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Water Corporation

Report for Mundaring Water Treatment Plant Site Selection Site Selection

**Preliminary Flora and Fauna
Assessment - O'Connor Site**

July 2007



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Executive Summary

The Water Corporation is currently conducting a site selection process for the proposed Mundaring Water Treatment Plant (WTP). This process involves community-based consultation, and has included preliminary consideration of the environmental, social, technical and economic features of a number of site options.

As part of the site selection process GHD Pty Ltd (GHD) was commissioned by the Water Corporation to undertake preliminary environmental investigations on a number of the Mundaring WTP site options. This report presents the results of the preliminary flora and fauna assessment on the O'Connor Site.

This investigation is a preliminary investigation aimed at identifying any major environmental constraints on the site and to assess the environmental values of the site. A full flora and vegetation assessment and fauna assessment will be required once a final site has been determined.

A total of four sites were investigated in spring 2006. An additional site known as the O'Connor Site was proposed by the community in early 2007 and could not be included in the spring surveys. This preliminary flora and fauna assessment for the O'Connor Site is based on desktop investigations and site visits in April and June 2007. The results of the assessment concluded that:

- » The Site is located within State Forest at the junction of Mundaring Weir Road and Firewood Road.
- » The majority of the O'Connor Site supports Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) Forest. The site has been logged previously and the vegetation is regrowth. In some areas the previous logging activities have removed much of the overstorey and the vegetation consists of an open woodland. In these areas the understorey is generally intact and there is evidence of regeneration of the mid and overstorey. Some sections of the site are dominated by disturbance specialist species such as Parrot Bush (*Dryandra sessilis*).
- » In the south-west of the O'Connor site there is evidence of previous disturbance factors, particularly near to the access tracks that occur throughout the site. Generally, the condition of the vegetation improves away from the road and in these areas the structure of the understorey is generally intact. Most of the south-west of the site was rated between Condition 3 (*Very Good*) to Condition 4 (*Good*). While there is disturbance evident in these areas the vegetation structure remains intact and the site retains the ability to regenerate to a better condition. Additionally, away from the main access tracks the vegetation structure is still generally intact and there is less evidence of disturbance, these areas were rated Condition 2 (*Excellent*).
- » No Declared Rare Flora (DRF) or Priority flora species were identified during the survey. While it is unlikely that the site supports significant flora species a spring flora survey will be required if this site is selected as the preferred site for the WTP.



- » The site contains a number of introduced species, particularly around the cleared and disturbed areas. Weed species present included introduced *Acacias* and Eucalypts. However, the introduced species are predominantly restricted to the disturbed areas and the majority of the bushland is relatively weed-free.
- » A number of fauna species occur in the general vicinity of the site and the site would provide habitat for a number of fauna species. A number of species were observed during the opportunistic surveys, particularly woodland bird species. While the site has potential to support some significant fauna species it is unlikely to be considered as containing 'significant' habitat for these species. The habitat type is uniform across the site and is well-represented in the surrounding area.

The O'Connor Site contains native vegetation, predominantly Jarrah-Marri forest. While this site has been subject to a number of historical disturbances, particularly logging, it still contains areas of good quality vegetation and is of value as fauna habitat. While there does not appear to be any 'significant' ecological constraints at this site, clearing of native vegetation will be required and there will be impacts on native flora and fauna.

This preliminary flora and fauna assessment is sufficient for comparative purposes during the site selection process. However, if this site becomes the preferred location for the WTP a spring flora and fauna survey will be required at this site.



1. Introduction

1.1 Background

The Water Corporation proposes to improve the quality and security of water supplies to the Eastern Hills areas of Perth and to the Goldfields and Agriculture regions. The \$55 million Mundaring Water Supply Improvement Project was announced in 2002, and involved the first stage construction over about six years of a 50 megalitre water tank and a 150 megalitres per day capacity Water Treatment Plant (WTP) at Sawyers Valley Tank site. Two more stages were planned and by 2030 it was projected that a total of three 50 megalitre water tanks would be constructed on the site and the WTP capacity would be increased to 250 megalitres per day.

Strong community objections emerged against the location of the WTP at Sawyers Valley. Due to these community objections the Water Corporation decided to withdraw the application to the Environmental Protection Authority (EPA) to build the WTP at Sawyers Valley and a commitment was made to undergo a more detailed site selection process, with the involvement of the community. The Water Corporation's application to the EPA to build one 50 megalitre water tank remained active.

The current site selection process commenced in mid-2005 and is a community-based consultation process, which involved reconsidering all previous site options and including any other potentially suitable options. This process has involved preliminary consideration of the environmental, social, technical and economic features of a number of options. Further detailed investigations will be required once a preferred site has been identified.

1.2 Scope of this Report

GHD Pty Ltd (GHD) has been commissioned by the Water Corporation to assist with the site selection process for the Mundaring WTP and to provide independent advice to the Water Corporation and the community on the environmental features of the site options, as required.

As part of the site selection process GHD was commissioned by the Water Corporation to undertake preliminary biological field surveys in spring 2006 at a number of the Mundaring WTP site options. At this time a number of site options were considered that contain considerable areas of remnant vegetation. These included:

- » Site One;
- » Site Two;
- » Site '1km below Weir';
- » Pine Plantation Site;
- » Department of Environment and Conservation (DEC) Land (formerly "CALM Land");
- » Site Five (Sawyers Hill); and



» Site Seven.

There had been previous biological investigations conducted at Site One and Two, so further detailed survey was not considered necessary but a brief site visit was conducted to determine the environmental condition of the site. A number of biological surveys have been conducted previously at Site Five but none were conducted in early spring so a survey was considered necessary. A biological survey was not undertaken at Site Seven but a brief inspection of the site was conducted to determine the environmental condition of the site.

