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Environmental Assessment and Management Strategy

Hazelmere Enterprise Area Precinct 9A

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Executive Summary

Emerge Associates were engaged by the Hazelmere Landowners Group to provide a range of environmental consulting services to support the design and documentation of a Local Structure Plan (LSP) to guide the future industrial development of part Lots 2 and 3, Lot 15, 50, 199, 200, 201 and 500 Midland Road; Lot 10, part Lot 148 and Lot 149 Talbot Road; and Lots 6 and 97 Adelaide Street, Hazelmere. This LSP area is referred to herein as "the site." The site forms Precinct 9A of the wider Hazelmere Enterprise Area Structure Plan (HEASP) area within the City of Swan.

The site was rezoned in 2014 from 'Rural' to 'Urban Deferred' under the Metropolitan Region Scheme (MRS) and is currently zoned 'General Rural' (with 'Additional Use' over the south of the site) under the City of Swan's Local Planning Scheme No. 17 (LPS No. 17). The ultimate gazettal of the MRS amendment (Amendment No. 1256/57) will trigger an amendment to the City of Swan's LPS No. 17, rezoning the site from 'General Rural' to 'Industrial Development'. The City of Swan LPS 17 (in Schedule 2, #75) identifies Lot 198 (now 500), Lot 97 and part of Lot 6 as able to accommodate 'Caravan Park' as a permitted land use. Until the LPS is modified, this use will be permitted even if the local structure plan is approved.

This Environmental Assessment and Management Strategy (EAMS) has been prepared to address the requirements of the Western Australian Planning Commission's (WAPC) *Structure Plan Framework* (WAPC 2015) to support the LSP design and implementation, and to outline future environmental management requirements for the future subdivision, or other changes in land use within the site.

This report provides a synthesis of information from a range of sources regarding the environmental features, attributes and values of the site. It is based on publicly available information, plus site specific assessments and reporting that have been undertaken over the site including:

- *Hazelmere Enterprise Area District Structure Plan, Environmental Assessment* (ENV 2010).
- *District Stormwater Management Strategy* (AECOM 2010).
- *Level 2 Flora and Vegetation Assessment* (Emerge Associates 2015a), as attached in **Appendix C**.
- *Fauna Assessment* (Greg Harewood 2014), as attached in **Appendix D**.
- *Bushfire Management Plan* (Emerge Associates and Bushfire Safety Consulting 2018).
- *Local Water Management Strategy* (Emerge Associates 2018).
- *Contamination Risk Assessment* (Emerge Associates 2015b), as attached in **Appendix E**.
- Bush Forever Site No. 481 boundary resolution investigations and consultation with relevant authorities (letter from Emerge Associated to the WAPC dated 22 May 2014, as attached in **Appendix F**.

Based on the above information, the environmental attributes and values identified within the site have been outlined in **Section 2** and include:

- The site has a "moderate to low risk" of Acid Sulfate Soils (ASS) occurring within three metres of the natural soil surface.
- One federally and State listed Threatened Flora species and one Priority Flora species occur within the site.
- Remnant native vegetation occurs in patches throughout the site, the majority of which is in 'Completely Degraded' to 'Degraded' condition due to historic clearing and agricultural land

uses. Some small areas are considered to be in 'Good' condition. These areas are considered representative of a Threatened Ecological Community (TEC) and should be retained through any future change in land use or subdivision.

- Bush Forever Site No. 481 lies to the west of the site, and its boundary encroaches into Lot 3 Midland Road. There is no remnant vegetation within Lot 3 to support this area's inclusion with Bush Forever Site No. 481, so it would seem logical that industrial development could be considered within this area. A submission on MRS Amendment No. 1256/57 was lodged on behalf of the current landowner of Lot 3 in this regard (see **Appendix G**).
- The site contains some vegetation that could be considered suitable habitat for the conservation significant Black Cockatoo species, although this habitat is quite limited in terms of quality and extent.
- One registered Indigenous heritage site occurs over the south-east corner of the site.

The LSP, attached in **Appendix A**, has responded to the environmental values and attributes of the site through the broad scale planning and identification of significant vegetation for retention in order to minimise the impact on those values considered significant. Specific responses to the environmental values and attributes of the site can be addressed at future subdivision and/or development stages by individual lot owners, or at the time of any future change in the current land uses. These future management requirements/responses have been outlined in **Section 4**.

Land ownership across the site is fragmented, therefore there is not likely to be a single or consistent progression of development or subdivision within the site resulting from the endorsement of the LSP. It is also envisioned that in some cases current lots are unlikely to be subdivided further. The LSP has been prepared to guide any future development or subdivision that may occur at an individual lot level to ensure that overall development, when this occurs, is undertaken in a planned and coordinated way. The LSP does not provide an indicative road network, and while some subdivision may occur, this is likely to be constrained by the extent of the existing road network. Each land owner will therefore be required to specifically address environmental values and servicing requirements applicable to their property as part of any future subdivision or development approval process.

Overall, the environmental attributes and values of the site have been accommodated within the LSP, or can be managed appropriately through future subdivision and development in line with the relevant federal, state and local government legislation, policies and guidelines and best environmental management practices. As such, the proposed future development of the site will not significantly impact on the environmental values and attributes of the site.

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Local Structure Plan (Burgess Design Group 2018)

Appendix B

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Level 2 Flora and Vegetation Assessment (Emerge Associates 2015)

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2.4 Biodiversity and natural assets

2.4.1 Flora and Vegetation

2.4.1.1 Regional vegetation context

The site lies within the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) region. This region is broadly categorised as *Banksia* low woodland on leached soils with *Melaleuca* swamps on ill-drained soils and woodlands of Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) on less leached soils (Thackway and Cresswell 1995).

Regional vegetation mapping undertaken by Heddle *et al* (1986) indicates that the site was originally composed primarily of the 'Forrestfield' vegetation complex which is described as "open forest of *Eucalyptus calophylla – Eucalyptus wandoo – Eucalyptus marginata* to open forest of *Eucalyptus marginata – Eucalyptus calophylla – Allocasuarina fraseriana – Banksia* spp. Fringing woodland of *Eucalyptus rudis* in the gullies that dissect this landform." This is shown in **Figure 4**.

Based on the EPA's *Guidance Statement No. 10. Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region*, approximately 11.9% of the original extent of the Forrestfield Vegetation Complex remains on the Swan Coastal Plain, which is just above the 10% biodiversity objective threshold for 'constrained areas' (EPA 2006) and below the broader biodiversity objective of 30% retention. However, only those areas of intact ('Good' or better condition) remnant vegetation would be considered to be representative of this complex for conservation and land use planning applications.

2.4.1.2 Extent and condition of remnant vegetation

A Level 2 flora and vegetation survey (Emerge Associates 2015) was conducted across the site in September and November 2013. This survey found there to be generally limited intact remnant vegetation within the site (see **Figure 5**), with the majority of vegetation in 'Completely Degraded' to 'Degraded' condition (Emerge Associates 2015). Some small patches of vegetation were considered to be in 'Good' condition. Vegetation condition within the site is shown in **Figure 6**.

2.4.1.3 Significant Flora

Species of flora acquire Threatened Flora (TF) or Priority Flora (PF) conservation status where populations are restricted geographically or threatened by local processes. The Department of Biodiversity, Conservation and Attractions (DBCA) (previously the Department of Parks and Wildlife (DPaW)) recognises these threats and subsequently applies regulations towards population protection and species conservation. DPaW enforces regulations under the *Wildlife Conservation Act 1950* (WC Act) to conserve TF species and protect significant populations. PF are described as potentially rare or threatened species and are classified in order of threat.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) promotes the conservation of biodiversity by providing statutory protection for plants at a species level. Some TF species listed under the WC Act are also listed at a Federal level. Section 178 and 179 of the EPBC Act provides for the lists and categories of threatened species under the Act.

Based on the detailed Level 2 flora and vegetation survey undertaken for the site, one TF species (also listed pursuant to the EPBC Act) and one PF species were found to occur within the site. Nine individuals of the TF species *Conospermum undulatum* was recorded from one area of remnant vegetation in the south western corner of the site, while one Priority 3 flora species *Isopogon drummondii* was recorded at various locations within the site (Emerge Associates 2015).

The considerations associated with significant flora is discussed further in **Section 4**.

2.4.1.4 Plant communities

Three plant communities and areas of 'Parkland Cleared' paddocks were identified and described within the site (Emerge Associates 2015). They are shown in **Figure 5** and described as follows:

- **CcOF -** *Corymbia calophylla* open forest over sparse shrubland of *Xanthorrhoea preissii* (or absent) over closed grassland and forbland of pasture weeds.
- **EmBaBmW** – Isolated trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over woodland of *Banksia attenuata*, *B. menziesii*, *B. grandis* and *Adenanthos cygnorum* over low shrubland of *Xanthorrhoea preissii* and *Hibbertia hypericoides* over forbland of *Dasypogon obliquifolius*, *Conostylis* spp. and *Anigozanthos manglesii* and sedgeland of *Desmocladus flexuosus* and *Alexgeorgea nitens*.
- **EmAfOW** – Isolated trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over open shrubland of *Xanthorrhoea preissii* over grassland and forbland of pasture weeds.
- **'Parkland Cleared'/Planted** – Isolated *Corymbia calophylla*, *Eucalyptus marginata* and planted non-endemic trees over pasture weeds.

Plate 1: plant community CcOF in 'Degraded' condition

*Plate 2: plant community **EmBaBmW** in the north of the site, in 'good' condition*

*Plate 3: plant community **EmAfOW** in 'Degraded' condition*

Plate 4: Parkland Cleared/planted vegetation in 'Completely Degraded' condition

2.4.1.5 Threatened and/or Priority Ecological Communities

In Western Australia, TECs are defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. Generally, these can be described as vegetation communities that are assemblages of species that occur together in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole provide many of the processes which support a specific ecosystem. TECs are recognised as specific ecological communities that are rare or under threat.

TECs are not afforded direct statutory protection at a State level but their significance is acknowledged through other State environmental approval processes (i.e. environmental impact assessment pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act)). Under the State process the DPaW has been identifying and listing TECs since 1994, using a range of definitions to indicate the level of threat to the TEC in question. Specific TECs are also protected under the EPBC Act.

In addition to listing as a TEC, a community may be listed as a Priority Ecological Community (PEC). This is an ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined.

The Level 2 flora and vegetation survey of the site indicated that all areas of plant community **EmBaBmW** that are in 'Good' or better condition are representative of FCT 20a which is a State listed TEC. This is discussed further in **Section 4** of this report. While in an undisturbed state, plant community **CcOF** would likely have been representative of FCT 3a, a State and Commonwealth listed TEC. Any residual areas of this community are in 'Degraded' or poorer condition and is therefore not considered to be representative of this TEC any longer.

2.4.2 Bush Forever and conservation reserves

The Government of Western Australia's *Bush Forever Policy* is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of Bush Forever is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10 % of each vegetation complex for protection (Government of Western Australia 2000). Bush Forever Sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

There are no Bush Forever Sites within the site boundary, as shown in **Figure 7**. Bush Forever Site No. 481 falls within portions of Lot 2 and 3 Midland Road adjacent to the northern portions of the site, and extends west of the site, and west of the Roe Highway. Bush Forever Site No. 213 lies east of the site, east of Midland Road, and Bush Forever Site No. 122 lies south-west of the site.

A significant portion of Lot 3 Midland Road is currently included within the boundary of Bush Forever Site No. 481 as shown in **Figure 7**. However, due to historic clearing and subsequent land uses by previous landowners there are no longer any flora and vegetation values present within Lot 3 and there is limited potential for the rehabilitation of these values. The interface with the remaining vegetation within Bush Forever Site No. 481 will need to be managed to address bushfire hazard implications, and is discussed further in **Section 4**, however there are currently no values to support Lot 3's inclusion within the Bush Forever Site boundary.

Bush Forever Sites in the vicinity of the site are shown in **Figure 7**.

2.4.3 Biodiversity linkages

Biodiversity linkages allow the movement of fauna, flora and genetic material between areas of fragmented remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improve the viability of those remnants by allowing greater access to breeding partners, food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Biological linkages are often continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Molloy *et al*. 2007).

Biodiversity linkages have been generally identified by the State Government in Bush Forever, Perth's Greenways and the System 6 study (Molloy *et al*. 2007) and have been published by the Perth Biodiversity Project. These identified linkages reflect the on-ground linkages throughout the Perth Metropolitan area. The dataset is employed as a conservation tool aimed to conserve and enhance our regional biological linkages.

Remnant vegetation adjacent to the northern portions of the site (within Bush Forever Site No. 481, north of Lakes Road) contributes to the intactness of Regional Ecological Linkage 33 which is mapped within the northern portion of the site, as shown in **Figure 7**. While some areas of vegetation remain within the site in this area, the majority of vegetation within the site is in 'Completely Degraded' condition (Emerge Associates 2015). The connectivity of this linkage will be maintained through the long-term retention of vegetation within areas reserved for 'Parks and Recreation' associated with Bush Forever Sites to the west and east of the site, and the integrity of the connection is not

dependent on the limited remnant vegetation within the site. No further consideration is required within the LSP.

2.4.4 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Within a declared ESA, exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply and the presence of an ESA would indicate that the area is likely to support significant environmental values. However, exemptions under Schedule 6 of the *Environmental Protection Act 1986* still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the *Environmental Protection Act 1986*).

The site falls within a declared ESA, related to the various Bush Forever sites, wetland, flora and floristic community values occurring in proximity to the site. The extents of declared ESAs are shown in **Figure 7**.

2.4.5 Terrestrial fauna

The conservation status of fauna species in Western Australia is assessed under the state administered WC Act. The WC Act utilises a set of schedules and DPaW also produces a list of priority fauna species which while not considered threatened under the WC Act, there is some concern over their long-term survival. As well as those species protected under the WC Act, the Federal government also maintains a list of protected species under the EPBC Act.

A level 1 fauna assessment was undertaken for the site and part of Bush Forever Site No. 481 adjacent to the northern and western portions of the site (Greg Harewood 2014). This assessment indicated that areas of remnant native vegetation within the site (including isolated trees) can be regarded as representative of foraging habitat for black cockatoos due to the dominance of marri, jarrah, sheoak and Banksia (Greg Harewood 2014).

Foraging evidence left by black cockatoos across the site included chewed marri, jarrah and sheoak fruits and Banksia cones were found at several locations across the site, and was attributed to the forest red-tailed black-cockatoo, Baudin's black-cockatoo and Carnaby's black-cockatoo (based on marks left on the fruit body and/or preferred foraging species). No existing roosting trees were identified (Greg Harewood 2014).

Overall fauna habitat values at the site have been severely compromised by the total or partial clearing of native vegetation and ongoing livestock grazing. Most areas lack any natural attributes and are now only utilised by generally common and widespread fauna species with non-specific requirements which allow them to persist in highly disturbed habitats (Greg Harewood 2014).

The management of terrestrial fauna and habitat values within the site is addressed further in **Section 4**.

Appendix C

Level 2 Flora and Vegetation Assessment (Emerge Associates 2015)

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LEVEL 2 FLORA AND VEGETATION ASSESSMENT

HAZELMERE PRECINCT 9A LOCAL STRUCTURE PLAN

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	Level 1 assessment				
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	Incorporation of addition survey results to encompass Level 2 assessment				
B	March 2015	Sarah Paul	SKP	Jason Hick	JDH
	Incorporating updated site boundary				
C					
D					

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Executive Summary

The Hazelmere Enterprise Area (HEA) was identified as suitable for future industrial use within the Kewdale Hazelmere Integrated Master Plan (WAPC 2006). Following this, the City of Swan (CoS) and the Department of Planning (DoP) jointly prepared the HEA Structure Plan (HEASP) which identified precincts within the HEASP for future and more detailed structure planning. Precinct 9A of the HEASP comprises Lots 3, 15, 199, 200, 201 and 500 Midland Road, Lots 10 and 149 Talbot Road, and Lots 6 and 97 Adelaide Street, Hazelmere and the collective landowners have formed the Hazelmere Landowners Group. Precinct 9A is referred to herein as "the site". The site is located within the CoS and lies between Roe Highway to the west, Midland Road to the east and Adelaide Road to the south, comprising 55 ha. In addition to the site, three lots directly adjacent to the site have been included within this assessment for contextual purposes, but are not proposed for industrial development. These lots are Lot 2 Lakes Road, Lot 50 Midland Road and Lot 148 Talbot Road Hazelmere. The wider area that was surveyed as part of this assessment is referred to herein as "the survey area" and comprised an additional 10.5 ha.

The site is zoned 'Rural' in accordance with the Metropolitan Region Scheme (MRS) and 'General Rural' in accordance with the CoS's Town Planning Scheme (TPS) 17 (CoS 2013). Within TPS 17, the southern portion of the site incorporating parts of Lots 97, 500, 6, and 50, are listed as "Additional Use" (CoS 2013).

Emerge Associates (Emerge) was engaged to provide a range of environmental consultancy services to support the preparation of a local structure plan for Precinct 9A. The purpose of this assessment is to provide sufficient environmental information pertaining to the flora and vegetation values within the site to inform the local structure plan preparation and endorsement process.

The scope of this assessment was to undertake a Level 2 flora and vegetation assessment in accordance with the Environmental Protection Authority's (EPA's) Guidance Statement No. 51 – *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004).

The background review undertaken as part of this assessment indicated that a portion of the survey area is recognised as regionally significant bushland and therefore included within Bush Forever policy as Bush Forever Site No. 481 – *Stirling Crescent Bushland, Hazelmere* (Government of WA 2000). This Bush Forever site extends further west of the site. Two additional Bush Forever sites also occur in close proximity to the south-west and east of the site.

The flora and vegetation survey was undertaken on the 13, 14 and 22 August, 6 September and 7 November 2013 by two botanists from Emerge. The survey area was traversed on foot and sampling of the vegetation was undertaken in the form of non-permanent relevés and 10 x 10 m quadrats at 21 locations.

A total of 122 native and 49 introduced (weed) species were recorded within the survey area by Emerge in 2013, representing 35 families and 119 genera. The dominant families representing native taxa were Fabaceae (25 native taxa and nine introduced taxa), Proteaceae (15 native taxa) and Myrtaceae (nine native taxa and nine introduced taxa). The most common genera were *Daviesia* (seven native taxa) and *Banksia* (six native taxa). Within the site itself, 85 native taxa and 43 introduced taxa were recorded.

The Threatened ('Declared Rare') flora species *Conospermum undulatum* and the Priority 3 flora species *Isopogon drummondii* were recorded in one and two locations within the site respectively. Both species were only recorded in the south western portion of the site, in small patches of intact remnant vegetation outside of Bush Forever Site No. 481. In addition to the above listed Threatened and Priority Flora species, three species noted as significant within the Bush Forever (Government of WA 2000) documentation were also recorded; *Dasypogon obliquifolius, Hemiphora bartlingii* and *Lambertia multiflora* var. *darlingensis*. The three significant species were recorded both inside and outside of the Bush Forever portion of the survey area. Based on the soils, landforms and extent of previous disturbance, no other Threatened or Priority flora species are considered likely to inhabit the site.

Three plant communities and areas of 'Parkland Cleared' vegetation were found to occur within the site. These are described below:

CcOF - *Corymbia calophylla* open forest over sparse shrubland of *Xanthorrhoea preissii* (or absent) over closed grassland and forbland of pasture weeds.

EmBaBmW – Isolated trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over woodland of *Banksia attenuata*, *B. menziesii*, *B. grandis* and *Adenanthos cygnorum* over low shrubland of *Xanthorrhoea preissii* and *Hibbertia hypericoides* over forbland of *Dasypogon obliquifolius*, *Conostylis* spp. and *Anigozanthos manglesii* and sedgeland of *Desmocladus flexuosus* and *Alexgeorgea nitens*.

EmAfOW – Isolated trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over open shrubland of *Xanthorrhoea preissii* over grassland and forbland of pasture weeds.

'Parkland Cleared'/Planted – Isolated *Corymbia calophylla*, *Eucalyptus marginata* and planted non-endemic trees over pasture weeds.

An additional disturbed plant community was recorded outside of the site within the wider survey area. Plant community **AdAnS** was described as a tall shrubland to tall closed shrubland of *Adenanthos cygnorum* over low sparse to open shrubland of *Hibbertia* spp. over sparse to open forbland of *Hybanthus calycinus* and *Dasypogon bromeliifolius* and open sedgeland of *Alexgeorgea nitens* and *Desmocladus flexuosus.*

Plant community **CcOF** was inferred to previously represent FCT 3c, which is a TEC listed at the state and federal level. The site however only contains areas of this plant community in 'Degraded' condition in which limited native flora species remained; therefore it is questionable that it is still representative of FCT 3c.

Plant community **EmBaBmW** was statistically determined to represent FCT 20a, which is a state listed TEC. Plant community **EmAfOW** and **AdAnS** were inferred to also represent this FCT but have been subject to considerable disturbance. The areas containing these communities was largely located within the Bush Forever portions of the survey area (Lots 2 and 148), however a number of small patches remain within the site. Due to a high level of historical disturbance, only the portions of plant community **EmBaBmW** in 'Good' or better condition are considered to still be representative of this FCT and are represented in **Figure 5**.

The vegetation across the survey area ranged from 'Completely Degraded' to 'Very Good' condition, with vegetation in 'Good' and 'Very Good' condition primarily located within Bush Forever Site No. 481, however some smaller patches were also located within the site in Lots 500, 199, 97 and 149.

The entirety of the survey area is mapped as an Environmentally Sensitive Area (ESA) and the northern portion of remnant bushland contributes to the intactness of an ecological linkage linking Bush Forever Site No. 213 to the east of the survey area to adjacent areas of remnant bushland.

The site contains limited flora and vegetation values, with 'Completely Degraded' and 'Parkland Cleared' vegetation comprising a large proportion of the site and including numerous areas of planted non-endemic trees and shrubs. The patches of intact remnant vegetation (in 'Good' or better condition), however, represent a TEC and contain Threatened flora and Priority flora species. Whilst the majority of vegetation within the survey area comprising FCT 20a was situated within Bush Forever Site No. 481, a number of small areas of relatively intact vegetation occur within the site itself and these support Threatened, Priority and other significant flora species. Given these values within the site and the limited vegetation remaining within the Forrestfield vegetation complex on the Swan Coastal Plain, some patches of remnant vegetation within the site are considered to be of local and regional significance.

Based on the findings of this assessment, it is recommended that in the context of the local structure plan preparation process, consideration is given to:

- Retention of areas comprising plant community **EmBaBmW** in 'Good' condition.
- Retention of areas containing occurrences of Threatened flora species *Conospermum undulatum* and Priority 3 flora species *Isopogon drummondii*.
- Future management of areas of retained remnant vegetation should be resolved through the planning and approvals process for industrial development/use.

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1 This Introduction

1.1 Project Background

The Hazelmere Enterprise Area (HEA) was identified as suitable for future industrial use within the Kewdale Hazelmere Integrated Master Plan (WAPC 2006). Following this, the City of Swan (CoS) and the Department of Planning (DoP) jointly prepared the HEA Structure Plan (HEASP) which identified precincts within the HEASP for future and more detailed structure planning. Precinct 9A of the HEASP comprises Lots 3, 15, 199, 200, 201 and 500 Midland Road, Lots 10 and 149 Talbot Road, and Lots 6 and 97 Adelaide Street, Hazelmere and the collective landowners have formed the Hazelmere Landowners Group. This area is referred to herein as "the site" and shown on **Figure 1**. The site is located within the CoS and lies between Roe Highway to the west, Midland Road to the east and Adelaide Road to the south, comprising 55 ha. In addition to the site, three lots directly adjacent to the site have been included within this assessment for contextual purposes, but are not proposed for industrial development. These lots are Lot 2 Lakes Road, Lot 50 Midland Road and Lot 148 Talbot Road Hazelmere. The wider area that was surveyed as part of this assessment is referred to herein as "the survey area", is shown on **Figure 1** and comprises an additional 10.5 ha.

The site is zoned 'Rural' in accordance with the Metropolitan Region Scheme (MRS) and 'General Rural' in accordance with the CoS's Town Planning Scheme (TPS) 17 (CoS 2013). Within TPS 17, the southern portion of the site, incorporating parts of Lots 97, 500 6, and 50, are listed as 'Additional Use' (CoS 2013).

1.2 Purpose and Scope of Assessment

Emerge Associates (Emerge) was engaged to provide environmental consultancy services to support the preparation of a local structure plan. The purpose of this assessment was to provide sufficient environmental information pertaining to the flora and vegetation values within the site to inform this process.

The scope of this assessment was to undertake a Level 2 flora and vegetation assessment in accordance with the Environmental Protection Authorities (EPA's) Guidance Statement No. 51 – *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). As part of this scope of works, the following tasks have been undertaken:

- Desktop review of relevant information pertaining to the site and surrounds, including database searches for threatened flora species and communities.
- A Level 2 flora and vegetation survey (over multiple seasons) in accordance with EPA Guidance Statement No. 51.
- A list of flora species recorded as part of the field survey.
- Determination and mapping of plant communities and vegetation condition across the survey area.
- Documentation of the desktop assessment and field methods and results into a report.

2 Background

2.1 Climate

The survey area occurs within the south west of Western Australia, which experiences a moderate Mediterranean climate of hot dry summers and cool wet winters. Long-term climatic averages indicate the site is located in an area of relatively high rainfall, receiving an annual average of 773.2 mm (data for Perth Airport, the nearest current reporting station (Bureau of Meteorology 2013)) with the majority of rainfall received between May and September. Mean maximum temperatures range from 19.7 ºC in July and to 36.3 ºC in February. Mean minimum temperatures range from 16.2 ºC in July to 28.7 ºC in February.

2.2 Geomorphology and Soils

The survey area occurs on the eastern edge of the Swan Coastal Plain (SCP), the geomorphic unit that characterises the Perth metropolitan area and surrounds. It is approximately 20-30 km wide and consists of two sedimentary belts of different origin. Three dune systems (Quindalup, Spearwood and Bassendean) form the western part of the Swan Coastal Plain and are of Aeolian origin (Seddon 2004). The dune systems represent differing ages of deposition with soils at different stages of leaching and formation. On the eastern side of the Swan Coastal Plain, the Pinjarra Plain has been formed from the deposition of alluvial material washed down from the Darling Scarp, which occurs further to the east.

The survey area specifically forms part of the Ridge Hill Shelf landform, a highly segmented and narrow strip 1.5 - 3 km wide which forms part of the foothills at the base of the Darling Scarp. The Ridge Hill Shelf consists of coalescing alluvial fans deposited by streams losing grade at the bottom of the scarp and remnants of marine terraces (Beard 1990).

The Perth Metropolitan Region 1: 50,000 Environmental Geology Series, Perth (Sheet 2034 II and Part Sheets 2034 III and 2134 III) show that the survey area is comprised of “Sand”, namely the S_8 and S_{10} map units. The general descriptions for these map units are provided in **Table 1** below.

Table 1: *Soil units found within the survey area.*

MAP UNIT	DESCRIPTION	GEOLOGICAL UNIT
S_8	Sand – very light grey at surface, yellow at depth, fine to medium grained, sub rounded quartz, moderately well sorted and of eolian origin.	Bassendean Sand (Qpb)
S_{10}	Sand – as S_8 as relatively thin veneer over C_2, M_4 and Mc_2	Thin Bassendean Sand over Guildford Formation (Qpb/Qpa)

Available topographical contours indicate that the survey area is generally undulating, with a north-westerly aspect. The survey area ranges in elevation from approximately 16 metres Australian Height Datum (mAHD) at its lowest point in the north-west, up to approximately 42 mAHD through the south-east.

2.3 Regional vegetation

The survey area occurs within the Southwest Province natural region of Western Australia as defined by Beard (1990). Much of the Southwest Province occupies the ancient Western Shield. The Interim Biogeographic Regionalisation of Australia (IBRA) further divides the Southwest Province into smaller areas (Environment Australia 2000) and the site is contained within the Drummond Subregion which occurs along the south-western coast of Western Australia. The Drummond Subregion is characterised as containing mainly *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of tuart (*Eucalyptus gomphocephala*), jarrah (*E. marginata*) and marri (*Corymbia calophylla*) on less leached soils (Beard 1990).

At a local level, the survey area is mapped as containing the Forrestfield complex which is described as "open forest of *Eucalyptus calophylla – Eucalyptus wandoo – Eucalyptus marginata* to open forest of *Eucalyptus marginata – Eucalyptus calophylla – Allocasuarina fraseriana – Banksia* spp. Fringing woodland of *Eucalyptus rudis* in the gullies that dissect this landform" (Heddle *et al.* 1986).

Prior to European settlement and the extensive land clearing that followed, the Forrestfield complex covered 21,211 ha of the Swan Coastal Plain. In 2013, 2,524 ha (11.9%) of this complex was estimated to remain on the Swan Coastal Plain (LBP 2013). Of this 2,524 ha remaining, 790 ha (or 3.7% of its pre-European extent) is under some form of protection (for example, within Department of Parks and Wildlife (DPaW) conservation estate, Bush Forever on DPaW managed lands or Bush Forever in Regional Parks) (LBP 2013).

Many studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). However this is a purely biodiversity orientated objective, and on the Swan Coastal Plain, which is considered a 'constrained area', the EPA has applied a biodiversity protection objective of retaining 10% of each vegetation complex (EPA 2006). The area remaining of Forrestfield Complex falls below the 30% objective, but just above the 10% constrained area objective.

2.4 Significant Flora Species

Flora species may be considered 'Threatened' pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened species under the EPBC Act are listed as 'Critically Endangered', 'Endangered' or 'Vulnerable'. Any action likely to have a significant impact on a species listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment.

At a state level under the *Wildlife Conservation Act 1950* (WC Act), plant species can be classified as 'Threatened' ('Declared Rare') or 'Priority' where populations are restricted geographically or threatened by local processes. DPaW recognise these threats and subsequently considers population protection and species conservation. DPaW enforces the WC Act to conserve Threatened flora and protect populations. Threatened flora are gazetted under subsection 2 of section 23F of the WC Act and it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the Act defines "to take" as "… to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means".

Priority flora species are potentially rare or threatened and are classified in order of threat, however are not afforded statutory protection. The definition and categories of Threatened and Priority flora are listed in **Table 2**.

Table 2: *Definition of Threatened and Priority Flora Species (Smith 2010)*

CONSERVATION CODE	CATEGORY
T	**Threatened Flora – Extant Taxa** 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, and have been gazetted as such.
X	**Threatened Flora – Presumed Extinct Taxa** Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
P1	**Priority One – Poorly Known Taxa** Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	**Priority Two – Poorly Known Taxa** 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 (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey.
P3	**Priority Three – Poorly Known Taxa** Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but needs further survey.
P4	**Priority Four – Rare Taxa** Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

A search was conducted of the DPaW's databases for Threatened and Priority flora and of the EPBC Act list of Matters of National Environmental Significance (MNES) that occur within the wider local area, and the results are listed in **Table 3**. Seven Threatened flora species (*Acacia aphylla, Anthocercis gracilis, Calytrix breviseta* subsp. *breviseta*, *Conospermum undulatum, Macarthuria keigheryi, Thelymitra stellata and Trithuria occidentalis*) and 35 Priority flora species were determined to potentially occur within the wider general area.

It should be noted that whilst *Hypocalymma* sp. Cataby (G.J. Keighery 5151*)* was listed as occurring in the area within DPaW's Threatened and Priority flora list, this species is only listed in FloraBase as occurring within the Eneabba region (approximately 250 km north of the site) and in substantially different habitat, thus it is considered that the inclusion of this species is likely to be a technical error.

Table 3: *Significant flora species known to occur within the general area*

SPECIES	LEVEL OF SIGNIFICANCE		LIFE STRATEGY	SUBSTRATE	FLOWERING PERIOD
	STATE	EPBC ACT LISTING			
Acacia aphylla	T	V	P	Sand, loam, clay loam. Granite outcrops, hills.	Aug-Oct
Anthocercis gracilis	T	V	P	Sandy or loamy soils. Granite outcrops.	Sep-Oct
Calytrix breviseta subsp. *breviseta*	T	E	P	Sandy clay. Swampy flats.	Oct-Nov
Conospermum undulatum	T	V	P	Grey or yellow -orange clayey sand.	May-Oct
Macarthuria keigheryi	T	E	P	White or grey sand.	Sept-Dec or Feb-Mar
Thelymitra stellata	T	E	PG	Gravelly loam and lateritic hilltops.	Oct-Nov
Trithuria occidentalis	T	E	A	Claypans. Muddy.	Sep-Oct
Acacia drummondii subsp. affinis	P3	-	P	Lateritic gravelly soils.	Jul-Oct
Acacia horridula	P3	-	P	Gravelly soils over granite, sand. Rocky hillsides.	May-Oct
Acacia oncinophylla subsp. oncinophylla	P3	-	P	Granitic soils.	Aug-Oct
Asteridea gracilis	P3		A	Sand, clay, gravelly soils.	Sep-Dec
Banksia pteridifolia subsp. vernalis	P3	-	P	White/grey sand over laterite.	Sep-Oct
Bolboschoenus medianus	P1	-	P	Mud. In water and on river banks.	Nov
Byblis gigantea	P3	-	P	Seasonally wet areas.	Sep-Dec or Jan
Calothamnus accedens	P4	-	P	Sandy soils over laterite.	Sep-Apr
Carex tereticaulis	P1	-	P	Black peaty sand.	Sept-Oct
Eryngium sp. Subdecumbens (G.J. Keighery 5390)	P3	-	P/A	Seasonally wet areas. Clay soils.	Sep-Nov
Grevillea manglesii subsp. dissectifolia	P3	-	P	Gravelly loam, moist. Roadsides	June-Nov
Grevillea pimeleoides	P4	-	P	Rocky hillsides.	May-Nov
Haemodorum loratum	P3	-	P	Grey or yellow sand, gravel.	Nov
Halgania corymbosa	P3	-	P	Gravelly soils and soils over granite.	Aug-Nov

SPECIES	LEVEL OF SIGNIFICANCE		LIFE STRATEGY	SUBSTRATE	FLOWERING PERIOD
	STATE	EPBC ACT LISTING			
Hydrocotyle lemnoides	P4	-	Aq	Swamps.	Aug-Oct
Hydrocotyle striata	P1	-	A	Clay. Springs.	Sep-Oct
Hypocalymma sp. Cataby (G.J. Keighery 5151)	P2	-	P	Grey Sand.	Aug
Isopogon drummondii	P3	-	P	White, grey or yellow sand, often over laterite.	Feb-June
Jacksonia sericea	P4	-	P	Calcareous and sandy soils.	Dec-Feb
Lasiopetalum bracteatum	P4	-	P	Sandy clay, clay, lateritic gravel.	Aug-Nov
Lepyrodia curvescens	P2	-	P	Sand, laterite, seasonally inundated swampland.	Sept-Nov
Meionectes tenuifolia	P3	-	P/A	Swamp. Clay.	Sep-Nov
Myriophyllum echinatum	P3	-	A	Clay, winter wet flats.	Nov
Ornduffia submersa	P4	-	P	Wetlands. Wet clay or sandy soils	Sep-Nov
Phyllangium palustre	P2	-	A	Winter- wet claypans, low- lying seasonal wetlands.	Oct-Nov
Pithocarpa corymbulosa	P3	-	P	Gravelly or sandy loam.	Jan-Apr
Schoenus griffinianus	P3	-	P	White sand.	Sept-Oct
Senecio gilbertii	P1	-	P	Peaty sand, swamps, slopes.	Sept-Nov
Stylidium longitubum	P3	-	A	Sandy clay, clay, seasonal wetlands.	Oct-Dec
Stylidium striatum	P4	-	P	Brown clay loam over laterite.	Oct-Nov
Templetonia drummondii	P4	-	P	Lateritic soils.	Aug-Sep
Tetratheca sp. Granite (S. Patrick SP1224)	P3	-	P	Clay. Moist loam, clayey sand, granite boulders.	Sep-Nov(Dec)
Thelymitra magnifica	P1	-	PG	Stony ridges.	Oct
Thelymitra variegata	P3	-	PG	Sandy clay, sand, laterite.	Jun-Sept
Verticordia lindleyi subsp. lindleyi	P4	-	P	Sand, sandy clay.	May or Nov-Dec or Jan

Note: P=Perennial, PG=Perennial Geophyte, A=Annual, E=Endangered, CE=Critically Endangered, V=Vulnerable.

2.5 Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs)

In Western Australia, Threatened Ecological Communities (TECs) are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organizations including tertiary institutions, the WA Museum and DPaW. Communities are assigned to one of the categories outlined in **Table 4** relating to their status of threat. While they are not afforded direct statutory protection at a state level (unlike Threatened flora under the WC Act) their significance is acknowledged through other state environmental approval processes such as Environmental Impact Assessment pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and Part V of the EP Act and associated clearing regulations.

Table 4: *Categories of Threatened Ecological Communities (English and Blyth 1997)*

CONSERVATION CATEGORY	DESCRIPTION
PD	**Presumably Totally Destroyed** An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	**Critically Endangered** An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	**Endangered** An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	**Vulnerable** An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

Communities may also be listed as a Priority Ecological Community (PEC). This is an ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined, and can be placed on the list of PECs in either Category 1, 2 or 3 (these are described in **Table 5**). Ecological communities that are adequately known and are rare but not threatened, or meet criteria for “Near Threatened”, or that have been recently removed from the Threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5 (DEC 2009a).

Table 5: *Categories of Priority Ecological Communities (DEC 2009a)*

PRIORITY CATEGORIES	DESCRIPTION
Priority 1	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of

PRIORITY CATEGORIES	DESCRIPTION
	destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (i) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (ii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.
Priority 5	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

'Threatened Communities' are also afforded statutory protection at a Federal level pursuant to the EPBC Act. The EPBC Act provides for the protection of ecological communities, which are listed under section 181 of the Act. They are categorised as either 'Critically Endangered', 'Endangered' or 'Vulnerable'.

A search was conducted of the DPaW's TEC and PEC database, as well as the EPBC Act list of MNES. These searches resulted in one PEC and six TEC's occurring within 10 km of the survey area, as listed in **Table 6**. Of the TECS listed, three (SCP 3c, SCP 20c and SCP 3a) are listed as 'Critically Endangered' within Western Australia and also 'Endangered' pursuant to the Commonwealth's EPBC Act.

