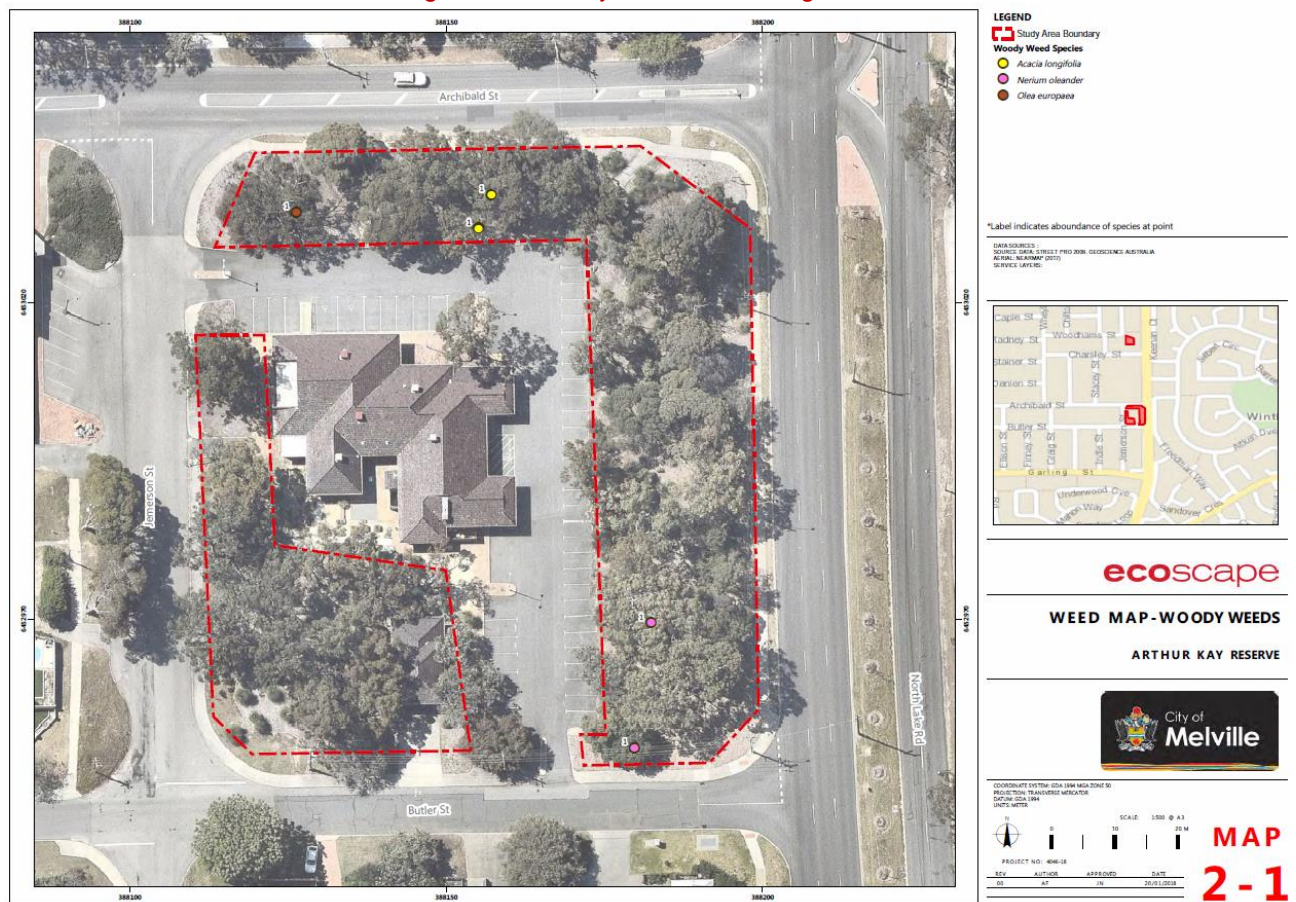


Figure 33 Woody Weeds- Arthur Kay



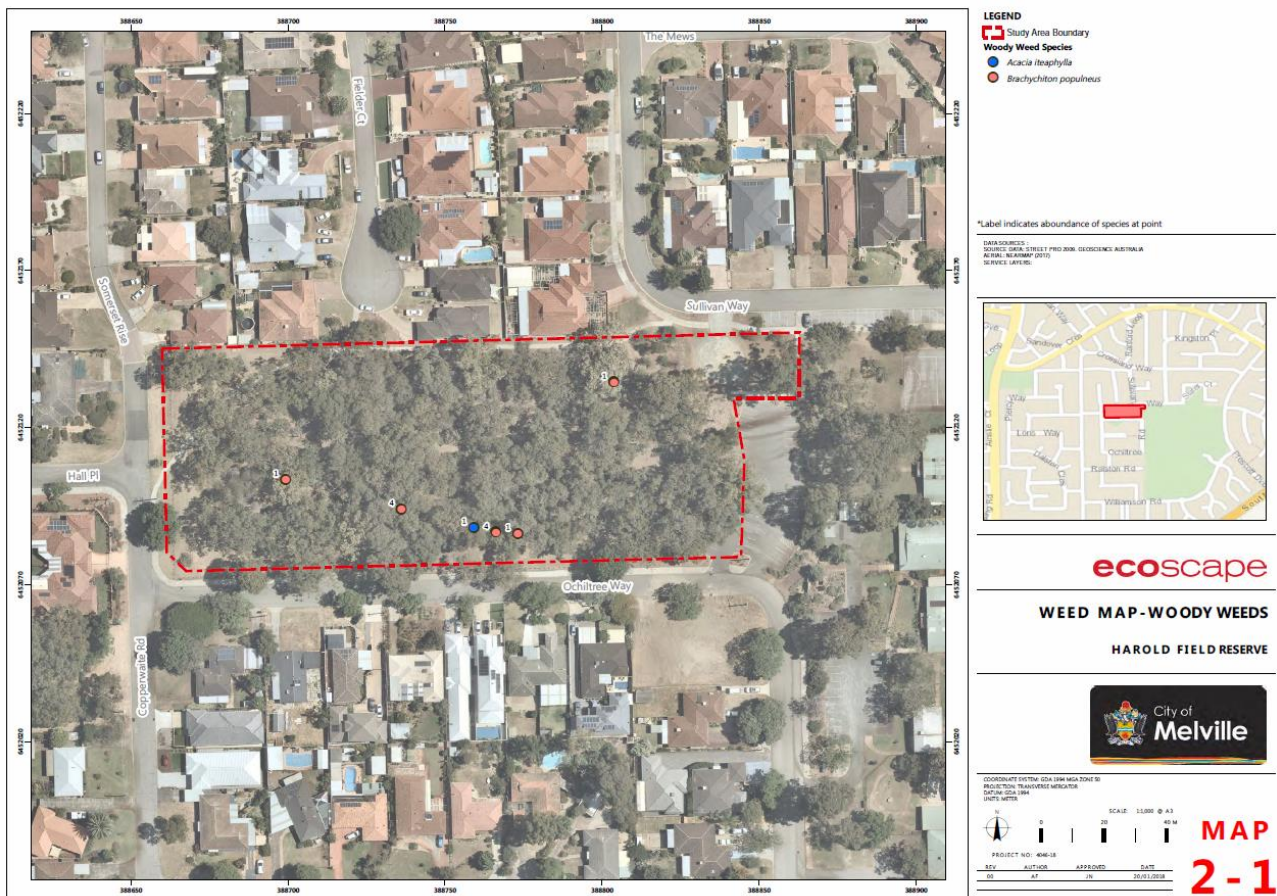