The Water Corporation determined that preliminary biological surveys in spring 2006 were to be conducted at the following sites:

- » Site '1km below Weir';
- » Pine Plantation Site;
- » DEC Land; and
- » Site Five (Sawyers Hill).

In early 2007 the community undertook an assessment of the sites to determine a short-list of four sites that were to be investigated further. The Water Corporation also undertook their own assessment that concurred with the community assessment on the sites to be short-listed. The four short-listed sites were:

- » Site One;
- » Pine Plantation Site;
- » DEC Land (formerly 'CALM Site'); and
- » "O'Connor Site" (a new site proposed by members of the community group).

Further detailed investigations were required for these short-listed sites including; preliminary environmental impact assessment, Indigenous and Non-indigenous Heritage assessment and a risk assessment. A flora and fauna assessment was also required for Site One and O'Connor Site.

This report details the flora and fauna assessment for O'Connor Site and includes:

- » A broad-scale vegetation assessment, including assessment of vegetation types, vegetation condition, dominant species and potential presence of diseases such as dieback, and weeds;
- » A targeted search for any Declared Rare Flora (DRF) and Priority flora species that occur in the area;
- » An assessment of habitat potential, including the assessment of the significance of habitat trees; and
- » A targeted opportunistic fauna search, particularly for any significant fauna species.



1.3 Site Location

Participants in the community forums proposed a site located in the general area of O'Connor Hill. A revised site boundary was determined by site investigation with 9 community members of Advisory Group.

The O'Connor Site is located within 39.7 ha of State Forest at the junction of Mundaring Weir Road and Firewood Road, north of Mundaring Weir. An old track runs through the centre of the site, off Firewood Road.

1.4 Limitations of this Survey

This biological investigation is only a preliminary survey and a full flora and vegetation assessment and fauna assessment will be required once a final site has been determined. The investigation focused on the site of the WTP and detailed investigations of the access routes was not undertaken. However, the potential access routes were assessed at a general level to determine any major biological constraints.

The site has not been surveyed during Spring, which in the south-west of Australia is the main flowering and growth period and is thus considered the optimum time to undertake flora surveys as the maximum number of species can be recorded. In particular, some of the DRF and Priority flora species can only be identified at certain times in their lifecycle, with spring allowing identification of the maximum number of species (though the optimum time for survey is dependent on the specific species and some targeted surveys should be conducted at other times of year). Further targeted surveys will be required once the final site has been selected to confirm there are no significant flora species at the site.

Desktop investigations on fauna species were conducted at the regional level to determine species that are present in the general area and that have the potential to occur at the site. While this does not allow comparison between sites the information on fauna habitat obtained during the survey provides some indication of the likelihood of fauna species occurring at the site and of the value of the site as fauna habitat.



2. Desktop Assessment

2.1 Vegetation

Beard (1979) has mapped the vegetation of the general area at a scale of 1:250,000. The site vegetation is within the Darling Botanical District: Dale Subdistrict of the South Western Botanical Province as recognised by Beard (1979). According to Beard the vegetation of the sub-district is primarily Jarrah – Marri forest.

Mapping by Heddle *et al.* (1980) shows the site to be within the **Dwellingup Complex in medium to high rainfall**. Open forest of *Eucalyptus marginata* – *E. calophylla* (now *Corymbia calophylla*).

Mundaring Weir and the study site occur on the Darling Plateau region, which has the following general vegetation complexes as defined in the Regional Forest Agreement Vegetation Complexes mapping of Mattiske and Havel (1998):

- » **Dwellingup 2 (D2) (uplands)** Open forest of *Eucalyptus marginata subsp. marginata* – *Corymbia calophylla* on lateritic uplands in the arid zone.
- » **Helena 2 (He2) (in valleys)** Mosaic of open forest of *Eucalyptus marginata subsp. thalassica-Corymbia calophylla* and woodland of *Eucalyptus wandoo* with some *Eucalyptus accedens* and *Eucalyptus rudis* on the deeper soils ranging to closed heaths and lithic complex on shallow soils associated with granite on steep slopes of valleys in semiarid and arid zones.
- » **Murray 2 (My2) (in valleys)** Open forest of *Eucalyptus marginata subsp. thalassica-Corymbia calophylla-Eucalyptus patens* and woodlands of *Eucalyptus wandoo* with some *Eucalyptus accedens* on valley slopes to woodlands of *Eucalyptus rudis-Melaleuca raphiophylla* on the valley floor in semiarid and arid zones.
- » **Yarragil 1 (in valleys)** Open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.
- » **Pindalup (in valleys)** Open forest of *Eucalyptus marginata subsp. thalassica-Corymbia calophylla* on slopes and open woodlands of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.

The Mattiske and Havel mapping (1998) indicates that the O'Connor Site occurs mainly in the vegetation complex **Dwellingup 2 (D2) (uplands)**.

2.2 Vegetation Extent and Status

A vegetation type is considered underrepresented if there is less than 30 percent of its original distribution remaining. From a purely biodiversity perspective, and not taking into account any other land degradation issues, there are several key criteria now being applied to vegetation in States where clearing is still occurring (EPA, 2000)



- » The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-European/ pre-1750 extent of the vegetation type;
- » A level of 10% of the original extent is regarded as being a level representing *Endangered*; and
- » Clearing which would put the threat level into the class below should be avoided.