Identified occurrences of TEC's SCP 20a and 20c within DPaW's TEC and PEC database are located in close proximity to the survey area. Within DPaW's database, the recorded locations of these occurrences are mapped with a 5 km radius surrounding that may also contain the TECs. The 5 km radius areas surrounding the occurrences fall within the northern part of the survey area, indicating that additional areas of TECs SCP 20a and 20c may occur within the survey area.

Table 6: *TEC's within the wider local area*

COMMUNITY CODE	COMMUNITY NAME	TEC/PEC	LEVEL OF SIGNIFICANCE	
			STATE	EPBC ACT LISTED
SCP3c	*Eucalyptus calophylla-Xanthorrhoea preissii* woodlands and shrublands	TEC	Critically Endangered	Endangered
SCP20a	*Banksia attenuata* woodland over species rich dense shrublands	TEC	Endangered	-

COMMUNITY CODE	COMMUNITY NAME	TEC/PEC	LEVEL OF SIGNIFICANCE	
			STATE	EPBC ACT LISTED
SCP20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	TEC	Endangered	-
SCP20c	Shrublands and woodlands of the eastern side of the Swan Coastal Plain	TEC	Critically Endangered	Endangered
SCP07	Herb rich saline shrubs in clay pans	TEC	Vulnerable	-
SCP3a	*Eucalyptus calophylla-Kingia australis* woodlands on heavy soils	TEC	Critically Endangered	Endangered
Central Granite Shrublands (Com 5, Markey)	Central Northern Darling Scarp Granite Shrubland Community	PEC	Priority 4	-

2.6 Bush Forever and Conservation Reserves

Remnant vegetation present outside of the site but within the northern part of the survey area (Lots 2, 3 and 148) and directly west of the survey area on both sides of Roe Highway is recognised as regionally significant bushland and therefore included within Bush Forever policy as Bush Forever Site No. 481 – *Stirling Crescent Bushland, Hazelmere* (Government of WA 2000). The Floristic Community Types (FCTs) 3a and 20c were inferred to occur within Bush Forever Site No. 481. The attributes contributing to the regional significance of Bush Forever Site No. 481 include the representation of ecological communities and rarity (Government of WA 2000).

Directly to the east of the survey area, a large area of remnant vegetation is included within Bush Forever Site No. 213 – *Bushmead Bushland, Swan* (Government of WA 2000). The FCTs 3c, 20a and 20c were either inferred or identified (through field survey) to occur within Bush Forever Site No. 213. The attributes contributing to the regional significance of Bush Forever Site No. 213 include the representation of ecological communities, rarity, scientific or evolutionary importance and general criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation (Government of WA 2000).

A small area of remnant bush to the south west of the survey area forms the small Bush Forever Site No.122 – *Hawkevale Bushland, High Wycombe* (Government of WA 2000). FCT 20a was identified as occurring within Bush Forever Site No.122. The attributes contributing to the regional significance of Bush Forever Site No.122 include the representation of ecological communities, rarity, scientific or evolutionary importance (Government of WA 2000).

The Bush Forever sites within or in close proximity to the survey area are shown on **Figure 2**.

2.7 Biodiversity Linkages

Biodiversity linkages allow the movement of fauna, flora and genetic material between areas of fragmented remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improve the viability of those remnants by allowing greater access to breeding partners, food sources, refuge from disturbances such as fire and maintenance of genetic diversity of

plant communities and populations. Biological linkages are often continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

Biodiversity linkages have been identified by the State Government in Bush Forever, Perth's Greenways and the System 6 study and are supported by the WA Local Government Association (Molloy *et al.* 2007) and have been published by the Perth Biodiversity Project. These identified linkages reflect the on-ground linkages throughout the Perth Metropolitan area. The dataset is employed as a conservation tool aimed to conserve and enhance our regional biological linkages.

Remnant vegetation in the northern section of the survey area contributes to the intactness of Regional Ecological Linkage 33. This ecological linkage joins up with Regional Ecological Linkage 134 north of the survey area and Regional Ecological Linkage 34 south-east of the survey area. Regional Ecological Linkage 33 is shown on **Figure 2**.

2.8 Wetlands

Wetlands in Western Australia are defined as "*areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or otherwise, fresh and saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and the tributaries*" (Wetlands Advisory Committee 1977). This definition has been adopted by Semeniuk (1987) and by V & C Semeniuk Group for the purposes of wetland mapping and classification on the Swan Coastal Plain (Hill *et al.* 1996).

The DPaW digitised the original Hill *et al.* (1996) mapping to form the Geomorphic Wetland Swan Coastal Plain Dataset, which categorises the individual wetlands into specific management categories as described in **Table 7**.

Table 7: *Wetland management categories and management objectives (WAPC 2005)*

MANAGEMENT CATEGORY	DESCRIPTION OF WETLAND	MANAGEMENT OBJECTIVES
Conservation (CCW)	Supports high levels of attributes and functions	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state owned land. Protection provided under environmental protection policies.
Resource Enhancement (REW)	Partially modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple Use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

A review of the area indicated that no geomorphic wetlands occur within the survey area. The nearest geomorphic wetlands are located at least 500 m from the survey area and are MUWs.

2.9 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are areas prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.* As a result ESAs are relevant when clearing permit

requirements are being considered. ESAs have been identified to protect the native vegetation values of areas surrounding significant, threatened or scheduled ecosystems and communities. ESA's generally occur over or in association with:

- A declared World Heritage property.
- An area that is registered on the Register of the National Estate, because of its natural values.
- A defined wetland and the area within 50 m of the wetland.
- The area covered by vegetation within 50 m of Threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened flora is found.
- The area covered by a TEC.
- In the Metropolitan Region a Bush Forever site listed in "Bush Forever" Volumes 1 and 2 (Government of WA 2000).

In addition to the above, ESAs are declared in accordance with the following policies:

- The *Environmental Protection (Gnangara Mound Crown Land) Policy 1992.*
- The *Environmental Protection (Western Swamp Tortoise) Policy 2002.*
- The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* applies.
- Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998.*
- Areas of fringing native vegetation in the policy area as defined in the *Environmental Protection (Swan and canning Rivers) Policy 1998.*

A search of the DPaW's Native Vegetation mapping database identified that the entire survey area comprises a large ESA is likely to be associated with the Bush Forever sites and occurrences of TECs close to the survey area.

2.10 Regional and Local Significance

Apart from being listed as either Threatened or Priority flora, plant species may be significant for a number of other reasons. EPA *Guidance Statement No. 51* (2004) states that significant flora may include taxa that have:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species
- relic status
- anomalous features that indicate a potential new discovery
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- the presence of restricted subspecies, varieties or naturally occurring hybrid
- local endemism/a restricted distribution
- being poorly reserved.

Similarly, plant communities may be significant for reasons other than a listing as a TEC or PEC. EPA (2004) indicates that these reasons include:

- scarcity
- unusual species
- novel combinations of species

- a role as a refuge
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species
- being representative of the range of a unit (particularly, a good local and/or regional example
- of a unit in 'prime' habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- a restricted distribution.

Conospermum incurvum was identified as occurring within Bush Forever Site No. 481 (Government of WA 2000) and thus may occur within the portion of this Bush Forever site within the survey area. *C. incurvum* is not listed as Threatened or Priority Flora but is noted to be of significance due to 'populations at the northern or southern limit of their known geographical range' and 'significant populations' (Government of WA 2000). No other species of regional or local significance were identified as highly likely to occur within the site based on the background review. Any significant species found to occur within the site on the basis of the field survey will be identified in **Section 4.3**.

2.11 Previous Surveys

No previous flora and vegetation surveys of the site or survey area as a whole are known, however an assessment of the flora and vegetation values present within Lot 97 Adelaide Street (in the south western corner of the site) was conducted by Mattiske Consulting in 2009. This included a targeted search for Threatened flora.

The survey conducted by Mattiske Consulting identified Threatened flora species *Conospermum undulatum* and Priority flora species *Isopogon drummondii* occurring within Lot 97 within a plant community determined by PATN analysis to represent FCT 20a – '*Banksia attenuata* woodland over species dense shrubland', which is a state listed TEC. The majority of Lot 97 was considered to be highly disturbed; however a small portion of vegetation was relatively intact.

3 Methodology

3.1 Field Survey

3.1.1 Flora and Vegetation

Two botanists from Emerge visited the survey area on the 13, 14 and 22 August, 6 September and 7 November 2013 and undertook a flora and vegetation survey. The survey area was traversed on foot and sampling of the vegetation was undertaken using 17 non-permanent relevés and four 10 x 10 m non-permanent quadrats, selected to adequately sample the range of vegetation observed (as shown on **Figure 3**). The position of each survey location was recorded with a hand-held GPS unit and all vascular plant species were recorded within the quadrat or relevé area. An estimate of the percentage Foliage Projective Cover (FPC) was made for each species at each survey location. Ten 'points of interest' were also documented to show particular site conditions. In addition, opportunistic plant taxa observed across the survey area were recorded over the course of the survey.

Data recorded at each quadrat and relevé included:

- Site details (site name, site number, observers, date and location).
- Environmental data (slope, aspect, bare-ground, rock outcropping soil type and colour class, litter layer, topographical position and time since last fire event).
- Biological data (vegetation structure and condition, degree of disturbance, species present and cover percentages).

The condition of the vegetation across the survey area was assessed to assist in determining conservation values of the remnant vegetation. Vegetation condition was rated according to Keighery (1994), a vegetation condition scale commonly used in the Perth Metropolitan Region, but which is also appropriate for peri-urban areas. The categories are listed and defined in **Table 8**.

All plant specimens collected during the field survey were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys.

Table 8: *Vegetation condition scale (Keighery 1994).*

VEGETATION CONDITION	DEFINITION
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

VEGETATION CONDITION	DEFINITION
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

3.2 Mapping and Data Analysis

Aerial photography (1:6,500) was used to map the local plant communities. The plant communities were identified from the quadrat and relevé data. A cluster analysis was performed on the dataset by converting the FPC for each species at each sample location to a Domin value (Kent and Coker 1994). Classification was undertaken using hierarchical clustering within the analysis package Primer-6 (Clarke and Gorley 2006), with groups defined using the Bray-Curtis distance measure. Groups were further defined by using a similarity probability measure, with a significance level of p = 5%. The resultant dendrogram is provided in **Appendix A.**

Once the groups had been defined by the cluster analysis, the vegetation was described according to the dominant species present using the structural formation descriptions of the National Vegetation Inventory System (NVIS) (ESCAVI 2003). The identified plant communities were then mapped on aerial photography (1:6,500) from the survey data points and boundaries interpreted from aerial photography.

Once each plant community had been described and mapped, the community was compared to the regional FCT studies and dataset by Gibson *et al.* (1994). FCTs were determined statistically using presence/absence species data. Site quadrat data was reconciled with the SCP dataset of Gibson *et al*. (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level were excluded while some infra-species that have been identified since 1994 were reduced to species level. The combined dataset was then imported into the statistical analysis package Primer-6 (Clarke and Gorley 2006). As data from a localised study as this one is often highly spatially correlated compared to the data from a regional study, the site data was added to the SCP dataset and analysed for each individual sample site. This removes the influence of spatial correlation when assigning a FCT to the local plant communities. Classification was undertaken using a group-average hierarchical clustering technique using the Bray-Curtis distance measure (as described above for plant community determination). The relevant portions of the dendrograms produced are provided in **Appendix B.**

Where the statistical analysis provided unclear results, for example when site data showed a low percentage of similarity to a large group containing many FCTs due to high levels of disturbance and loss of native species, FCTs were inferred based on species presence as well as soils and landform information provided within Gibson *et al.* (1994) and known locations of FCTs provided within Bush Forever (2000) and DPaW's TEC and PEC database.

Determining FCTs based on the Gibson *et al.* (1994) dataset has a number of limitations which include;

- Areas of disturbance and reduced condition tend to have reduced numbers of native species and increased numbers of introduced weed species. Statistical analysis results may be skewed by a small number of species where species loss and disturbance has occurred, leading to misleading similarities to FCTs.
- The Gibson *et al.* (1994) survey was focused on the least degraded sites available. Thus, highly degraded sites can be very difficult to place within this data.
- The Gibson *et al.* (1994) dataset comprises a relatively limited number of sites (509) in relation to the degree of variability of vegetation present within the large area on which it is based.
- As noted within Bush Forever (Government of WA 2000), not all geographical or geomorphological variation was sampled. The foothills (in which the site is situated), Pinjarra Plain, Quindalup Dunes and Dandaragan Plain were either under-sampled or not sampled. As a result a number of the defined FCTs were based on as few as two survey locations.
- A number of supplementary surveys were conducted from 1994-1998 in order to update the dataset. These surveys comprised an additional 613 quadrats and when analysed against the Gibson *et al.* (1994) dataset, resulted in a further 23 FCTs being identified (Government of WA 2000). These additional FCTs are listed in Bush Forever (Government of WA 2000) and inferred to occur within the descriptions of Bush Forever sites but were never formally described or published. Nor has the data been made available in order to include within analyses of FCTs.
- The Gibson *et al.* (1994) dataset records presence or absence of flora species, but does not account for changes in species dominance, which is highly variable on the Swan Coastal Plain.
- The survey area was largely surveyed using relevés (vegetation sampled within a radius of approximately 10 m from a central point), as opposed to the quadrats (vegetation surveyed within a defined 10 x 10 m square) used within the Gibson *et al.* (1994) survey. These methods sample different areas of land, thus are not strictly comparable. Within degraded areas however it is unlikely that surveying quadrats would yield widely different results, thus on the basis that approximately three times the area of land is surveyed within a relevé, sampling relevés may identify more species within degraded areas and yield more comparable results to the Gibson *et al.* (1994) dataset (which was focused on the least degraded locations possible).

4 Results

4.1 Flora

A total of 122 native and 49 introduced (weed) species were recorded during this survey as occurring within the survey area in 2013, representing 35 families and 119 genera. Within the site itself, 85 native taxa and 43 introduced taxa were recorded. The dominant families containing native taxa were Fabaceae (25 native taxa and nine introduced taxa), Proteaceae (15 native taxa) and Myrtaceae (nine native taxa and nine introduced taxa). The most common genera were *Daviesia* (seven native taxa) and *Banksia* (six native taxa).

For a complete species list, species list by plant community and individual survey site data refer to **Appendix C, Appendix D and Appendix E** respectively.

4.1.1 Declared Weeds

Particularly invasive weed species are listed as 'Declared Pests' pursuant to the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Declared Pest status means weed species are highly invasive and aggressive. No Declared Pest species were located during the field survey.

4.1.2 Threatened, Priority Flora and Species of Significance

The Threatened flora species *Conospermum undulatum* (**Plate 1**) was recorded from one area of remnant vegetation in the south western corner of the site. Nine individuals were observed. The recorded locations of this species and the number of plants recorded at each location are shown on **Figure 3**. Similar vegetation was recorded in the northern section of the survey area thus *C. undulatum* may occupy a wider distribution within the survey area, however these additional areas of potential occurrence are included within Bush Forever Site No. 481 and thus are likely to remain uncleared.

Plate 1: *Photographs of Threatened flora species Conospermum undulatum (left) and Priority 3 flora species Isopogon drummondii (right) found to occur within the site. Images taken from FloraBase (DPaW 2013).*

In addition, one Priority 3 flora species *Isopogon drummondii* (**Plate 1**) was also recorded within the site. In total, 18 individuals of *Isopogon drummondii* were recorded from ten locations within two small patches of remnant vegetation in the south-western part of the site. These locations are shown on **Figure 3**. As for *C. undulatum*, additional habitat was also recorded in the northern section of the

survey area, suggesting that *I. drummondii* may occupy a wider distribution within the survey area; however the potential areas of occurrence are included within Bush Forever Site No. 481 and thus are likely to remain uncleared.

Three species that are not currently listed as Threatened or Priority Flora, but are listed in Bush Forever (Government of WA 2000) as significant, were recorded within the survey area. These species were; *Dasypogon obliquifolius, Hemiphora bartlingii* and *Lambertia multiflora* var. *darlingensis*. *D. obliquifolius* and *H. bartlingii* are noted as occurring within Bush Forever Site No. 213 (to the east of the site) and Bush Forever Site No. 122 (to the south-west of the site) and are ascribed significance within the Bush Forever (2000) document on the basis of their geographical range, comprising 'significant populations' and 'populations disjunct from the known geographical range'. *L. multiflora* var. *darlingensis* was previously listed as a Priority 3 Flora species but has since been removed from the Priority Flora list. Bush Forever (2000) notes this species to have 'significant populations' and was 'considered to be poorly reserved' (this characteristic is generally associated with all Threatened or Priority Flora species thus may no longer be relevant given the downgraded conservation status of this species). All three significant species were recorded within the site and wider survey area. *Conospermum incurvum* was noted within **Section 2.10** as potentially occurring within the survey area due to its presence within Bush Forever Site No. 481. *C. incurvum* is not listed as a Threatened or Priority Flora species but was listed within the Bush Forever documentation as comprising 'populations at the northern or southern limit of their known geographical range' and 'significant populations' (Government of WA 2000). This species was not recorded within the site or wider survey area.

4.2 Plant Communities

Three intact plant communities and areas of 'Parkland Cleared' paddocks were identified and described within the site. They are shown on **Figure 3** and described as follows:

> **CcOF -** *Corymbia calophylla* open forest over sparse shrubland of *Xanthorrhoea preissii* (or absent) over closed grassland and forbland of pasture weeds (**Plate 2**).
>
> **EmBaBmW** – Isolated trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over woodland of *Banksia attenuata*, *B. menziesii*, *B. grandis* and *Adenanthos cygnorum* over low shrubland of *Xanthorrhoea preissii* and *Hibbertia hypericoides* over forbland of *Dasypogon obliquifolius*, *Conostylis* spp. and *Anigozanthos manglesii* and sedgeland of *Desmocladus flexuosus* and *Alexgeorgea nitens* (**Plate 3**).
>
> **EmAfOW** – Isolated trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over open shrubland of *Xanthorrhoea preissii* over grassland and forbland of pasture weeds (**Plate 4**).
>
> **'Parkland Cleared'/Planted** – Isolated *Corymbia calophylla*, *Eucalyptus marginata* and planted non-endemic trees over pasture weeds (**Plate 5**).

An additional disturbed plant community was recorded outside of the site within the wider survey area. Plant community **AdAnS** was described as a tall shrubland to tall closed shrubland of *Adenanthos cygnorum* over low sparse to open shrubland of *Hibbertia* spp. over sparse to open forbland of *Hybanthus calycinus* and *Dasypogon bromeliifolius* and open sedgeland of *Alexgeorgea nitens* and *Desmocladus flexuosus* (

Plate 6).

Plate 2: *Plant Community* ***CcOF*** *in 'Degraded' condition. Taken facing west at 407306 E; 6467016 S.*

Plate 3: *Plant Community* ***EmBaBmW*** *in 'Very Good' condition within Bush Forever Site No. 481. Taken facing south at 407013 E; 6467850 S.*

Plate 4: *Plant Community* ***EmAfOW*** *in 'Degraded' condition. Taken facing east at 407152 E; 6467921 S.*

Plate 5: *'Parkland Cleared'/Planted vegetation.*

Plate 6: *Plant Community* ***AdAnS*** *in 'Good' condition within Bush Forever Site No. 481. Taken facing east at 407043 E; 6467784 S.*

4.3 Analysis of Floristic Community Types

Based on the comparison between the plant communities described above and the Gibson *et al.* (1994) Swan Coastal Plain floristic survey dataset, the FCTs present within the survey area are likely to be FCT 3c – "*Corymbia calophylla-Xanthorrhoea preissii* woodlands and shrublands" and FCT 20a – "*Banksia attenuata* woodlands over species rich dense shrublands". Only those areas of intact vegetation can be considered to still represent these FCTs.

Given the high level of disturbance that has occurred historically within the site, the FCT for plant community **CcOF** was inferred based on community descriptions and species presence due to inconclusive results from the statistical analysis. Plant community **CcOF** is inferred to represent FCT 3c on the basis that it contained *Corymbia calophylla* and scattered understorey species such as *Xanthorrhoea preissii, Mesomelaena tetragona* and *Banksia nivea*, is known to occur within Bush Forever Site No. 213 to the east of the site and this community is generally found on similar soils and landforms as represented within the site.

Survey data from plant community **EmBaBmW** tended to show 30-40% similarity to Gibson *et al.* (1994) dataset sites APBF-1 and APBF-2 which represent FCT 20a. There was also a relatively high similarity to FCT 20c (25%). On the basis of a number of floristic characteristics however, it was determined that FCT 20a was the most likely FCT represented within the site. These characteristics include:

- The presence of *Alexgeorgea nitens, Daviesia nudiflora* and *Synaphea spinulosa* - these species are characteristic of FCT 20a and used to separate this FCT from other subgroups.

- Presence of *Eucalyptus marginata* subsp. *marginata* as an emergent canopy tree within plant community **EmBaBmW** throughout the site – this species is not associated with FCT 20c.

Statistical analysis of survey data for plant communities **EmAfOW** and **AdAnS** were inconclusive due to high levels of disturbance. Due to species similarities, it is inferred that these plant communities once represented FCT 20a.

FCT 3c is described as "poorly reserved" and "vulnerable" by Gibson *et al.* (1994) and listed as a 'Critically Endangered' TEC pursuant to the EP Act. FCT 3c is also listed as 'Endangered' pursuant to the EPBC Act.

FCT 20a is described as "unreserved" and "endangered" by Gibson *et al.* (1994). FCT 20a is listed as an 'Endangered' TEC pursuant to the EP Act, but is not listed under the EPBC Act.

4.4 Vegetation Condition

The vegetation across the site ranged from 'Completely Degraded' to 'Good' condition, with some areas of vegetation within the survey area but outside of the site itself comprising 'Very Good' condition. Vegetation condition across the site and survey area is shown on **Figure 4**. 'Completely Degraded' areas covered the majority of the site (51 ha or 92.7%), where historic clearing has occurred. These areas have been subject to significant weed invasion and contained occasional native trees and shrubs as well as numerous planted non-endemic tree species.

'Degraded' areas existed as small pockets within 'Completely Degraded' paddocks, or as relatively disturbed areas within remnant vegetation, and comprised 3.6 ha or 6.7% of the site. Within the wider survey area, a portion of Bush Forever Site No. 481 was in 'Degraded' condition due to grazing (Lot 2), edge effects (Lots 2 and 148) and historical clearing for power lines (Lot 148).

A number of small patches of 'Good' vegetation were recorded within the site, largely in the south western corner of the site. Over the site, 'Good' vegetation comprised 0.4 ha (0.7% of the site). 'Good' condition vegetation was also recorded outside of the site in Bush Forever Site No. 481.

Outside of the site, relatively undisturbed vegetation in 'Very Good' condition was recorded within Bush Forever Site No. 481. These areas were subject to some weed invasion but contained a relatively high number of native species.

5 Discussion

The survey area is mapped as comprising vegetation of the Forrestfield vegetation complex, which is described as an "open forest of *Eucalyptus calophylla – Eucalyptus wandoo – Eucalyptus marginata* to open forest of *Eucalyptus marginata – Eucalyptus calophylla – Allocasuarina fraseriana – Banksia* spp. Fringing woodland of *Eucalyptus rudis* in the gullies dissect this landform". The remnant vegetation within the survey area is considered to be consistent with the Forrestfield vegetation complex.

Approximately 11.9% of the original extent of the Forrestfield Vegetation Complex remains on the Swan Coastal Plain, which is just above the 10% biodiversity objective threshold for 'constrained areas' (EPA 2006) and below the biodiversity objective of 30% retention. However, only those areas of intact ('Good' or better condition) remnant vegetation would still be considered to be representative of this complex.

171 flora species were found to occur within the survey area, including 49 non-native introduced species. Within the site itself, 131 flora species (85 native taxa and 46 introduced taxa) were recorded. Threatened flora species *Conospermum undulatum* was recorded in the south western corner of the site at one survey location. The Priority 3 flora species *Isopogon drummondii* was recorded at two locations in the south west of the site. Both of these conservation significant species were only recorded within the south western populations of plant community **EmBaBmW**, as shown on **Figure 3**. Given the further distribution of this community within the survey area, these species may also occur within vegetation in the areas of this community mapped within Bush Forever Site No. 481 in the northwest of the survey area. The very northern point of the survey area (part of Lot 2) also contained plant community **EmBaBmW** and is not located within Bush Forever Site No. 481, however given that this area is 'Degraded' and of limited size it is considered unlikely that *C. undulatum* and *I. drummondii* occur within this area or were overlooked during the field survey. In addition to the above listed Threatened and Priority Flora species, three species noted as significant within the Bush Forever (2000) documentation were also recorded; *Dasypogon obliquifolius, Hemiphora bartlingii* and *Lambertia multiflora* var. *darlingensis*. These three species were recorded both within the Bush Forever portion of the survey area and within the site itself. Given the varied timing of the surveys conducted by Emerge in 2013 it is considered unlikely that additional flora species of conservation significance occur within the site and were not recorded.

Three native (remnant) plant communities plus areas of 'Parkland Cleared' were recorded within the site, with an additional community occurring only within the portion of the survey area comprising Bush Forever Site No. 481. Native plant communities comprised less than 8% of the site.

Plant community **CcOF** was located in a number of small patches throughout the south eastern part of the site. These patches generally exist as marginally more intact areas within 'Parkland Cleared' vegetation, and consisted of an intact open forest (30-70% FPC) of *Corymbia calophylla* trees over isolated native shrubs and herbs. Little native understorey remained and the understorey was dominated by pasture grasses and other introduced weed species. Patches of plant community **CcOF** and adjacent areas of 'Parkland Cleared' vegetation are likely to have once represented FCT 3c - *Corymbia calophylla-Xanthorrhoea preissii* woodlands and shrublands, a 'Critically Endangered' TEC, however as the vegetation was in either 'Degraded' or 'Completely Degraded' condition, the patches of plant community **CcOF** within the site cannot be considered to still represent this FCT.

Plant community **EmBaBmW** was located primarily within the Bush Forever Site No. 481 portion of the survey area. Within the site this community exists as scattered small remnant patches. Plant community **EmBaBmW** consisted of isolated trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over woodland of *Banksia attenuata*, *B. menziesii*, *B. grandis* and *Adenanthos cygnorum* over low shrubland of *Xanthorrhoea preissii* and *Hibbertia hypericoides* over forbland of *Dasypogon obliquifolius*, *Conostylis* spp. and *Anigozanthos manglesii* and sedgeland of *Desmocladus flexuosus* and *Alexgeorgea nitens*. This community was relatively species rich despite the disturbances and clearing in adjacent areas, with the areas in 'Very Good' condition within Bush Forever Site No. 481 containing an average of 50 species per survey location. Threatened flora species *Conospermum undulatum* and Priority 3 flora species *Isopogon drummondii* were both found to occur within this plant community within the site. Historical aerial photography of a patch of remnant vegetation containing *Isopogon drummondii* indicated that the area had recently been subject to considerable clearing, with approximately two thirds of the vegetation present in January 2013 removed by the time of field survey. Plant Community **EmBaBmW** is considered to represent FCT 20a - *Banksia attenuata* woodlands over species rich dense shrublands. This FCT is listed as an 'Endangered' TEC within Western Australia, but is not listed federally under the EPBC Act. The areas containing plant community **EmBaBmW** in 'Good' condition within the site are considered to be of local and regional conservation significance, based of its status as a TEC and due to the occurrence of *Conospermum undulatum* and *Isopogon drummondii*.

Plant community **EmAfOW** was recorded in the northern part of the site and existed as marginally more intact areas within areas of 'Parkland Cleared vegetation. Plant community **EmAfOW** consisted of scattered trees to open woodland of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* over scattered to an open shrubland of *Xanthorrhoea preissii*. Occasional individuals of *Banksia* spp. were also observed. The understorey was dominated by introduced pasture grasses and other weed species. Woody weeds such as **Leptospermum laevigatum* and **Chamaecytisus palmensis* were also present in moderate densities. Plant community **EmAfOW** is likely to have once represented FCT 20a; however this area has been considerably disturbed since 1953, at which time the area was already largely cleared (Landgate 2013) and is currently in 'Degraded' condition. Thus plant community **EmAfOW** is not considered to fully represent FCT 20a and is not of conservation significance.

Plant community **AdAnS** was only located outside of the site within Bush Forever Site No. 481, forming a distinct strip running from north to south between two power line towers. The vegetation appears to have been cleared historically, and native vegetation has recolonised to dominate the area. The native shrub species *Adenanthos cygnorum* is dominant and forms a two metre high closed shrubland, however numerous understorey species have also recolonised the area to the extent that the southern portion was largely in 'Good' condition despite the disturbances. A review of historical aerial photography available through Landgate indicated that this area was cleared first between 1965-1974 when the power line towers were first established, and then subsequently cleared in between 2001 and 2002. Plant community **AdAnS** is likely to have represented FCT 20a historically, however due to episodic clearing the floristic composition has changed to the extent that this area is unlikely to fully represent FCT 20a.

The vegetation across the site ranged from 'Completely Degraded' to 'Good' condition, with areas of 'Very Good' condition also occurring within the wider survey area. 'Completely Degraded' areas covered the majority of the site (93%), where previous clearing has occurred. These areas have been subject to significant weed invasion and contained occasional native trees and shrubs as well as numerous planted non-endemic tree species. Vegetation in 'Good' and 'Very Good' condition was

primarily located within the Bush Forever site (Lots 2 and 148) however some smaller patches of 'Good' condition vegetation were also located within the site. All areas of 'Good' condition vegetation comprised plant community **EmBaBmW** and thus represent the TEC, FCT 20a.

Over the vast majority of its area, the site contains very limited flora and vegetation values, with 'Parkland Cleared' areas comprising 93% of the site and including numerous areas of planted non-endemic trees. The small patches of remnant vegetation in 'Good' or better condition however represent a TEC and contain a Threatened flora species in at least one location, a Priority flora species in at least two locations and a number of other flora species recognised as significant within the Bush Forever (Government of WA 2000) documentation. Given these values and the limited vegetation remaining within the Forrestfield Vegetation Complex, the remnant vegetation within the site in 'Good' is considered to be of local and regional significance.

6 Conclusions and Recommendations

Over the vast majority of its area, the site supports very limited flora and vegetation values, with 'Parkland Cleared' areas in 'Completely Degraded' condition comprising a large proportion of the site and including numerous areas of planted non-endemic trees. Some remnant vegetation however represent a state listed TEC (FCT 20a) and contain a Threatened, a Priority flora species, as well as a number of other significant flora. All vegetation representing FCT 20a present within the survey area in 'Very Good' condition is located within Bush Forever Site No. 481, however a number of smaller remnants in 'Good' condition occur within the site itself, including all recorded occurrences of *C. undulatum* (Threatened) and *I. drummondii* (Priority 3). The entire site is mapped as an ESA and the northern portion contributes to the intactness of an ecological linkage connecting adjacent areas of remnant bushland.

Given the values listed above and the limited vegetation remaining within the Forrestfield vegetation complex, the remnant vegetation in 'Good' condition within the site is considered to be of local and regional significance.

Based on the findings of this assessment, it is recommended that in the context of the local structure plan preparation process, consideration is given to:

- Retention of areas comprising plant community **EmBaBmW** in 'Good' or better condition.
- Retention of areas containing occurrences of Threatened flora species *Conospermum undulatum* and Priority 3 flora species *Isopogon drummondii*.
- Future management of areas of retained remnant vegetation should be resolved through the planning and approvals process for industrial development/use.

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FIGURES

Figure 1: Site Plan and Locality

Figure 2: Environmental Features

Figure 3: Plant Communities

Figure 4: Vegetation Condition

Figure 5: Vegetation Recommended for Retention

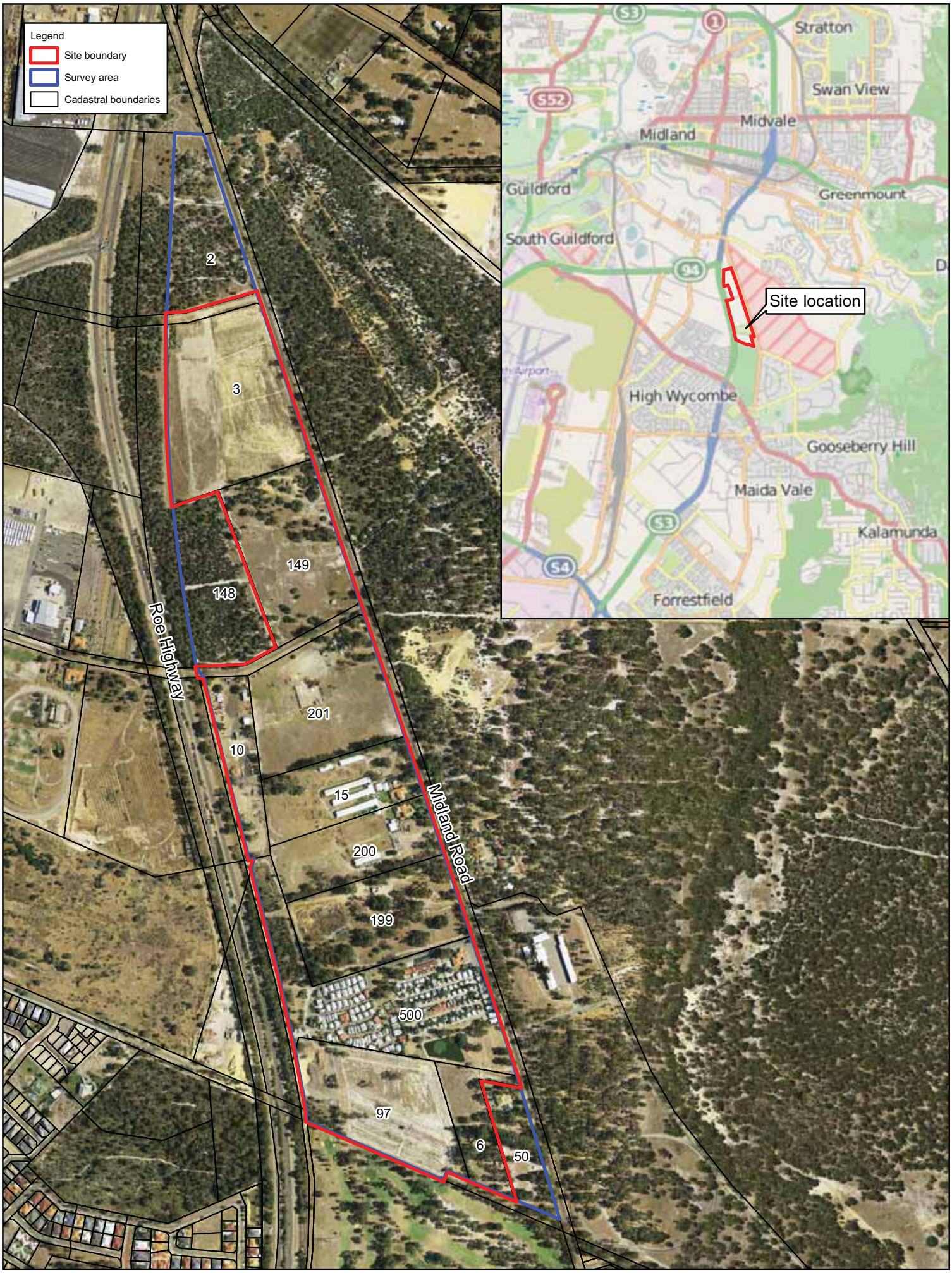

Figure 1:	**Site Plan and Locality**	**Plan Number: EP13-027(06)--F30a**	
Project:	Level 2 Flora and Vegetation Assessment Hazelmere Precinct 9A Local Structure Plan	Drawn: GRO	Date: 05/03/15
Client:	Hazelmere Landowners Group	Approved: JDH	Date: 05/03/15
		Checked: SKP	Scale: 1:9,500@A4

0 90 180 360 Metres

emerge ASSOCIATES Integrated Science & Design

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used

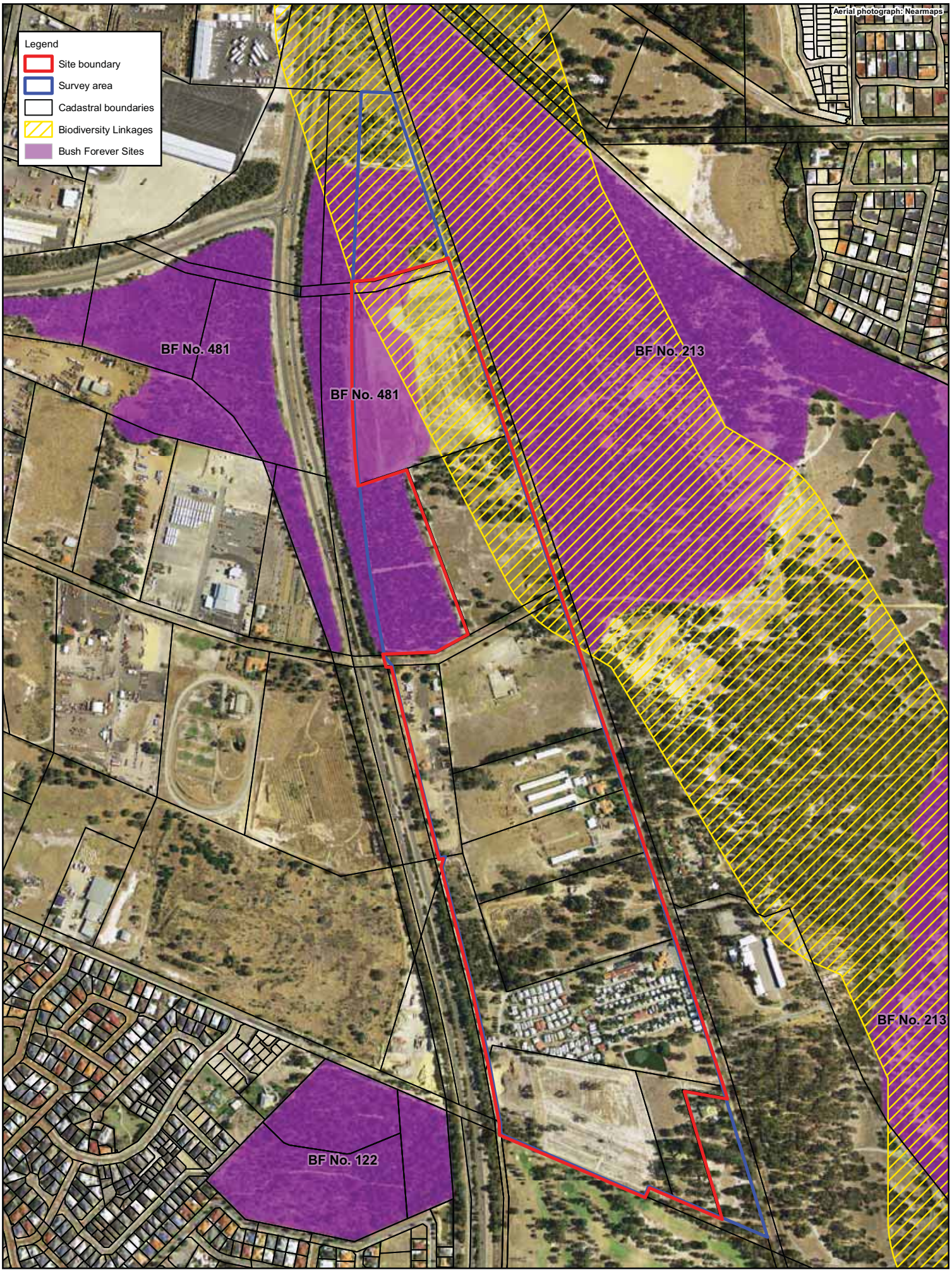

Figure 2:	**Environmental Features**
Project:	Level 2 Flora and Vegetation Assessment Hazelmere Precinct 9A Local Structure Plan
Client:	Hazelmere Landowners Group