Figure 34 Woody Weeds- Harold Field



Figure 35 Woody Weeds- Olding Park



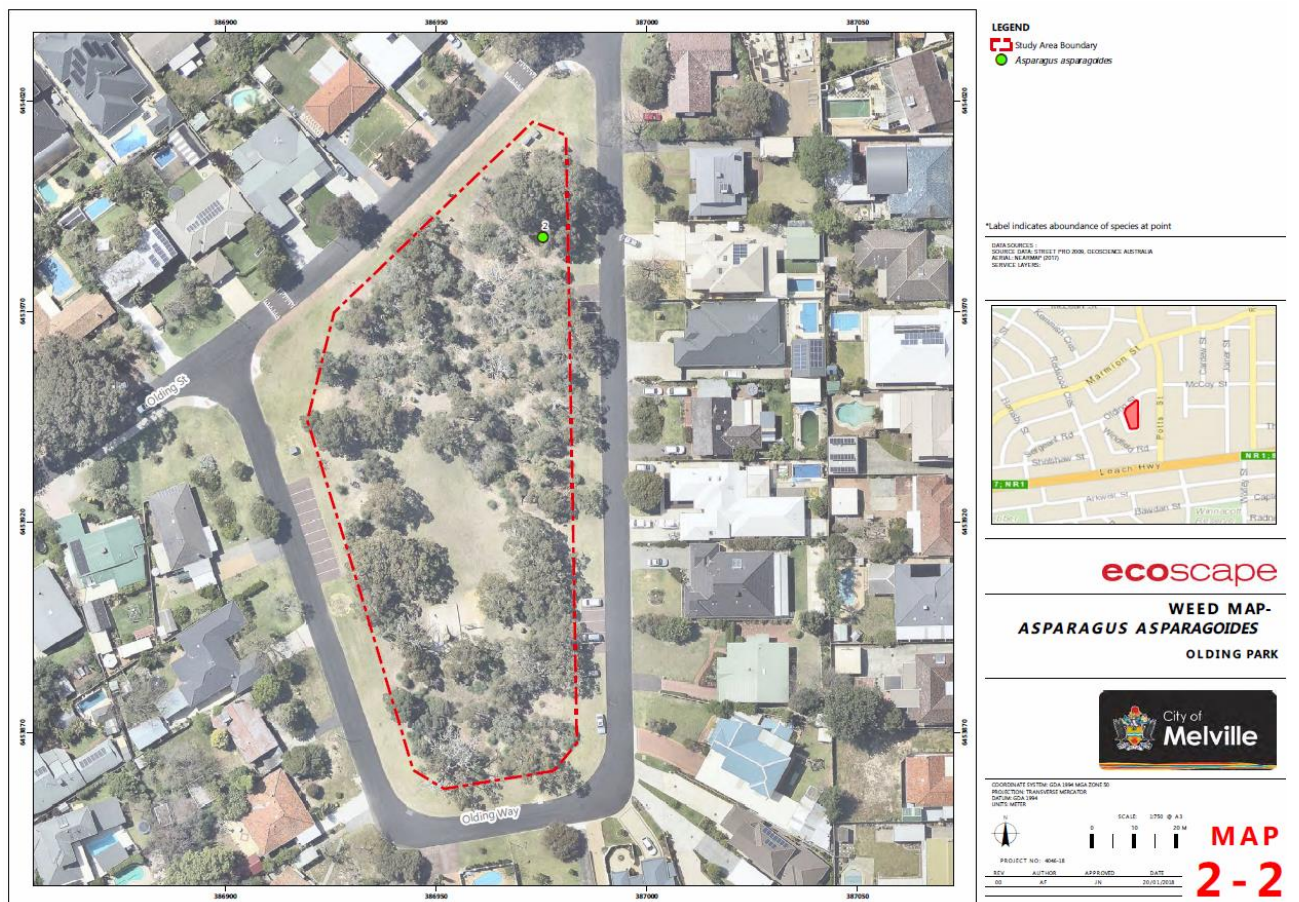


Figure 36 *Asparagus asparagoides* Bridal Creeper location- Olding Park