Such status can be delineated into five (5) classes, where:

- » *Presumed Extinct*: Probably no longer present in the bioregion
- » *Endangered**: <10% of pre-European extent remains
- » *Vulnerable**: 10-30% of pre-European extent exists
- » *Depleted**: >30% and up to 50% of pre-European extent exists
- » *Least Concern*: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

* or a combination of depletion, loss of quality, current threats and rarity gives a comparable status

Native vegetation types represented in the survey area, their regional extent and reservation status are generally drawn from Shepherd, *et al.* (2002), and Shepherd pers. comm., which are in turn based on broadscale mapping undertaken by Beard (1979). These are shown in **Table 1**.

Table 1 Vegetation extent and status for Beard (1979) Vegetation Associations in the Mundaring areas (after Shepherd, *et al.* (2002), Shepherd, pers. comm.)

Vegetation Association	Vegetation Description	Pre-European Extent (ha)	Current Extent (ha)	% Remaining
3	Medium Forest: Jarrah – Marri	908, 040	747, 888	82.4

Generally the extent of the vegetation remaining on the Darling Scarp is above the threshold level and it can be seen from the table above the Jarrah – Marri Medium Forest is relatively well preserved.

2.3 Threatened Ecological Communities

Ecological communities are defined as ‘naturally occurring biological assemblages that occur in a particular type of habitat’ (English and Blythe, 1997). Threatened Ecological Communities (TECs) are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered, and Vulnerable. Some TECs are protected under the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act). Although TECs are not formally protected under the State *Wildlife Conservation Act 1950*, the loss of, or disturbance to, some TECs triggers the EPBC Act. The EPA’s position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment.



A search of the DEC's TEC database was undertaken for the Mundaring area. This search recorded that there were no known occurrences of TECs for the general area of Mundaring Weir. Occurrences of the 'Critically Endangered' communities known as 'Shrublands and woodlands of the eastern side of the Swan Coastal Plain' and 'Eucalyptus calophylla – Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain' and an occurrence of the 'Endangered' TEC known as 'Banksia attenuata woodland over species rich dense shrublands' occur nearby to the general Mundaring area. The potential for these communities to occur in the study site was taken into consideration during the field surveys.

2.4 Flora

Flora species that are considered to be significant are listed under the Western Australian *Wildlife Conservation Act 1950* and the Commonwealth *EPBC Act*. A description of the DEC's conservation codes is provided in **Table 5, Appendix B**.

A search of the DEC's Rare Flora Databases and the Western Australian Herbarium indicates that a number of significant species are known to occur in the general Mundaring area. There are no records of significant species at or near to the site, but this may simply reflect the lack of flora surveys conducted in the area. The recorded significant species in the general vicinity of the site are presented in **Table 2** and **Figure 1, Appendix A**. Please note that a large search area was requested due to the large study area for all the Mundaring WTP site options, and this search area has resulted in a large number of recorded significant flora species.

Table 2 Significant Flora Species Previously Recorded within the Mundaring Area (Source: DEC and the WA Herbarium)

Species	Conservation Code
<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i>	P3
<i>Adenanthos filifolius</i>	P3
<i>Acacia anomala</i>	DRF
<i>Acacia aphylla</i>	DRF
<i>Acacia horridula</i>	P3
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	P3
<i>Anthocercis gracilis</i>	DRF
<i>Aotus cordifolia</i>	P3
<i>Boronia tenuis</i>	P4
<i>Bossiaea modesta</i>	P2
<i>Caladenia arrecta</i>	P4



<i>Cyanicula ixiooides</i> subsp. <i>ixiooides</i>	P4
<i>Darwinia apiculata</i>	DRF
<i>Darwinia pimelioides</i>	P4
<i>Daviesia oxylobium</i>	P4
<i>Diplolaena andrewsii</i>	P2
<i>Grevillea drummondii</i>	
<i>Grevillea flexuosa</i>	DRF
<i>Grevillea pimeleoides</i>	P4
<i>Halgania corymbosa</i>	P3
<i>Hemigenia rigida</i>	P1
<i>Isopogon drummondii</i>	P3
<i>Lasiopetalum bracteatum</i>	P4
<i>Lepyrodia heleocharoides</i>	P3
<i>Persoonia sulcata</i>	P4
<i>Pimelea rara</i>	P4
<i>Pithocarpa corymbulosa</i>	P2
<i>Scholtzia</i> sp. Bickley	P1
<i>Senecio gilbertii</i>	P1
<i>Senecio leucoglossus</i>	P4
<i>Stylidium</i> sp. Boulder Rock	
<i>Stylidium striatum</i>	P4
<i>Templetonia drummondii</i>	P4
<i>Tetratheca pilifera</i>	P3
<i>Tetratheca</i> sp. Granite	P3
<i>Thelymitra manginiorum</i>	DRF
<i>Thysanotus anceps</i>	P3
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4
<i>Verticordia serrata</i> var. <i>linearis</i>	P3



2.5 Fauna

A search of the Western Australian Museum records was undertaken which determined that 19 amphibian species, 46 bird species, 26 mammal species, 3 fish species and 56 reptile species have been recorded within the general Mundaring area. These results are included in **Table 10, Appendix D**. Please note that a large area was searched for fauna records, due to the large study area for all the Mundaring WTP site options, and this search area has resulted in a substantial number of recorded fauna species.

2.5.1 Fauna of Conservation Significance

The conservation status of fauna species is assessed under State and Commonwealth Acts; in particular the Western Australian *Wildlife Conservation Act 1950*; *Wildlife Conservation (Specially Protected Fauna) Notice 2006*, and the Commonwealth *EPBC Act*.

The significance levels for fauna used in the *EPBC Act* are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). These levels are described in **Table 7, Appendix D**.

The *EPBC Act* also has lists of migratory species that are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals).

Listed migratory species also include any native species identified in an international agreement approved by the Commonwealth Environment Minister. The Minister may approve an international agreement for this purpose if satisfied that it is an agreement relevant to the conservation of migratory species.