Plan Number: EP13-027(06)--F31a			
Drawn:	GRO	Date:	05/03/15
Approved:	JDH	Date:	05/03/15
Checked:	SKP	Scale:	1:9,000@A4

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emerge ASSOCIATES
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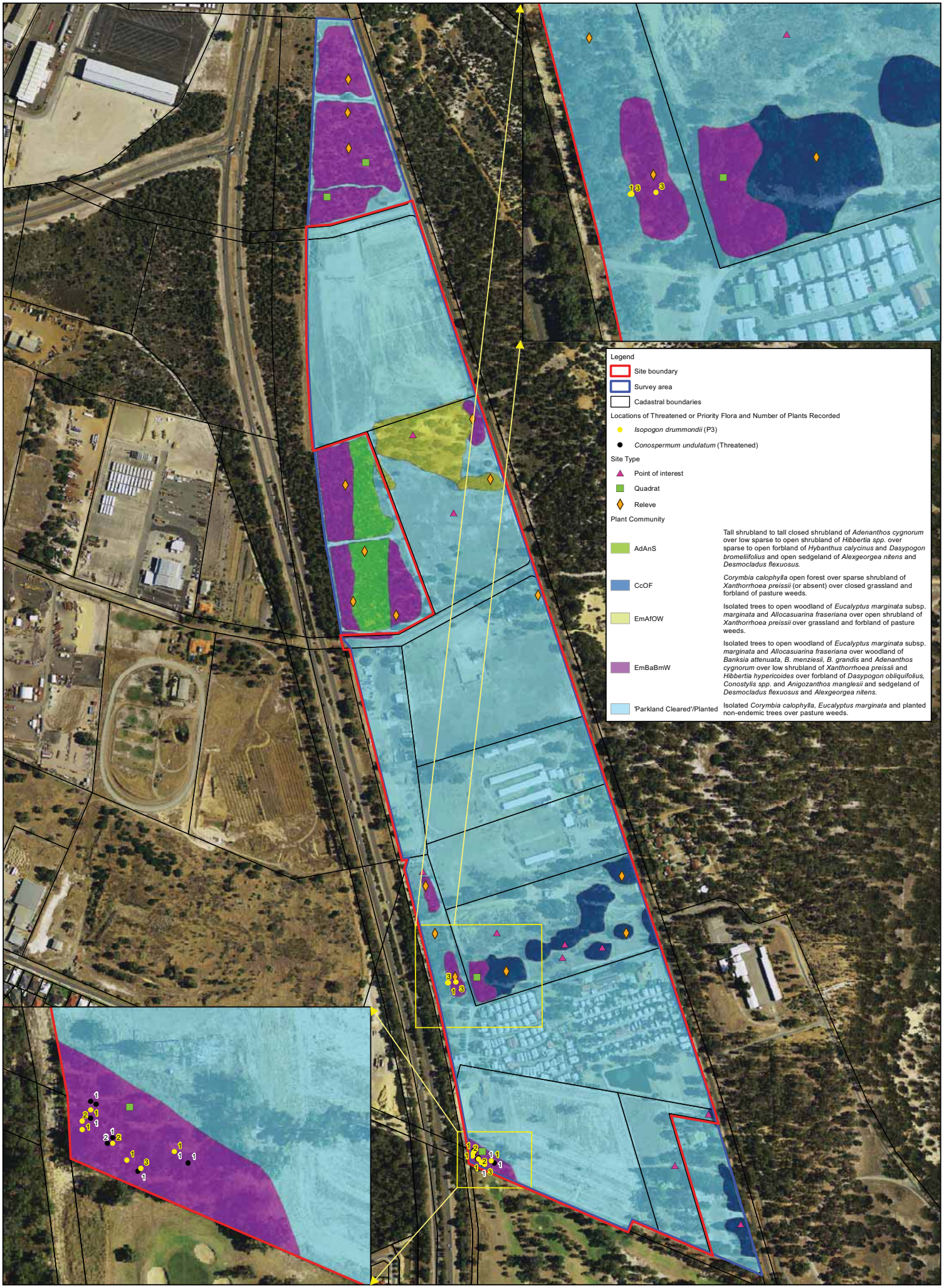

Figure 3: Plant Communities

Project: Level 2 Flora and Vegetation Assessment
Hazelmere Precinct 9A Local Structure Plan

Client: Hazelmere Landowners Group

Plan Number: EP13-027(06)--F32b	
Drawn: GRO	Date: 05/03/15
Approved: JDH	Date: 05/03/15
Checked: SKP	Scale: 1:5,750@A3

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emerge ASSOCIATES Integrated Science & Design

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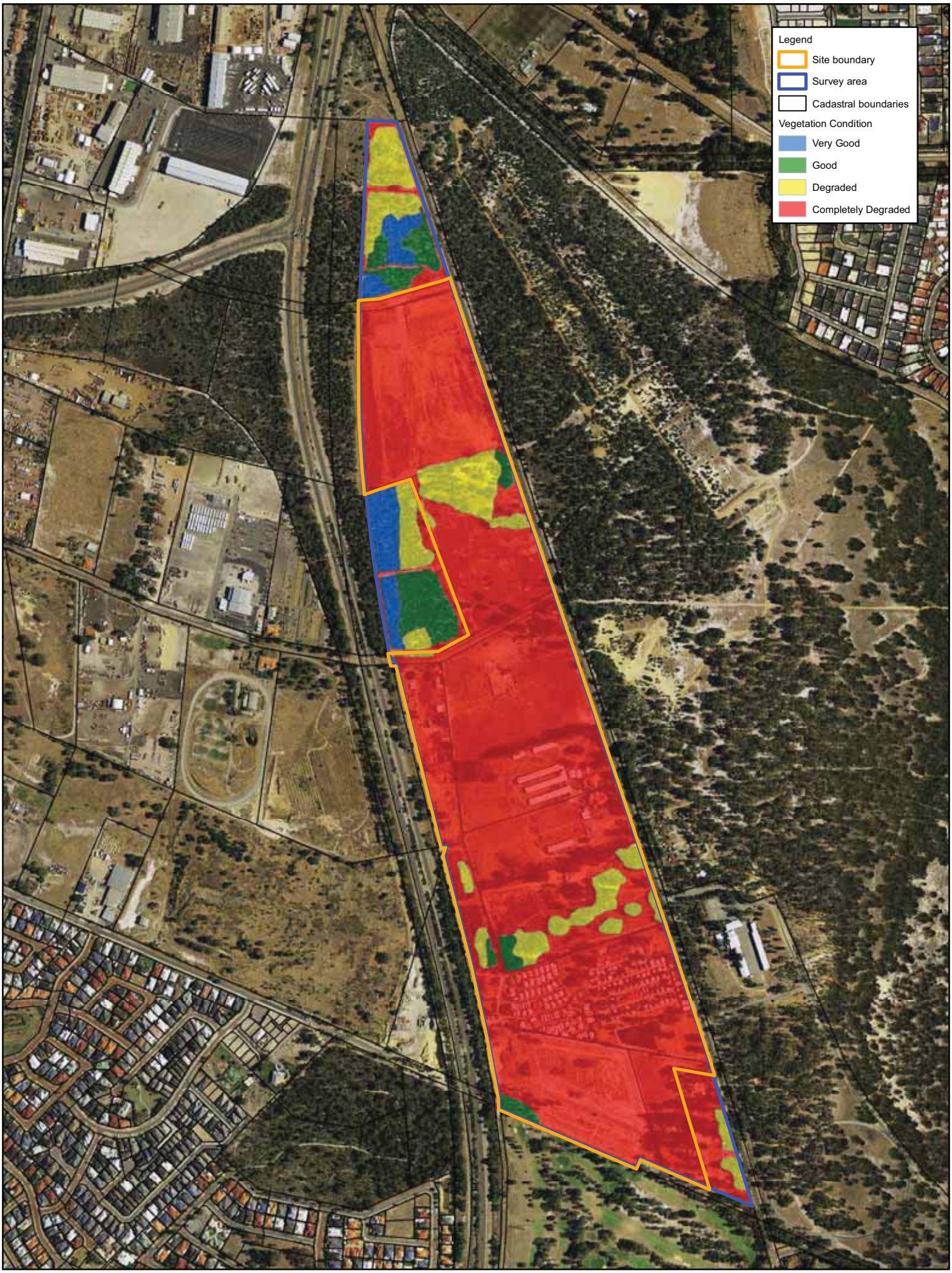

Figure 4: Vegetation Condition

Project: Level 2 Flora and Vegetation Assessment
Hazelmere Precinct 9A Local Structure Plan

Client: Hazelmere Landowners Group

Plan Number: EP13-027(06)--F33b

Drawn:	GRO	Date:	05/03/15
Approved:	JDH	Date:	06/03/2015
Checked:	SKP	Scale:	1:9,500@A4

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emerge ASSOCIATES
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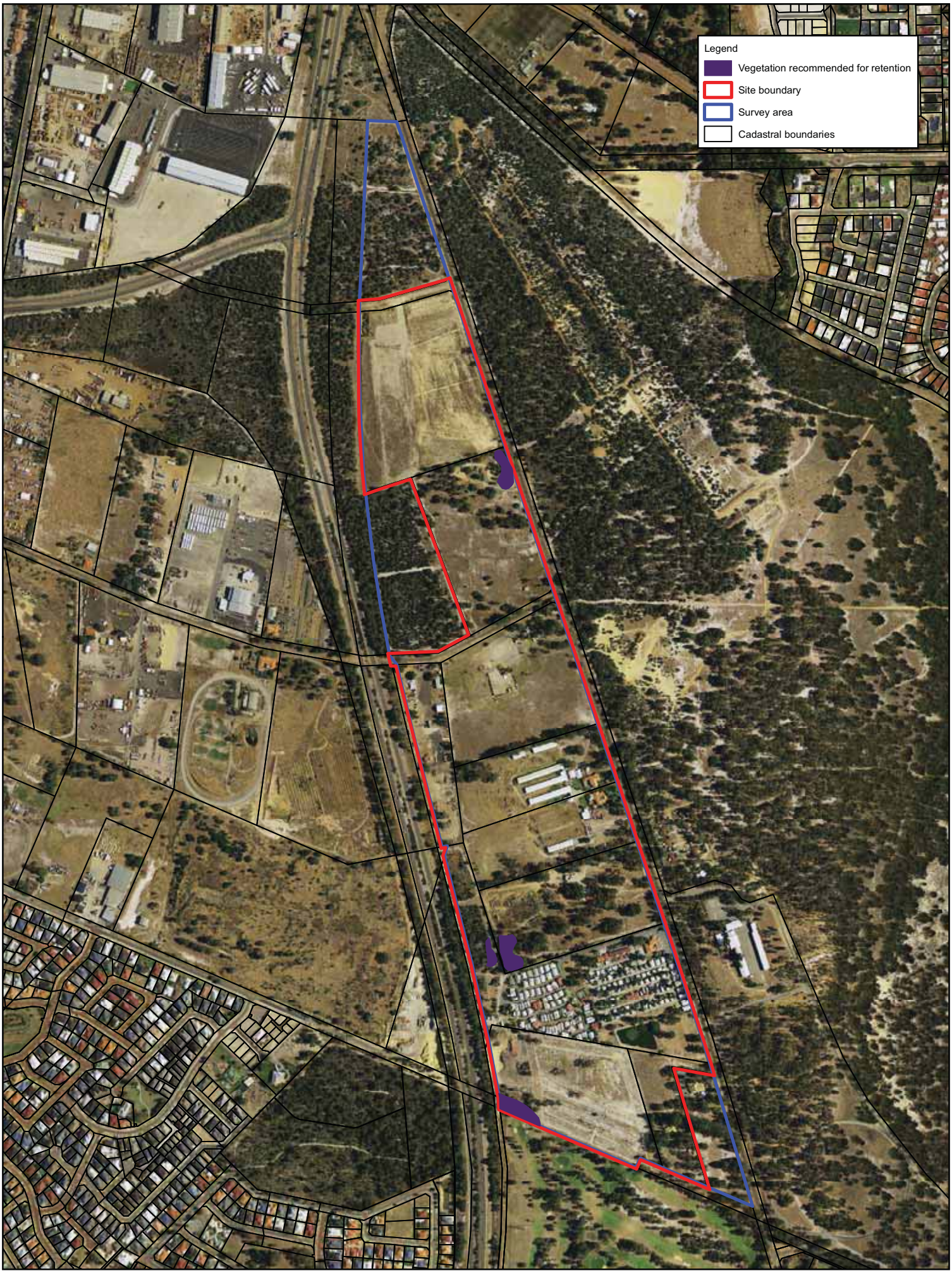

Figure 5: Vegetation Recommended for Retention

Project: Level 2 Flora and Vegetation Assessment
Hazelmere Precinct 9A Local Structure Plan

Client: Hazelmere Landowners Group

Plan Number: EP13-027(06)--F77

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Approved:	JDH	Date:	06/03/2015
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emerge ASSOCIATES
Integrated Science & Design

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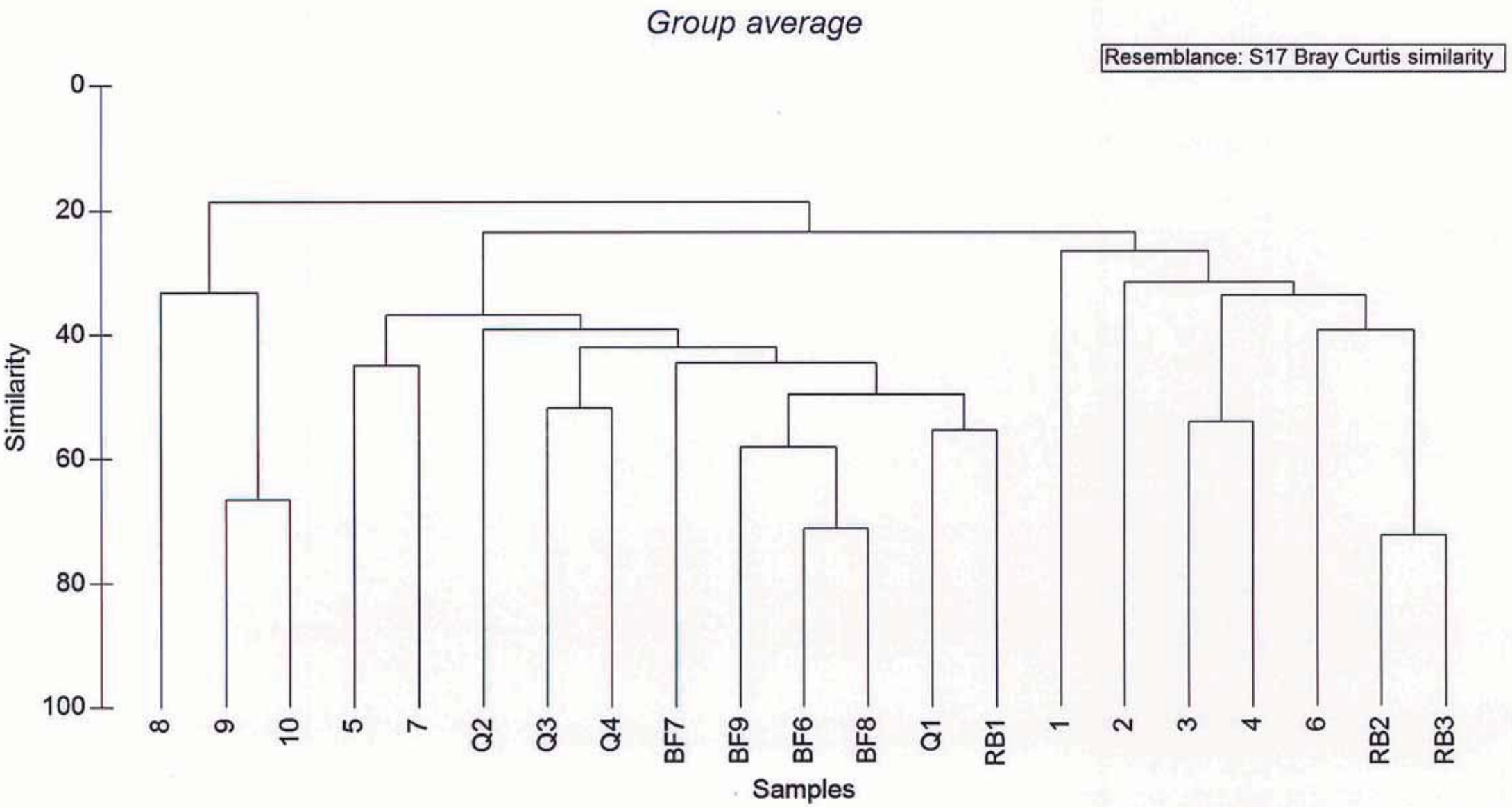
APPENDIX A

PLANT COMMUNITY DENDROGRAM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60
80
100
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9
10
5
7
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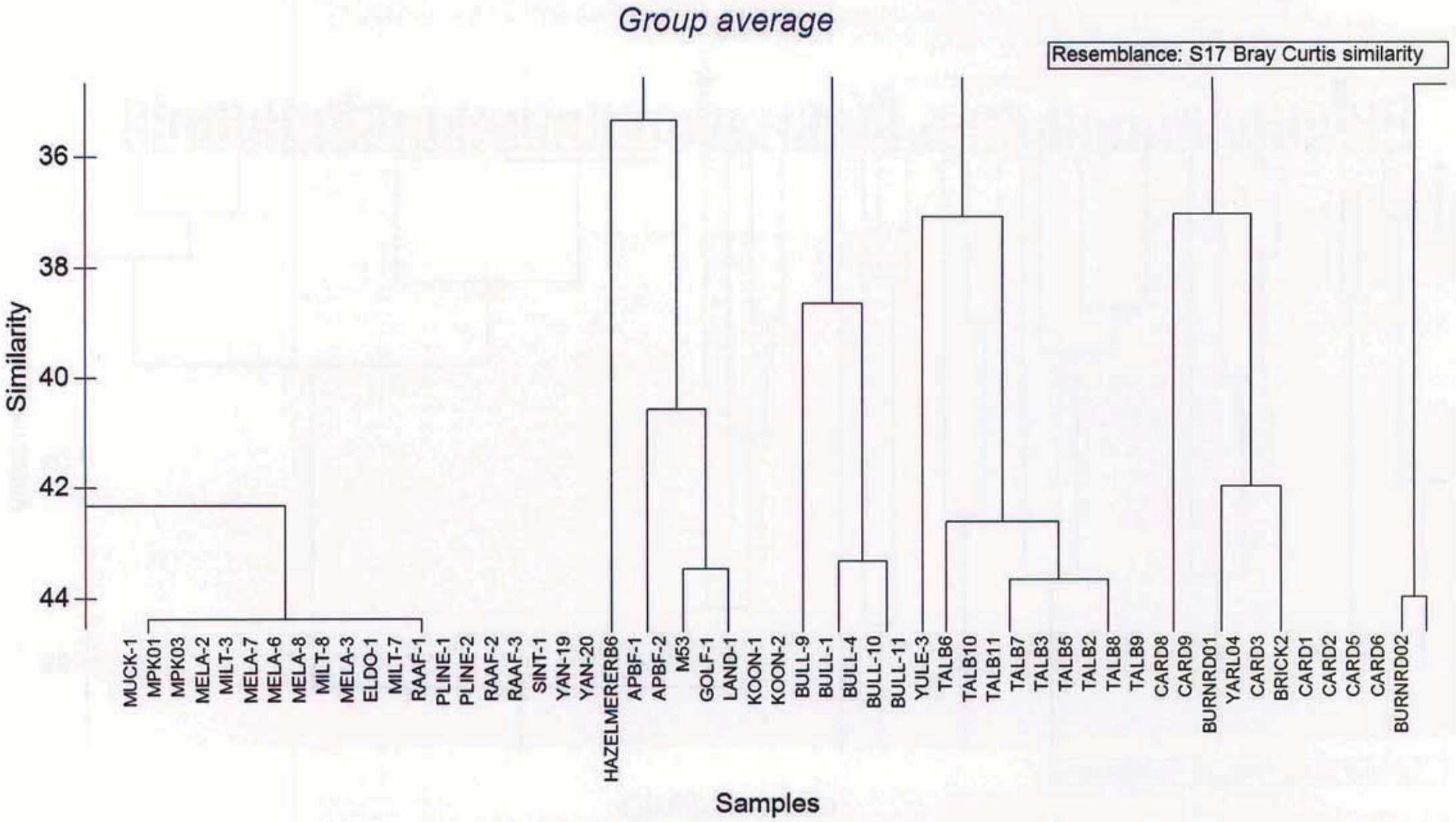
Q3
Q4
BF7
BF9
BF6
BF8
Q1
RB1
1
2
3
4
6
RB2
RB3
Samples

APPENDIX B

GIBSON *ET AL.* (1994) DATASET COMPARISON DENDROGRAMS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MPK03
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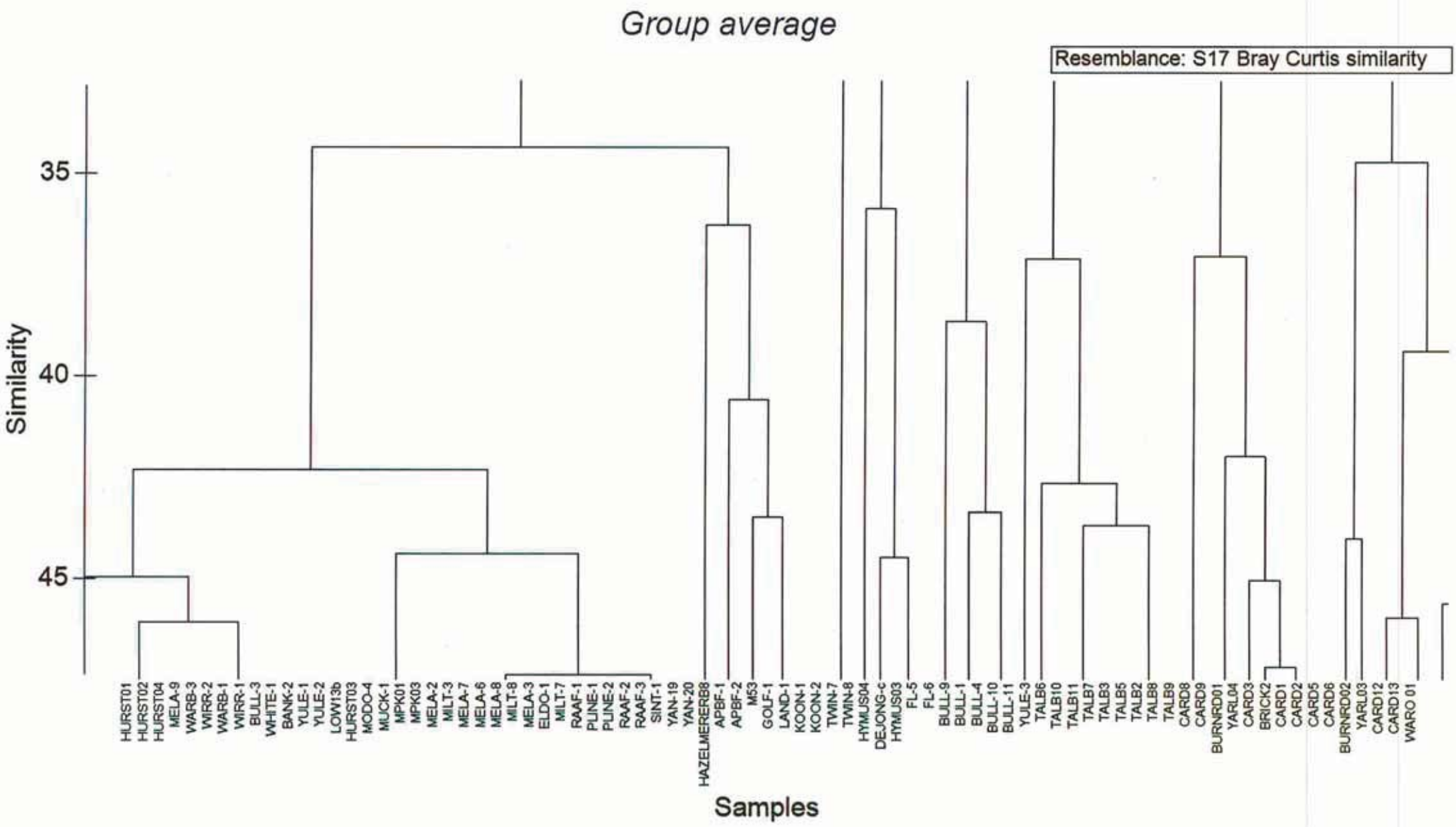
MELA-7
MELA-6
MELA-8
MILT-8
MELA-3
ELDO-1
MILT-7
RAAF-1
PLINE-1
PLINE-2
RAAF-2
RAAF-3
SINT-1
YAN-19
YAN-20
HAZELMERERB6
APBF-1
APBF-2
M53
GOLF-1
LAND-1
KOON-1
KOON-2
BULL-9
BULL-1
BULL-4
BULL-10
BULL-11
YULE-3
TALB6
TALB10
TALB11
TALB7
TALB3
TALB5
TALB2
TALB8
TALB9
CARD8
CARD9
BURNRD01
YARL04
CARD3
BRICK2
CARD1
CARD2
CARD5
CARD6
BURNRD02
Samples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40
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WIRR-2
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WIRR-1
BULL-3
WHITE-1
BANK-2
YULE-1
YULE-2
LOW13b
HURST03
MODO-4
MUCK-1
MPK01
MPK03
MELA-2
MILT-3
MELA-7
MELA-6
MELA-8
MILT-8
MELA-3
ELDO-1
MILT-7
RAAF-1
PUNE-1
PUNE-2
RAAF-2
RAAF-3
SINT-1
YAN-19
YAN-20
HAZELMERERB8
APBF-1
APBF-2
M53
GOLF-1
LAND-1
KOON-1
KOON-2
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TWIN-8
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DEJONG-c
HYMUS03
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BULL-1
BULL-4
BULL-10
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TALB10
TALB11
TALB7
TALB3
TALB5
TALB2
TALB8
TALB9
CARD8
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YARL04
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YARL03
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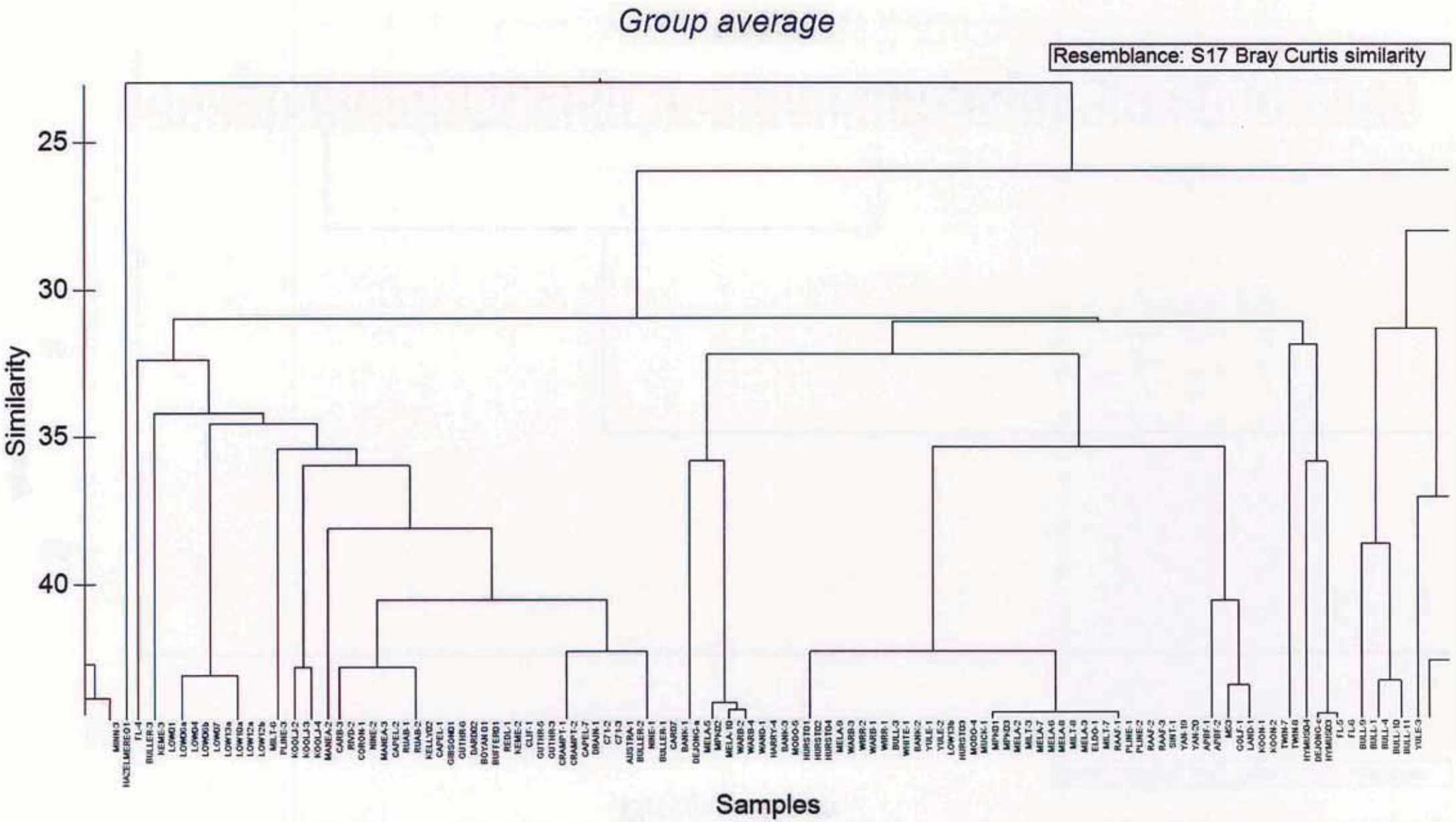
Samples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Similarity
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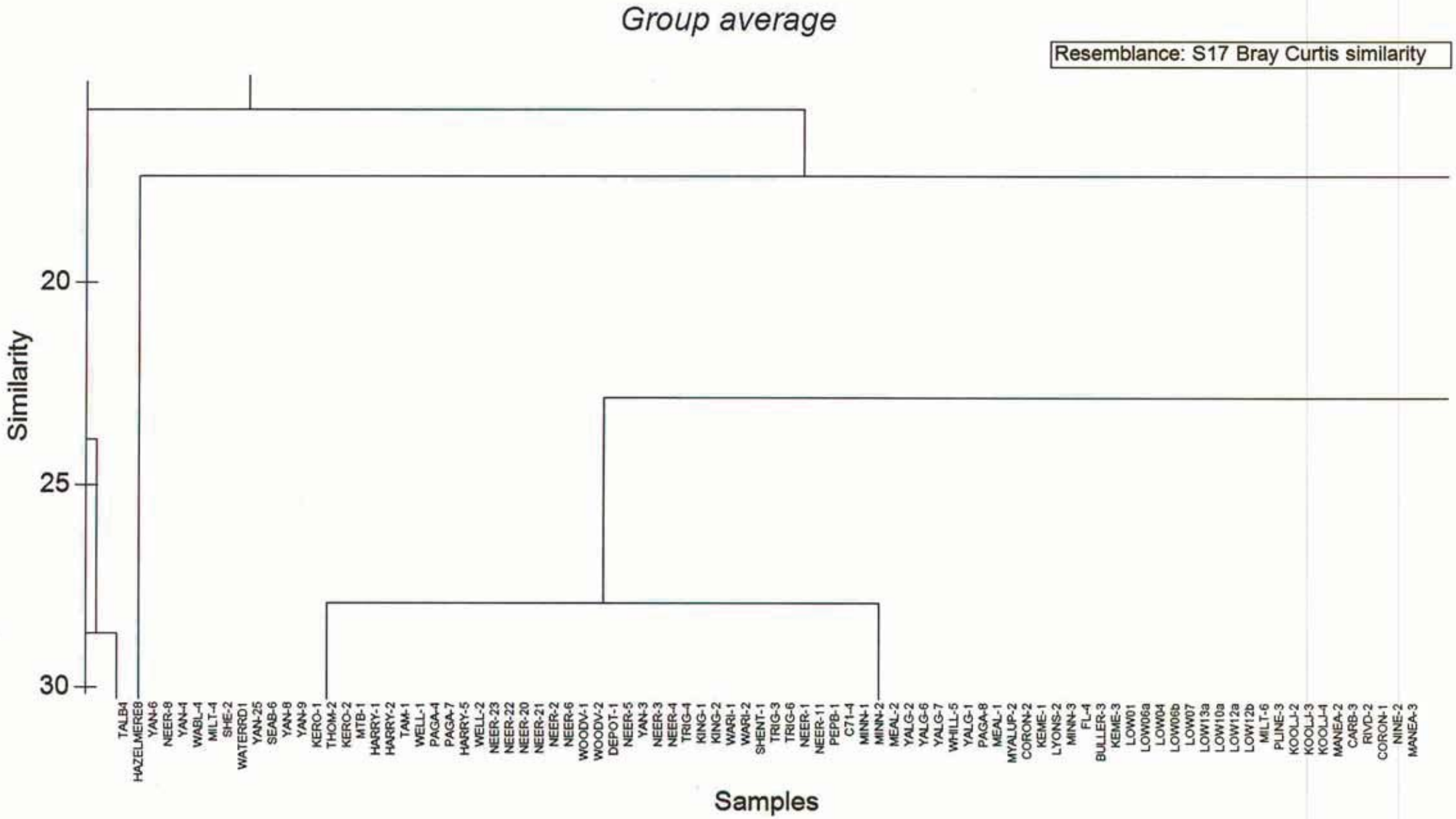
Samples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MILT-4
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SEAB-6
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YAN-9
KERO-1
THOM-2
KERO-2
MTB-1
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HARRY-2
TAM-1
WELL-1
PAGA-4
PAGA-7
HARRY-5
WELL-2
NEER-23
NEER-22
NEER-20
NEER-21
NEER-2
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WOODV-1
WOODV-2
DEPOT-1
NEER-5
YAN-3
NEER-3
NEER-4
TRIG-4
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KING-2
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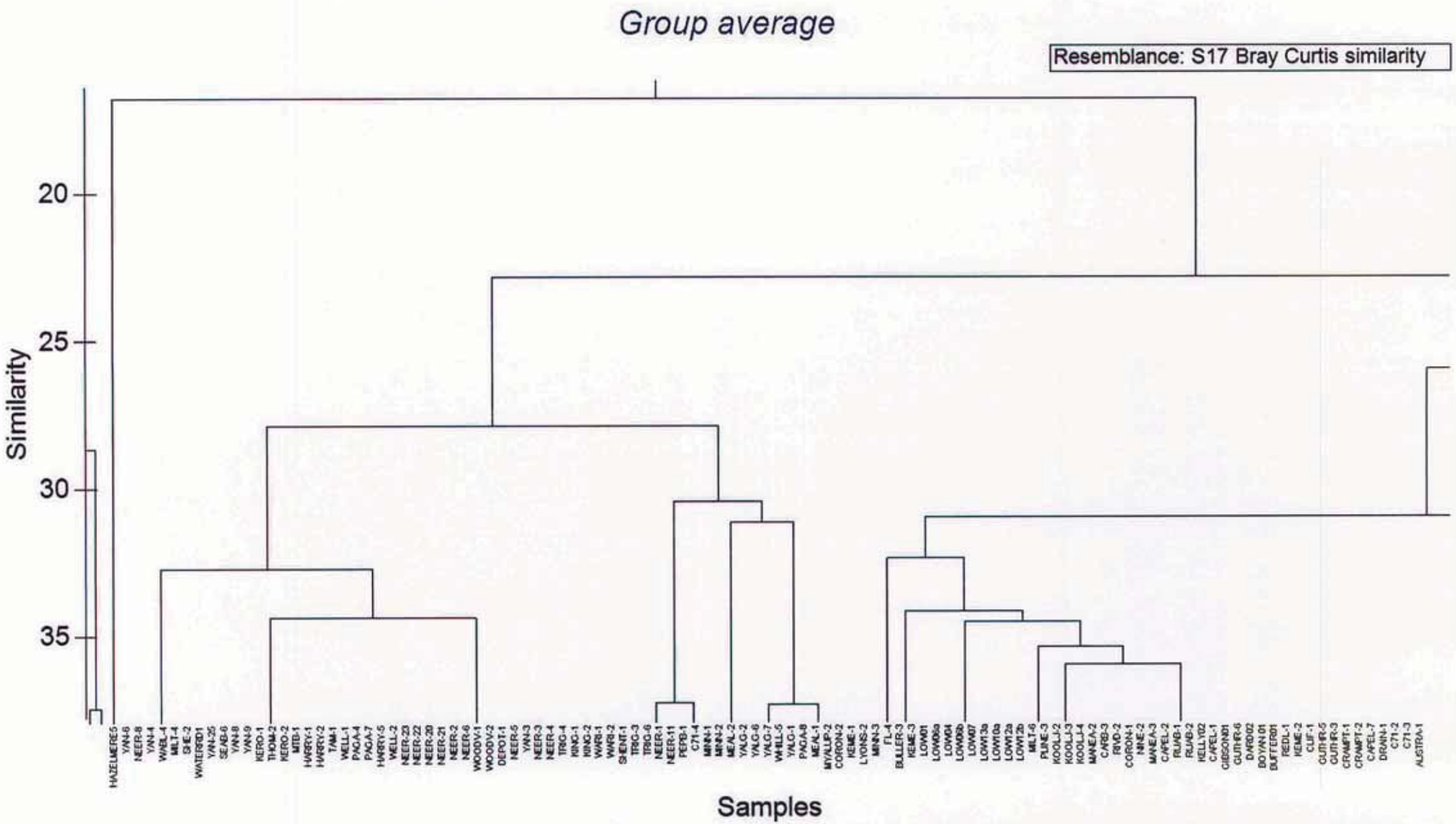
MANEA-3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CORON-1
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MANEA-3
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RUNB-1
RUNB-2
KELLY02
CAPEL-1
GIBSON01
GUITAR-6
DARD02
BOYAN 01
BUFFER01
REDL-1
KEME-2
CLIF-1
GUITAR-5
GUITAR-3
CRAMPT-1
CRAMPT-2
CAPEL-7
DRANN-1
C71-2
C71-3
AUSTRA-1

APPENDIX C

SPECIES LIST

Flora Species List - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species; T denotes Threatened status and P3 denotes Priority 3 status.