In Western Australia, the *Wildlife Conservation (Specially Protected Fauna) Notice 2006* has significant levels for fauna classified in a series of Schedules (**Table 8, Appendix C**). The DEC also produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the Western Australian *Wildlife Conservation Act 1950* but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered and they need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in **Table 9, Appendix C**.

A listing of Significant Fauna from the *EPBC Act* Protected Matters Search Tool and Rare and Priority species from the DEC's rare fauna database for the general Mundaring area are presented in **Table 3**.

It should be noted that the results of the searches are only an indication of the threatened fauna that may be present in the general area and detailed fauna surveys, including trapping programs are required to verify these results.



Table 3 Listing of Potentially Occurring Rare and Priority Fauna Species – Mundaring Weir area (Source: EPBC Act Protected Matters Search and DEC Threatened and Priority Fauna Database search results for the general Mundaring Weir area)

Genus	Species	Common Name	DEC/ Wildlife Conservation Act 1950 Rating	EPBC Act Rating	DEC Database	EPBC Act Protected Matters search
<i>Dasyurus</i>	<i>geoffroii</i>	Chuditch	Vulnerable / Schedule 1	Vulnerable	x	
<i>Myrmecobius</i>	<i>fasciatus</i>	Numbat	Vulnerable / Schedule 1	Vulnerable	x	
<i>Calyptorhynchus</i>	<i>latirostris</i>	Carnaby's Cockatoo	Endangered / Schedule 1	Endangered	x	
<i>Calyptorhynchus</i>	<i>baudinii</i>	Baudin's Cockatoo	Endangered / Schedule 1	Vulnerable		x
<i>Pseudocheirus</i>	<i>occidentalis</i>	Western Ringtail Possum	Vulnerable / Schedule 1	Vulnerable		X
<i>Phascogale</i>	<i>tapoatafa tapoatafa</i>	Southern Brush-tailed Phascogale	Priority 3		x	
<i>Macropus</i>	<i>irma</i>	Western Brush Wallaby	Priority 4		x	
<i>Hydromys</i>	<i>chrysogaster</i>	Water-rat (Rakali)	Priority 4		x	
<i>Isoodon</i>	<i>obesulus fusciventer</i>	Quenda	Priority 5		x	
<i>Haliaeetus</i>	<i>leucogaster</i>	White-bellied Sea-eagle		Migratory		X
<i>Apus</i>	<i>pacificus</i>	Fork-tailed Swift		Marine		X
<i>Ardea</i>	<i>alba</i>	Great Egret, White Egret		Marine		X



Genus	Species	Common Name	DEC/ Wildlife Conservation Act 1950 Rating	EPBC Act Rating	DEC Database	EPBC Act Protected Matters search
<i>Ardea</i>	<i>ibis</i>	Cattle Egret		Marine		X
<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater		Marine		X



Some species that appear in the *EPBC Act* Protected Matters Search Tool are often unlikely to occur within the specified area, as the search provides an approximate guidance to matters of national significance that require further investigation. The records from the DEC searches of threatened fauna provide more accurate information for the general area. However some records of sightings or trappings can be dated and often misrepresent the current range of threatened species.

The habitat requirements of the protected species listed under the *EPBC Act*, the *Wildlife Conservation Act 1950* and listed as priority species by the DEC, and the likelihood of their occurrence in the site is considered below.

***Dasyurus geoffroii* Chuditch**

The Chuditch is the largest carnivorous marsupial in Western Australia. This species occupies a wide range of habitats including woodlands, riparian vegetation, beaches and deserts. The Chuditch formerly ranged over nearly 70 % of Australia but now retains only a patchy distribution through the Jarrah forest and mixed Karri/Marri/Jarrah forest of south-western WA. This reduction in range and decline in population numbers have been caused by habitat alteration, impacts from the introduction of foxes and cats, hunting and poisoning (CALM, 2005a).

The site contains some habitat that is suitable for Chuditch and they have been known to occur in the region, so while the habitat available is not optimum for this species there is potential for Chuditch to utilise the site.

***Myrmecobius fasciatus* Numbat**

The Numbat is a small, banded, diurnal marsupial that feeds solely on termites. This species once ranged widely in southern semi-arid and arid Australia, distributed within a number of vegetation types. However, the Numbat's current distribution is limited to Dryandra and Perup/Kingston area east of Manjimup and a number of nature reserves into which it has been reintroduced. This species occupies a number of habitat types including Jarrah forest, open eucalypt woodland, Banksia woodland and tall closed shrubland (CALM, 2005b).

This species only occurs in isolated populations in Western Australia, in a number of small reserves, and it is highly unlikely that this species would be found at the site.

***Calyptorhynchus latirostris* Carnaby's Cockatoo**

Carnaby's Cockatoo, also known as the Short-billed Black-Cockatoo, is distributed across the south-west of Western Australia in uncleared or remnant areas of eucalypt woodland and shrubland or Kwongan heath. Breeding usually occurs in the Wheatbelt region of Western Australia, with flocks moving to the higher rainfall coastal areas to forage after the breeding season. These black cockatoos feed on the seeds of a variety of native plants, including *Allocasuarina*, *Banksia*, *Dryandra*, *Eucalyptus*, *Grevillea* and *Hakea*, and some introduced plants, including *Pinus*. They will also feed on the nectar from flowers of a number of species, and on insect larvae. Carnaby's Cockatoo has been listed as Endangered under the Federal *EPBC Act*.



This species is known to occur in the study area and could use a number of the plant species on this site for foraging.

***Calyptrorhynchus baudinii* Baudin's Cockatoo**

Baudin's Cockatoo, also known as the Long-billed Black-Cockatoo, is found in the south-west of Western Australia in the forest and woodlands of Jarrah (*Eucalyptus marginata*), Karri (*E. diversicolor*) and Marri (*Corymbia calophylla*). The primary food source of this cockatoo is the seeds of the Marri (Garnett and Crowley, 2000). This species has been impacted by the removal of large Marri throughout its range. Baudin's Cockatoo has been listed as Vulnerable under the Commonwealth *EPBC Act*.

Baudin's Cockatoo are known to occur in the Mundaring area and the site contains habitat that is suitable for this species. This species may utilise the site for foraging, and the site also contains Marri trees, that are used by this cockatoo for breeding.

***Pseudocheirus occidentalis* Western Ringtail Possum**

The Western Ringtail Possum (*Pseudocheirus occidentalis*) is found in the south-west of Western Australia, with a patchy occurrence from the Collie River to Two Peoples Bay (Jones, *et al.*, 1994). Urban populations of this species are located in Busselton, as well as East Augusta and Albany.

This species was recorded in the *EPBC Act* Protected Matters Search but this species is not known from the Mundaring area and this record is likely to be inaccurate.

***Phascogale tapoatafa tapoatafa* Southern Brush-tailed Phascogale**

This arboreal marsupial occurs in forest and woodland with suitable tree hollows. Populations fluctuate dramatically in response to invertebrate prey abundance. This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. Records are less common from wetter forests (CALM, 2005c).

The Southern Brush-tailed Phascogale is known to occur in low densities in the northern Jarrah forests. This species is known to occur in the Mundaring area and may occur on the study site.

***Macropus irma* Western Brush Wallaby**

The Western Brush Wallaby, a medium sized macropod, is a grazer found primarily in open forest and woodland. This species was once very common in the south-west of Western Australia but has undergone a reduction in range and a significant decline in abundance in its current habitat. The decline in populations of this species has resulted from extensive clearing within its original distribution and from predation of juvenile Western Brush Wallabies by foxes (CALM, 2005d).

This species is not protected under legislation but is listed as a Priority 4 species by DEC, which means it is a species in need of monitoring. This species is known to occur in the general area and may occur on the study site.



***Hydromys chrysogaster* Water-rat (Rakali)**

The water rat occupies habitat in the vicinity of permanent water and nests are constructed in logs or at the end of tunnels dug into banks. Unlike many other Australian rodents, the water rat is not entirely nocturnal, with activity usually high at sunset, though animals have been seen foraging during the day. The water rat is an opportunistic predator, feeding upon large aquatic insects, fish, crustaceans and mussels. They are also known to feed on frogs, lizards, small mammals, fresh carrion, and birds (CALM, 2005e).

This species may occur in the general Mundaring area but there is no suitable habitat for this species at the study site and it would be unlikely to occur here.

***Isoodon obesulus fusciventer* Quenda**

The Quenda is an omnivorous marsupial that occurs in the south-west of Western Australia. It prefers areas with dense understorey vegetation, particularly around swamps and along watercourses. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. On the Swan Coastal Plain Quenda are often associated with wetlands (CALM, 2005f).

Quenda are known to occur in the Mundaring region and may be present at the site.



3. Field Survey

3.1 Survey Methods

GHD has conducted site visits to determine; a species list for the site (including dominant species), map vegetation type, condition and weed status, assess the site for the presence of TECs, assess fauna habitat potential and to determine the general environmental characteristics of the site. Brief site visits occurred on 11 April, 2007 and 20 June 2007, with a full day visit on 28 June 2007.

A reconnaissance survey was conducted for the presence of fauna. A consideration of fauna habitat was undertaken within the study area.

Nomenclature of the species follows that of *Florabase* (2007) for flora species and the *Faunabase* (2007) for fauna species.

3.2 Vegetation Types

The majority of the O'Connor Site supports Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) Forest. The site has been logged previously and the vegetation is regrowth. In some areas the previous logging activities have removed much of the overstorey and the vegetation consists of an open woodland. In these areas the understorey is generally intact and there is evidence of regeneration of the mid and overstorey. In the northern section of the study area Jarrah is dominant and there is less evidence of logging activities. On the uplands in the east and north of the site the overstorey cover increases and includes the additional species Sheoak (*Allocasuarina fraseriana*) and Bull Banksia (*Banksia grandis*) amongst Jarrah and Marri.

Some sections of the site, particularly the area adjacent and east of the central track, are dominated by species such as Parrot Bush (*Dryandra sessilis*), a well known colonising species of disturbed areas.

Small sections of the site, specifically the access tracks and cleared patches that have been classified as vegetation "Degraded / Cleared / Planted". While many of these areas do not contain vegetation there are some planted with non-native species, including eastern states Eucalyptus and *Acacia* species.

A full description of the vegetation types, photographs and inventory of vascular plants is provided in **Appendix B** and **Appendix C** and this is mapped at **Figure 2**.

3.3 Vegetation Condition

The vegetation in the study area was given a condition rating based on the Bush Forever (Government of Western Australia, 2000) vegetation condition ratings scale. This scale recognises a level of intactness of vegetation, which is defined by the following:

- » Completeness of structural levels;
- » Extent of weed invasion;



- » Historical disturbance from tracks and other clearing or dumping;
- » The potential for natural or assisted regeneration.