Family		Species
Anacardiaceae		
	*	*Schinus terebinthifolius*
Anarthriaceae		
		Lyginia imberbis
Apiaceae		
		Xanthosia huegelii
		Homalosciadium homalocarpum
Apocynaceae		
	*	*Nerium oleander*
Asparagaceae		
		Laxmannia squarrosa
		Lomandra hermaphrodita
		Lomandra nigricans
		Lomandra preissii
		Lomandra sp.
		Sowerbaea laxiflora
		Thysanotus manglesianus
Asteraceae		
	*	*Arctotheca calendula*
	*	*Conyza bonariensis*
	*	*Cotula australis*
		Hyalosperma cotula
	*	*Hypochaeris glabra*
		Millotia tenuifolia subsp. *?tenuifolia*
	*	*Monoculus monstrosus*
		?Quinetia urvillei
		Senecio condylus
	*	*Sonchus oleraceus*
	*	*Ursinia anthemoides*
Bignoniaceae		
	*	*Jacaranda mimosifolia*
	*	*Tecoma stans*
Brassicaceae		
	*	*Brassica tournefortii*
Casuarinaceae		
		Allocasuarina fraseriana
Colchicaceae		
		Burchardia congesta

Flora Species List - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species; T denotes Threatened status and P3 denotes Priority 3 status.

Family		Species
Convolvulaceae		
	*	*Ipomoea cairica*
Cucurbitaceae		
	*	*Citrullus lanatus*
Cyperaceae		
		Caustis dioica
		Cyathochaeta equitans
		Lepidosperma leptostachyum
		Lepidosperma squamatum
		Mesomelaena pseudostygia
		Mesomelaena tetragona
		Schoenus pedicellatus
Dasypogonaceae		
		Calectasia narragara
		Dasypogon bromeliifolius
		Dasypogon obliquifolius
Dilleniaceae		
		Hibbertia huegelii
		Hibbertia hypericoides
		Hibbertia sericosepala
Droseraceae		
		Drosera erythrorhiza subsp. *erythrorhiza*
		Drosera glanduligera
		Drosera menziesii subsp. *menziesii*
		Drosera stolonifera
Ericaceae		
		Conostephium preissii
		Lysinema ciliatum
Euphorbiaceae		
	*	*Euphorbia terracina*
		Monotaxis grandiflora var. grandiflora
	*	*Ricinus communis*
		Stachystemon vermicularis
Fabaceae		
		Acacia applanata
	*	*Acacia coriacea* subsp. *coriacea*
		Acacia extensa
	*	*Acacia iteaphylla*
	*	*Acacia longifolia* subsp. *longifolia*

Flora Species List - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species; T denotes Threatened status and P3 denotes Priority 3 status.

Family		Species
Fabaceae	*	*Acacia podalyriifolia*
		Acacia pulchella
		Acacia sessilis
		Bossiaea eriocarpa
		Bossiaea ?ornata
	*	*Chamaecytisus palmensis*
		Cristonia biloba subsp. *biloba*
		Daviesia decurrens subsp. *decurrens ms*
		Daviesia divaricata subsp. *divaricata ms*
		Daviesia nudiflora subsp. *nudiflora*
		Daviesia physodes
		Daviesia polyphylla
		Daviesia preissii
		Daviesia triflora
		Gompholobium tomentosum
		Hardenbergia comptoniana
		Hovea trisperma
		Isotropis cuneifolia
		Jacksonia floribunda
		Jacksonia furcellata
		Jacksonia lehmannii
		Jacksonia sternbergiana
		Kennedia prostrata
		Kennedia stirlingii
		Labichea punctata
	*	*Lupinus angustifolius*
	*	*Lupinus cosentinii*
	*	*Trifolium arvense*
	*	*Ornithopus sativus*
Geraniaceae		
	*	*Pelargonium* sp.
Goodeniaceae		
		Dampiera linearis
		Scaevola canescens
		Scaevola repens var. *repens*
Haemodoraceae		
		Anigozanthos manglesii
		Conostylis aculeata
		Conostylis juncea
		Conostylis setigera
		Conostylis setosa
		Haemodorum spicatum
		Phlebocarya ciliata

Flora Species List - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species; T denotes Threatened status and P3 denotes Priority 3 status.

Family		Species
Hemerocallidaceae		
		Arnocrinum preissii
		Caesia sp.
		Corynotheca micrantha var. *micrantha*
		Dianella revoluta
		Johnsonia pubescens subsp. *pubescens*
		Tricoryne elatior
		Stypandra glauca
Iridaceae		
	*	*Freesia alba x leichtlinii*
	*	*Gladiolus caryophyllaceus*
		Patersonia occidentalis
	*	*Romulea rosea*
	*	*Watsonia meriana*
Lamiaceae		
		Hemiandra pungens
		Hemiphora bartlingii
Loranthaceae		
		Amyema linophylla subsp. *linophylla*
		Nuytsia floribunda
Myrtaceae		
		Agonis flexuosa
	*	*Callistemon* sp.
		Corymbia calophylla
		Eremaea pauciflora
	*	*Eucalyptus camaldulensis* subsp. *obtusa*
	*	*Eucalyptus citriodora*
		Eucalyptus gomphocephala
	*	Eucalyptus lehmannii
		Eucalyptus marginana subsp. *?thalassica*
		Eucalyptus marginata subsp. *marginata*
	*	*Eucalyptus* sp. 1
	*	*Eucalyptus* sp. 2
	*	*Eucalyptus* sp. 3
		Eucalyptus todtiana
	*	*Leptospermum laevigatum*
		Melaleuca armillaris subsp. *armillaris*
	*	*Melaleuca quinquinervia*
		Scholtzia involucrata

Flora Species List - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species; T denotes Threatened status and P3 denotes Priority 3 status.

Family		Species
Orchidaceae		
		Caladenia flava
		Pterostylis sanguinea
		Pterostylis sp. Slender Snail Orchid (G.J. Keighery 14516)
Oxalidaceae		
	*	*Oxalis pes-caprae*
	*	*Fumaria capreolata*
Poaceae		
		Amphipogon amphipogonoides
	*	*Avena barbata*
	*	*Briza maxima*
	*	*Bromus diandrus*
	*	*Cynodon dactylon*
	*	*Ehrharta calycina*
	*	*Ehrharta longiflora*
	*	*Eragrostis curvula*
Proteaceae		
		Adenanthos cygnorum
		Banksia attenuata
		Banksia grandis
		Banksia ilicifolia
		Banksia menziesii
		Banksia nivea subsp. *nivea*
		Banksia sessilis
		Conospermum canaliculatum subsp. c*analiculatum*
	T	*Conospermum undulatum*
		Hakea prostrata
	P3	*Isopogon drummondii*
		Lambertia multiflora var. *darlingensis*
		Petrophile linearis
		Stirlingia latifolia
		Synaphea spinulosa subsp. *spinulosa*
Restionaceae		
		Alexgeorgea nitens
		Chordifex sinuosus
		Desmocladus fasciculatus
		Desmocladus flexuosus
		Hypolaena exsulca
Rutaceae		
		Philotheca spicata

Flora Species List - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species; T denotes Threatened status and P3 denotes Priority 3 status.

Family		Species
Stylidiaceae		
		Stylidium diuroides subsp. *diuroides*
Tropaeolaceae		
	*	*Tropaeolum majus*
Thymelaeaceae		
		Pimelea ?brevistyla subsp. *minor*
Violoceae		
		Hybanthus calycinus
Xanthorrhoeaceae		
		Xanthorrhoea preissii

APPENDIX D

SPECIES LIST BY PLANT COMMUNITY

Flora Species List by Plant Community - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species, T denotes Threatened status and P3 denotes Priority 3 status

	Species	Plant Community				
		CCOF	AdAnS	EmAfOW	EmBaBmW	Parkland Cleared
	?Quinetia urvillei				X	
	Acacia applanata				X	
*	*Acacia coriacea* subsp. *coriacea*					X
	Acacia extensa				X	
*	*Acacia iteaphylla*					X
*	*Acacia longifolia* subsp. l*ongifolia*	X				X
*	*Acacia podalyriifolia*					X
	Acacia pulchella				X	
	Acacia sessilis				X	
	Adenanthos cygnorum		X		X	
	Agonis flexuosa					X
	Alexgeorgea nitens		X		X	
	Allocasuarina fraseriana			X	X	
	Amphipogon amphipogonoides				X	
	Amyema? linophylla subsp. *linophylla*					X
	Anigozanthos manglesii		X		X	
*	*Arctotheca calendula*				X	X
	Arnocrinum preissii				X	
*	*Avena barbata*	X		X		X
	Banksia attenuata			X	X	
	Banksia grandis				X	
	Banksia ilicifolia				X	
	Banksia menziesii		X		X	
	Banksia nivea subsp. *nivea*	X			X	
	Banksia sessilis	X			X	
	Bossiaea ?ornata				X	
	Bossiaea eriocarpa		X		X	
*	*Brassica tournefortii*				X	
*	*Briza maxima*	X		X	X	

Flora Species List by Plant Community - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species, T denotes Threatened status and P3 denotes Priority 3 status

		Plant Community				
	Species	CCOF	AdAnS	EmAfOW	EmBaBmW	Parkland Cleared
*	*Bromus diandrus*			X		X
	Burchardia congesta				X	
	Caesia sp.				X	
	Caladenia flava				X	
	Calectasia narragara				X	
*	*Callistemon* sp.					X
	Caustis dioica				X	
*	*Chamaecytisus palmensis*			X	X	
	Chordifex sinuosus				X	
*	*Citrullus lanatus*					X
	Conospermum canaliculatum subsp. *canaliculatum*				X	
T	*Conospermum undulatum*				X	
	Conostephium preissii				X	
	Conostylis aculeata				X	
	Conostylis juncea			X	X	
	Conostylis setigera				X	
	Conostylis setosa				X	
*	*Conyza bonariensis*					X
	Corymbia calophylla	X			X	X
	Corynotheca micrantha subsp. *micrantha*				X	
*	*Cotula australis*				X	X
	Cristonia biloba subsp. *biloba*				X	
	Cyathochaeta equitans				X	
*	*Cynodon dactylon*			X	X	X
	Dampiera linearis		X		X	
	Dasypogon bromeliifolius		X		X	
	Dasypogon obliquifolius				X	
	Daviesia decurrens subsp. *decurrens ms*				X	
	Daviesia divaricata subsp. *divaricata ms*				X	

Flora Species List by Plant Community - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species, T denotes Threatened status and P3 denotes Priority 3 status

	Species	Plant Community				
		CCOF	AdAnS	EmAfOW	EmBaBmW	Parkland Cleared
	Daviesia nudiflora subsp. *nudiflora*				X	
	Daviesia physodes				X	
	Daviesia polyphylla				X	
	Daviesia preissii			X		
	Daviesia triflora				X	
	Desmocladus fasciculatus				X	
	Desmocladus flexuosus		X		X	
	Dianella revoluta				X	
	Drosera erythrorhiza subsp. *erythrorhiza*				X	
	Drosera glanduligera				X	
	Drosera menziesii subsp. *menziesii*				X	
	Drosera stolonifera		X		X	
*	*Ehrharta calycina*		X	X	X	X
*	*Ehrharta longiflora*			X	X	X
*	*Eragrostis curvula*	X		X	X	X
	Eremaea pauciflora				X	
	Eucalyptus gomphocephala					X
*	*Eucalyptus camaldulensis* subsp. *obtusa*					X
*	*Eucalyptus citriodora*					X
*	*Eucalyptus lehmannii*					X
	Eucalyptus marginana subsp. *?thalassica*				X	X
	Eucalyptus marginata subsp. *marginata*			X	X	X
*	*Eucalyptus* sp. 1					X
*	*Eucalyptus* sp. 2					X
*	*Eucalyptus* sp. 3				X	X
	Eucalyptus todtiana				X	X
*	*Euphorbia terracina*					X
*	*Freesia alba x leichtlinii*				X	X
*	*Fumaria capreolata*					X

Flora Species List by Plant Community - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species, T denotes Threatened status and P3 denotes Priority 3 status

		Plant Community				
	Species	CCOF	AdAnS	EmAfOW	EmBaBmW	Parkland Cleared
*	*Gladiolus caryophyllaceus*		X	X	X	
	Gompholobium tomentosum				X	
	Haemodorum spicatum				X	
	Hakea prostrata		X			
	Hardenbergia comptoniana			X		
	Hemiandra pungens				X	
	Hemiphora bartlingii				X	
	Hibbertia huegelii		X			
	Hibbertia hypericoides		X		X	
	Hibbertia sericosepala				X	
	Homalosciadium homalocarpum				X	
	Hovea trisperma				X	
	Hyalosperma cotula		X		X	
	Hybanthus calycinus		X		X	
*	*Hypochaeris glabra*		X		X	
	Hypolaena exsulca				X	
*	*Ipomoea cairica*				X	
P3	*Isopogon drummondii*				X	
	Isotropis cuneifolia				X	
*	*Jacaranda mimosifolia*					X
	Jacksonia floribunda				X	
	Jacksonia furcellata				X	
	Jacksonia lehmannii				X	
	Jacksonia sternbergiana				X	
	Johnsonia pubescens subsp. *pubescens*				X	
	Kennedia prostrata				X	
	Kennedia stirlingii			X	X	
	Labichea punctata				X	
	Lambertia multiflora var. *darlingensis*				X	

Flora Species List by Plant Community - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species, T denotes Threatened status and P3 denotes Priority 3 status

	Species	Plant Community				
		CCOF	AdAnS	EmAfOW	EmBaBmW	Parkland Cleared
	Laxmannia squarrosa				X	
	Lepidosperma leptostachyum				X	
	Lepidosperma squamatum	X			X	
	Leptospermum laevigatum		X	X	X	
	Lomandra hermaphrodita				X	
	Lomandra nigricans				X	
	Lomandra preissii				X	
	Lomandra sp.		X			
*	*Lupinus angustifolius*				X	X
*	*Lupinus cosentinii*			X	X	X
	Lyginia imberbis		X		X	
*	*Lysinema ciliatum*		X			
	Melaleuca armillaris subsp. *armillaris*					X
*	*Melaleuca quinquinervia*					X
	Mesomelaena pseudostygia		X		X	
	Mesomelaena tetragona	X			X	
	Millotia tenuifolia subsp. ?*tenuifolia*				X	
*	*Monoculus monstrosus*			X	X	
	Monotaxis grandiflora var. grandiflora				X	
*	*Nerium oleander*					X
	Nuytsia floribunda				X	
*	*Ornithopus sativus*				X	
*	*Oxalis pes-caprae*			X	X	X
	Patersonia occidentalis				X	
*	*Pelargonium* sp.					X
	Petrophile linearis				X	
	Philotheca spicata				X	
	Phlebocarya ciliata				X	
	Pimelea ?brevistyla subsp. *minor*				X	

Flora Species List by Plant Community - Various Allotments Midland Road, Hazelmere

Note: * denotes introduced species, T denotes Threatened status and P3 denotes Priority 3 status

		Plant Community				
	Species	CCOF	AdAnS	EmAfOW	EmBaBmW	Parkland Cleared
	Pterostylis sanguinea				X	
	Pterostylis sp. Slender Snail Orchid (G.J. Keighery 14516)				X	
*	*Ricinus communis*			X	X	
*	*Romulea rosea*				X	X
	Scaevola canescens		X		X	
	Scaevola repens subsp. *repens*		X		X	
*	*Schinus terebinthifolius*					X
	Schoenus pedicellatus				X	
	Scholtzia involucrata				X	
	Senecio condylus			X		
*	*Sonchus oleraceus*	X		X		X
	Sowerbaea laxiflora				X	
	Stachystemon vermicularis				X	
	Stirlingia latifolia				X	
	Stylidium diuroides subsp. *diuroides*				X	
	Stypandra glauca				X	
	Synaphea spinulosa subsp. *spinulosa*				X	
*	*Tecoma stans*					X
	Thysanotus manglesianus				X	
	Tricoryne elatior				X	
*	*Trifolium arvense*			X		X
*	*Tropaeolum majus*					X
*	*Ursinia anthemoides*		X		X	X
*	*Watsonia meriana*				X	X
	Xanthorrhoea preissii			X	X	X
	Xanthosia huegelii				X	

APPENDIX E

emerge ASSOCIATES
Integrated Science & Design

RAW DATA

Locality	Hazelmere	Photo No.	Cam 4 - 1-4
Date	13.08.2013	Photo direction	NESW
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407375
Sample number	R1	Northing	6467666

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	Flat	Vegetation Condition	D
Altitude		Time since fire	> 5 years
Bare ground %		Disturbance	weeds and clearing
Soil type/texture	loamy sand (fine)	Rock type	
Soil colour	light brown/grey	Rock %	
Microclimate		Litter type and %	

Vegetation Description

Scattered trees (native and non-native) over isolated Xanthorrhoea preissii over pasture weeds

Strata			**Observations**
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	**Species**	**Layer**	**Life Form**	**Height**	**Habit**	**% Cover**
	Agonis flexuosa					3
ST01	*Arctotheca calendula*					15
	Callistemon sp.					5
ST02	*Cotula australis*					20
	Cynodon dactylon					15
ST03	*Ehrharta calycina*					15
	Eucalyptus gomphocephala					6
ST06	*Eucalyptus camaldulensis subsp. obtusa*					1
	Eucalyptus citriodora					2
ST04	*Eucalyptus marginata subsp. marginata*					6
	Jacaranda mimosifolia					2
	Melaleuca quinquinervia					1
	Oxalis pes-caprae					2
	Romulea rosea					3
	Schinus terebinthifolius					2
	Tecoma stans					1
ST 05	*Trifolium arvense*					10
	Ursinia anthemoides					8

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Xanthorrhoea preissii					1

Site Details				
Locality	Hazelmere	Photo No.	Cam 4 13-18	
Date	13.08.2013	Photo direction	NESW	
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407248	
Sample number	R2	Northing	6467964	

Geographic and Habitat Data			
Aspect	N	Hydrology	
Slope	1-2 deg	Adjacent Vegetation	
Topographic position	flat/slight und	Vegetation Condition	D
Altitude		Time since fire	
Bare ground %	30	Disturbance	weeds, clearing
Soil type/texture	sand	Rock type	
Soil colour	light grey	Rock %	
Microclimate		Litter type and %	large logs/stumps

Vegetation Description

Banksia menziesii and Eucalyptus marginata over weed dominated shrubland but many native species present

Strata			Observations
	Height	Total % Cover	
Emergent tree			Forest red tails over head
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
ST19	*Acacia applanata*					1
ST07	*Acacia extensa*					1
ST08	*Allocasuarina fraseriana*					2
	Arctotheca calendula					2
	Arctotheca calendula					2
	Banksia grandis					1
	Banksia menziesii					10
ST09	*Bossiaea eriocarpa*					2
	Brassica tournefortii					2
ST21	*Caladenia flava*					1
	Cotula australis					2
ST22	*Daviesia divaricata subsp. divaricata ms*					1
ST12	*Daviesia physodes*					1
	Dianella revoluta					1
ST13	*Drosera stolonifera*					1
	Ehrharta calycina					15
St14	*Eucalyptus marginana subsp. ?thalassica*					2
	Eucalyptus marginata subsp. marginata					15

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Gladiolus caryophyllaceus					1
ST16	*Gompholobium tomentosum*					1
ST17	*Hypolaena exsulca*					1
	Ipomoea cairica					1
	Jacksonia floribunda					1
St20	*Kennedia prostrata*					1
ST18	*Kennedia stirlingii*					1
	Leptospermum laevigatum					30
	Lupinus angustifolius					2
	Lupinus cosentinii					2
	Oxalis pes-caprae					5
ST10	*Pterostylis sanguinea*					1
ST11	*Pterostylis sp. Slender Snail Orchid (G.J. Keighery 14516)*					1
	Ricinus communis					2
ST15	*Stirlingia latifolia*					1
	Xanthorrhoea preissii					2

Site Details				
Locality	Hazelmere	Photo No.		
Date	13.08.2013	Photo direction	Cam 4 - 22-27	
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407279	
Sample number	R3	Northing	6467861	

Geographic and Habitat Data			
Aspect		Hydrology	drainage
Slope	3	Adjacent Vegetation	
Topographic position	Depression	Vegetation Condition	D
Altitude		Time since fire	> 5 years
Bare ground %		Disturbance	weeds, clearing altered landform
Soil type/texture		Rock type	
Soil colour		Rock %	
Microclimate		Litter type and %	leaf 20

Vegetation Description

patch of Eucalyptus marginata over Chamaecytisus palmensis over occasional native shrubs and weeds

Strata			Observations
	Height	Total % Cover	7 white tail BCs seen
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Allocasuarina fraseriana					2
ST 25	*Chamaecytisus palmensis*					20
ST26	*Conostylis juncea*					1
ST24	*Daviesia preissii*					2
	Ehrharta calycina					10
St27	*Ehrharta longiflora*					20
ST23	*Eucalyptus marginata subsp. marginata*					40
	Gladiolus caryophyllaceus					1
	Leptospermum laevigatum					10
	Senecio condylus					opp.
	Monoculus monstrosus					opp.
	Cynodon dactylon					opp.

Site Details				
Locality	Hazelmere	Photo No.		
Date	13.08.2013	Photo direction	cam 4 32-37	
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407152	
Sample number	4	Northing	6407921	

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	flat/dep to NE	Vegetation Condition	D
Altitude		Time since fire	
Bare ground %	10	Disturbance	weeds, clearing
Soil type/texture		Rock type	
Soil colour		Rock %	
Microclimate		Litter type and %	10 leaf

Vegetation Description

Eucalyptus marginata, Banksia attenuata and Allocasuarina fraseriana open woodland with large woody weeds over occasional Xanthorrhoea preissii over weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			cockatoo foraging evidence
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Allocasuarina fraseriana					10
	Banksia attenuata					10
	Ehrharta calycina					20
	Ehrharta longiflora					20
	Eucalyptus marginata subsp. marginata					10
	Gladiolus caryophyllaceus					1
	Hardenbergia comptoniana					2
	Leptospermum laevigatum					10
	Lupinus cosentinii					2
	Oxalis pes-caprae					2
	Ricinus communis					2
	Trifolium arvense					5
	Xanthorrhoea preissii					2
	Kennedia stirlingii					opp.

Site Details			
Locality	Hazelmere	Photo No.	
Date	13.08.2013	Photo direction	
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407209
Sample number	R5	Northing	6467016

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	flat	Vegetation Condition	G (small patch) mostly D
Altitude		Time since fire	
Bare ground %	60	Disturbance	clearing, weeds. adj to Roe H
Soil type/texture		Rock type	
Soil colour	dark brown	Rock %	
Microclimate		Litter type and %	

Vegetation Description

Low woodland of Banksia attenuata, B. menziesii, Adenanthos cygnorum and Allocasuarina fraseriana over open shurbland of Xanthorrhoea preissii and Stirlingia latifolia over forbland of Dasypogon spp., Banksia nivea, Alexgeorgea nitens and Gompholobium tomentosum

Strata			Observations
	Height	Total % Cover	
Emergent tree			Cockatoos - red and white tails. in tree
Canopy			adjacent to road reserve on W boundary
Sub-canopy			407185 6467003
Lower tree			photos 249-251 (tree)
Upper shrub			photos 239-242 (cockatoos)
Lower shrub			
Upper herb			recent clearing - aerial from Jan more veg
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Acacia applanata					1
	Adenanthos cygnorum					20
ST46	*Alexgeorgea nitens*					5
	Allocasuarina fraseriana					5
	Anigozanthos manglesii					1
	Banksia attenuata					10
	Banksia menziesii					10
ST40	*Banksia nivea subsp. nivea*					5
	Banksia sessilis					5
ST47	*Bossiaea ?ornata*					1
	Bossiaea eriocarpa					1
ST43	*Conostephium preissii*					1
	Conostylis juncea					1
ST41	*Cyathochaeta equitans*					1
	Dasypogon obliquifolius					5
	Daviesia triflora					2
	Ehrharta calycina					10
	Gladiolus caryophyllaceus					1

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Gompholobium tomentosum					5
ST48	*Hibbertia hypericoides*					5
ST49	*Hibbertia hypericoides*					1
ST45	*Hibbertia sericosepala*					1
ST42	*Hybanthus calycinus*					2
ST44	*Isopogon drummondii*					3
	Lepidosperma squamatum					1
	Mesomelaena pseudostygia					2
	Stirlingia latifolia					5
	Stirlingia latifolia					2
	Xanthorrhoea preissii					10
	Daviesia divaricata subsp. divaricata					2

Site Details				
Locality	Hazelmere	Photo No.	252-257 SKP	
Date	14.08.2013	Photo direction	NESW	
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407184	
Sample number	R6	Northing	6467080	

Geographic and Habitat Data			
Aspect	E	Hydrology	
Slope		Adjacent Vegetation	road res intact. E weeds
Topographic position	flat/slight slope	Vegetation Condition	CD
Altitude		Time since fire	
Bare ground %	95	Disturbance	clearing recently
Soil type/texture	sand	Rock type	
Soil colour	light grey	Rock %	
Microclimate		Litter type and %	

Vegetation Description

Isolated Eucalyptus marginata subsp. marginata over isolated Xanthorrhoea preissii and small natives and weeds

Strata			Observations
	Height	Total % Cover	recent clearing - some natives seeding/resprout
Emergent tree			
Canopy			weeds currently in low densities
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Adenanthos cygnorum					2
	Allocasuarina fraseriana					2
	Anigozanthos manglesii					1
	Arctotheca calendula					2
	Banksia sessilis					2
	Cynodon dactylon					2
ST51	*Desmocladus fasciculatus*					2
ST52	*Desmocladus fasciculatus*					2
	Drosera stolonifera					1
	Ehrharta calycina					5
ST53	*Eucalyptus marginata subsp. marginata*					5
	Gladiolus caryophyllaceus					1
	Hibbertia hypericoides					1
	Mesomelaena pseudostygia					1
	Ricinus communis					2
	Thysanotus manglesianus					1
	Xanthorrhoea preissii					6

Site Details				
Locality	Hazelmere	Photo No.	SKP	261-266
Date	14.08.2013	Photo direction	NESW	
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407168	
Sample number	7	Northing	6467162	

Geographic and Habitat Data			
Aspect	E	Hydrology	
Slope	1	Adjacent Vegetation	patches of D-G to south (R5)
Topographic position	slight slope	Vegetation Condition	D
Altitude		Time since fire	
Bare ground %	25	Disturbance	clearing, track thoughout
Soil type/texture	sand	Rock type	
Soil colour	light grey	Rock %	
Microclimate		Litter type and %	

Vegetation Description

Shrubland of Xanthorrhoea preissii and Adenanthos cygnorum over Daviesia spp., Banksia nivea, Corynotheca micrantha, Mesomelaena spp. and weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Acacia applanata					2
ST61	*Acacia sessilis*					0.5
	Adenanthos cygnorum					5
ST64	*Alexgeorgea nitens*					20
	Allocasuarina fraseriana					2
	Banksia nivea subsp. nivea					2
	Banksia sessilis					2
ST66	*Caesia sp.*					1
ST63	*Caustis dioica*					1
ST55	*Corynotheca micrantha subsp. micrantha*					20
	Dasypogon obliquifolius					2
St65	*Dasypogon obliquifolius*					2
ST62	*Daviesia decurrens subsp. decurrens ms*					0.5
ST57	*Daviesia nudiflora subsp. nudiflora*					2
ST56	*Daviesia polyphylla*					2
ST58	*Daviesia triflora*					1
ST60	*Drosera erythrorhiza subsp. erythrorhiza*					1
	Ehrharta calycina					40

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Gladiolus caryophyllaceus					1
	Hibbertia hypericoides					2
	Jacksonia floribunda					1
	Jacksonia furcellata					1
	Mesomelaena pseudostygia					1
	Mesomelaena tetragona					1
ST59	*Petrophile linearis*					1
ST54	*Pimelea ?brevistyla subsp. minor*					1
	Ursinia anthemoides					3
	Xanthorrhoea preissii					10

Site Details				
Locality	Hazelmere	Photo No.	SKP	272-277
Date	14.08.2013	Photo direction		
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407306	
Sample number	R8	Northing	6467016	

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	patch of Em community G
Topographic position	Flat	Vegetation Condition	D
Altitude		Time since fire	
Bare ground %	10	Disturbance	clearing, weed invasion
Soil type/texture	sandy	Rock type	
Soil colour	brown/grey	Rock %	
Microclimate		Litter type and %	2

Vegetation Description

Corymbia calophylla over occasional Xanthorrhoea preissii over isolated native forbs with Ehrharta calycina and Ehrharta longiflora

Strata			Observations
	Height	Total % Cover	
Emergent tree			Juvenile Euc/Marri/banksias observed
Canopy			patch of Eucalyptus marginata W to west
Sub-canopy			(opportunistic collections)
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Allocasuarina fraseriana					1
	Corymbia calophylla					20
ST68	*Ornithopus sativus*					1
	Oxalis pes-caprae					3
	Ursinia anthemoides					4
	Xanthorrhoea preissii					3
	Stirlingia latifolia					1
	Gladiolus caryophyllaceus					1
	Briza maxima					1
	Cyathochaeta equitans					1
	Dampiera linearis					1
	Ehrharta calycina					30
	Ehrharta longiflora					40
	Eragrostis curvula					2
	Eucalyptus marginata subsp. marginata					opp.
ST73	*Arnocrinum preissii*					opp.
	Banksia attenuata					opp.
	Banksia menziesii					opp.

Coll. No.	***Species***	**Layer**	**Life Form**	**Height**	**Habit**	**% Cover**
	Bossiaea ?ornata					opp.
	Bossiaea eriocarpa					opp.
	Alexgeorgea nitens					opp.
	Caesia sp.					opp.
	Conostylis juncea					opp.
ST69	*Conostylis setosa*					opp.
	Dasypogon obliquifolius					opp.
	Daviesia triflora					opp.
	Drosera stolonifera					opp.
ST67	*Eucalyptus sp. 3*					opp.
	Hibbertia hypericoides					opp.
	Jacksonia floribunda					opp.
ST70	*Lepidosperma squamatum*					opp.
ST75	*Lomandra preissii*					opp.
ST71	*Nuytsia floribunda*					opp.
	Patersonia occidentalis					opp.
	Pterostylis sanguinea					opp.
ST72	*Schoenus pedicellatus*					opp.
ST74	*Tricoryne elatior*					opp.

Site Details			
Locality	Hazelmere	Photo No.	SKP 301-306
Date	14.08.2013	Photo direction	NESW
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407512
Sample number	R9	Northing	6467081

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	Flat	Vegetation Condition	D
Altitude		Time since fire	
Bare ground %	2	Disturbance	weeds, clearing, no under
Soil type/texture	organic	Rock type	
Soil colour	dark brown	Rock %	
Microclimate		Litter type and %	leaf 30

Vegetation Description

Corymbia calophylla over weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Acacia longifolia subsp. longifolia					5
	Corymbia calophylla					50
	Ehrharta calycina					30
	Ehrharta longiflora					40
	Eragrostis curvula					opp.
	Romulea rosea					2

Site Details			
Locality	Hazelmere	Photo No.	SKp 307-312
Date	14.08.2013	Photo direction	
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407505
Sample number	R10	Northing	6467180

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	flat	Vegetation Condition	D
Altitude		Time since fire	
Bare ground %	2	Disturbance	weeds, clearing
Soil type/texture	organic	Rock type	
Soil colour	dark brown	Rock %	
Microclimate		Litter type and %	

Vegetation Description

Corymbia calophylla over occasional Xanthorrhoea preissii over weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Arctotheca calendula					opp.
	Corymbia calophylla					30
	Ehrharta calycina					60
	Ehrharta longiflora					20
	Eragrostis curvula					10
	Euphorbia terracina					opp.
	Freesia alba x leichtlinii					opp.
	Oxalis pes-caprae					2
	Romulea rosea					2
	Xanthorrhoea preissii					5

Site Details				
Locality	Hazelmere	Photo No.		
Date	22.08.2013	Photo direction		
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407036	
Sample number	RB1	Northing	6468430	

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	flat	Vegetation Condition	VG patches of G in wider
Altitude		Time since fire	> 5 years
Bare ground %	8	Disturbance	weeds
Soil type/texture	sand	Rock type	
Soil colour	grey	Rock %	
Microclimate		Litter type and %	leaf 10

Vegetation Description

Jarrah, Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana and Adenanthos cygnorum over Xanthorrhoea preissii and forbland

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			weeds more dominant in understroey
Sub-canopy			than Q1
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Adenanthos cygnorum					5
	Allocasuarina fraseriana					5
	Anigozanthos manglesii					2
	Banksia attenuata					10
	Banksia menziesii					10
	Briza maxima					10
	Caesia sp.					2
ST92	*Conostylis juncea*					2
	Conostylis setigera					2
ST93	*Cristonia biloba subsp. biloba*					1
	Dasypogon bromeliifolius					2
	Desmocladus flexuosus					3
	Drosera erythrorhiza subsp. erythrorhiza					opp.
	Drosera stolonifera					3
	Ehrharta calycina					10
	Eucalyptus marginata subsp. marginata					5
	Gladiolus caryophyllaceus					1
	Gompholobium tomentosum					2

Coll. No.	*Species*	Layer	Life Form	Height	Habit	% Cover
	Hibbertia hypericoides					2
	Jacksonia sternbergiana					5
	Lyginia imberbis					2
	Patersonia occidentalis					3
	Ursinia anthemoides					2
	Xanthorrhoea preissii					15

Site Details			
Locality	Hazelmere	Photo No.	
Date	22.08.2013	Photo direction	
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407034
Sample number	RB2	Northing	6468491

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	Banksia woodland
Topographic position	flat	Vegetation Condition	D
Altitude		Time since fire	> 5 years
Bare ground %	10	Disturbance	clearing, weeds, grazing
Soil type/texture	sand	Rock type	
Soil colour	white	Rock %	
Microclimate		Litter type and %	leaf 2

Vegetation Description

Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana and Nuytsia floribunda over Xanthorrhoea preissii over weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Adenanthos cygnorum					3
	Allocasuarina fraseriana					3
	Arctotheca calendula					5
	Banksia attenuata					5
	Banksia menziesii					15
	Briza maxima					10
	Drosera glanduligera					opp.
	Ehrharta calycina					30
	Eucalyptus marginata subsp. marginata					3
	Gladiolus caryophyllaceus					1
	Hypochaeris glabra					5
	Jacksonia floribunda					2
	Nuytsia floribunda					2
	Monoculus monstrosus					3
	Ursinia anthemoides					5
	Xanthorrhoea preissii					5

Site Details			
Locality	Hazelmere	Photo No.	
Date	22.08.2013	Photo direction	
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407035
Sample number	RB3	Northing	6468548

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	wetland to NW
Topographic position	flat	Vegetation Condition	D
Altitude		Time since fire	> 5 years
Bare ground %	20	Disturbance	
Soil type/texture	sand	Rock type	
Soil colour	white/grey	Rock %	
Microclimate		Litter type and %	leaf 2

Vegetation Description

Banksia attenuata, Eucalyptus marginata, Adenanthos cygnorum and Nuytsia floribunda over Xanthorrhoea preissii and occasional native shrubs over weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			numerous dead trees
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Acacia pulchella					opp.
	Adenanthos cygnorum					10
	Arctotheca calendula					2
	Banksia attenuata					10
ST95	*Banksia ilicifolia*					5
	Ehrharta calycina					20
	Eucalyptus todtiana					2
	Eucalyptus marginata subsp. marginata					5
	Gladiolus caryophyllaceus					1
	Hypochaeris glabra					10
	Jacksonia floribunda					2
	Lupinus cosentinii					3
	Lyginia imberbis					2
	Nuytsia floribunda					2
ST94	*Scholtzia involucrata*					1
	Monoculus monstrosus					2
	Ursinia anthemoides					5
	Xanthorrhoea preissii					10

Site Details				
Locality	Hazelmere	Photo No.		
Date	06.09.2013	Photo direction	NESW	
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407013	
Sample number	BF6	Northing	6467850	

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	flat	Vegetation Condition	VG
Altitude		Time since fire	>5 years
Bare ground %	4	Disturbance	occasional weeds
Soil type/texture	sand	Rock type	
Soil colour	white/grey	Rock %	
Microclimate		Litter type and %	large fallen log

Vegetation Description

Banksia attenuata, Jarrah and Allocasuarina over Xanthorrhoea, Hibbertia and Anigozanthos over herbs and weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree	10	5	
Canopy	7	35	
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Eucalyptus marginata subsp. marginata					15
	Banksia menziesii					25
	Banksia grandis					5
	Allocasuarina fraseriana					5
	Burchardia congesta					2
	Xanthorrhoea preissii					5
	Philotheca spicata					2
	Conostylis setigera					2
	Conostylis juncea					1
	Banksia nivea subsp. nivea					5
	Dasypogon obliquifolius					5
	Dasypogon bromeliifolius					5
	Pterostylis sanguinea					1
	Mesomelaena pseudostygia					10
	Desmocladus fasciculatus					10
	Petrophile linearis					2
	Caladenia flava					1
	Bossiaea eriocarpa					3

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Adenanthos cygnorum					7
	Alexgeorgea nitens					5
	Cristonia biloba subsp. biloba					2
	Anigozanthos manglesii					3
	Drosera erythrorhiza subsp. erythrorhiza					3
	Hibbertia hypericoides					3
SP01	*Hemiphora bartlingii*					1
	Hyalosperma cotula					2
	Acacia sessilis					1
	Lepidosperma squamatum					1
	Drosera stolonifera					2
	Patersonia occidentalis					3
	Ehrharta calycina					1
	Gladiolus caryophyllaceus					1
	Leptospermum laevigatum					1
	Ursinia anthemoides					1
	Conostephium preissii					1
SP10	*Kennedia stirlingii*					1
	Dampiera linearis					1
SP07	*Scaevola repens subsp. repens*					2
SP05	*Thysanotus manglesianus*					1
	Haemodorum spicatum					2
SP02	*Scaevola canescens*					2
SP03	*Hybanthus calycinus*					1
SP04	*Isotropis cuneifolia*					2
SP06	*Daviesia polyphylla*					1
SP08	*Daviesia divaricata subsp. divaricata*					1
SP09	*Stachystemon vermicularis*					1
	Jacksonia floribunda					1
SP11	*Conospermum canaliculatum subsp. canaliculatum*					1
SP12	*Daviesia divaricata subsp. divaricata*					1
	Hovea trisperma					1
SP	*Laxmannia squarrosa*					1
	Briza maxima					1
	Banksia attenuata					1
SP13	*Johnsonia pubescens subsp. pubescens*					1
	Gompholobium tomentosum					1

Site Details			
Locality	Hazelmere	Photo No.	
Date	06.09.2013	Photo direction	NESW
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407063
Sample number	BF7	Northing	6467737

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	flat	Vegetation Condition	G
Altitude		Time since fire	> 5 years
Bare ground %		Disturbance	regrowth - Ac high density
Soil type/texture	sand	Rock type	
Soil colour	white/grey	Rock %	
Microclimate		Litter type and %	

Vegetation Description

Adenanthos cygnorum shrubland over open sedge/forb/shrublands

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy	6	10	weeds in understorey but not dominant
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Adenanthos cygnorum					60
	Hibbertia hypericoides					2
	Hibbertia huegelii					2
	Alexgeorgea nitens					10
	Scaevola canescens					2
	Anigozanthos manglesii					2
SP15	*Lysinema ciliatum*					opp.
	Ursinia anthemoides					1
	Desmocladus flexuosus					5
	Hybanthus calycinus					3
	Gladiolus caryophyllaceus					1
	Caladenia flava					1
	Hyalosperma cotula					2
	Dasypogon bromeliifolius					3
	Scaevola repens subsp. repens					3
	Leptospermum laevigatum					3
	Hypochaeris glabra					1
	Conostylis juncea					1

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Conostephium preissii					2
	Drosera stolonifera					2
	Conostylis aculeata					1
	Bossiaea eriocarpa					2
	Dampiera linearis					1
	Drosera stolonifera					1
	Banksia menziesii					2
SP24	*Lomandra sp.*					1
	Ehrharta calycina					2
	Daviesia divaricata subsp. divaricata					1
	Lyginia imberbis					1
	Mesomelaena pseudostygia					1
	Hakea prostrata					opp.

Site Details				
Locality	Hazelmere	Photo No.		
Date	06.09.2013	Photo direction	NESW	
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	releve	Easting	407043	
Sample number	BF8	Northing	6467651	

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	G to west Ac Closed shrub
Topographic position	flat	Vegetation Condition	VG
Altitude		Time since fire	>5 years
Bare ground %		Disturbance	low weeds and adjacent clearing
Soil type/texture	sand	Rock type	
Soil colour	white/grey	Rock %	
Microclimate		Litter type and %	leaf 20

Vegetation Description

Jarrah over Banksia attenuata, B. menziesii, Allocasuarina fraseriana over Xanthorrhoea preissii and Anigozanthos manglesii over herbs and weeds

Strata			Observations
	Height	Total % Cover	patch of Adenanthos cygnorum to E
Emergent tree	10	5	(regrowth)
Canopy			Allocasuarina more dominant to W
Sub-canopy			
Lower tree	6	35	
Upper shrub			
Lower shrub	1	15	
Upper herb			
Middle herb	0.5	80	
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Banksia attenuata					15
	Eucalyptus marginata subsp. marginata					5
	Banksia menziesii					10
	Allocasuarina fraseriana					10
	Adenanthos cygnorum					5
	Anigozanthos manglesii					3
	Hibbertia hypericoides					7
	Daviesia nudiflora subsp. nudiflora					2
	Dasypogon bromeliifolius					5
	Dasypogon obliquifolius					2
	Drosera erythrorhiza subsp. erythrorhiza					2
	Bossiaea eriocarpa					2
	Alexgeorgea nitens					30
	Conostylis setigera					2
	Xanthorrhoea preissii					10
	Burchardia congesta					2
	Banksia nivea subsp. nivea					7
	Daviesia divaricata subsp. divaricata					2

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Philotheca spicata					2
	Conostylis juncea					1
	Briza maxima					1
SP17	*Amphipogon amphipogonoides*					3
	Haemodorum spicatum					3
	Petrophile linearis					2
	Mesomelaena pseudostygia					4
	Gompholobium tomentosum					2
	Hybanthus calycinus					2
	Bossiaea eriocarpa					3
	Drosera stolonifera					1
	Watsonia meriana					2
	Scaevola repens subsp. repens					2
SP16	*Calectasia narragara*					3
	Stirlingia latifolia					3
	Isotropis cuneifolia					3
	Stachystemon vermicularis					1
	Pterostylis sanguinea					1
	Drosera menziesii subsp. menziesii					1
SP19	*Synaphea spinulosa subsp. spinulosa*					3
	Conostephium preissii					2
	Johnsonia pubescens subsp. pubescens					2
SP18	*Homalosciadium homalocarpum*					1
	Caustis dioica					1
	Lepidosperma squamatum					2
	Daviesia triflora					1
	Acacia applanata					2
	Scaevola canescens					2
	Gladiolus caryophyllaceus					2
	Patersonia occidentalis					2
	Ehrharta calycina					2
	Cristonia biloba subsp. biloba					1

Site Details			
Locality	Hazelmere	Photo No.	
Date	06.09.2013	Photo direction	NESW
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	releve	Easting	407117
Sample number	BF9	Northing	6467627

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	
Topographic position	flat	Vegetation Condition	G
Altitude		Time since fire	> 5 years
Bare ground %		Disturbance	weeds, track adj
Soil type/texture	sand	Rock type	
Soil colour	white/grey	Rock %	
Microclimate		Litter type and %	

Vegetation Description

Jarrah over Banksia attenuata, B. menziesii and Adenanthos cygnorum over Xanthorrhoea preissii and Anigozanthos manglesii over herbs and weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy	8	20	adjacent disturbances
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Eucalyptus marginata subsp. marginata					20
	Adenanthos cygnorum					5
	Banksia sessilis					2
	Xanthorrhoea preissii					15
	Ursinia anthemoides					2
	Dampiera linearis					5
	Patersonia occidentalis					2
	Anigozanthos manglesii					5
	Dasypogon bromeliifolius					5
	Conostylis juncea					1
	Philotheca spicata					2
	Caladenia flava					1
	Freesia alba x leichtlinii					4
	Ehrharta calycina					4
	Gompholobium tomentosum					2
	Drosera stolonifera					2
	Stirlingia latifolia					3
	Briza maxima					2

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Scaevola canescens					2
	Scaevola repens subsp. repens					1
	Conospermum canaliculatum subsp. canaliculatum					2
	Daviesia nudiflora subsp. nudiflora					2
	Hybanthus calycinus					1
	Mesomelaena pseudostygia					3
	Jacksonia sternbergiana					2
	Daviesia divaricata subsp. divaricata					3
	Acacia applanata					2
	Bossiaea eriocarpa					2
	Stachystemon vermicularis					2
SP20	*Laxmannia squarrosa*					4
	Romulea rosea					2
	Conostylis setigera					1
	Daviesia polyphylla					2
	Petrophile linearis					2
	Lyginia imberbis					1
SP21	*Hemiandra pungens*					1
SP22	*Pimelea ?brevistyla subsp. minor*					1
	Johnsonia pubescens subsp. pubescens					2
	Leptospermum laevigatum					opp.
	Chamaecytisus palmensis					opp.
	Hypolaena exsulca					opp.
SP23	*Xanthosia huegelii*					opp.

Site Details			
Locality	Hazelmere	Photo No.	Cam 4 - NW corner
Date	22.08.2013	Photo direction	
Author	ST and SP	Geographic datum and zone	GDA94 50
Sampling unit	quadrat	Easting	406999
Sample number	Q1	Northing	6468346

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	weedy paddock to 2, regrowth to
Topographic position	flat	Vegetation Condition	VG
Altitude		Time since fire	>5 years
Bare ground %	5	Disturbance	weeds, adjacent clearing, grazing
Soil type/texture	sandy	Rock type	-
Soil colour	white over dark grey	Rock %	-
Microclimate		Litter type and %	leaf 20

Vegetation Description

Open woodland of Eucalyptus marginata and Allocasurarina fraseriana over low open woodland of Banksia attenuata and B. menziesii over shrubland of Adenanthos cygnorum, Philotheca spicata, Jacksonia floribunda and Bossiaea eriocarpa over forbland

Strata			Observations
	Height	Total % Cover	
Emergent tree			some grass weeds- patchy
Canopy	10		Condition through wider area very patchy
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
ST77	*Acacia applanata*					2
	Adenanthos cygnorum					10
	Allocasuarina fraseriana					opp.
	Banksia attenuata					10
	Banksia menziesii					1
	Bossiaea eriocarpa					2
	Briza maxima					2
	Burchardia congesta					1
	Conostephium preissii					2
ST78	*Conostylis juncea*					4
ST85	*Conostylis juncea*					
ST86	*Conostylis setigera*					1
ST87	*Cristonia biloba subsp. biloba*					1
	Dampiera linearis					4
ST79	*Desmocladus flexuosus*					5
ST81	*Drosera menziesii subsp. menziesii*					2
	Drosera stolonifera					2
	Ehrharta calycina					3

Coll. No.	*Species*	Layer	Life Form	Height	Habit	% Cover
	Eucalyptus marginata subsp. marginata					15
	Gladiolus caryophyllaceus					1
ST89	*Haemodorum spicatum*					1
ST82	*Hibbertia hypericoides*					1
	Jacksonia floribunda					2
	Kennedia prostrata					1
ST88	*Lepidosperma squamatum*					1
ST83	*Lomandra nigricans*					1
ST84	*Lyginia imberbis*					2
	Mesomelaena pseudostygia					2
	Patersonia occidentalis					2
	Philotheca spicata					5
	Pterostylis sanguinea					2
	Sowerbaea laxiflora					2
ST80	*Stylidium diuroides subsp. diuroides*					2
ST91	*Stylidium diuroides subsp. diuroides*					1
	Ursinia anthemoides					2

Site Details					
Locality	Hazelmere	Photo No.			
Date	22.08.2013	Photo direction		NE corner	
Author	ST and SP	Geographic datum and zone		GDA94	50
Sampling unit	quadrat	Easting		407065	
Sample number	Q2	Northing		6468405	
Geographic and Habitat Data					
Aspect		Hydrology			
Slope		Adjacent Vegetation	Banksia woodland		
Topographic position	flat	Vegetation Condition	G (this patch) VG general area		
Altitude		Time since fire	>5 years		
Bare ground %	30	Disturbance			
Soil type/texture	sand	Rock type			
Soil colour	white/grey	Rock %			
Microclimate		Litter type and %			

Vegetation Description

Banksia attenuata, B. menziesii, Jarrah over Xanthorrhoea preissii and Anigozanthos manglesii over herbs and weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy	6	10	weedy undersotrey
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
ST97	*?Quinetia urvillei*					1
	Acacia applanata					opp.
	Alexgeorgea nitens					3
	Allocasuarina fraseriana					3
	Anigozanthos manglesii					5
	Banksia menziesii					5
	Briza maxima					5
	Cristonia biloba subsp. biloba					2
	Dampiera linearis					2
	Dasypogon bromeliifolius					2
	Drosera erythrorhiza subsp. erythrorhiza					1
	Drosera erythrorhiza subsp. erythrorhiza					2
	Drosera stolonifera					2
	Ehrharta calycina					10
	Eucalyptus marginata subsp. marginata					opp.
	Gladiolus caryophyllaceus					2
	Gompholobium tomentosum					1
	Haemodorum spicatum					12

Coll. No.	*Species*	Layer	Life Form	Height	Habit	% Cover
ST95	*Hyalosperma cotula*					4
	Lyginia imberbis					2
ST98	*Millotia tenuifolia subsp. ?tenuifolia*					1
	Patersonia occidentalis					opp.
	Pimelea ?brevistyla subsp. minor					opp.
ST96	*Stypandra glauca*					2
	Ursinia anthemoides					5
	Xanthorrhoea preissii					10
ST99	*Lomandra hermaphrodita*					1

Site Details				
Locality	Hazelmere	Photo No.		
Date	7/11/2013	Photo direction		
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	quadrat	Easting		
Sample number	Q3	Northing		

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	degraded edges, PC
Topographic position	flat	Vegetation Condition	G
Altitude		Time since fire	> 5 years
Bare ground %	8	Disturbance	weeds
Soil type/texture	sand	Rock type	none
Soil colour	grey	Rock %	0
Microclimate		Litter type and %	

Vegetation Description

Eucalyptus marginata over Xanthorrhoea preissii over herbs, sedges and weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Eucalyptus marginata					15
	Xanthorrhoea preissii					15
	Jacksonia floribunda					3
	Stirlingia latifolia					5
	Alexgeorgea nitens					5
	Ehrharta calycina					4
	Briza maxima					2
	Jacksonia lehmannii					3
	Bossiaea eriocarpa					3
	Schoenus pedicellatus					2
	Tricoryne elatior					2
	Banksia menziesii					5
	Dampiera linearis					1
	Scaevola canescens					3
	Lyginia imberbis					2
	Banksia sessilis					4
	Cyathochaeta equitans					3
	Phlebocarya ciliata					5

Coll. No.	*Species*	Layer	Life Form	Height	Habit	% Cover
	Hibbertia hypericoides					2
	Dasypogon obliquifolius					3
	Conostylis juncea					2
	Hemiandra pungens					5
	Allocasuarina fraseriana					1
	Patersonia occidentalis					3
	Desmocladus fasciculatus					5
	Lomandra hermaphrodita					3
	Daviesia triflora					2
	Haemodorum spicatum					7
	Banksia attenuata					2

Site Details				
Locality	Hazelmere	Photo No.		
Date	7/11/2013	Photo direction		
Author	ST and SP	Geographic datum and zone	GDA94	50
Sampling unit	quadrat	Easting		
Sample number	Q3	Northing		

Geographic and Habitat Data			
Aspect		Hydrology	
Slope		Adjacent Vegetation	D edges, PC surrounding
Topographic position	flat	Vegetation Condition	G
Altitude		Time since fire	> 5 years
Bare ground %	5	Disturbance	weeds, adj clearing
Soil type/texture	sand	Rock type	
Soil colour	grey	Rock %	0
Microclimate		Litter type and %	5

Vegetation Description

Banksia attenuata and B. menziesii over Xanthorrhoea preissii, Lambertia multiflora and Jacksonia floribunda over herbs and weeds

Strata			Observations
	Height	Total % Cover	
Emergent tree			
Canopy			
Sub-canopy			
Lower tree			
Upper shrub			
Lower shrub			
Upper herb			
Middle herb			
Lower herb			

Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	Allocasuarina fraseriana					opp.
	Banksia attenuata					5
	Banksia menziesii					10
	Banksia nivea subsp. nivea					10
	Lambertia multiflora var. darlingensis					10
	Conospermum undulatum					2
	Jacksonia floribunda					5
	Hibbertia hypericoides					5
	Mesomelaena pseudostygia					5
	Dampiera linearis					2
	Ursinia anthemoides					2
	Arnocrinum preissii					1
	Hemiandra pungens					2
	Cyathochaeta equitans					2
	Alexgeorgea nitens					5
	Lepidosperma leptostachyum					1
	Dasypogon obliquifolius					2
	Daviesia divaricata subsp. divaricata ms					2

Coll. No.	*Species*	Layer	Life Form	Height	Habit	% Cover
	Haemodorum spicatum					3
	Xanthorrhoea preissii					2
	Avena barbata					5
	Ehrharta calycina					1
	Haemodorum spicatum					2
	Scaevola repens subsp. repens					1
	Conostephium preissii					1
	Pimelea ?brevistyla subsp. minor					3
	Briza maxima					1
	Gladiolus caryophyllaceus					2
	Caustis dioica					2
	Philotheca spicata					1
	Tricoryne elatior					2
	Phlebocarya ciliata					5
	Labichea punctata					2
	Homalosciadium homalocarpum					opp.
	Eremaea pauciflora					opp.
	Haemodorum spicatum					opp.
	Monotaxis grandiflora var. grandiflora					opp.
	Chordifex sinuosus					opp.

Appendix D

Fauna Assessment (Greg Harewood 2014)

Fauna Assessment

Hazelmere
Precinct 9A

MARCH 2014
Version 2

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SUMMARY

This report details the results of a fauna assessment of the Precinct 9A located within the suburb of Hazelmere (Figure 1). The subject site is made up of 11 individual lots (Lot 3, 6, 10, 15, 97, 148, 149, 199, 200, 201 and 500) and has a total area of approximately 65 hectares (ha) most of which is cleared of native vegetation (Figure 2). The largest areas of continuous vegetation (totalling approximately 7 ha) are present in the northern and central sections of the site and form part of Bush Forever Site 481 – *Stirling Crescent Bushland, Hazelmere* (Figure 2).

It is understood that the proponents (the Hazelmere Landowners Group) are currently undertaking local structure planning to support future development within the subject site. A range of investigations, including this fauna survey, have been undertaken in order to fully understand the suite of environmental values across the area.

The scope of works was to conduct a level 1 fauna survey as defined by the Environmental Protection Authority (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include targeted assessment of the site's significance to these particular species. The assessment has included a desktop study and single daytime reconnaissance survey.

Descriptions of the broadly defined fauna habitats, mainly based on the remaining vegetation units onsite as mapped by Emerge Associates (2013) are given below, with the extent of each identified unit being shown in Figure 3.

- Tall shrubland to tall closed shrubland of *Adenanthos cygnorum* over low sparse to open shrubland of *Hibbertia* spp. Over sparse to open forbland of *Hybanthus calycinus* and *Dasypogon bromeliifolius* and open sedgeland of *Alexgeorgea nitens* and *Desmocladus flexuosus*;

- *Corymbia calophylla* open forest over sparse shrubland of *Xanthorrhoea preissii* (or absent) over closed grassland and forbland of pasture weeds;

- Isolated trees to open woodland of *Eucalyptus marginata* and *Allocasuarina fraseriana* over open shrubland of *Xanthorrhoea preissii* over grassland and forbland of pasture weeds*;*

- Isolated trees to open woodland of *Eucalyptus marginata* and *Allocasuarina fraseriana* over woodland of *Banksia attenuata, B. menziesii, B. grandis* and *Adenanthos cygnorum* over low shrubland of *Xanthorrhoea preissi*i and *Hibbertia hypericoides* over forbland of *Dasypogon obliquifolius, Conostylis spp.* and *Anigozanthos manglesii* and sedgeland of *Desmocladus flexuosus* and *Alexgeorgea nitens.*;

- Isolated *Corymbia calophylla, Eucalyptus marginata* and planted non-endemic trees over pasture weeds;
- Man-made Dam.

Overall fauna habitat values at the site have been severely compromised by total or partial clearing of native vegetation and ongoing livestock grazing. Most areas lack any natural attributes and are now only utilised by generally common and widespread fauna species with non-specific requirements which allow them to persist in highly disturbed habitats. The Bush Forever areas in the northern and central sections of the site have the most value as fauna habitat though some areas lack native groundcover/shrubs and microhabitats such as hollow logs, presumably a consequence of partial clearing, livestock grazing, logging and frequent fires. This has also seen the biodiversity values of these areas of the site diminish from their original natural state.

Despite the area's history of disturbance the site does however still provide suitable habitat for a range of species, some of which are of conservation significance.

Opportunistic fauna observations are listed in Appendix B. A total of 36 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the single day time survey. Signs of four introduced species were also seen.

Evidence of all three listed threatened black cockatoos species was observed (foraging evidence - chewed marri (*Corymbia calophylla*), jarrah (*Eucalyptus marginata*) and sheoak (*Allocasuarina fraseriana*) fruits and *Banksia* cones). No evidence of any migratory or Department of Parks and Wildlife (DPaW) priority fauna species using the area was found

The habitat tree assessment identified 132 specimens within the areas examined that fit the Federal Department of the Environment's (DoE's) criteria for black cockatoo breeding habitat (i.e. suitable tree species with a diameter at breast height (DBH) of >50cms (SEWPaC 2012)) (Figure 4).

Twenty (20) of the 132 trees were observed to contain hollows of some type with two (2) being assessed at the time to possibly have large enough hollows for black cockatoos to use for nesting though this assessment was based on the size of the entrance into an apparent hollow only. No actual evidence of any hollows being used by black cockatoos for nesting (currently or previously) was seen.

Additional details on each observed "habitat tree" can be found in Appendix D.

Foraging evidence left by black cockatoos in the form of chewed marri, jarrah and sheoak fruits and *Banksia* cones were found at several locations across the site (Figure 4). This evidence was attributed to the forest red-tailed black-cockatoo, Baudin's black-cockatoo and Carnaby's black-cockatoo (based on marks left on the fruit body

and/or preferred foraging species). Additional details on the foraging evidence observed can be found in Appendix D.

Almost all the remnant native vegetation on-site (including isolated trees) can be regarded as representing foraging habitat for black cockatoos due to the dominance of marri, jarrah, sheoak and *Banksia* species.

No existing roosting trees (trees used at night by black cockatoos to rest) were positively identified during the survey.

With respect to native vertebrate fauna, 13 mammals (includes eight bat species), 101 bird, 32 reptile and ten frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 153 native animals that are listed as potentially occurring in the area, four are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law, these being the three species of black cockatoo and the peregrine falcon. In addition, three migratory species (great egret, cattle egret and the rainbow bee-eater) and one DPaW priority species (southern brown bandicoot) may also utilise the area at times.

With respect to vertebrate fauna in general, no substantial impacts are anticipated as a consequence of development at the site. In cases where some impact is anticipated, the degree of the impact is only expected to be low and relates to the loss of small areas of habitat, but as most species are common and widespread no overall change in their conservation status is anticipated, despite a possible localised reduction in habitat extent.

It is considered unlikely that impacts on black cockatoos that may occur as a result of development at any scale within each individual landholding would result in a "significant impact" as defined by the Federal DoE (DoE 2013) and therefore no constraints on development in regard to this matter are, at this stage, anticipated.

1. INTRODUCTION

This report details the results of a fauna assessment of the Precinct 9A located within the suburb of Hazelmere (Figure 1). The subject site is situated about 15 kilometres east of the Perth central business district in south west Western Australia and is centred at approximately 31.923754°S and 116.018627°E.

The subject site is made up of 11 individual lots (Lot 3, 6, 10, 15, 97, 148, 149, 199, 200, 201 and 500) and has a total area of approximately 65 hectares (ha) most of which is cleared of native vegetation (Figure 2). The largest areas of continuous vegetation (totalling approximately 7 ha) are present in the northern and central sections of the site and form part of Bush Forever Site 481 – *Stirling Crescent Bushland*, *Hazelmere* (Figure 2).

2. DEVELOPMENT PROPOSAL

It is understood that the proponents (the Hazelmere Landowners Group) are currently undertaking local structure planning to support future development within the subject site. A range of investigations, including this fauna survey, have been undertaken in order to fully understand the suite of environmental values across the area. The findings of this fauna survey and other investigations will be used to inform and support the development of a Local Structure Plan, with the primary aim of minimising potential environmental impacts as much as reasonable and practicable.

It is also anticipated that the information presented will be used by regulatory authorities to assess the potential impact of the proposal on fauna and fauna habitats as part of any required approval process.

3. SCOPE OF WORKS

The scope of works was to conduct a level 1 fauna survey as defined by the EPA (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include targeted assessment of the site's significance to these species.

The fauna assessment has therefore included:

1. Level 1 Fauna Survey (to EPA standard).

2. Black Cockatoo Habitat Assessment ("habitat trees" = DBH >50cm, existing and potential nest hollows, roosting habitat and foraging habitat); and

3. Report summarising results with management/planning recommendations.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black-cockatoo *Calyptorhynchus baudinii*, Carnaby's black-cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black-cockatoo *Calyptorhynchus banksii naso*.

4. METHODS

4.1 POTENTIAL FAUNA INVENTORY - DESKTOP STUDY

4.1.1 Database Searches

Searches of the following databases were undertaken to aid in the compilation of a list of vertebrate fauna potentially occurring within the study area:

- DPaW's NatureMap Database Search (combined data from DPaW, Western Australian Museum, Birds Australia and consultants reports) (DPaW 2013b); and

- Protected matters search tool (Department of the Environment – DoE 2013).

It should be noted that these lists are based on observations from a broader area than the study site and therefore may include species that would only ever occur as vagrants in the actual study area due to a lack of suitable habitat or the presence of only marginal habitat. The databases also often included very old records and in some cases the species in question have become locally or regionally extinct.

Information from these sources should therefore be taken as indicative only and local knowledge and information needs also to be taken into consideration when determining what actual species may be present within the specific area being investigated.

4.1.2 Previous Fauna Surveys in the Area

Fauna surveys, assessments and reviews have been undertaken in nearby areas in the past, though not all are publically available and could not be referenced. The most significant of those available have been used as the primary reference material for compiling the potential fauna assemblage for the general area.

Those reports referred to included, but were not limited to:

- ATA (1994). A Report of a Fauna Survey of Perth Airport. Report 93/78. Unpublished report for the Federal Airports Corporation.
- ATA Environmental (2006) Vertebrate Fauna Assessment Brookdale Redevelopment Area. Unpublished report for the Armadale Redevelopment Authority.
- Dell, J. (pers.comm) (1994). Results of Western Australia Museum Surveys, December 1986 to April 1990.
- ENV Australia (2005). Southern River Precinct 3 - Environmental Review. Unpublished report for the City of Gosnells.
- Harvey, M. S., Dell, J. How, R. A., & Waldock, J. M. (1987). Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms, Perth. Report to the Australian Heritage Commission. NEP Grant N95/49. 56 pp.
- How, R.A (1995). Objection Assessment of Fauna Values for Perth Airport. Unpublished report for the Australian Heritage Commission.
- How, R.A, Harvey, M.S., Dell J., & Waldock, J.M. (1996). Ground Fauna of Urban Bushland Remnants in Perth. Report to the Australian Heritage Commission. NEP Grant N93/04. 103 pp.
- Turpin, J. and Bamford, M. (2009). Keane Road Strategic Link Armadale, Fauna Assessment. Unpublished report for EnviroWorks Consulting.

As with the databases searches some reports refer to species that would not occur in the study area due to a lack of suitable habitat (extent and/or quality) and this fact was taken into consideration when compiling the potential fauna species list for the study area. It should also be noted that the NatureMap database is likely to include some records from previous fauna surveys in the area including some of those listed above.

4.1.3 Existing Publications

The following represent the main publications used to identify and refine the potential fauna species list for the study area:

- Anstis, M. (2013). Tadpoles and Frogs of Australia. New Holland Publishers, Sydney.

- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds. Royal Australasian Ornithologists Union, Victoria.

- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2007). Reptiles and Frogs in the Bush: Southwestern Australia. UWA Press, Nedlands.

- Churchill, S. (2008). Australian Bats. Second Edition, Allen & Unwin.

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- Johnstone, R.E. and Storr, G.M. (2004). Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth Western Australia.

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4.1.4 Fauna of Conservation Significance

The conservation significance of fauna species has been assessed using data from the following sources:

- *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). Administered by the Australian Government Department of the Environment (DoE);

- *Wildlife Conservation Act 1950 (WC Act).* Administered by the Western Australian Department of Parks and Wildlife (DPaW) (Govt. of WA 2013);

- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List - the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and the

- DPaW Priority Fauna list. A non-statutory list maintained by the DPaW for management purposes (DPaW 2013a).

The *EPBC Act* also requires the compilation of a list of migratory species that are recognised under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA);

- China Australia Migratory Bird Agreement 1998 (CAMBA);

- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and

- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

(Note - Species listed under JAMBA are also protected under Schedule 3 of the *WC Act*.)

All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance (NES) under the *EPBC Act*.

The conservation status of all vertebrate fauna species listed as occurring or possibly occurring in the vicinity of the study area has been assessed using the most recent lists published in accordance with the above-mentioned instruments and is indicated as such in the fauna listings of this report. A full listing of conservation codes are provided in Appendix A.

A number of other species not listed in official lists can also be considered of local or regional conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range.

While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of bird species have been listed as of significance on the Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998 and 2000). The bird species are often referred to as Bush Forever Decreaser Species. The three categories used for birds within the Bush Forever documents are:

- Habitat specialists with reduced distribution on the Swan Coastal Plain (code Bh)
- Wide ranging Species with reduced population's on the Swan Coastal Plain. (code Bp)
- Extinct in the Perth region (code Be)

The presence of Bush Forever species should be taken into some consideration when determining the fauna values of an area. Bush Forever decreaser species are indicated as such within the species list held in Appendix B.

4.1.5 Invertebrate Fauna of Conservation Significance

It can be difficult to identify what may be significant invertebrate species (e.g. Short Range Endemics - SREs) as there are uncertainties in determining the range-restrictions of many species due to lack of surveys, lack of taxonomic resolutions within target taxa and problems in identifying certain life stages. Where invertebrates are collected during surveys, a high percentage are likely to be unknown, or for known species there can be limited knowledge or information on their distribution (Harvey 2002).

For this project, the assessment for conservation significant invertebrates has been limited to those listed by the DPaW and *EPBC Act* database searches (which rely on distribution records and known habitat preferences). No assessment of the potential for SREs to be present has been made.

4.1.6 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report is generally taken from the DPaW's WA Fauna Census Database which is assumed to follow Aplin and Smith (2001) for amphibians and reptiles, How *et al*. (2001) for mammals and Johnstone (2001) for birds.

Common names are taken from the Western Australia Museum (WAM) recognised primary common name listings when specified, though where common names are not provided they have been acquired from other publications. Sources include Wilson and Swan (2013), Van Dyck & Strahan (2013), Christidis and Boles (2008), Bush *et al.* (2010), Bush *et al.* (2002), Tyler *et al*. (2000), and Glauret (1961). Not all common names are generally accepted.

4.2 SITE SURVEYS

A daytime reconnaissance survey of the site was carried out on the 6 September, 2013. All survey work was carried out by Greg Harewood (B.Sc. Zoology).

4.2.1 Fauna Habitat Assessment

The communities identified during the botanical survey of the site carried out by Emerge Associates (Emerge 2013) have been used as the basis for a classification of areas into broad fauna habitats types. This information has been supplemented with observations made during the fauna assessment.

The main aim of the habitat assessment was to determine if it was likely that any species of conservation significance would be utilising the areas that may be impacted on as a consequence of development at the site. The habitat information obtained was also used to aid in finalising the overall potential fauna list.

As part of the desktop literature review, available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area was researched. During the field survey the habitats within the study area were assessed and specific elements identified, if present, to determine the likelihood of listed threatened species utilising the area and its significance to them.

4.2.2 Opportunistic Fauna Observations

Opportunistic observations of fauna species were made during all field survey work which involved a series of transects across the site during the day while searching microhabitats such as logs, rocks, leaf litter and observations of bird species with binoculars. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted if observed/heard.

4.2.3 Black Cockatoo Habitat Assessment

The black cockatoo habitat assessment included a:

- Habitat tree survey: This involved the identification of all suitable trees species within the study area that have a Diameter at Breast Height (DBH) of over 50cm (irrespective of the presence/absence of suitable hollows – DoE

(SEWPaC 2012) criteria). The location of each tree identified was recorded with a GPS and details on tree species, number and size of hollows (if any) noted. Trees with hollows were marked with "H" using spray paint.

Target tree species included marri (*Corymbia calophylla*) and jarrah *(Eucalyptus marginata*) or any other endemic *Corymbia/Eucalyptus* species of a suitable size that may be present. Peppermints (*Agonis flexuosa*), *Banksia*, sheoak (*Allocasuarina* sp.) and *Melaleuca* tree species (for example) were not assessed as they typically do not develop hollows that are used by black cockatoos.

For the purposes of this study a potential cockatoo nest hollow was defined as:

Generally any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by any of the three black cockatoo species for the purpose of nesting/breeding. Hollows that had an entrance greater than about 12cm in diameter and would allow the entry of a cockatoo (white tailed or red-tailed) into a suitably orientated and sized branch/trunk, were recorded as a "potential nest hollow".

Identified hollows were examined using binoculars for evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Trees with possible nest hollows were also scratched and raked with a large stick/pole to flush any sitting birds from hollows and calls of chicks were also listened for.

- Black cockatoo foraging assessment: The location and nature of black cockatoo foraging evidence (e.g. chewed fruits around the base of trees) observed during the field survey was recorded along with an assessment of the extent and quality of foraging habitat present, based on mapped vegetation units.

- Roosting habitat survey: Direct and indirect evidence of black cockatoos roosting within trees on site was noted if observed (e.g. branch clippings, droppings or moulted feathers).

5. SURVEY CONSTRAINTS

No seasonal sampling has been carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field

assessments. It should also be recognised that site conditions can change with time.

Some fauna species are reported as potentially occurring within the study area based on there being suitable habitat (quality and extent) within the study area or immediately adjacent. With respect to opportunistic observations, the possibility exists that certain species may not have been detected during field investigations due to:

- seasonal inactivity during the field survey;
- species present within micro habitats not surveyed;
- cryptic species able to avoid detection; and
- transient wide-ranging species not present during the survey period.

Lack of observational data on some species should therefore not necessarily be taken as an indication that a species is absent from the site.

The habitat requirements and ecology of many of the species known to occur in the wider area are often not well understood or documented. It can therefore be difficult to exclude species from the potential list based on a lack of a specific habitat or microhabitat within the study area. As a consequence of this limitation the potential fauna list produced is most likely an overestimation of those species that actually utilise the study area for some purpose. Some species may be present in the general area but may only use the study area itself on rare occasions or as vagrants/transients.

In recognition of survey limitations, a precautionary approach has been adopted for this assessment. Any fauna species that would possibly occur within the study area (or immediately adjacent), as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the Author, has been assumed to potentially occur in the study area.

During the black cockatoo habitat survey trees with hollows were searched for. It should be noted that identifying hollows suitable for fauna species from ground level has limitations. Generally the full characteristics of any hollow seen are not fully evident (e.g. internal dimensions). It is also difficult to locate all hollows within all trees as some are not observable from ground level.

The location of observations was recorded using a handheld GPS. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can increase or decrease beyond this range.

6. RESULTS

6.1 POTENTIAL FAUNA INVENTORY - DESKTOP STUDY

A list of fauna species considered most likely to occur in the study area has compiled from information obtained during the desktop study and is presented in Appendix B. This listing was refined after information gathered during the site reconnaissance survey was assessed. The results of some previous fauna surveys carried out in the general area are summarised in this species listing as are the DPaW NatureMap database search results. The raw database search results from NatureMap (DPaW 2013b) and the Protected Matters Search Tool (DoE 2013) are contained within Appendix C.

The list of potential fauna takes into consideration that firstly the species in question is not known to be locally extinct and secondly that suitable habitat for each species, as identified during the habitat assessment, is present within the study area, though compiling an accurate list has limitations (see Section 5 above) and therefore as discussed the listing is likely to be an overestimation of the fauna species actually present onsite at any one time.

6.2 SITE SURVEYS

6.2.1 Fauna Habitat Assessment

Descriptions of the broadly defined fauna habitats, mainly based on the remaining vegetation units onsite as mapped by Emerge Associates (Emerge 2013) are given below, with the extent of each identified unit being shown in Figure 3.

Table 1: Main Fauna Habitats within the Study Area

No.	Fauna Habitat Description	Example Image
1	Tall shrubland to tall closed shrubland of *Adenanthos cygnorum* over low sparse to open shrubland of *Hibbertia* spp. Over sparse to open forbland of *Hybanthus calycinus* and *Dasypogon bromeliifolius* and open sedgeland of *Alexgeorgea nitens* and *Desmocladus flexuosus.*	

No.	Fauna Habitat Description	Example Image
2	*Corymbia calophylla* open forest over sparse shrubland of *Xanthorrhoea preissii* (or absent) over closed grassland and forbland of pasture weeds.	
3	Isolated trees to open woodland of *Eucalyptus marginata* and *Allocasuarina fraseriana* over open shrubland of *Xanthorrhoea preissii* over grassland and forbland of pasture weeds.	
4	Isolated trees to open woodland of *Eucalyptus marginata* and *Allocasuarina fraseriana* over woodland of *Banksia attenuata, B. menziesii, B. grandis* and *Adenanthos cygnorum* over low shrubland of *Xanthorrhoea preissi*i and *Hibbertia hypericoides* over forbland of *Dasypogon obliquifolius, Conostylis spp.* and *Anigozanthos manglesii* and sedgeland of *Desmocladus flexuosus* and *Alexgeorgea nitens.*	

No.	Fauna Habitat Description	Example Image
5	Isolated *Corymbia calophylla, Eucalyptus marginata* and planted non-endemic trees over pasture weeds.	
6	Man-made Dam.	