The ratings in this scale are described as follows:

Table 4 Government of Western Australia (2000) Vegetation Condition Scale

Assigned Number	Classification	Description
1	<i>Pristine or nearly so</i>	No obvious signs of disturbance
2	<i>Excellent</i>	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species
3	<i>Very Good</i>	Vegetation structure altered, obvious signs of disturbance
4	<i>Good</i>	Vegetation structure significantly altered by very obvious signs of multiple disturbance, retains basic vegetation structure or ability to regenerate it
5	<i>Degraded</i>	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	<i>Completely Degraded</i>	The structure of the vegetation is no longer intact and the area is completely or almost without native species

In the south-west of the O'Connor Site there is evidence of previous disturbance factors, particularly near to the access tracks that occur throughout the site. The overstorey is generally sparse in this area and many of the mature trees appear to have been removed, most likely by previous logging. The disturbance is also evident in areas where disturbance specialist species, such as Parrot Bush (*Dryandra sessilis*), are dominant. There are a number of introduced species at the site, particularly along the edge of the access tracks. Generally, the condition of the vegetation improves away from the road where the structure of the understorey is considerably better.

Most of the south-west of the site was rated between Condition 3 (*Very Good*) to Condition 4 (*Good*). While there is some disturbance in these areas the vegetation structure remains intact and the site retains the ability to regenerate to a better condition. Away from the main access tracks the vegetation structure is still generally intact and there is less evidence of disturbance, these areas were rated Condition 2 (*Excellent*). The tracks and cleared patches of land, with no native vegetation remaining were rated as Condition 6 (*Completely Degraded*). The vegetation condition of the site is recorded at **Figure 3**.



3.3.1 Plant Pests and Diseases

There was some evidence to suggest that *Phytophthora cinnamomi* (commonly known as dieback) was present within the Site, based on patterns of death of susceptible plants. There appears to be a “dieback-line” along a contour on the hillside in the east of the site, with the vegetation above this line less affected than that directly below. Parts of the State Forest surrounding the site have been badly impacted by Dieback in the past and to the east of the site there is an old marked “Disease-risk Area”.

Should this site be considered further for the Mundaring WTP the determination of the presence of dieback should be assessed formally by a DEC interpreter or equivalent. Strict hygiene measures will be required during construction activities at the site to prevent the spread of Dieback.

3.4 Threatened Ecological Communities

No TECs were identified during the field survey.

3.5 Flora

The Site has moderate species diversity with a total of 105 taxa (95 native taxa) from 35 families recorded within the surveyed area.

The dominant families recorded from the area were:

» Proteaceae	13 taxa
» Myrtaceae	8 taxa
» Mimosaceae	7 taxa
» Asteraceae	6 taxa
» Haemodoraceae	6 taxa
» Papilionaceae	6 taxa

Additionally, the dominant genus recorded was:

» <i>Acacia</i>	7 taxa
» <i>Hibbertia</i>	5 taxa
» <i>Drosera</i>	4 taxa
» <i>Dryandra</i>	4 taxa
» <i>Hakea</i>	4 taxa

Fifteen species were identified to genus only, due to lack of distinctive features, such as flowers. Additionally three species were identifiable to family only, as there was only young growth of the plant and there were not enough identifying features available. Field surveys at different times of year would allow the identification of a greater number of plant species.

See **Appendix B** for a full list of flora species recorded in the project area.



3.5.1 Significant Species

No DRF or Priority flora species were identified during the survey. However, a full spring flora and fauna survey will be required if the O'Connor site is chosen as the preferred site for the WTP.

3.5.2 Weeds

Weed species were mostly evident along the road that passes through the site and in the old plantation in the south-east of the site. There was also some weed species scattered throughout the area of native vegetation. However, in general the number of weedy plants at the site was very low and the weed invasion of the native vegetation was limited.

A total of 10 weed species were recorded within the Site, which represents 9.5 % of the total species recorded. These were mainly daisies (Asteraceae) and *Acacias* (Mimosaceae) from the eastern states.

3.6 Fauna

3.6.1 Fauna Species

A number of fauna species occur in the general vicinity of the site and the site would provide habitat for a number of fauna species. An opportunistic fauna survey was completed in association with the flora survey. The results from this survey are included in **Table 10, Appendix D**.

The opportunistic survey noted a number of species, particularly bird species and the site appears to support a healthy population of woodland bird species. The number of species determined during the opportunistic species was limited by the short period of the survey and the fact that it was purely opportunistic and did not provide the opportunity to survey those species that are cryptic or not active during the day. Further detailed fauna surveys will be required once the final site of the Mundaring WTP has been selected.

The site has the potential to support some significant fauna species, it is unlikely to be considered as 'significant' habitat for these species. Of significance, noted in the opportunistic survey were feeding signs of black-cockatoos, including the Forest Red-tailed Black-cockatoo, species that are listed under both the *Wildlife Conservation Act 1950* and the *EPBC Act*.

3.6.2 Habitat Value

The site is within the northern Jarrah Forest of the Darling Scarp, which is an important area of fauna habitat as it contains significant areas of largely uninterrupted native vegetation. Many fauna species that have become locally extinct elsewhere due to large-scale development and clearing still occur within the remnant Jarrah Forest, and these areas are very important as habitat refuge for fauna in south-west Western Australia.



The habitat value of the site was assessed during the survey. The site contains native vegetation and while it is mainly regrowth with some areas showing evidence of disturbance the majority of the site has value as habitat for native fauna. However, the habitat type is uniform across the site and is generally well-represented in the surrounding area.

The site does not contain the balance of ecological niches that occur in well-preserved forests, such as trees at a range of ages and a good collection of microhabitats, such as logs and extensive leaf litter. However, while it is regrowth forest and most of the trees are the same age, the site has regenerated well and does contain some microhabitats, such as tree stumps and some mature trees.

The understorey of much of the site is in good condition and offers good cover for fauna species. In the more highly disturbed sections the cover is limited but shows potential to regenerate and provide shelter for fauna.