Overall fauna habitat values at the site have been severely compromised by the total or partial clearing of native vegetation and ongoing livestock grazing. Most areas lack any natural attributes and are now only utilised by generally common and widespread fauna species with non-specific requirements which allow them to persist in highly disturbed habitats. The Bush Forever areas in the northern and central sections of the site have the most value as fauna habitat though some areas lack native groundcover/shrubs and microhabitats such as hollow logs, presumably a consequence of partial clearing, livestock grazing, logging and frequent fires. This has also seen the biodiversity values of these areas of the site diminish from their original natural state.

Despite the area's history of disturbance the site does however still provide suitable habitat for a range of species, some of which are of conservation significance.

6.2.2 Opportunistic Fauna Observations

Opportunistic fauna observations are listed in Appendix B. A total of 36 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the single day time survey. Signs of four introduced species were also seen.

Evidence of all three listed threatened black cockatoos species was observed (foraging evidence - chewed marri, jarrah and sheoak fruits and banksia cones). No evidence of any migratory or DPaW priority fauna species using the area was found.

6.2.3 Black Cockatoo Habitat Assessment

The habitat tree assessment identified 132 specimens within the areas examined that fit DoE's (SEWPaC 2012) criteria for black cockatoo breeding habitat (i.e. suitable tree species with a diameter at breast height (DBH) of >50cms) (Figure 4). Most of the trees were jarrah (*E. marginata* - 68 specimens) or marri (*C. calophylla* – 51 specimens) while the balance being comprised of flooded gum (*E. rudis* - 6 specimens), coastal blackbutt (*E. todtiana* – 2 specimens) and several unidentifiable dead specimens (5).

Twenty (20) of the 132 trees were observed to contain hollows of some type with two (2) being assessed at the time to possibly have large enough hollows for black cockatoos to use for nesting though this assessment was based on the size of the entrance into an apparent hollow only. No actual evidence of any hollows being used by black cockatoos for nesting (currently or previously) was seen.

Additional details on each observed "habitat tree" can be found in Appendix D.

Foraging evidence left by black cockatoos in the form of chewed marri, jarrah and sheoak fruits and *Banksia* cones were found at several locations across the site (Figure 4). This evidence was attributed to the forest red-tailed black-cockatoo, Baudin's black-cockatoo and Carnaby's black-cockatoo (based on marks left on the fruit body and/or preferred foraging species). Additional details on the foraging evidence observed can be found in Appendix D.

Almost all the remnant native vegetation on-site (including isolated trees) can be regarded as representing foraging habitat for black cockatoos due to the dominance of marri, jarrah, sheoak and *Banksia*.

No existing roosting trees (trees used at night by black cockatoos to rest) were positively identified during the survey.

6.3 FAUNA INVENTORY – SUMMARY

6.3.1 Vertebrate Fauna

Table 2 summarises the number of vertebrate fauna species potentially occurring within or utilising at times the study area, based on results from the desktop study and observations made during the field assessment. A complete list of vertebrate fauna possibly inhabiting or frequenting the study area is located in Appendix B.

Not all species listed as potentially occurring within the study area in existing databases and publications (i.e. *EPBC Act* Threatened Fauna and Migratory species lists, DPaW's NatureMap database, various reports and publications) are shown in the expected listing in Appendix B. Some species have been excluded from this list based largely on the lack of suitable habitat at the study site and in the general area or known local extinction even if suitable habitat is present.

Table 2: Summary of Potential Vertebrate Fauna Species (as listed in Appendix B)

Group	Total number of potential species	Potential number of specially protected species	Potential number of migratory species	Potential number of priority species	Number of species observed - field survey 2013
Fish	1[1]	0	0	0	0
Amphibians	10	0	0	0	0
Reptiles	32	0	0	0	1
Birds	107[6]	4	3	0	36[2]
Non-Volant Mammals	11[6]	0	0	1	3[2]
Volant Mammals (Bats)	8	0	0	0	0
Total	**169[13]**	**4**	**3**	**1**	**40[4]**

Superscript = number of introduced species included in total.

Despite the omission of some species it should be noted that the list provided is still very likely an over estimation of the fauna species utilising the site (either on a regular or infrequent basis) as a result of the precautionary approach adopted for the assessment. At any one time only a subset of the listed potential species are likely to be present within the bounds of the study area.

6.3.2 Vertebrate Fauna of Conservation Significance

A review of the *EPBC Act* threatened fauna list, DPaW's Threatened Fauna Database and Priority List, unpublished reports and scientific publications identified 35 specially protected, priority or migratory vertebrate fauna species as potentially occurring in the general vicinity of the study area. Of these species, most that have

no potential whatsoever to utilise the study area for any purpose have been omitted from the potential list for the site (Appendix B), principally due to lack of suitable habitat on-site (including extent and/or quality) or known local extinction.

In summary, three vertebrate fauna species of conservation significance were positively identified as utilising the study area for some purpose during the survey period, these being:

- *Calyptorhynchus banksii naso* Forest Red-tailed Black-Cockatoo – S1 (*WC Act*), Vulnerable (*EPBC Act*)
  Foraging evidence attributed to this species was found during the day survey (chewed jarrah, marri and sheoak fruits). The majority of the remnant vegetation on site represents foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. May also occasionally roost on site.

- *Calyptorhynchus baudinii* Baudin`s Black-Cockatoo - S1 (*WC Act*), Vulnerable (*EPBC Act*)
  Foraging evidence attributed to this species was found during the day survey (chewed marri fruits and *Banksia* cones). The majority of the remnant vegetation on site represents foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. May also occasionally roost on site.

- *Calyptorhynchus latirostris* Carnaby`s Black-Cockatoo – S1 (*WC Act*), Endangered (*EPBC Act*)
  Foraging evidence attributed to this species was found during the day survey (chewed marri fruits and *Banksia* cones). The majority of the remnant vegetation on site represents foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. May also occasionally roost on site.

Based on the habitats present and current documented distributions it is considered possible that five additional species may use the study site for some purpose at times, though, as no evidence of any using the study site at the time of the field survey was found, the status of some in the area remains uncertain.

These species are:

- *Ardea alba* Great Egret – S3 (*WC Act*), Migratory (*EPBC Act*)
  The small dam onsite may be very occasionally visited by individuals of this species but frequency of occurrence would be very low. Would not breed onsite.

- *Ardea ibis* Cattle Egret – S3 (*WC Act*), Migratory (*EPBC Act*)
  The small dam onsite may be very occasionally visited by individuals of this species but frequency of occurrence would be very low. Would not breed onsite.

- *Merops ornatus* Rainbow Bee-eater – S3 (*WC Act*), Migratory (*EPBC Act*)
  This species is a common seasonal visitor to south west and during summer months a small number of individuals of this species may possibly forage and roost onsite. Sandy ground conditions appear suitable for breeding.

- *Falco peregrinus* Peregrine Falcon - S4 (*WC Act*)
  Uncommon but study site may form part of larger home range. No potential nest sites observed.

- *Isoodon obesulus fusciventer* Southern Brown Bandicoot – P5 (DPaW Priority Species)
  Very likely to be present in the small areas of native vegetation containing dense groundcover.

Habitat for some of these species on-site, while considered possibly suitable, may be marginal in extent/quality and species listed may only visit the area for short periods, or as rare/uncommon vagrants/transients.

A number of other species of conservation significance, while possibly present in the wider area (e.g. forested areas of the nearby Darling Range), are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas), lack of suitable habitat and/or the presence of feral predators. Details on conservation significant species and reasons for the omission of some from the potential listing are provided in Appendix E and Table 3.

Thirty one bird (31) species that potentially frequent or occur in the study area are noted as Bush Forever Decreaser Species in the Perth Metropolitan Region (eleven were sighted/identified as having used the study area during the survey). Decreaser species are a significant issue in biodiversity conservation in the Perth section of the coastal plain as there have been marked reductions in range and population levels of many sedentary bird species as a consequence of disturbance and land clearing (Dell & Hyder-Griffiths 2002).

6.3.3 Invertebrate Fauna of Conservation Significance

Three species of conservation significant invertebrate species appeared in the DPaW or *EPBC Act* database searches (DPaW 2013b, SEWPaC 2013), these being an unnamed scorpionfly (*Austromerope poultoni*), the graceful sun moth (*Synemon gratiosa*) and Carter's freshwater mussel (*Westralunio carteri*).

None of these species is considered likely to persist within the study area due to a total absence of suitable habitat and/or because the site is outside of their currently documented range. Additional information on both species can be found in Appendix E.

7. FAUNA VALUES

7.1 CONSERVATION SIGNIFICANCE OF THE STUDY AREA

The conservation significance of the study area has been determined by applying site specific criteria such as:

- Fauna species and/or habitat present that is poorly represented in the general vicinity of the study area;
- Fauna habitat within the study area supporting species of conservation or other significance; and
- Fauna habitat in better condition than other similar locations in the general vicinity of the study area.

Natural areas within the south west of Western Australia have been significantly altered since European settlement in the 1830's and a variety of environmental factors, in particular habitat fragmentation and fire, will continue to threaten many species of fauna with local extinction. As the local development of land progresses the significance of any remnant vegetation increases.

The regional and local conservation significance of the larger areas of remnant vegetation within the study site has already been recognised in the past and these areas given Bush Forever status (Figure 2).

The majority of the rest of the study site is cleared and as a consequence the diversity of fauna species has been significantly reduced from its original natural levels. Habitat degradation as a result of partial clearing, altered fire regimes and the presence of introduced predators is also likely to have had a significant effect on species diversity in the smaller bush remnants that remain in the largely cleared areas. Because of these factors most of the site has very little conservation significance to fauna in general.

7.2 VALUE OF THE STUDY AREA AS AN ECOLOGICAL LINKAGE/WILDLIFE CORRIDOR

Linkage with adjacent bushland areas is a natural attribute of high priority in the assessment of any sites significance. Within Bush Forever Volume 1 document (Figure 6 - Government of Western Australia 2000a), the study area forms part of Bush Forever Site 481 which is specifically identified as part of a Greenway corridor linking adjacent areas of remnant bush land (Greenways 50 – Tingay, Alan & Associates 1998). The site is noted as contributing to the linkage between bushland to the north and to Bush Forever Site 213 to the east.

Greenway corridors and other links between areas of ecological significance help maintain the diversity and vigour of ecological systems and also aid in the integration of natural areas within broader urban and industrial landscapes. Where possible, greenway concepts should be incorporated into future planning proposals as part of the development of best practice planning and design solutions (Government of Western Australia 2000a).

8. POTENTIAL IMPACTS AND DEVELOPMENT CONSIDERATIONS

8.1 POTENTIAL IMPACTS OF DEVELOPMENT

In general the most significant potential impacts to fauna of any development include:

- Loss of vegetation/fauna habitat that may be used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees);
- Fragmentation of vegetation/fauna habitat which may restrict the movement of some fauna species;
- Modifications to surface hydrology, siltation of creek lines;
- Changes to fire regimes;
- Pollution (e.g. oil spills);
- Noise/Light/Dust;
- Spread of plant pathogens (e.g. dieback) and weeds;
- Potential increase in the number of predatory introduced species (e.g. cats);

- Death or injury of fauna during clearing and construction; and
- An increase in fauna road kills subsequent to development.

The exact extent of development within the site is not known at this stage however the possible impacts on specific species of conservation significance previously recorded in the general area is provided in the table below. Additional information on those species listed is provided in Appendix E.

Table 3: Likelihood of Occurrence and Possible Impacts – Fauna Species of Conservation Significance (continues on following pages).

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Unnamed scorpionfly	*Austromerope poultoni*	P2	No	Unlikely	No impact.
Graceful Sun Moth	*Synemon gratiosa*	P4	No	Unlikely	No impact.
Carter's Freshwater Mussel	*Westralunio carteri*	P4	No	Unlikely	No impact.
Pouched Lamprey	*Geotria australis*	P1	No	Unlikely	No impact.
Western Swamp Tortoise	*Pseudemydura umbrina*	S1 CR	No	Unlikely	No impact.
Darling Range Heath Ctenotus	*Ctenotus delli*	P4	No	Unlikely	No impact.
Perth Lined Lerista	*Lerista lineata*	P3	No/Marginal	Unlikely	No impact.
Jewelled Ctenotus	*Ctenotus gemmula*	P3	No/Marginal	Unlikely	No impact.
Black-striped Snake	*Neelaps calonotos*	P3	No/Marginal	Unlikely	No impact.
Southern Carpet Python	*Morelia spilota imbricata*	S4	No/Marginal	Unlikely	No impact.
Malleefowl	*Leipoa ocellata*	S1 VU Mig	No	Unlikely - species locally extinct.	No Impact.
Australian Bustard	*Ardeotis australis*	P4	No	Unlikely - species locally extinct.	No Impact.
Migratory Shorebirds/Wetland Species	Various	Mig, Various	No/Very Marginal	Unlikely	No impact.
Great Egret	*Ardea alba*	S3 Mig	Yes/Marginal	Possible	Loss/modification of a very small area of marginal man-made habitat. No significant impact likely.
Cattle Egret	*Ardea ibis*	S3 Mig	Yes/Marginal	Possible	Loss/modification of a very small area of marginal man-made habitat. No significant impact likely.

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Australasian Bittern	*Botaurus poiciloptilus*	S1 EN	No	Unlikely	No impact.
Black Bittern	*Ixobrychus flavicollis*	P3	No	Unlikely	No impact.
Little Bittern	*Ixobrychus minutus*	P4	No	Unlikely	No impact.
Painted Snipe	*Rostratula benghalensis*	S1 S3 Mig EN	No	Unlikely	No impact.
Oriental Plover	*Charadis veredus*	S3 Mig	No	Unlikely	No impact.
Glossy Ibis	*Plegadis falcinellus*	Mig	No/Very Marginal	Unlikely	No impact.
Bush Stone Curlew	*Burhinus grallarius*	P4	No	Unlikely - species locally extinct.	No Impact.
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	S3 Mig	No	Unlikely	No impact.
Osprey	*Pandion haliaetus*	Mig	No	Unlikely	No impact.
Peregrine Falcon	*Falco peregrinus*	S4	Yes	Possible but only rarely.	Loss/modification of a very small area of natural habitat. No significant impact likely.
Muir's Corella	*Cacatua pastinator pastinator*	S4 VU	No	Unlikely	No Impact.
Major Mitchell's Cockatoo	*Cacatua leadbeateri*	S4	No	Unlikely.	No Impact.
Carnaby`s Black Cockatoo	*Calyptorhynchus latirostris*	S1 EN	Yes	Known to occur.	Loss/modification of small areas of natural habitat.
Baudin`s Black Cockatoo	*Calyptorhynchus baudinii*	S1 VU	Yes	Known to occur.	Loss/modification of small areas of natural habitat.
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	S1 VU	Yes	Known to occur.	Loss/modification of small areas of natural habitat.
Fork-tailed Swift	*Apus pacificus*	S3 Mig	Yes	Unlikely, Flyover only.	No impact.
Rainbow Bee-eater	*Merops ornatus*	S3 Mig	Yes	Known to occur.	Loss/modification of a areas of man-made and natural habitat. No significant impact likely.
Chuditch	*Dasyurus geoffroii*	S1 VU	No/Very Marginal	Unlikely	No impact.
Southern Brush-tailed Phascogale	*Phascogale tapoatafa ssp*	S1	No/Very Marginal	Unlikely	No impact.

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Western Ringtail Possum	*Pseudocheirus occidentalis*	S1 VU	No	Unlikely - species locally extinct.	No Impact.
Southern Brown Bandicoot	*Isoodon obesulus fusciventer*	P5	Yes	Possible	Loss/modification of small areas of natural habitat. No significant impact likely.
Woylie	*Bettongia penicillata ogibyi*	S1	No	Unlikely - species locally extinct.	No Impact.
Western Brush Wallaby	*Macropus irma*	P4	No/Marginal	Unlikely	No impact.
Water Rat	*Hydromys chrysogaster*	P4	No	Unlikely	No impact.

8.2 CONSIDERATIONS FOR PLANNING AND DEVELOPMENT

With respect to vertebrate fauna in general, no substantial impacts are anticipated as a consequence of development at the site. In cases where some impact is anticipated, the degree of the impact is only expected to be low and relates to the loss of small areas of habitat, but as most species are common and widespread no overall change in their conservation status is anticipated, despite a possible localised reduction in habitat extent. There are substantial areas of similar habitat in nearby areas and most if, not all species likely to utilise the study area will persist in these locations despite development of the site.

The assessment does indicate that any considerations required during ongoing development planning may possibly be limited to the presence of habitat used or potentially used by some threatened fauna species in particular those listed under the *EPBC Act*, namely the three species of black cockatoo. However, as the proposed development area is made of numerous individual lots with different landowners undertaking "actions" as separate entities, possible impacts in each area are likely to be assessed individually.

With this in mind it is considered unlikely that impacts on black cockatoos that may occur as a result of development at any scale within each individual landholding would result in a "significant impact" as defined by the Federal DoE (DoE 2013).

This conclusion is primarily based on the fact that most of the individual Lots are totally cleared or almost totally cleared of vegetation and therefore don't contain significant areas of potential cockatoo habitat. Where some habitat is present it is limited in extent. For example the foraging habitat present in the more coherent vegetated areas (primarily banksia woodland – in total ~7 ha only) is only likely to provide sufficient food to support about six cockatoos per year based on studies

carried out in areas containing similar habitat (Valentine and Stock 2008, Bamford 2011).

The study area is also not located in a documented cockatoo breeding area, and while some trees present are classified as "potential breeding habitat" using DoE criteria (SEWPaC 2012) the probability of any one tree actually developing hollows that would then be used by black cockatoos for breeding can be considered to be extremely low. The area is also unlikely to be considered of specific importance for the recovery of black cockatoos in the long term. For example the population growth of the Carnaby's black-cockatoo is primarily limited by factors associated with breeding, and consequently priority areas for the recovery of the species are currently focused on known breeding sites (Cale 2003).

So, while the retention of areas of vegetation should be considered during the planning process, based on the assessment above it is not likely to represent a constraint to development in any one lot.

9. CONCLUSION

The fauna assessment within the study area was undertaken for the purposes of categorising the fauna assemblages and identifying fauna habitats present. A targeted assessment of black cockatoo habitat within the area was also carried out.

With respect to native vertebrate fauna, 13 mammals (includes eight bat species), 101 bird, 32 reptile and ten frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 153 native animals that are listed as potentially occurring in the area, four are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law, these being the three species of black cockatoo and the peregrine falcon. In addition, three migratory species (great egret, cattle egret and the rainbow bee-eater) and one DPaW priority species (southern brown bandicoot) may also utilise the area at times.

With respect to vertebrate fauna in general, no substantial impacts are anticipated as a consequence of development at the site. In cases where some impact is anticipated, the degree of the impact is only expected to be low and relates to the loss of small areas of habitat, but as most species are common and widespread no overall change in their conservation status is anticipated, despite a possible localised reduction in habitat extent.

It is considered unlikely that impacts on black cockatoos that may occur as a result of development at any scale within each individual landholding would result in a "significant impact" as defined by the Federal DoE (DoE 2013) and therefore no constraints on development in regard to this matter are, at this stage, anticipated.

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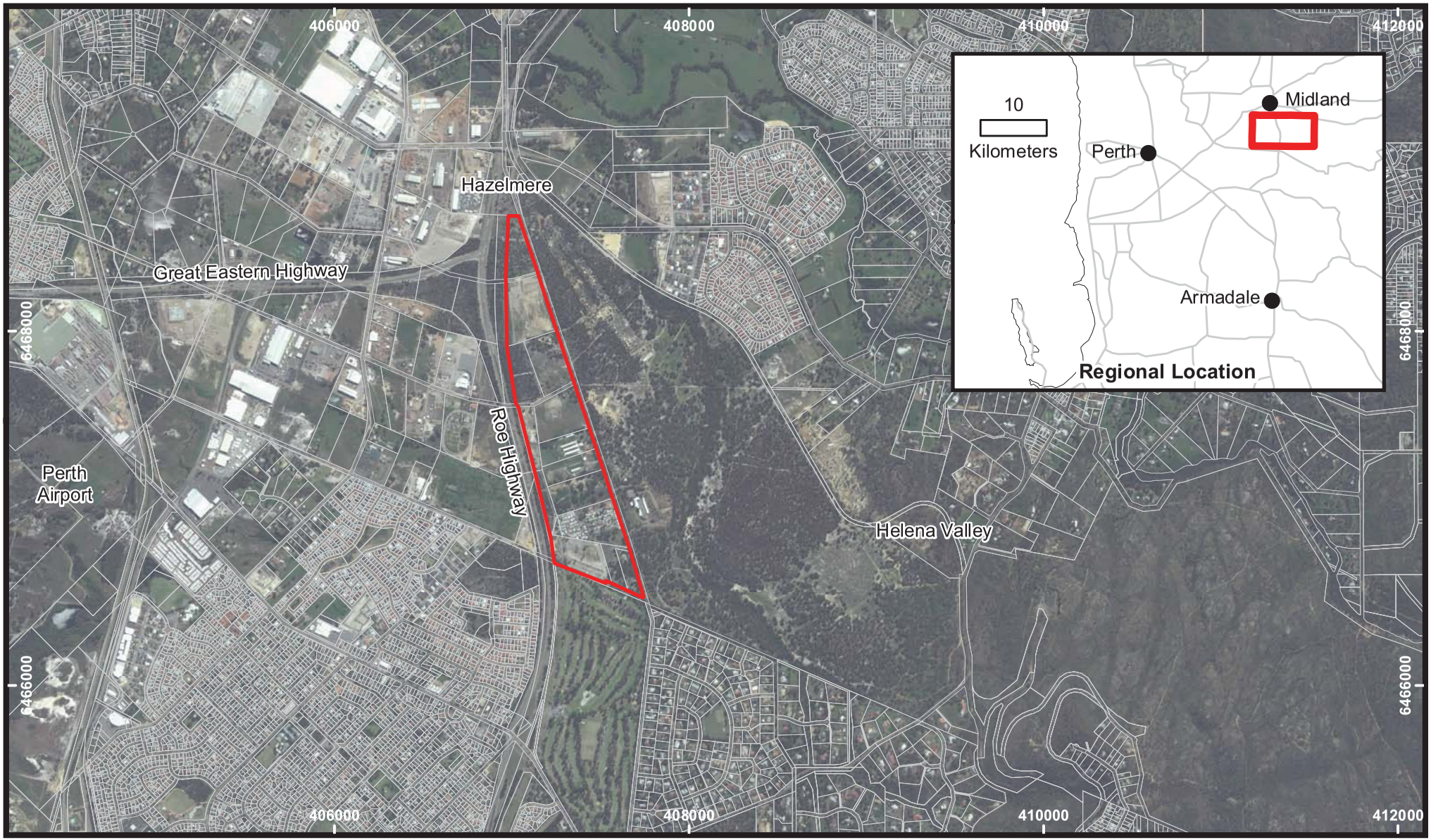
FIGURES



Legend

Study Area

0 0.5 1 1.5 2

Kilometres

MGA Zone 50

Fauna Survey

DRAWN:G Harewood

DATE : Feb 2014

SCALE: 1:30,000

Hazelmere Precinct 9A

Study Area and Surrounds

Figure: 1

Legend

Study Area

0 250 500

Meters

MGA Zone 50

Fauna Survey

DRAWN:G Harewood

DATE : Mar 2014

SCALE: 1:9,250

Hazelmere Precinct 9A

Study Area Air Photo

Figure: 2

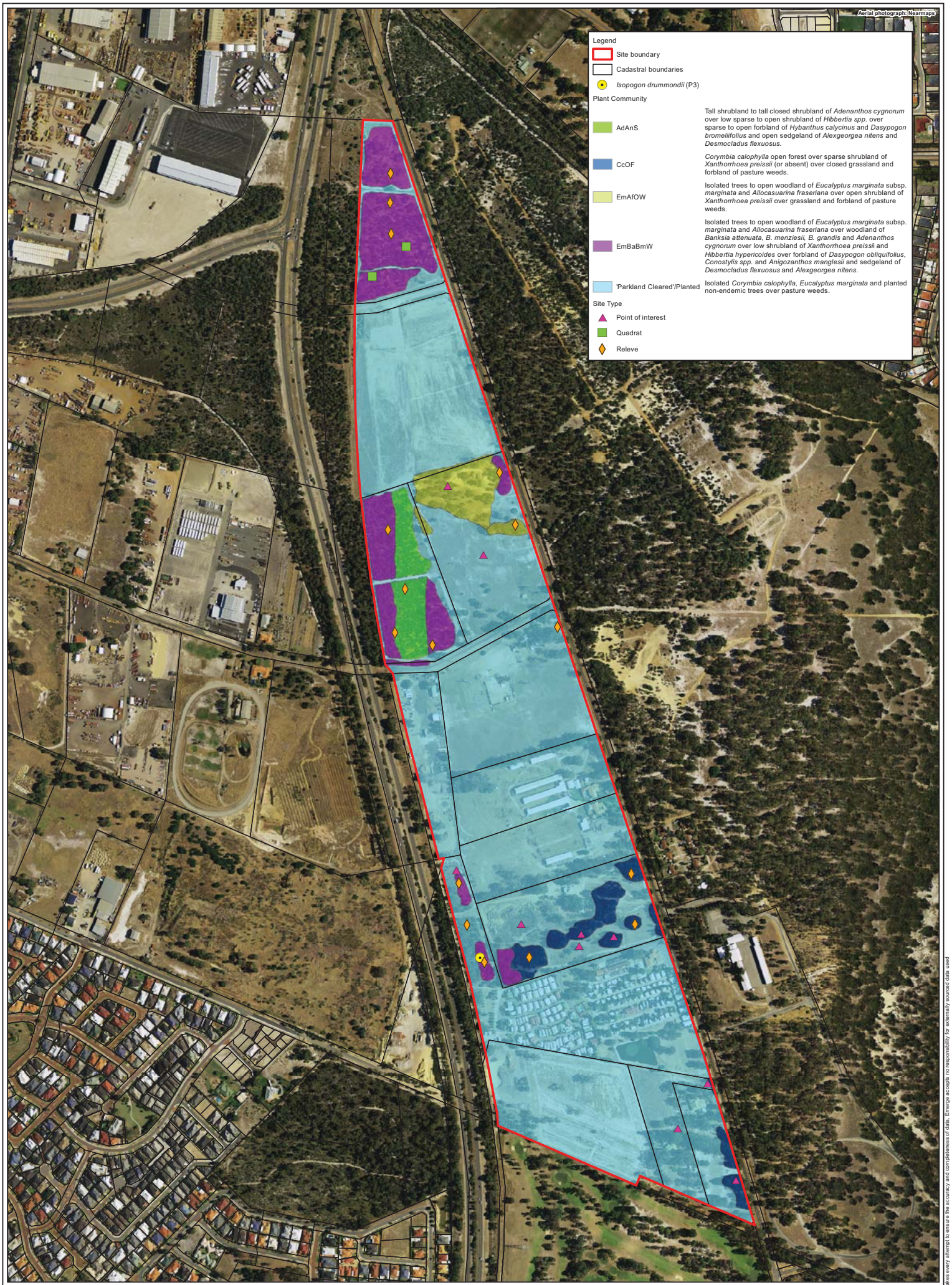


Figure 3: Plant Communities

Project: Level 1 Flora and Vegetation Assessment
Various Allotments Midland Road, Hazelmere

Client: Hazelmere Landowners Group

Plan Number: EP13-027(06)--F32	
Drawn: GRO	Date: 10/10/13
Approved: STT	Date: 24/10/13
Checked: SKP	Scale: 1:6,500@A3

0 62.5 125 250 Metres

emerge ASSOCIATES Integrated Science & Design

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used

Legend

- Study Area
- Tree >50cm DBH, no hollows seen
- Tree >50cm DBH, one or more hollows seen
- Tree >50cm DBH, one or more hollows possibly suitable for a Black Cockatoo
- Black Cockatoo Foraging Evidence

0 200 400

Meters

MGA Zone 50

Fauna Survey

DRAWN:G Harewood

DATE : Mar 2014

SCALE: 1:9,250

Hazelmere Precinct 9A

Field Observations

Figure: 4

APPENDIX A

CONSERVATION CATEGORIES

EPBC Act (1999) Threatened Fauna Categories

Category	Code	Description
Extinct	E	There is no reasonable doubt that the last member of the species has died.
*Extinct in the wild	EW	A species (a) is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
*Critically endangered	CE	A species is facing an extremely high risk of extinction in the wild in the immediate future.
*Endangered	EN	A species: (a) is not critically endangered; and (b) is facing a very high risk of extinction in the wild in the near future.
*Vulnerable	VU	A species (a) is not critically endangered or endangered; and (b) is facing a high risk of extinction in the wild in the medium-term future.
Conservation dependent	CD	A species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered
*Migratory	Migratory	(a) all migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and (c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Marine	Ma	Species in the list established under s248 of the EPBC Act

Note: Only species in those categories marked with an asterix are matters of national environmental significance under the *EPBC Act*.

Western Australian Wildlife Conservation Act (1950) Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct Threatened fauna (Schedule 1) are further ranked by the DEC according to their level of threat using IUCN Red List criteria: **CR: Critically Endangered** - considered to be facing an extremely high risk of extinction in the wild. **EN: Endangered** - considered to be facing a very high risk of extinction in the wild. **VU: Vulnerable** - considered to be facing a high risk of extinction in the wild.
Schedule 2	S2	Fauna which is presumed extinct
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction
Schedule 4	S4	Fauna that is otherwise in need of special protection

Western Australian DPaW Priority Fauna Categories

Category	Code	Description
Priority 1	P1	Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes..
Priority 2	P2	Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
Priority 3	P3	Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
Priority 4	P4	(a) **Rare**. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) **Near Threatened**. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Priority 5	P5	Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

IUCN Red List Threatened Species Categories

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or and as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing a high risk of extinction in the wild.
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

A full list of categories and their meanings are available at:

http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria

APPENDIX B

FAUNA OBSERVED OR POTENTIALLY IN STUDY AREA

Fauna Observed or Potentially in Region of Study Area

Hazelmere Precinct 9A, W.A.

Approximate centroid = 31.923754°S 116.018627°E

Compiled by Greg Harewood - December 2013

Recorded (Sighted/Heard/Signs/Captured) = X

A = Harewood, G. (2013). Fauna Assessmnt of Hazelmere Precinct 9A, Local Structure Plan. Unpublished report for Emerge Associates.

B = Turpin, J. and Bamford, M. (2009) Keane Road Strategic Link Armadale, Fauna Assessment. Unpublished report for the EnviroWorks Consulting.

C = ATA Environmental (2006) Vertebrate Fauna Assessment Brookdale Redevelopment Area. Unpublished report for the Armadale Redevelopment Authority.

D = ENV Australia (2005) Southern River Precinct 3 - Environmental Review. Unpublished report for the City of Gosnells.

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F = DPaW (2013). NatureMap Database search. “By Circle” 116°01' 08" E ,31°55' 27" S – Study area (plus 10 km buffer). 16 September 2013.

Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Osteichthyes								
Poeciliidae Livebearers								
Gambusia holbrooki	Mosquito Fish	Introduced					X	

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Amphibia								
Myobatrachidae Ground or Burrowing Frogs								
Crinia georgiana	Quacking Frog	LC			X			X
Crinia glauerti	Clicking Frog	LC			X	X	X	X
Crinia insignifera	Squelching Froglet	LC		X	X	X	X	X
Geocrinia leai	Ticking Frog	LC						X
Heleioporus eyrei	Moaning Frog	LC			X	X	X	X
Limnodynastes dorsalis	Western Banjo Frog	LC		X	X	X	X	X
Myobatrachus gouldii	Turtle Frog	LC					X	X
Pseudophryne guentheri	Crawling Toadlet	LC					X	X
Hylidae Tree or Water-Holding Frogs								
Litoria adelaidensis	Slender Tree Frog	LC		X	X	X	X	X
Litoria moorei	Motorbike Frog	LC			X	X		X
Reptilia								
Diplodactylidae Geckoes								
Strophurus spinigerus	Soft Spiny-tailed Gecko							X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Gekkonidae Geckoes								
Christinus marmoratus	Marbled Gecko				X			X
Pygopodidae Legless Lizards								
Aprasia repens	Sandplain Worm Lizard				X			X
Delma fraseri	Fraser's Legless Lizard					X	X	X
Delma grayii	Side-barred Delma						X	X
Lialis burtonis	Burton's Legless Lizard				X	X	X	X
Pletholax gracilis	Keeled Legless Lizard					X	X	X
Agamidae Dragon Lizards								
Pogona minor	Western Bearded Dragon					X	X	X
Varanidae Monitor's or Goanna's								
Varanus gouldii	Gould's Sand Monitor			X	X	X	X	X
Varanus rosenbergi	Heath Monitor				X			
Varanus tristis	Racehorse Monitor						X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Scincidae Skinks								
Acritoscincus trilineatum	Southwestern Cool Skink				X	X	X	
Cryptoblepharus buchananii	Fence Skink		X		X	X	X	X
Ctenotus australis	Western Ctenotus				X	X	X	X
Ctenotus fallens	West Coast Ctenotus						X	X
Ctenotus impar	Odd-striped Ctenotus						X	X
Ctenotus labillardieri	Red-legged Skink							X
Egernia kingii	King's Skink							X
Egernia napoleonis	Salmon-bellied Skink							X
Hemiergis quadrilineata	Two-toed Mulch Skink						X	X
Lerista elegans	West Coast Four-toed Lerista				X	X	X	X
Menetia greyii	Dwarf Skink				X	X	X	X
Morethia lineoocellata	West Coast Pale-flecked Morethia				X			X
Morethia obscura	Shrubland Pale-flecked Morethia				X			X
Tiliqua rugosa	Bobtail			X	X	X	X	X
Typhlopidae Blind Snakes								
Ramphotyphlops australis	Southern Blind Snake				X		X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Elapidae Elapid Snakes								
Elapognathus coronatus	Crowned Snake					X	X	X
Neelaps bimaculatus	Black-naped Snake						X	X
Notechis scutatus	Tiger Snake				X	X		X
Parasuta gouldii	Gould's Hooded Snake						X	X
Parasuta nigriceps	Black-backed Snake							X
Pseudonaja affinis	Dugite				X	X	X	X
Aves								
Phasianidae Quails, Pheasants								
Coturnix pectoralis	Stubble Quail	LC				X		
Coturnix ypsilophora	Brown Quail	LC			X			