Of particular importance at the site are the few mature Eucalypt trees (particularly Marris) that are of good size and which either contain hollows or are of an age conducive to hollow formation. Lack of hollows for shelter and breeding is a limiting factor for a number of threatened species, including black-cockatoos, and all hollow-bearing and mature trees should be protected where possible.

3.6.3 Habitat Linkages

Fauna corridors and habitat linkages are important to allow animals to move between areas of resource availability. Such corridors are important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction. Corridors are essential in areas with limited habitat, such as largely cleared landscapes where fauna habitat is generally present in isolated remnants.

While there are some degraded areas in the site with limited cover the majority of the area contains good quality understorey that would be used for the movement of fauna. The clearing of the site would cause some fragmentation of fauna habitat and interruption to fauna movements. However, the site is relatively small and there are large areas of good quality bushland on all sides that would provide alternate habitat linkages. If the O'Connor site is selected as the preferred site the degraded areas of site with limited cover should be used in preference to the areas of good quality habitat linkages.



4. Conclusions and Recommendations

The preliminary flora and fauna investigations for the O'Connor Site included a desktop assessment and a preliminary field assessment. The results of the assessment concluded that:

- » The Site is located within State Forest at the junction of Mundaring Weir Road and Firewood Road.
- » The majority of the O'Connor Site supports Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) Forest. The site has been logged previously and the vegetation is regrowth. In some areas the previous logging activities have removed much of the overstorey and the vegetation consists of an open woodland. In these areas the understorey is generally intact and there is evidence of regeneration of the mid and overstorey. Some sections of the site are dominated by disturbance specialist species such as Parrot Bush (*Dryandra sessilis*).
- » In the south-west of the O'Connor site there is evidence of previous disturbance factors, particularly near to the access tracks that occur throughout the site. Generally, the condition of the vegetation improves away from the road and in these areas the structure of the understorey is generally intact. Most of the south-west of the site was rated between Condition 3 (*Very Good*) to Condition 4 (*Good*). While there is disturbance evident in these areas the vegetation structure remains intact and the site retains the ability to regenerate to a better condition. Additionally, away from the main access tracks the vegetation structure is still generally intact and there is less evidence of disturbance, these areas were rated Condition 2 (*Excellent*).
- » No Declared Rare Flora (DRF) or Priority flora species were identified during the survey. While it is unlikely that the site supports significant flora species a spring flora survey will be required if this site is selected as the preferred site for the WTP.
- » The site contains a number of introduced species, particularly around the cleared and disturbed areas. Weed species present included introduced *Acacias* and *Eucalypts*. However, the introduced species are predominantly restricted to the disturbed areas and the majority of the bushland is relatively weed-free.
- » A number of fauna species occur in the general vicinity of the site and the site would provide habitat for a number of fauna species. A number of species were observed during the opportunistic surveys, particularly woodland bird species. While the site has potential to support some significant fauna species it is unlikely to be considered as containing 'significant' habitat for these species. The habitat type is uniform across the site and is well-represented in the surrounding area.

The O'Connor Site contains native vegetation, predominantly Marri-Jarrah forest. While this site has been subject to a number of historical disturbances, particularly logging, it still contains areas of good quality vegetation and is of value as fauna habitat. While there does not appear to be any 'significant'



ecological constraints at this site, clearing of native vegetation will be required and there will be impacts on native flora and fauna.

This preliminary flora and fauna assessment is sufficient for comparative purposes during the site selection process. However, if this site becomes the preferred location for the WTP a spring flora and fauna survey will be required at this site.



5. Limitations

This report presents the results of a Preliminary Flora and Fauna Assessment prepared for the purpose of this commission. The data and advice provided herein relate only to the project described herein and must be reviewed by a competent scientist before being used for any other purpose. GHD accepts no responsibility for other use of the data.

Where reports, searches, any third party information and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

For these investigations GHD has conducted desktop data searches and preliminary field surveys. The conclusions of this report were based on the information gathered during these investigations and thus reflect the environment of the site at the time of survey. GHD accepts no responsibility for any variation in the flora and fauna present at the site due to natural and seasonal variability.



6. References

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Appendix A

Figures

- Figure 1** **Location Plan and Environmental Constraints**
- Figure 2** **Vegetation Type at the O'Connor Site**
- Figure 3** **Vegetation Condition at the O'Connor Site**



Appendix B

Flora

Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species.

Flora List for the Pine Plantation Site



Table 5 Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species.

Conservation Code	Description
R: Declared Rare 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.
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 are in urgent need of 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 are in need of further survey.
P4: Priority Four – Taxa in need of monitoring	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.



Table 6 Flora List for the O'Connor Site (Surveyed: 11/04/07, 20/06/07 and 28/06/07)