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Anatidae Geese, Swans, Ducks								
Anas gracilis	Grey Teal	LC			X	X	X	X
Anas platyrhynchos	Mallard	Introduced				X		X
Anas rhynchotis	Australasian Shoveler	Bh LC					X	X
Anas superciliosa	Pacific Black Duck	LC		X	X	X	X	X
Biziura lobata	Musk Duck	Bh LC					X	X
Chenonetta jubata	Australian Wood Duck	LC	X	X	X	X	X	X
Cygnus atratus	Black Swan	LC					X	X
Tadorna tadornoides	Australian Shelduck	LC	X	X	X	X	X	X
Podicipedidae Grebes								
Tachybaptus novaehollandiae	Australasian Grebe	LC					X	X
Phalacrocoracidae Cormorants								
Phalacrocorax melanoleucos	Little Pied Cormorant	LC					X	
Phalacrocorax sulcirostris	Little Black Cormorant	LC					X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Ardeidae Herons, Egrets, Bitterns								
Ardea alba	Great Egret	S3 Mig CA JA					X	
Ardea garzetta	Little Egret	LC						
Ardea ibis	Cattle Egret	S3 Mig CA JA						X
Ardea novaehollandiae	White-faced Heron	LC			X	X	X	X
Ardea pacifica	White-necked Heron	LC			X	X		X
Threskiornithidae Ibises, Spoonbills								
Threskiornis molucca	Australian White Ibis	LC			X	X	X	X
Threskiornis spinicollis	Straw-necked Ibis	LC		X		X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Accipitridae Kites, Goshawks, Eagles, Harriers								
Accipiter cirrocephalus	Collared Sparrowhawk	Bp LC					X	X
Accipiter fasciatus	Brown Goshawk	Bp LC				X	X	X
Aquila audax	Wedge-tailed Eagle	Bp LC				X	X	X
Aquila morphnoides	Little Eagle	Bp LC	X				X	
Circus approximans	Swamp Harrier	LC						X
Circus assimilis	Spotted Harrier	LC						
Elanus caeruleus	Black-shouldered Kite	LC				X	X	X
Haliastur sphenurus	Whistling Kite	Bp LC			X			X
Hamirostra isura	Square-tailed Kite	Bp LC	X					
Falconidae Falcons								
Falco berigora	Brown Falcon	Bp LC			X		X	X
Falco cenchroides	Australian Kestrel	LC		X	X	X	X	X
Falco longipennis	Australian Hobby	LC						X
Falco peregrinus	Peregrine Falcon	S4 Bp LC						X
Rallidae Rails, Crakes, Swamphens, Coots								
Fulica atra	Eurasian Coot	LC					X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Charadriidae Lapwings, Plovers, Dotterels								
Charadrius melanops	Black-fronted Dotterel	LC					X	
Columbidae Pigeons, Doves								
Columba livia	Domestic Pigeon	Introduced				X		X
Ocyphaps lophotes	Crested Pigeon	LC	X	X	X	X	X	X
Phaps chalcoptera	Common Bronzewing	Bh LC	X	X	X	X	X	X
Streptopelia chinensis	Spotted Turtle-Dove	Introduced			X	X	X	X
Streptopelia senegalensis	Laughing Turtle-Dove	Introduced	X	X	X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Psittacidae Parrots								
Cacatua roseicapilla	Galah	LC	X	X	X	X	X	X
Cacatua sanguinea	Little Corella	LC	X			X		X
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	S1 VU Be VU A2c+3c+4c	X		X	X		X
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	S1 VU Bp VU C2a(ii)	X					X
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	S1 EN Bp EN A2bcde+3bc	X		X	X	X	X
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	LC						X
Neophema elegans	Elegant Parrot	LC			X		X	X
Platycercus icterotis icterotis	Western Rosella (western ssp)	Bp LC						X
Platycercus spurius	Red-capped Parrot	LC	X	X	X	X	X	X
Platycercus zonarius semitorquatus	Australian Ringneck Parrot	LC	X	X	X	X	X	X
Polytelis anthopeplus	Regent Parrot	LC			X			X
Trichoglossus haematodus	Rainbow Lorikeet	Introduced		X	X	X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Cuculidae Parasitic Cuckoos								
Cacomantis flabelliformis	Fan-tailed Cuckoo	LC			X			X
Chrysococcyx basalis	Horsfield's Bronze Cuckoo	LC		X	X	X	X	X
Chrysococcyx lucidus	Shining Bronze Cuckoo	LC		X	X	X	X	X
Cuculus pallidus	Pallid Cuckoo	LC	X	X			X	
Strigidae Hawk Owls								
Ninox novaeseelandiae	Boobook Owl	LC			X			X
Tytonidae Barn Owls								
Tyto alba	Barn Owl	LC			X			X
Podargidae Frogmouths								
Podargus strigoides	Tawny Frogmouth	LC			X			X
Aegothelidae Owlet-nightjars								
Aegotheles cristatus	Australian Owlet-nightjar	LC						X
Halcyonidae Tree Kingfishers								
Dacelo novaeguineae	Laughing Kookaburra	Introduced	X		X	X	X	X
Todiramphus sanctus	Sacred Kingfisher	LC			X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Meropidae Bee-eaters								
Merops ornatus	Rainbow Bee-eater	S3 Mig JA LC			X	X	X	X
Maluridae Fairy Wrens, GrassWrens								
Malurus splendens	Splendid Fairy-wren	Bh LC	X	X	X	X	X	X
Acanthizidae Thornbills, Geryones, Fieldwrens & Whitefaces								
Acanthiza apicalis	Broad-tailed Thornbill	Bh LC		X	X	X	X	X
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Bh LC	X	X	X	X	X	X
Acanthiza inornata	Western Thornbill	Bh LC						X
Gerygone fusca	Western Gerygone	LC	X	X	X	X	X	X
Sericornis frontalis	White-browed Scrubwren	Bh LC		X	X	X		X
Smicrornis brevirostris	Weebill	Bh LC	X	X	X			X
Pardalotidae Pardalotes								
Pardalotus punctatus	Spotted Pardalote	LC					X	X
Pardalotus striatus	Striated Pardalote	LC	X		X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Meliphagidae Honeyeaters, Chats								
Acanthorhynchus superciliosus	Western Spinebill	LC		X		X	X	X
Anthochaera carunculata	Red Wattlebird	LC	X	X	X	X	X	X
Anthochaera lunulata	Western Little Wattlebird	Bp LC	X	X	X	X	X	X
Epthianura albifrons	White-fronted Chat	LC					X	X
Lichenostomus virescens	Singing Honeyeater	LC	X	X	X	X	X	
Lichmera indistincta	Brown Honeyeater	LC	X	X	X	X	X	X
Manorina flavigula	Yellow-throated Miner	LC						X
Phylidonyris melanops	Tawny-crowned Honeyeater	Bp LC		X			X	
Phylidonyris nigra	White-cheeked Honeyeater	Bp LC		X		X	X	
Phylidonyris novaehollandiae	New Holland Honeyeater	Bp LC	X	X		X	X	X
Petroicidae Australian Robins								
Microeca fascinans	Jacky Winter	LC						X
Petroica goodenovii	Red-capped Robin	LC		X		X	X	X
Petroica multicolor	Scarlet Robin	Bh LC			X			X
Neosittidae Sitellas								
Daphoenositta chrysoptera	Varied Sittella	Bh LC					X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Pachycephalidae Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers								
Colluricincla harmonica	Grey Shrike-thrush	Bh LC		X	X	X		X
Pachycephala pectoralis	Golden Whistler	Bh LC		X			X	X
Pachycephala rufiventris	Rufous Whistler	LC	X	X	X	X	X	X
Dicruridae Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo								
Grallina cyanoleuca	Magpie-lark	LC	X	X	X	X	X	X
Rhipidura fuliginosa	Grey Fantail	LC		X	X	X	X	X
Rhipidura leucophrys	Willie Wagtail	LC	X	X	X	X	X	X
Campephagidae Cuckoo-shrikes, Trillers								
Coracina novaehollandiae	Black-faced Cuckoo-shrike	LC	X	X	X	X	X	X
Lalage tricolor	White-winged Triller	LC			X	X	X	X
Artamidae Woodswallows, Butcherbirds, Currawongs								
Artamus cinereus	Black-faced Woodswallow	Bp LC				X	X	X
Artamus cyanopterus	Dusky Woodswallow	Bp LC					X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Cracticidae Currawongs, Magpies & Butcherbirds								
Cracticus tibicen	Australian Magpie	LC	X	X	X	X	X	X
Cracticus torquatus	Grey Butcherbird	LC	X	X	X	X	X	X
Corvidae Ravens, Crows								
Corvus coronoides	Australian Raven	LC	X	X	X	X	X	X
Motacillidae Old World Pipits, Wagtails								
Anthus australis	Australian Pipit	LC	X	X	X		X	
Dicaeidae Flowerpeckers								
Dicaeum hirundinaceum	Mistletoebird	LC			X		X	X
Hirundinidae Swallows, Martins								
Hirundo ariel	Fairy Martin	LC					X	X
Hirundo neoxena	Welcome Swallow	LC	X		X	X	X	X
Hirundo nigricans	Tree Martin	LC		X	X	X	X	X
Sylviidae Old World Warblers								
Cincloramphus cruralis	Brown Songlark	LC					X	X
Cincloramphus mathewsi	Rufous Songlark	LC					X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Zosteropidae White-eyes								
Zosterops lateralis	Grey-breasted White-eye	LC	X	X	X	X	X	X
Mammalia								
Peramelidae Bandicoots								
Isoodon obesulus fusciventer	Southern Brown Bandicoot	P5 LC		X	X	X	X	X
Phalangeridae Brushtail Possums, Cuscuses								
Trichosurus vulpecula	Common Brushtail Possum	LC			X			X
Burramyidae Pygmy Possums								
Cercartetus concinnus	Western Pygmy-possum	LC						X
Tarsipedidae Honey Possum								
Tarsipes rostratus	Honey Possum, Noolbenger	LC						X
Macropodidae Kangaroos, Wallabies								
Macropus fuliginosus	Western Grey Kangaroo	LC	X	X		X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Molossidae Freetail Bats								
Mormopterus planiceps	Southern Freetail-bat	LC						
Tadarida australis	White-striped Freetail-bat	LC						X
Vespertilionidae Ordinary Bats								
Chalinolobus gouldii	Gould's Wattled Bat	LC			X			X
Chalinolobus morio	Chocolate Wattled Bat	LC						X
Nyctophilus geoffroyi	Lesser Long-eared Bat	LC			X			X
Nyctophilus gouldi	Gould's Long-eared Bat	LC						
Nyctophilus major	Western Long-eared Bat	LC						
Vespadelus regulus	Southern Forest Bat	LC						X
Muridae Rats, Mice								
Mus musculus	House Mouse	Introduced			X	X	X	X
Rattus rattus	Black Rat	Introduced			X		X	X
Canidae Dogs, Foxes								
Canis lupus familiaris	Dog	Introduced		X	X			X
Vulpes vulpes	Red Fox	Introduced	X	X	X	X	X	

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Felidae Cats								
Felis catus	Cat	Introduced		X	X	X		X
Leporidae Rabbits, Hares								
Oryctolagus cuniculus	Rabbit	Introduced	X	X	X	X	X	X

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APPENDIX C

DPaW & EPBC DATABASE SEARCH RESULTS

NatureMap
Mapping Western Australia's biodiversity

NatureMap - Hazelmere - Invertebrates

Created By Greg Harewood on 16/09/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Invertebrates
Method 'By Circle'
Centre 116°01' 08" E,31°55' 27" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	-13157	*Acroaspis olorina*			Y
2.	-13292	*Aganippe cupulifex*			Y
3.	-12082	*Akamptogonus novarae*			
4.	-11863	*Allothereua maculata*			
5.	-13079	*Ambicodamus kochi*			
6.	-12132	*Amblyomma albolimbatum*			
7.	-12532	*Amblyomma triguttatum*			
8.	-12196	*Aname mainae*			
9.	-13038	*Aname tepperi*			
10.	-12101	*Antichiropus variabilis*			
11.	-12533	*Aponomma fimbriatum*			
12.	-13382	*Araneus cyphoxis*			
13.	-12612	*Araneus eburneiventris*			
14.	-12581	*Araneus ginninderranus*			
15.	-12899	*Araneus senicaudatus*			
16.	-1751	*Argiope protensa*			
17.	-13324	*Argiope trifasciata*			
18.	-11630	*Artoria flavimana*			
19.	-12620	*Artoria linnaei*			
20.	-11840	*Artoriopsis eccentrica*			
21.	-11720	*Artoriopsis expolita*			
22.	-12249	*Artoriopsis joergi*			
23.	-11836	*Austracantha minax*			
24.	-11817	*Australomimetus aurioculatus*			
25.	-11939	*Australomimetus ovidi*			
26.	33972	*Austromerope poultoni (scorpionfly)*		P2	
27.	-11600	*Backobourkia brounii*			
28.	-13261	*Backobourkia heroine*			
29.	-13133	*Badumna insignis*			
30.	-12823	*Ballarra longipalpus*			
31.	-11681	*Celaenia excavata*			
32.	-1746	*Cercophonius granulosus*			
33.	-12810	*Cercophonius sulcatus*			
34.	-11616	*Ceryerda cursitans*			
35.	-12199	*Cethegus fugax*			
36.	33939	*Cherax cainii (Marron)*			
37.	-1758	*Cormocephalus aurantiipes*			
38.	-13272	*Cormocephalus rubriceps*			
39.	-1683	*Cormocephalus strigosus*			
40.	-1711	*Cormocephalus turneri*			
41.	-13029	*Cryptoerithus quobba*			
42.	-13332	*Cyclosa trilobata*			
43.	-11830	*Cyrtophora parnasia*			
44.	-12773	*Delena cancerides*			
45.	-13355	*Dingosa murata*			
46.	-13283	*Dingosa serrata*			
47.	-11742	*Dinocambala ingens*			
48.	-12113	*Eodelena lapidicola*			
49.	-13140	*Erigone prominens*			
50.	-12821	*Eriophora biapicata*			
51.	-12115	*Eriophora pustulosa*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.	-12122	*Eucyrtops latior*			
53.	-12332	*Eupograpta kottae*			
54.	-13380	*Gea theridioides*			
55.	-12435	*Hemicloea sublimbata*			
56.	-12692	*Heurodes turritus*			
57.	-12558	*Hoggicosa storri*			
58.	-13118	*Hogna crispipes*			
59.	-11890	*Hogna immansueta*			
60.	-12321	*Hogna kuyani*			
61.	-12225	*Holasteron perth*			
62.	-12255	*Holasteron wamuseum*			Y
63.	-12793	*Holconia westralia*			
64.	-12938	*Holocnemus pluchei*			
65.	-13273	*Idiommata blackwalli*			
66.	-12117	*Idiosoma sigillatum*			
67.	-1666	*Isometroides vescus*			
68.	-12192	*Isopeda leishmanni*			
69.	-13034	*Isopeda magna*			
70.	-12112	*Isopedella cana*			
71.	-12111	*Isopedella tindalei*			
72.	-12097	*Karaops ellenae*			
73.	-11966	*Lactrodectus hasseltii*			
74.	-1712	*Lampona cylindrata*			
75.	-12414	*Lampona yanchep*			
76.	-12644	*Lycidas chlorophthalmus*			
77.	-12809	*Lycosa ariadnae*			
78.	-13043	*Lycosa godeffroyi*			
79.	-12684	*Masasteron maini*			
80.	-12224	*Masasteron mas*			
81.	-13329	*Missulena granulosa subsp. granulosa*			
82.	-12846	*Missulena granulosa subsp. hoggi*			
83.	-12829	*Missulena occatoria*			
84.	-12540	*Mituliodon tarantulinus*			
85.	-12103	*Myandra bicincta*			
86.	-13072	*Myandra cambridgei*			
87.	-1644	*Nicodamus mainae*			
88.	-12167	*Notiasemus glauerti*			
89.	-12918	*Novakiella trituberculosa*			
90.	-12530	*Nunciella aspera*			
91.	-12547	*Occiperipatoides gilesii*			
92.	-1668	*Ocrisiona leucocomis*			
93.	-12646	*Oecobius navus*			
94.	-12391	*Ommatoiulus moreletii*			
95.	-12515	*Orphnaeus brevilabiatus*			
96.	-12817	*Ostearius melanopygius*			
97.	-11755	*Oxyopes gracilipes*			
98.	-12254	*Oxyopes punctatus*			
99.	-11918	*Paralampona marangaroo*			
100.	-12109	*Pediana occidentalis*			
101.	-13030	*Pentasteron securifer*			
102.	-11878	*Pholcus phalangioides*			
103.	-12596	*Phryganoporus candidus*			
104.	-12520	*Pinkfloydia harveii*			
105.	-12205	*Raveniella cirrata*			
106.	-11693	*Raveniella peckorum*			
107.	-13319	*Sandalodes joannae*			
108.	-12172	*Sandalodes superbus*			
109.	-1669	*Scolopendra laeta*			
110.	-11934	*Servaea melaina*			
111.	-12036	*Servaea spinibarbis*			
112.	-13381	*Smeringopus natalensis*			
113.	-11802	*Steatoda grossa*			
114.	-12390	*Supunna funerea*			
115.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
116.	-12251	*Synothele durokoppin*			
117.	-11691	*Synothele michaelseni*			
118.	-12635	*Synsphyronus magnus*			
119.	-11618	*Tamopsis darlingtoniana*			
120.	-11615	*Tamopsis perthensis*			
121.	-13279	*Tasmanicosa leuckartii*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
122.	-13069	*Tetragnatha demissa*			
123.	-13412	*Tetragnatha luteocincta*			Y
124.	-12610	*Trachycosmus sculptilis*			
125.	-12787	*Trachyspina mundaring*			
126.	-13162	*Trichocyclus balladong*			
127.	-11695	*Trichocyclus nullarbor*			
128.	-1670	*Urodacus armatus*			
129.	-12778	*Urodacus novaehollandiae*			
130.	-12796	*Urodacus planimanus*			
131.	-11721	*Venator immansueta*			
132.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		P4	
133.	-11716	*Westrarchaea spinosa*			
134.	-12244	*Withius piger*			
135.	-12197	*Zachria flavicoma*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

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NatureMap
Mapping Western Australia's biodiversity

NatureMap - Hazelmere - Fish

Created By Greg Harewood on 16/09/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Fish
Method 'By Circle'
Centre 116°01' 08" E,31°55' 27" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	-16445	*Acentrogobius bifrenatus*			
2.	-14503	*Aldrichetta forsteri*			
3.	-15781	*Amniataba caudavittata*			
4.	-14684	*Atherinosoma wallacei*			
5.	-15743	*Carassius auratus*			
6.	-16819	*Carcharhinus leucas*			
7.	-14792	*Engraulis australis*			
8.	-15804	*Favonigobius sp.*			
9.	34028	*Galaxias occidentalis (Western Minnow)*			
10.	34030	*Geotria australis (Pouched Lamprey)*		P1	
11.	-14675	*Mugil cephalus*			
12.	-15745	*Neatypus obliquus*			
13.	-15572	*Papillogobius punctatus*			
14.	-13839	*Rhabdosargus sarba*			

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NatureMap
Mapping Western Australia's biodiversity

NatureMap - Hazelmere - Frogs

Created By Greg Harewood on 16/09/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Amphibians
Method 'By Circle'
Centre 116°01' 08" E,31°55' 27" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25400	*Crinia insignifera (Squelching Froglet)*			
4.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
5.	25404	*Geocrinia leai (Ticking Frog)*			
6.	25408	*Heleioporus albopunctatus (Western Spotted Frog)*			
7.	25409	*Heleioporus barycragus (Hooting Frog)*			
8.	25410	*Heleioporus eyrei (Moaning Frog)*			
9.	25412	*Heleioporus psammophilus (Sand Frog)*			
10.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
11.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
12.	25388	*Litoria moorei (Motorbike Frog)*			
13.	25420	*Myobatrachus gouldii (Turtle Frog)*			
14.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
15.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			

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NatureMap
Mapping Western Australia's biodiversity

NatureMap - Hazelmere - Reptiles

Created By Greg Harewood on 16/09/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Reptiles
Method 'By Circle'
Centre 116°01' 08" E,31°55' 27" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	42368	*Acritoscincus trilineatus*			
2.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
3.	24990	*Aprasia pulchella*			
4.	24991	*Aprasia repens*			
5.	42380	*Brachyurophis fasciolatus subsp. fasciolatus*			
6.	42381	*Brachyurophis semifasciatus*			
7.	25337	*Chelodina oblonga (Oblong Turtle)*			
8.	24980	*Christinus marmoratus (Marbled Gecko)*			
9.	24918	*Crenadactylus ocellatus subsp. ocellatus (Clawless Gecko)*			
10.	30893	*Cryptoblepharus buchananii*			
11.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
12.	25027	*Ctenotus australis*			
13.	25035	*Ctenotus delli (Darling Range Heath Ctenotus, skink)*		P4	
14.	25039	*Ctenotus fallens*			
15.	25047	*Ctenotus impar*			
16.	25049	*Ctenotus labillardieri*			
17.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
18.	24999	*Delma grayii*			
19.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
20.	24929	*Diplodactylus granariensis subsp. granariensis*			
21.	24939	*Diplodactylus polyophthalmus*			
22.	24940	*Diplodactylus pulcher*			
23.	25251	*Echiopsis curta (Bardick)*			
24.	25096	*Egernia kingii (King's Skink)*			
25.	25100	*Egernia napoleonis*			
26.	25250	*Elapognathus coronatus (Crowned Snake)*			
27.	24959	*Gehyra variegata*			
28.	25232	*Hemidactylus frenatus (Asian House Gecko)*	Y		
29.	25115	*Hemiergis initialis subsp. initialis*			
30.	25119	*Hemiergis quadrilineata*			
31.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
32.	25131	*Lerista distinguenda*			
33.	25133	*Lerista elegans*			
34.	25148	*Lerista lineopunctulata*			
35.	25165	*Lerista praepedita*			
36.	25005	*Lialis burtonis*			
37.	25184	*Menetia greyii*			
38.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*		S	
39.	25192	*Morethia obscura*			
40.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
41.	25249	*Neelaps calonotos (Black-striped Snake)*		P3	
42.	25252	*Notechis scutatus (Tiger Snake)*			
43.	25253	*Parasuta gouldii*			
44.	25255	*Parasuta nigriceps*			
45.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
46.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
47.	25261	*Pseudechis australis (Mulga Snake)*			
48.	25345	*Pseudemydura umbrina (Western Swamp Turtle, tortoise)*		T	
49.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
50.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
51.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.	25271	*Ramphotyphlops australis*			
53.	25273	*Ramphotyphlops bituberculatus*			
54.	25312	*Ramphotyphlops braminus*	Y		
55.	25285	*Ramphotyphlops pinguis*			
56.	25288	*Ramphotyphlops waitii*			
57.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
58.	24943	*Strophurus spinigerus subsp. inornatus*			
59.	24942	*Strophurus spinigerus subsp. spinigerus*			
60.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
61.	25519	*Tiliqua rugosa*			
62.	25207	*Tiliqua rugosa subsp. rugosa*			
63.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
64.	25526	*Varanus tristis (Racehorse Monitor)*			

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NatureMap
Mapping Western Australia's biodiversity

NatureMap - Hazelmere - Birds

Created By Greg Harewood on 16/09/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Birds
Method 'By Circle'
Centre 116°01' 08" E,31°55' 27" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
5.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
6.	24281	*Accipiter cirrocephalus subsp. cirrocephalus (Collared Sparrowhawk)*			
7.	25536	*Accipiter fasciatus (Brown Goshawk)*			
8.	24283	*Accipiter fasciatus subsp. didimus (Brown Goshawk)*			
9.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
10.	25751	*Acridotheres tristis (Common Myna)*	Y		Y
11.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
12.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
13.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
14.	24310	*Anas castanea (Chestnut Teal)*			
15.	24312	*Anas gracilis (Grey Teal)*			
16.	24313	*Anas platyrhynchos (Mallard)*			
17.	24315	*Anas rhynchotis (Australasian Shoveler)*			
18.	24316	*Anas superciliosa (Pacific Black Duck)*			
19.	24332	*Anhinga melanogaster subsp. novaehollandiae (Darter)*			
20.	24506	*Anous tenuirostris subsp. melanops (Australian Lesser Noddy)*		T	
21.	24561	*Anthochaera carunculata (Red Wattlebird)*			
22.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
23.	24719	*Aprosmictus erythropterus (Red-winged Parrot)*			
24.	25554	*Apus pacificus (Fork-tailed Swift)*		IA	
25.	24285	*Aquila audax (Wedge-tailed Eagle)*			
26.	25558	*Ardea ibis (Cattle Egret)*		IA	
27.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
28.	24340	*Ardea novaehollandiae (White-faced Heron)*			
29.	24341	*Ardea pacifica (White-necked Heron)*			
30.	24610	*Ardeotis australis (Australian Bustard)*		P4	
31.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
32.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
33.	25567	*Artamus leucorynchus (White-breasted Woodswallow)*			
34.	24356	*Artamus personatus (Masked Woodswallow)*			
35.	24318	*Aythya australis (Hardhead)*			
36.	24319	*Biziura lobata (Musk Duck)*			
37.	24345	*Botaurus poiciloptilus (Australasian Bittern)*		T	
38.	24359	*Burhinus grallarius (Bush Stone-curlew)*		P4	
39.	25713	*Cacatua galerita (Sulphur-crested Cockatoo)*			
40.	24721	*Cacatua galerita subsp. galerita (Sulphur-crested Cockatoo)*	Y		
41.	24722	*Cacatua leadbeateri (Major Mitchell's Cockatoo)*		S	
42.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
43.	24723	*Cacatua pastinator subsp. butleri (Butler's Corella)*			
44.	24724	*Cacatua pastinator subsp. pastinator (Muir's Corella, Muir's Corella (Western Corella SW WA))*		S	
45.	25715	*Cacatua roseicapilla (Galah)*			
46.	25716	*Cacatua sanguinea (Little Corella)*			
47.	24727	*Cacatua sanguinea subsp. westralensis (Little Corella)*			
48.	-13680	*Cacatua sulphurea subsp. galerita*			Y
49.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
50.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
51.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
52.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
53.	24789	*Calidris subminuta (Long-toed Stint)*		IA	
54.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
55.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
56.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo (long-billed black-cockatoo), Baudin's Cockatoo)*		T	
57.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
58.	25625	*Carduelis carduelis (Goldfinch, European Goldfinch)*	Y		
59.	24480	*Carduelis carduelis subsp. britannica (Goldfinch)*	Y		
60.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
61.	24378	*Charadrius veredus (Oriental Plover)*		IA	
62.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
63.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
64.	24432	*Chrysococcyx lucidus subsp. plagosus (Shining Bronze Cuckoo)*			
65.	24833	*Cincloramphus cruralis (Brown Songlark)*			
66.	24288	*Circus approximans (Swamp Harrier)*			
67.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
68.	24396	*Climacteris rufa (Rufous Treecreeper)*			
69.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
70.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
71.	24399	*Columba livia (Domestic Pigeon)*	Y		
72.	24361	*Coracina maxima (Ground Cuckoo-shrike)*			
73.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
74.	25592	*Corvus coronoides (Australian Raven)*			
75.	25593	*Corvus orru (Torresian Crow)*			
76.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
77.	25595	*Cracticus tibicen (Australian Magpie)*			
78.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
79.	25596	*Cracticus torquatus (Grey Butcherbird)*			
80.	-13635	*Cyanorhamphus auriceps*			Y
81.	24322	*Cygnus atratus (Black Swan)*			
82.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
83.	30902	*Dacelo novaeguineae subsp. novaeguineae (Laughing Kookaburra)*	Y		
84.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
85.	24606	*Daphoenositta chrysoptera subsp. pileata (Varied Sittella, Black-capped Sitella)*			
86.	24325	*Dendrocygna eytoni (Plumed Whistling Duck)*			
87.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
88.	24470	*Dromaius novaehollandiae (Emu)*			
89.	24290	*Elanus caeruleus subsp. axillaris (Australian Black-shouldered Kite)*			
90.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
91.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
92.	24567	*Epthianura albifrons (White-fronted Chat)*			
93.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
94.	25591	*Eurystomus orientalis (Dollarbird)*			
95.	25621	*Falco berigora (Brown Falcon)*			
96.	24471	*Falco berigora subsp. berigora (Brown Falcon)*			
97.	25622	*Falco cenchroides (Australian Kestrel)*			
98.	24472	*Falco cenchroides subsp. cenchroides (Australian Kestrel)*			
99.	25623	*Falco longipennis (Australian Hobby)*			
100.	24474	*Falco longipennis subsp. longipennis (Australian Hobby)*			
101.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
102.	24475	*Falco peregrinus subsp. macropus (Australian Peregrine Falcon)*		S	
103.	24476	*Falco subniger (Black Falcon)*			
104.	25727	*Fulica atra (Eurasian Coot)*			
105.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
106.	24764	*Gallinula ventralis (Black-tailed Native-hen)*			
107.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
108.	24401	*Geopelia cuneata (Diamond Dove)*			
109.	25585	*Geopelia striata (Zebra Dove)*			
110.	25530	*Gerygone fusca (Western Gerygone)*			
111.	24735	*Glossopsitta porphyrocephala (Purple-crowned Lorikeet)*			
112.	-13470	*Gracula religiosa*			
113.	24443	*Grallina cyanoleuca (Magpie-lark)*			
114.	24484	*Grus rubicunda (Brolga)*			
115.	24295	*Haliastur sphenurus (Whistling Kite)*			
116.	24689	*Halobaena caerulea (Blue Petrel)*			
117.	24297	*Hamirostra melanosternon (Black-breasted Buzzard)*			
118.	25734	*Himantopus himantopus (Black-winged Stilt)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
119.	24489	*Hirundo ariel (Fairy Martin)*			
120.	24491	*Hirundo neoxena (Welcome Swallow)*			
121.	25629	*Hirundo nigricans (Tree Martin)*			
122.	24492	*Hirundo nigricans subsp. nigricans (Tree Martin)*			
123.	24347	*Ixobrychus flavicollis subsp. australis (Australian Black Bittern)*		P3	
124.	24348	*Ixobrychus minutus subsp. dubius (Australian Little Bittern)*		P4	
125.	24367	*Lalage tricolor (White-winged Triller)*			
126.	25661	*Lichmera indistincta (Brown Honeyeater)*			
127.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
128.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
129.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
130.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
131.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
132.	25654	*Malurus splendens (Splendid Fairy-wren)*			
133.	24552	*Malurus splendens subsp. splendens (Splendid Fairy-wren)*			
134.	24583	*Manorina flavigula (Yellow-throated Miner)*			
135.	25758	*Megalurus gramineus (Little Grassbird)*			
136.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
137.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
138.	25693	*Microeca fascinans (Jacky Winter)*			
139.	25542	*Milvus migrans (Black Kite)*			
140.	25545	*Mirafra javanica (Horsfield's Bushlark, Singing Bushlark)*			
141.	25610	*Myiagra inquieta (Restless Flycatcher)*			
142.	25686	*Neochmia temporalis (Red-browed Finch)*	Y		
143.	24738	*Neophema elegans (Elegant Parrot)*			
144.	-13724	*Neophema pulchella*			
145.	24327	*Nettapus pulchellus (Green Pygmy-goose)*			
146.	25747	*Ninox connivens (Barking Owl)*			
147.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
148.	24820	*Ninox novaeseelandiae subsp. boobook (Boobook Owl)*			
149.	24799	*Numenius minutus (Little Curlew)*		IA	
150.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
151.	24350	*Nycticorax caledonicus subsp. hilli (Rufous Night Heron)*			
152.	24742	*Nymphicus hollandicus (Cockatiel)*			
153.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
154.	24328	*Oxyura australis (Blue-billed Duck)*			
155.	25679	*Pachycephala pectoralis (Golden Whistler)*			
156.	24623	*Pachycephala pectoralis subsp. fuliginosa (Golden Whistler)*			
157.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
158.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
159.	24693	*Pachyptila desolata (Antarctic Prion)*			
160.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
161.	24625	*Pardalotus punctatus subsp. punctatus (Spotted Pardalote)*			
162.	25682	*Pardalotus striatus (Striated Pardalote)*			
163.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			
164.	25687	*Passer domesticus (House Sparrow)*	Y		
165.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
166.	24659	*Petroica goodenovii (Red-capped Robin)*			
167.	25695	*Petroica multicolor (Scarlet Robin)*			
168.	24660	*Petroica multicolor subsp. campbelli (Scarlet Robin)*			
169.	25697	*Phalacrocorax carbo (Great Cormorant)*			
170.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
171.	25699	*Phalacrocorax varius (Pied Cormorant)*			
172.	24409	*Phaps chalcoptera (Common Bronzewing)*			
173.	25587	*Phaps elegans (Brush Bronzewing)*			
174.	25668	*Philemon citreogularis (Little Friarbird)*			
175.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
176.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
177.	-13740	*Platycercus elegans*			
178.	25720	*Platycercus icterotis (Western Rosella)*			
179.	24747	*Platycercus spurius (Red-capped Parrot)*			
180.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
181.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
182.	25703	*Podargus strigoides (Tawny Frogmouth)*			
183.	24679	*Podargus strigoides subsp. brachypterus (Tawny Frogmouth)*			
184.	24680	*Podiceps cristatus subsp. australis (Great Crested Grebe)*			
185.	24643	*Poephila acuticauda (Long-tailed Finch)*			
186.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
187.	25722	*Polytelis anthopeplus (Regent Parrot)*			
188.	25706	*Pomatostomus temporalis (Grey-crowned Babbler)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
189.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
190.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
191.	24769	*Porzana fluminea (Australian Spotted Crake)*			
192.	25732	*Porzana pusilla (Baillon's Crake)*			
193.	24771	*Porzana tabuensis (Spotless Crake)*			
194.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
195.	24452	*Rhipidura fuliginosa subsp. preissi (Grey Fantail)*			
196.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
197.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
198.	30948	*Smicrornis brevirostris (Weebill)*			
199.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
200.	24525	*Sterna fuscata subsp. nubilosa (Sooty Tern)*			
201.	24482	*Stiltia isabella (Australian Pratincole)*			
202.	25655	*Stipiturus malachurus (Southern Emu-wren)*			
203.	25597	*Strepera versicolor (Grey Currawong)*			
204.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
205.	30951	*Streptopelia chinensis subsp. tigrina (Spotted Turtle-Dove)*	Y		
206.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
207.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
208.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
209.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
210.	30872	*Taeniopygia bichenovii (Double-barred Finch)*			
211.	30870	*Taeniopygia guttata (Zebra Finch)*			
212.	24844	*Threskiornis molucca (Australian White Ibis)*			
213.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
214.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
215.	24309	*Todiramphus sanctus subsp. sanctus (Sacred Kingfisher)*			
216.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
217.	24754	*Trichoglossus haematodus subsp. rubritorquis (Red-collared Lorikeet)*			
218.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
219.	24808	*Tringa nebularia (Common Greenshank)*		IA	
220.	24809	*Tringa stagnatilis (Marsh Sandpiper)*		IA	
221.	24849	*Turnix varia subsp. varia (Painted Button-quail)*			
222.	24851	*Turnix velox (Little Button-quail)*			
223.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
224.	25577	*Vanellus miles (Masked Lapwing)*			
225.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
226.	24856	*Zosterops lateralis subsp. gouldi (Grey-breasted White-eye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap - Hazelmere - Mammals

Created By Greg Harewood on 16/09/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Mammals
Method 'By Circle'
Centre 116°01' 08" E,31°55' 27" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	24088	*Antechinus flavipes subsp. leucogaster (Yellow-footed Antechinus, Mardo)*			
2.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
3.	25454	*Canis lupus*			
4.	30883	*Canis lupus subsp. familiaris (Dog)*	Y		
5.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
6.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
7.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
8.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
9.	24258	*Equus caballus (Horse)*	Y		
10.	24041	*Felis catus (Cat)*	Y		
11.	30916	*Funambulus pennanti (Indian Palm Squirrel)*	Y		
12.	24215	*Hydromys chrysogaster (Water-rat)*		P4	
13.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P5	
14.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
15.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
16.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
17.	24135	*Macropus robustus subsp. erubescens (Euro, Biggada)*			
18.	24223	*Mus musculus (House Mouse)*	Y		
19.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
20.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
21.	34016	*Ovis aries (Sheep)*			
22.	24099	*Phascogale tapoatafa subsp. tapoatafa (Southern Brush-tailed Phascogale, Wambenger)*		T	
23.	24166	*Pseudocheirus occidentalis (Western Ringtail Possum)*		T	
24.	24243	*Rattus fuscipes (Western Bush Rat)*			
25.	24245	*Rattus rattus (Black Rat)*	Y		
26.	24259	*Sus scrofa (Pig)*	Y		
27.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
28.	24185	*Tadarida australis (White-striped Freetail-bat)*			
29.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
30.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
31.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
32.	24206	*Vespadelus regulus (Southern Forest Bat)*			

Conservation Codes
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S - Other specially protected fauna
1 - Priority 1
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3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

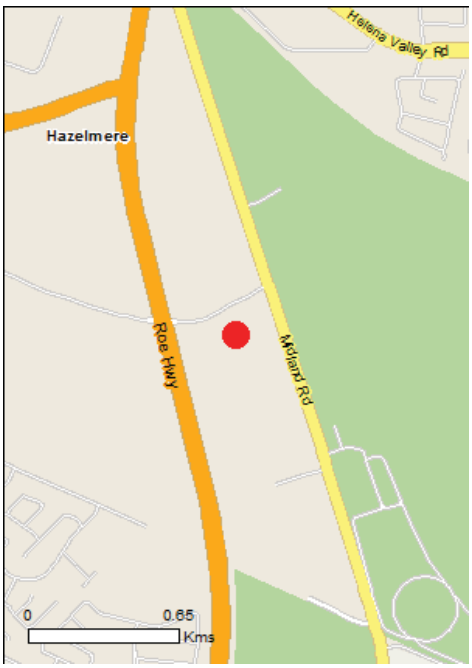
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 16/09/13 21:09:23

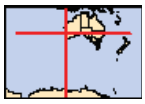
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	20
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	1
State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	35
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii		
Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area
Calytrix breviseta subsp. breviseta		
Swamp Starflower [23879]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat likely to occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat may occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Thelymitra manginii K.Dixon & Batty ms. [67443]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area
Villarsia calthifolia Mountain Villarsia [10886]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Midgegooroo and Kalleep Munday Heritage Precincts	WA	Indicative Place

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Feral deer		
Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii		
Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus		
House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus		
Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia		
Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides		
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica		
Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera		
Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera		
Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes		
Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia		
Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana		
Broom [67538]		Species or species habitat may occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area

Coordinates

-31.92433 116.01886

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

APPENDIX D

BLACK COCKATOO HABITAT TREE & FORAGING EVIDENCE DETAILS

Habitat Trees (DBH >50cm)
Datum = GDA94

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt002	50J	407050	6468575	Blackbutt	5-10	>50	1	Spout Branch	5-12									No Signs	No Signs	No	
wpt003	50J	407039	6468523	Blackbutt	20+	>50	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt006	50J	407067	6468391	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt008	50J	406995	6468306	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt009	50J	406977	6468319	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt010	50J	406978	6468328	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt011	50J	406988	6468350	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt012	50J	407004	6468350	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt015	50J	407041	6467885	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt016	50J	407043	6467826	Jarrah	20+	>50	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt017	50J	407047	6467810	Jarrah	20+	>50	5+	Branch	5-12	Branch	12-20	Branch	5-12	Branch	12-20	Branch	5-12	No Signs	No Signs	No	
wpt018	50J	407028	6467727	Jarrah	10-15	>50	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt019	50J	407025	6467684	Jarrah	15-20	>50	5+	Knot Hole	20+	Branch	5-12	Branch	12-20	Branch	5-12	Branch	12-20	No Signs	No Signs	Yes	Depth of hollows unknown
wpt020	50J	407043	6467562	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt021	50J	407050	6467565	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt022	50J	407045	6467566	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt023	50J	407072	6467472	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt024	50J	407106	6467559	Jarrah	15-20	>50	5+	Knot Hole	5-12	Branch	5-12	Branch	12-20	Branch	5-12	Branch	12-20	No Signs	No Signs	Yes	Depth of hollows unknown
wpt026	50J	407109	6467592	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt027	50J	407137	6467605	Dead Unknown	20+	>50	5+	Knot Hole	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt028	50J	407128	6467541	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt029	50J	407129	6467463	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt030	50J	407198	6467633	Dead Jarrah	10-15	>50	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt031	50J	407240	6467658	Jarrah	15-20	>50	1	Fissure	5-12									No Signs	No Signs	No	
wpt032	50J	407246	6467658	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt033	50J	407250	6467662	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt034	50J	407250	6467663	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt035	50J	407253	6467665	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt036	50J	407255	6467665	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt037	50J	407279	6467676	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt038	50J	407321	6467588	Dead Unknown	20+	>50	5+	Knot Hole	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Corellas	Corellas	No	
wpt039	50J	407324	6467599	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt040	50J	407325	6467602	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt041	50J	407334	6467586	Dead Unknown	20+	>50	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt042	50J	407304	6467553	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt043	50J	407174	6467372	Marri	20+	>50	0											No Signs	No Signs	No	
wpt044	50J	407177	6467371	Marri	20+	>50	0											No Signs	No Signs	No	
wpt045	50J	407179	6467368	Marri	20+	>50	0											No Signs	No Signs	No	
wpt046	50J	407230	6467347	Marri	10-15	>50	1	Spout Branch	5-12									No Signs	No Signs	No	
wpt047	50J	407232	6467355	Marri	15-20	>50	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt048	50J	407217	6467364	Dead Unknown	20+	>50	5+	Knot Hole	<5	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Bees	No Signs	No	
wpt049	50J	407093	6467364	Marri	15-20	>50	0											No Signs	No Signs	No	
wpt050	50J	407361	6467608	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt051	50J	407366	6467607	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt052	50J	407372	6467608	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt053	50J	407379	6467611	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt054	50J	407375	6467635	Flooded Gum	20+	>50	0											No Signs	No Signs	No	
wpt055	50J	407371	6467647	Flooded Gum	20+	>50	0											No Signs	No Signs	No	
wpt056	50J	407364	6467643	Flooded Gum	20+	>50	0											No Signs	No Signs	No	
wpt057	50J	407361	6467648	Flooded Gum	20+	>50	0											No Signs	No Signs	No	
wpt058	50J	407350	6467642	Flooded Gum	20+	>50	0											No Signs	No Signs	No	
wpt059	50J	407331	6467630	Flooded Gum	20+	>50	0											No Signs	No Signs	No	
wpt060	50J	407356	6467692	Jarrah	15-20	>50	5+	Knot Hole	5-12	Knot Hole	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Bees	No Signs	No	
wpt061	50J	407270	6467845	Jarrah	20+	>50	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt062	50J	407288	6467861	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt063	50J	407280	6467866	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt064	50J	407270	6467861	Dead Unknown	15-20	>50	3	Spout Branch	12-20	Spout Branch	12-20	Spout Branch	12-20					No Signs	No Signs	No	
wpt065	50J	407255	6467858	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt067	50J	407230	6467852	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt068	50J	407229	6467850	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt069	50J	407265	6467937	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt070	50J	407162	6467894	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt072	50J	407156	6467920	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt073	50J	407134	6467958	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt074	50J	407093	6467963	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt075	50J	407448	6467374	Marri	20+	>50	0											No Signs	No Signs	No	
wpt076	50J	407396	6467401	Marri	20+	>50	0											No Signs	No Signs	No	
wpt077	50J	407475	6467349	Marri	20+	>50	0											No Signs	No Signs	No	
wpt079	50J	407484	6467235	Marri	20+	>50	0											No Signs	No Signs	No	
wpt080	50J	407480	6467208	Marri	20+	>50	0											No Signs	No Signs	No	
wpt081	50J	407511	6467216	Marri	20+	>50	0											No Signs	No Signs	No	
wpt082	50J	407510	6467188	Marri	20+	>50	1	Knot Hole	12-20									No Signs	No Signs	No	
wpt083	50J	407523	6467174	Marri	15-20	>50	1	Knot Hole	5-12									Bees	No Signs	No	
wpt085	50J	407486	6467146	Marri	20+	>50	0											No Signs	No Signs	No	
wpt086	50J	407478	6467146	Marri	20+	>50	0											No Signs	No Signs	No	
wpt087	50J	407478	6467142	Marri	20+	>50	0											No Signs	No Signs	No	
wpt088	50J	407478	6467160	Marri	20+	>50	0											No Signs	No Signs	No	
wpt089	50J	407470	6467124	Marri	20+	>50	0											No Signs	No Signs	No	
wpt090	50J	407468	6467094	Marri	20+	>50	0											No Signs	No Signs	No	
wpt091	50J	407469	6467091	Marri	20+	>50	0											No Signs	No Signs	No	
wpt092	50J	407455	6467089	Marri	20+	>50	0											No Signs	No Signs	No	
wpt093	50J	407507	6467075	Marri	20+	>50	0											No Signs	No Signs	No	
wpt094	50J	407506	6467081	Marri	20+	>50	0											No Signs	No Signs	No	
wpt095	50J	407509	6467083	Marri	20+	>50	0											No Signs	No Signs	No	
wpt096	50J	407474	6467043	Marri	20+	>50	0											No Signs	No Signs	No	
wpt097	50J	407473	6467047	Marri	20+	>50	0											No Signs	No Signs	No	
wpt098	50J	407417	6467062	Marri	20+	>50	0											No Signs	No Signs	No	
wpt099	50J	407379	6467049	Marri	20+	>50	0											No Signs	No Signs	No	
wpt100	50J	407372	6467040	Marri	20+	>50	0											No Signs	No Signs	No	
wpt101	50J	407370	6467038	Marri	20+	>50	0											No Signs	No Signs	No	
wpt102	50J	407368	6467040	Marri	20+	>50	0											No Signs	No Signs	No	
wpt103	50J	407327	6467014	Marri	20+	>50	0											No Signs	No Signs	No	
wpt104	50J	407315	6467007	Marri	20+	>50	0											No Signs	No Signs	No	
wpt105	50J	407298	6467000	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt106	50J	407292	6467001	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt107	50J	407269	6467012	Jarrah	15-20	>50	2	Branch	<5	Branch	<5							No Signs	No Signs	No	
wpt108	50J	407260	6466981	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt109	50J	407180	6467002	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt110	50J	407219	6467143	Marri	20+	>50	0											No Signs	No Signs	No	
wpt111	50J	407227	6467139	Marri	20+	>50	0											No Signs	No Signs	No	
wpt112	50J	407254	6467143	Marri	20+	>50	0											No Signs	No Signs	No	
wpt113	50J	407261	6467189	Dead Marri	20+	>50	0											No Signs	No Signs	No	
wpt114	50J	407281	6467183	Dead Marri	20+	>50	0											No Signs	No Signs	No	
wpt115	50J	407278	6467174	Dead Marri	20+	>50	0											No Signs	No Signs	No	
wpt116	50J	407349	6467132	Marri	15-20	>50	0											No Signs	No Signs	No	
wpt117	50J	407385	6467162	Marri	20+	>50	0											No Signs	No Signs	No	
wpt118	50J	407393	6467171	Marri	20+	>50	0											No Signs	No Signs	No	
wpt119	50J	407390	6467128	Marri	20+	>50	0											No Signs	No Signs	No	
wpt120	50J	407391	6467109	Marri	20+	>50	0											No Signs	No Signs	No	
wpt121	50J	407418	6467173	Marri	20+	>50	0											No Signs	No Signs	No	
wpt122	50J	407649	6466807	Marri	20+	>50	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt123	50J	407634	6466828	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt124	50J	407595	6466874	Marri	20+	>50	0											No Signs	No Signs	No	
wpt125	50J	407584	6466869	Marri	20+	>50	0											No Signs	No Signs	No	
wpt126	50J	407587	6466859	Marri	20+	>50	0											No Signs	No Signs	No	
wpt127	50J	407583	6466757	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt128	50J	407581	6466757	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt129	50J	407590	6466733	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt130	50J	407563	6466690	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt131	50J	407421	6466777	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt132	50J	407368	6466760	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt133	50J	407317	6466820	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt134	50J	407300	6466827	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt135	50J	407214	6466845	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt136	50J	407316	6466685	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt137	50J	407362	6466697	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt138	50J	407363	6466697	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt139	50J	407532	6466586	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt140	50J	407550	6466580	Jarrah	15-20	>50	0											No Signs	No Signs	No	
wpt141	50J	407577	6466583	Jarrah	20+	>50	0											No Signs	No Signs	No	
wpt142	50J	407679	6466532	Marri	15-20	>50	0											No Signs	No Signs	No	
wpt143	50J	407690	6466519	Jarrah	20+	>50	0											No Signs	No Signs	No	

Black Cokcatoo Foraging Evidence

Datum: GDA 94

Waypoint Number	Zone	mE	mN	Evidence Age	Evidence Type 1	Likely Species
wpt004	50J	407056	6468465	Old	Banksia Cones	Carnaby's/Baudin's
wpt005	50J	407048	6468414	Old	Banksia Cones	Carnaby's/Baudin's
wpt007	50J	407073	6468384	Old	Banksia Cones	Carnaby's/Baudin's
wpt013	50J	406993	6468365	Recent	Banksia Cones	Carnaby's/Baudin's
wpt014	50J	406946	6468105	Recent	Sheoak Fruits	FRTBC
wpt025	50J	407102	6467590	Old	Jarrah Fruits	Carnaby's/FRTBC
wpt045	50J	407179	6467368	Recent	Marri Fruits	Baudin's
wpt062	50J	407288	6467861	Recent	Jarrah Fruits	Carnaby's/FRTBC
wpt066	50J	407251	6467856	Recent	Jarrah Fruits	Carnaby's/FRTBC
wpt071	50J	407149	6467911	Recent	Banksia Cones	Carnaby's/Baudin's
wpt078	50J	407515	6467232	Recent	Marri Fruits	Baudin's
wpt084	50J	407537	6467133	Recent	Marri Fruits	Baudin's
wpt090	50J	407468	6467094	Old	Marri Fruits	Baudin's
wpt093	50J	407507	6467075	Recent	Marri Fruits	FRTBC
wpt104	50J	407315	6467007	Old	Marri Fruits	FRTBC
wpt122	50J	407649	6466807	Old	Marri Fruits	FRTBC
wpt144	50J	407702	6466570	Old	Marri Fruits	Baudin's

APPENDIX E

SIGNIFICANT SPECIES PROFILES

Unnamed scorpionfly *Austromerope poultoni*

Status and Distribution: Listed as Priority 2 by the DPaW. Distribution is poorly documented. NatureMap database contains widely scattered records from Eneabba to Walpole (DPaW 2013b).

Habitat: Occurs predominantly in dense understorey vegetation in high rainfall forest where it has been collected from beneath forest debris (logs, rocks) and in pitfall traps. Most NatureMap records are in the Jarrah forest belt.

Likely presence in study area: Preferred habitat absent and there are no records of this species from the coastal plain.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Graceful Sun Moth *Synemon gratiosa*

Status and Distribution: Listed as Priority 4 by the DPaW.

The GSM was up until a few years ago thought to be confined to a small number of bush reserves in the northern suburbs of Perth. Targeted survey work since that time by a number of consultants and the DPaW have extended the known range of the species north to Leeman and south as far as Binningup (Bishop *et al.* 2010b).

Survey work carried out in 2010 expanded the previously document area of occupancy of the GSM from 18km^2 to 43 km^2 and the extent of occurrence from 230km^2 to 2,015km^2. The area of occupancy is potentially a conservative estimate at this stage and if habitat anticipated to be occupied by GSM is included, the area of occupancy may be as high as 119 km^2 (Bishop *et al.* 2010b). Additional surveys have been carried out in 2011 north and south of the known range and these may also expand the species range (results not as yet publically available).

The conservation status of the graceful sun-moth was change at a state level in 2012 from Schedule 1 to Priority 4 as a consequence of the additional information illustrating the species much greater range and abundance.

Habitat: The graceful sun-moth is currently only known from two general vegetation types:

- *Banksia* woodland/woolly bush on deep sands, in the northern suburbs of Perth on the Swan Coastal Plain. In these sites the GSM breeds on *Lomandra hermaphrodita*, which often occurs in low numbers.

- Open areas of herbland, heathland and shrubland on Quindalup soils (sand and limestone) close to the coast where it breeds on *Lomandra maritima*, which is often present in reasonable numbers and may even be a dominant understorey herb. Sites on limestone may have both *Lomandra* species present.

The presence of *Lomandra* species therefore provides a good indication of prospective habitat, however, sufficient numbers and densities of these plants are thought to be necessary to sustain a viable breeding colony of Graceful Sun-Moths.

Likely presence in study area: Most of the study area is cleared of native vegetation and would therefore be unsuitable for this species to utilise. *Lomandra* appears to be absent or at best sparsely distributed within the remaining remnants. This information would suggest that a population of this species would be unlikely to be present.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development at the site occurring.

Carter's Freshwater Mussel *Westralunio carteri*

Status and Distribution: Listed as Priority 4 by DPaW and as Vulnerable by the ICUN. Carter's freshwater mussel is the only freshwater mussel species endemic to south-western WA, ranging from the Moore River south to the Frankland River (Morgan *et al.* 2011).

Habitat: Occurs in greatest abundance in slower flowing streams with stable sediments that are soft enough for burrowing amongst woody debris and exposed tree roots. Salinity tolerance quite low (Morgan *et al*. 2011).

Likely presence in study area: No suitable habitat for this species occurs within the study area.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Pouched Lamprey *Geotria australis*

Status and Distribution: Listed as Priority 1 by the DPaW. Status is secure but abundance has decreased due to proliferation of obstacles to upstream spawning migration such as dams and weirs. A southern hemisphere species. Western Australian distribution includes coastal drainages of the south west from Perth to Albany (Allen *et al.* 2003).

Habitat: This species lives in mud burrows in the upper reaches of coastal streams for the first 4 years of life until migrating to the sea. Adults migrate up to 60km upstream during spawning (Allen *et al.* 2003).

Likely presence in study area: The study area contains no suitable habitat for this species to utilise.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Western Swamp Tortoise *Pseudemydura umbrina*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Critically Endangered under the *EPBC Act (1999).* Confined to a small number of sites near Bullsbrook.

Habitat: Clay based ephemeral swamps (Bush *et al.* 2002).

Likely presence in study area: There is no suitable habitat for this species within the study site and it is considered very unlikely to occur.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Darling Range Heath Ctenotus *Ctenotus delli*

Status and Distribution: Listed as Priority 4 by DPaW. Main distribution is in the Darling Range from the Darlington/Mundaring area to near Collie (Storr *et al.* 1999).

Habitat: Humid zone, mainly laterite and clays (Storr *et al.* 1999) supporting jarrah/marri woodland with a shrub dominated understorey, sheltering in dense vegetation, inside grass trees and beneath rocks, sometimes in burrows (Nevill 2005). Occasionally found on granite outcrops (Bush *et al*. 2010).

Likely presence in study area: The study area is outside of this species current documented range and it contains no suitable habitat for this species to utilise.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Perth Lined Lerista *Lerista lineata*

Status and Distribution: Listed as Priority 3 by DPaW. Found in the lower west coast from Perth south to Leschenault Peninsula/Kemerton. It has also been found at Rottnest Island and Garden Island (Storr *et al.* 1999). Found in the southern suburbs of Perth (Bush *et al.* 2007).

Habitat: This small species of skink inhabits white sands (Storr *et al*. 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter (Nevill 2005) particularly in association with *Banksias* (Bush *et al.* 2007).

Likely presence in study area: There are no records of this species from the immediate vicinity of the study area despite several intensive surveys (e.g. Perth Airport) having been carried out in the past and it is therefore considered unlikely to be present.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Jewelled Ctenotus *Ctenotus gemmula*

Status and Distribution: Listed as Priority 3 by DPaW. In the west at Cataby and from Wanneroo south to Medina. In the southern interior and along the south coast from Rocky Gully inland to Lake Magenta and east to Toolina Cove (Storr *et al*. 1999).

Habitat: Prefers pale sandplains supporting either *Banksia* or mallee with heath. Seeks shelter beneath leaf litter, in abandoned stick-ant nest and burrows at the base of trees and shrubs (Bush *et al*. 2007).

Likely presence in study area: There are no records of this species from the immediate vicinity of the study area despite several intensive surveys (e.g. Perth Airport) having been carried out in the past and it is therefore considered unlikely to be present.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Black-striped Snake *Neelaps calonotos*

Status and Distribution: Listed as Priority 3 by DPaW. Found in the lower west coast from Lancelin to Mandurah. It is locally abundant but is under threat due to land clearing (Storr *et al.* 1999).

Habitat: This species of snake favours sandy soils supporting heath and *Banksia*/eucalypt woodland (Nevill 2005).

Likely presence in study area: There are no records of this species from the immediate vicinity of the study area despite several intensive surveys (e.g. Perth Airport) having been carried out in the past and it is therefore considered unlikely to be present.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Southern Carpet Python *Morelia spilota imbricata*

Status and Distribution: The south western population is classified Schedule 4 under the *WC Act*. This subspecies has wide distribution within the south west but is uncommon. Occurs north to Geraldton and Yalgoo and east to Pinjin, Kalgoorlie, Fraser Range and Eyre (Storr *et al.* 2002).

Habitat: This species has been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, Eucalypt woodlands, and grasslands. Most often found utilising hollow logs in addition the burrows of other animals for shelter. Often arboreal and will use tree hollows for refuge. Near Perth, this species is more often found in areas of substantial undisturbed bushland such as catchment areas and rocky outcrops of the Darling Range (Bush *et al.* 2010).

Likely presence in study area: Habitat within and near the study area appears too fragmented for a population of this species to persist. Near Perth, this species is more often found in areas of substantial undisturbed bushland such as catchment areas and rocky outcrops of the Darling Range (Bush *et al.* 2010). This species is therefore considered to be very unlikely to occur.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Malleefowl *Leipoa ocellata*

Status and Distribution: This species is listed as Schedule 1 under the *WC Act* and as Vulnerable and Migratory under the *EPBC Act*. Originally common, but now generally rare to uncommon and patchily distributed.

Current distribution mainly southern arid and semi-arid zones, north to Shark Bay, Jingemarra, Colga Downs and Yeelirrie, east to Earnest Giles Range, Yeo Lake, lower Ponton Creek and to Eucla and west and south to Cockleshell Gully, the Wongan Hills, Stirling Range, Beaufort Inlet, Hatters Hill, Mt Ragged and Point Malcolm (Johnstone and Storr 1998).

Habitat: Mainly scrubs and thickets of mallee *Eucalyptus* spp., boree *Melaleuca lanceolata* and bowgada *Acacia linophylla*, also dense litter forming shrublands.

Likely presence in study area: This species is regionally extinct and would never, under normal circumstances, occur anywhere on the Swan Coastal Plain/Darling Range.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Australian Bustard *Ardeotis australis*

Status and Distribution: This species is listed as Priority 4 by DPaW. A nomadic species that is common away from settled areas over much of Australia (Morcombe 2003).

Habitat: Grasslands, especially tussock grasses, like speargrass, Mitchell grass, spinifex; arid scrub with saltbush, bluebush; open dry woodland of mulga, mallee and, heath (Morcombe 2003).

Likely presence in study area: This species is regionally extinct and would never occur in this section of the Swan Coastal Plain.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Great Egret *Ardea alba*

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Great

Egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe 2004).

Habitat: Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe 2004).

Likely presence in study area: The small dam onsite may be very occasionally visited by individuals of this species but frequency of occurrence would be very low. Would not breed onsite.

Potential impact of development: Loss or modification of a small area or marginal man-made habitat. No significant impact on this species will occur.

Cattle Egret *Ardea ibis*

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Cattle Egret is common in the north sections of its range but is an irregular visitor to the better watered parts of the state (Johnstone and Storr 1998). The population is expanding (Morcombe 2004).

Habitat: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe 2004). As its name suggests, most often seen in association with cattle.

Likely presence in study area: The small dam onsite may be very occasionally visited by individuals of this species but frequency of occurrence would be very low. Would not breed onsite.

Potential impact of development: Loss or modification of a small area of marginal man-made habitat. No significant impact on this species will occur.

Migratory Shorebirds/Wetland Species

A number of migratory shorebirds/wetland species are listed as potentially occurring in the general area. Specific species are not discussed.

Status and Distribution: Migratory shorebirds are listed under the *EPBC Act 1999* and under international agreements to which Australia is a signatory. All species are either widespread summer migrants to Australia or residents. State and Federal conservation status varies between species.

Habitat: Varies between species but includes beaches and permanent/temporary wetlands varying from billabongs, swamps, lakes, floodplains, sewerage farms, saltwork ponds, estuaries, lagoons, mudflats sandbars, pastures, airfields, sports fields and lawns.

Likely presence in study area: The small dam onsite may be very occasionally visited by some species of wader but the frequency of occurrence would be very low and then only for very brief periods. Other areas of the study area are considered unsuitable for any species. None are listed as potential species for this reason.

Potential impact of development: No impact on migratory waders/wetland species or their preferred habitat is considered likely.

Australasian Bittern *Botaurus poiciloptilus*

Status and Distribution: Classified as Schedule 1 under the *WC Act* and as Endangered under the *EPBC Act (1999)*. The species is uncommon to rare (Morcombe 2004), but locally common in wetter parts of south west (Johnstone and Storr 1998). Occurs north to Moora and east to Mt Arid (Johnstone and Storr 1998).

Habitat: Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe 2004) such as beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps (Johnstone and Storr 1998).

Likely presence in study area: There is no suitable habitat for this species in the study area.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Black Bittern *Ixobrychus flavicollis*

Status and Distribution: Listed as Priority 3 by DPaW. Occurs north to Yanchep and Northam and east to Albany (Johnstone and Storr 1998).

Habitat: Freshwater pools, swamps and lagoons, well screened with trees. Shelters in dense waterside vegetation (Johnstone and Storr 1998).

Likely presence in study area: The study area contains no suitable habitat for this species to utilise.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development at the site occurring.

Little Bittern *Ixobrychus minutus*

Status and Distribution: Listed as Priority 4 by DPaW. Occurs north to Moora and east to Two Peoples Bay; accidental or on migration further north and east and on Rottnest Island and central district (Condingup district) (Johnstone and Storr 1998).

Habitat: Dense vegetation surrounding/within freshwater pools, swamps and lagoons, well screened with trees. Shelters in dense beds of *Typha*, *Baumea* and tall rushes in freshwater swamps around lakes and along rivers (Johnstone and Storr 1998).

Likely presence in study area: The study area contains no suitable habitat for this species to utilise.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development at the site occurring.

Osprey *Pandion haliaetus*

Status and Distribution: This species is listed as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. Moderately common to very common in sheltered seas around the north and west coast islands south to 31°S; uncommon to common on mainland coasts, estuaries and large rivers north of tropic, rare to uncommon elsewhere (Johnstone and Storr 1998).

Habitat: Coasts, estuaries, bays, inlets, islands, and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Ascends larger rivers (Pizzey & Knight 2012). Construct nests on prominent headland, large trees, communication towers (Simpson & Day 2010).

Likely presence in study area: The study area contains no suitable habitat for this species to utilise.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development at the site occurring.

White-bellied Sea Eagle *Haliaeetus leucogaster*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. White-bellied sea eagles are moderately common to common on Kimberley and Pilbara islands, coasts and estuaries, on Bernier, Dorre and Dirk Hartog Is., in Houtman Abrolhos and in the Archipelago of the Recherche; rare to uncommon elsewhere (Johnstone and Storr 1998). Also found in New Guinea, Indonesia, China, southeast Asia and India. Scarce near major coastal cities (Morcombe 2004).

Habitat: They nest and forage usually near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive (Morcombe 2004). White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession.

Likely presence in study area: The study area contains no suitable habitat for this species to utilise.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development at the site occurring.

Peregrine Falcon *Falco peregrinus*

Status and Distribution: This species is listed as Schedule 4 under the *WC Act*. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).

Habitat: Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe 2004). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.

Likely presence in study area: The species potentially utilises some sections of the study area as part of a much larger home range. No potential nest sites observed.

Potential impact of development: Loss/modification of a very small area of natural habitat. No significant impact likely.

Painted Snipe *Rostratula benghalensis*

Status and Distribution: This species is listed as Schedule 1 and 3 under the *WC Act* and as Endangered and Migratory under the *EPBC Act*. Sparsely distributed in better watered regions: Kimberley, North West and South Western divisions. Also eastern Australia and Tasmanian (Johnstone and Storr 1998).

Habitat: Well vegetated shallows and margins of wetlands, dams, sewerage ponds, wet pastures, marshy areas, irrigation systems, lignum, tea tree scrub, open timber. Requires dense low cover (Morcombe 2004).

Likely presence in study area: There is no suitable habitat for this species within the study site.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development at the site occurring.

Oriental Plover *Charadis veredus*

Status and Distribution: The oriental plover is listed as Schedule 3 under the WC Act and as Migratory under the *EPBC Act* including international agreements to which Australia is a signatory. Breeds in Mongolia and Manchuria – regular summer migrant to Australia (September to March) (Pizzey & Knight 2012). Kimberley, north western interior (Lake Gregory) and north west coastal plains (south to tropic); casual or vagrant elsewhere (south to 32°15'S) (Johnstone and Storr 1998).

Habitat: Mainly sparsely vegetated plains including samphire and short grasses flats. Also beaches, tidal flats, salt works and sewage ponds (Johnstone and Storr 1998).

Likely presence in study area: No suitable habitat and rarely recorded in the Perth area. . Not listed as a potential species.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development occurring at the site.

Glossy Ibis *Plegadis falcinellus*

Status and Distribution: This species is listed as Migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. The

Glossy Ibis frequents swamps and lakes throughout much of the Australian mainland, but is most numerous in the north. It is a non-breeding visitor to Tasmania and the south-west of Western Australia. The Glossy Ibis is both migratory and nomadic. Its range expands inland after good rains, but its main breeding areas seem to be in the Murray-Darling Basin of New South Wales and Victoria, the Macquarie Marshes in New South Wales, and in southern Queensland. Glossy Ibis often move north in autumn, then return south to their main breeding areas in spring and summer (Pizzey & Knight 2006).

Habitat: Well vegetated wetlands, wet pastures, rice fields, floodwaters, floodplains, brackish or occasionally saline wetlands, mangroves, mudflats, occasionally dry grasslands (Pizzey & Knight 2012).

Likely presence in study area: The small dam onsite may very rarely be visited by individuals or small groups of this species but frequency of occurrence would be very low and therefore it has not been listed as a potential species.

Potential impact of development: Loss or modification of a very small area of marginal man-made habitat. No significant impact on this species will occur.

Bush Stone Curlew *Burhinus grallarius*

Status and Distribution: Listed as Priority 4 by DPAW. Occurs over much of the western half of the state (and Kimberley) but rare to uncommon in the south of its range due to fox predation (Johnstone and Storr 1998).

Habitat: Lightly wooded country (including partly cleared forests) near daytime shelter e.g. thickets or long grass (Johnstone and Storr 1998).

Likely presence in study area: This species is regionally extinct and would never occur in this section of the Swan Coastal Plain.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Muir's Corella *Cacatua pastinator pastinator*

Status and Distribution: Listed as Scheduled 4 under the *WC Act* and as Vulnerable under the *EPBC Act*. Locally common in farmlands but generally uncommon and patchily distributed. Now confined to small part of the subhumid south western interior from Boyup Brook and Qualeup south to the Perup River, Lake Muir and Cambellup. Casual further east (Johnstone and Storr 1998).

Habitat: Mainly partly cleared eucalypt forests. Attracted to bulbs of guildford grass, *Drosera* spp, orchids, seeding oats and clover. Largely dependent on farming (Johnstone and Storr 1998).

Likely presence in study area: The project area is outside of this species current documented range.

Potential impact of development: No impact on this species or its preferred habitat will occur as a result of the any development proceeding.

Major Mitchell's Cockatoo *Cacatua leadbeateri*

Status and Distribution: Classified as Schedule 4 under the *WC Act*. Sedentary, generally uncommon and of patchy occurrence. Widespread but disjunct in arid and semi arid zones. Found across the arid and semi-arid inland, from south-western Queensland south to north-west Victoria, through most of South Australia, north into the south-west Northern Territory and across to the west coast between Shark Bay and Jurien Bay south to Queen Victoria Spring (Johnstone and Storr 1998).

Habitat: Lightly or sparsely wooded country near water and tall eucalypts (Johnstone and Storr 1998).

Likely presence in study area: The project area is outside of this species current documented range.

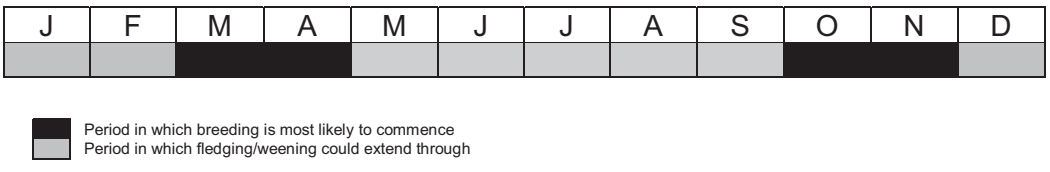
Potential impact of development: No impact on this species or its preferred habitat will occur as a result of the any development proceeding.

Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Habitat: Eucalypt forests, feeds on marri, jarrah, blackbutt, karri, sheoak and snottygobble. The forest red-tailed black cockatoo nests in the large hollows of marri, jarrah and karri (Johnstone and Kirkby 1999). In marri, the nest hollows of the forest red-tailed black cockatoo range from 8-14m above ground, the entrance is 12 – 41cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding commences in winter/spring. There are few records of breeding for the forest red-tailed black cockatoo (Johnstone and Storr 1998), but eggs are laid in October and November (Johnstone 1997; Johnstone and Storr 1998).



Recent data however indicates that breeding in all months of the year occurs with peaks in spring and autumn–winter (Ron Johnstone pers comms). Incubation period 29 – 31 days. Young fledge at 8 to 9 weeks (Simpson and Day 2010).

Likely presence in study area: Foraging evidence attributed to this species was found during the day survey (chewed jarrah, marri and sheoak fruits). The majority of the remnant vegetation on site represents foraging habitat for this species. Larger

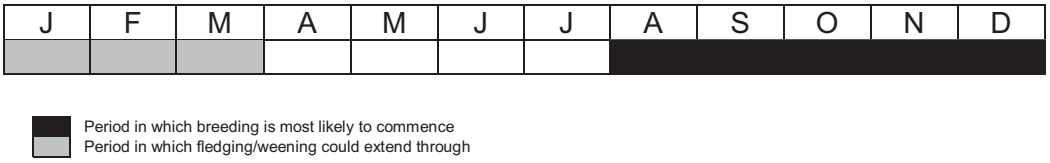
trees (>50cm DBH) can be considered potential breeding habitat. May also occasionally roost on site.

Potential impact of development: Loss/modification of a small area of natural habitat.

Baudin's Black-Cockatoo *Calyptorhynchus baudinii*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr 1998). On the southern Swan Coastal Plain this cockatoo is in some areas resident but mainly a migrant moving from the deep south-west to the central and northern Darling Range. Between March and September most flocks move north and are concentrated in the northern parts of the Darling Range. During this period birds forage well out onto the southern Swan Coastal Plain to areas such as Harvey, Myalup, Bunbury, Capel, Dunsborough and Meelup. While generally more common in the Darling Range this species can also be common on parts of the southern Swan Coastal Plain especially in mid-August – September when flocks begin to return to their breeding quarters (Johnstone 2008).

Habitat: Mainly eucalypt forests where it feeds primarily on the Marri seeds, (Morcombe 2004), *Banksia*, Hakeas and *Erodium* sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr 1998). This species of cockatoo nests in large tree hollows, 30–40 cm in diameter and more than 30 cm deep (Saunders 1974).



Baudin's black-cockatoo breeds in late winter and spring, from August to November or December (Gould 1972; Johnstone 1997; Saunders 1974; Saunders et al. 1985). Eggs laid in October (Johnstone and Storr 1998). Based on observations at currently known nest sites breeding mainly occurs within the October-December period (Ron Johnstone pers. comms.). Incubation is 28 – 30 days. Young fledge at 8 to 9 weeks (Simpson and Day 2010).

Likely presence in study area: Foraging evidence attributed to this species was found during the day survey (chewed marri fruits and *Banksia* cones). The majority of the remnant vegetation on site represents foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. May also occasionally roost on site.

Potential impact of development: Loss/modification of a small area of natural habitat.

Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*

Status and Distribution: Carnaby's black cockatoo is listed as Scheduled 1 under the *WC Act* and as Endangered under the *EPBC Act*. Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Habitat: Forests, woodlands, heathlands, farms; feeds on *Banksia*

, Hakeas and Marri. Carnaby's cockatoo has specific nesting site requirements. Nests are mostly in smoothed-barked eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe 2004). Judging from records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forest of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain including the region between Mandurah and Bunbury.

Carnaby's black cockatoo has been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (pers. comm., Ron Johnstone, WA Museum) and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

J	F	M	A	M	J	J	A	S	O	N	D

Period in which breeding is most likely to commence
Period in which fledging/weening could extend through

Carnaby's black-cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders 1986). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28-29 days. The young depart the nest 10–12 weeks after hatching (Saunders 1977; Smith & Saunders 1986).

Likely presence in study area: Foraging evidence attributed to this species was found during the day survey (chewed marri fruits and *Banksia* cones). The majority of the remnant vegetation on site represents foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. May also occasionally roost on site.

Potential impact of development: Loss/modification of a small area of natural habitat.

Fork-tailed Swift *Apus pacificus*

Status and Distribution: The fork-tailed swift is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. It is a summer migrant (Oct-Apr) to Australia (Morcombe 2004).

Habitat: Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe 2004).

Likely presence in study area: The fork-tailed swift is potentially a very occasional summer visitor to the south west but is entirely aerial and largely independent of terrestrial habitats. It would only occur rarely and for very short periods of time and therefore has not been listed as a potential species.

Potential impact of development: No impact on this species will occur.

Rainbow Bee-eater *Merops ornatus*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Rainbow Bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe 2004).

Habitat: Open country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe 2004). Breeds underground in burrows where areas of suitable soft soil, firm enough to support tunnel building exist.

Likely presence in study area: This species is a common seasonal visitor to south west and during summer months a small number of individuals of this species may possibly forage and roost onsite. Sandy ground conditions appear suitable for breeding.

Potential impact of development: Loss/modification of a very small area of natural habitat. No significant impact likely given that only a small number of individuals would ever be present at any one time.

Chuditch *Dasyurus geoffroii*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act.* Formerly occurred over nearly 70 per cent of Australia. The Chuditch now has a patchy distribution throughout the jarrah forest and mixed karri/marri/jarrah forest of southwest Western Australia. Also occurs in very low numbers in the Midwest, Wheatbelt and South Coast Regions with records from Moora to the north, Yellowdine to the east and south to Hopetoun.

Habitat: Chuditch are known to have occupied a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts. Riparian vegetation appears to support higher densities of Chuditch, possibly

because food supply is better or more reliable and better cover is offered by dense vegetation. Chuditch appear to utilise native vegetation along road sides in the wheatbelt (CALM 1994). The estimated home range of a male Chuditch is over 15 km^2 whilst that for females is 3-4 km^2 (Sorena and Soderquist 1995).

Likely presence in study area: This species required relatively large continuous areas of vegetation to persist and as a consequence it is rarely recorded on any section of the coastal plain given the extent of clearing and fragmentation that has occurred. Occasional records in the Perth area are transient individuals that have originated from the Darling Range where it is known to persist.

Potential impact of development: No impact on this species or its preferred habitat is anticipated.

Southern Brush-tailed Phascogale *Phascogale tapoatafa ssp*

Status and Distribution: Listed as Scheduled 1 under the *WC Act*. Present distribution is believed to have been reduced to approximately 50 per cent of its former range. Now known from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (DEC information pamphlet). Records are less common from wetter forests. Can also persist in floristically degraded areas such as relatively dense and continuous, but parkland cleared woodland in farmland (G. Harewood pers. obs.).

Habitat: This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites. The home range for a female brush-tailed phascogale is estimated at between 20 and 70 ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number (approximately 20) of different nest sites throughout their range (Soderquist 1995).

Likely presence in study area: Current status in the wider area uncertain but fragmented nature of the vegetation remnants would suggest it is unlikely to occur.

Potential impact of development: No impact on this species or its preferred habitat is anticipated.

Western Ringtail Possum *Pseudocheirus occidentalis*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act.* Common in suitable habitat (de Tores 2008). The highest densities of this species are recorded in Peppermint habitat near Busselton area; relatively high densities are found in Jarrah/Marri forest at Perup (de Tores 2008).

The Western Ringtail Possum (WRP) has a restricted distribution in south-western Western Australia. Most known populations (natural and translocated) are now restricted to near coastal areas of the south west from the Dawesville area to the Waychinicup National Park. Inland, it is also known to be relatively common in a

small part of the lower Collie River valley, the Perup Nature Reserve and surrounding forest blocks near Manjimup.

Habitat: The Western Ringtail Possum was once located in a variety of habitats including Coastal Peppermint, Coastal Peppermint-Tuart, Jarrah-Marri associations, Sheoak woodland, and eucalypt woodland and mallee. Coastal populations mostly inhabit Peppermint-Tuart associations with highest densities in habitats with dense, relatively lush vegetation. Inland, the largest known populations occur in the Upper Warren area east of Manjimup (Wayne *et al* 2005). In this area the peppermint tree is naturally absent and jarrah-marri associations constitute the species refuge and foraging habitat. In areas where Peppermint is absent or rare WRPs have been observed feeding predominately on young Jarrah, *Nuytsia floribunda* and *Allocasuarina fraseriana* (G Harewood pers. obs.*).*

Likely presence in study area: This species is locally extinct.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Southern Brown Bandicoot *Isoodon obesulus fusciventer*

Status and Distribution: Listed as Priority 5 by DPaW. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (DEC information pamphlet) and Nambung and Yalgorup National Parks (DPaW pers. comm.).

Habitat: Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quendas can thrive in more open habitat subject to exotic predator control (DPaW information pamphlet ND).

Likely presence in study area: Very likely to be present in the small areas of native vegetation containing dense groundcover.

Potential impact of development: Loss/modification of a small area of natural habitat.

Woylie *Bettongia penicillata ogibyi*

Status and Distribution: Listed as Schedule 1 under the *WC Act* and as Endangered under the *EPBC Act*. Restricted to remnant habitat patches in south west WA where populations are managed by way of fox control and reintroduction programs (e.g. Avon Valley, Walyunga National Park and Paruna Sanctuary).

Habitat: Open forest and woodland with a low, dense, understorey of tussock grasses or woody scrub. Formerly occurred in a wider range of habitats including spinifex hummock grasslands.

Likely presence in study area: Generally considered to be locally extinct in this area and there is no potential habitat onsite for this species.

Potential impact of development: No impact on this species is anticipated.

Western Brush Wallaby *Macropus irma*

Status and Distribution: Listed as Priority 4 by DPaW. The Western Brush Wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid (DEC information pamphlet).

Habitat: The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DPaW information pamphlet).

Likely presence in study area: Vegetation in the area is too small and fragmented to maintain a population of this species.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Water Rat *Hydromys chrysogaster*

Status and Distribution: Listed as Priority 4 by DPaW. The water rat is widely distributed around Australia and its offshore islands, New Guinea and some adjacent islands. It occurs in fresh brackish water habitats in the south-west of Western Australia, but occurs in marine environments along the Pilbara coastline and offshore islands. Previous survey work in the south west suggested this species was relatively common and widespread though difficult to capture (Christensen *et al.* 1985, How *et al.* 1987).

Habitat: The water rat occupies habitat in the vicinity of permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen *et al.* 1985).

Likely presence in study area: There is no suitable habitat for this species within the study area.

Potential impact of development: No impact on this species or its preferred habitat will occur as a consequence of development at the site occurring.

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