Family	Genus	Species	Common Name	Status
Anthericaceae	<i>Chamaescilla</i>	<i>corymbosa</i>	Blue Squill	
Apiaceae	<i>Pentapeltis</i>	<i>peltigera</i>		
Apiaceae	<i>Platysace</i>	<i>compressa</i>	Tapeworm Plant	
Apiaceae	<i>Trachymene</i>	<i>pilosa</i>	Native Parsnip	
Asteraceae	? <i>Senecio</i>	sp.		*
Asteraceae	<i>Hypochaeris</i>	sp.		*
Asteraceae	<i>Lagenophora</i>	<i>huegelii</i>		
Asteraceae	<i>Olearia</i>	<i>paucidentata</i>	Autumn Scrub Daisy	
Asteraceae	sp.			*
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Ursinia	*
Casuarinaceae	<i>Allocasuarina</i>	<i>fraseriana</i>	Sheoak	
Colchicaceae	<i>Burchardia</i>	<i>congesta</i>	Milkmaids	
Cyperaceae	<i>Lepidosperma</i>	<i>leptostachyum</i>		
Cyperaceae	<i>Lepidosperma</i>	<i>obtusum</i>		
Cyperaceae	<i>Tetraria</i>	<i>capillaris</i>	Hair Sedge	
Dasypogonaceae	<i>Lomandra</i>	? <i>caespitosa</i>	Tufted Mat Rush	
Dasypogonaceae	<i>Lomandra</i>	? <i>nigricans</i>		
Dasypogonaceae	<i>Lomandra</i>	sp.		
Dilleniaceae	<i>Hibbertia</i>	<i>amplexicaulis</i>		
Dilleniaceae	<i>Hibbertia</i>	<i>huegelii</i>		
Dilleniaceae	<i>Hibbertia</i>	<i>hypericoides</i>	Yellow Buttercups	
Dilleniaceae	<i>Hibbertia</i>	<i>ovata</i>		
Dilleniaceae	<i>Hibbertia</i>	<i>serrata</i>	Serrate Leaved Guinea Flower	
Droseraceae	<i>Drosera</i>	? <i>pulchella</i>	Pretty Sundew	
Droseraceae	<i>Drosera</i>	<i>erythrorhiza</i>	Red Ink Sundew	
Droseraceae	<i>Drosera</i>	<i>menziesii</i>	Pink Rainbow	
Droseraceae	<i>Drosera</i>	<i>microphylla</i>	Golden Rainbow	
Epacridaceae	<i>Astroloma</i>	<i>glaucescens</i>		
Epacridaceae	<i>Astroloma</i>	<i>pallidum</i>	Kick Bush	
Epacridaceae	<i>Leucopogon</i>	<i>capitellatus</i>		



Family	Genus	Species	Common Name	Status
Epacridaceae	<i>Leucopogon</i>	<i>propinquus</i>		
Epacridaceae	<i>Leucopogon</i>	<i>verticillatus</i>	Tassel Flower	
Euphorbiaceae	<i>Phyllanthus</i>	<i>calycinus</i>	False Boronia	
Goodeniaceae	<i>Dampiera</i>	<i>linearis</i>	Common Dampiera	
Goodeniaceae	<i>Lechenaultia</i>	sp.		
Haemodoraceae	<i>Anigozanthos</i>	sp.		
Haemodoraceae	<i>Conostylis</i>	<i>aculeata</i>	Prickly Conostylis	
Haemodoraceae	<i>Conostylis</i>	<i>setigera</i>	Bristly Cottonhead	
Haemodoraceae	<i>Conostylis</i>	<i>setosa</i>	White Cottonhead	
Haemodoraceae	<i>Haemodorum</i>	sp.		
Haemodoraceae	<i>Tribonanthes</i>	sp.		
Haloragaceae	<i>Glischrocaryon</i>	<i>aureum</i>	Common Popflower	
Iridaceae	<i>Patersonia</i>	sp.		
Iridaceae	<i>Romulea</i>	<i>rosea</i>	Guildford Grass	*
Lauraceae	<i>Cassytha</i>	sp.		
Loranthaceae	<i>Amyema</i>	<i>?miquelii</i>	Stalked Mistletoe	
Mimosaceae	<i>Acacia</i>	<i>alata var. alata</i>		
Mimosaceae	<i>Acacia</i>	<i>baileyana</i>		*
Mimosaceae	<i>Acacia</i>	<i>drummondii</i> subsp. <i>drummondii</i>	Drummond's Wattle	
Mimosaceae	<i>Acacia</i>	<i>iteaphylla</i>		*
Mimosaceae	<i>Acacia</i>	<i>pulchella</i>	Prickly Moses	
Mimosaceae	<i>Acacia</i>	<i>pycnantha</i>	Golden Wattle	*
Mimosaceae	<i>Acacia</i>	<i>urophylla</i>		
Myrtaceae	<i>?Calytrix</i>	<i>angulata</i>	Yellow Starflower	
Myrtaceae	<i>Corymbia</i>	<i>calophylla</i>	Marri	
Myrtaceae	<i>Eucalyptus</i>	<i>?fibrosa</i> subsp. <i>fibrosa</i>		*planted
Myrtaceae	<i>Eucalyptus</i>	<i>marginata</i>	Jarrah	
Myrtaceae	<i>Eucalyptus</i>	sp.		*planted
Myrtaceae	<i>Hypocalymma</i>	<i>angustifolium</i>	White Myrtle	
Myrtaceae	<i>Kunzea</i>	<i>micrantha</i>		
Myrtaceae	<i>Leptospermum</i>	<i>erubescens</i>	Roadside Teatree	
Orchidaceae	<i>Pterostylis</i>	<i>?vittata</i>	Banded Greenhood	



Family	Genus	Species	Common Name	Status
Orchidaceae	<i>Pyrorchis</i>	<i>nigricans</i>	Red Beaks	
Orchidaceae	sp.			
Orchidaceae	<i>Thelymitra</i>	sp.		
Papilionaceae	<i>Bossiaea</i>	<i>pulchella</i>		
Papilionaceae	<i>Chorizema</i>	sp.		
Papilionaceae	<i>Daviesia</i>	<i>angulata</i>		
Papilionaceae	<i>Daviesia</i>	<i>divaricata</i>	Marno	
Papilionaceae	<i>Gompholobium</i>	<i>knightianum</i>		
Papilionaceae	<i>Hovea</i>	<i>chorizemifolia</i>	Holly-leaved Hovea	
Papilionaceae	<i>Hovea</i>	sp.		
Papilionaceae	<i>Hovea</i>	<i>trisperma</i>	Common Hovea	
Papilionaceae	<i>Kennedia</i>	<i>prostrata</i>	Scarlet Runner	
Phormiaceae	<i>Dianella</i>	<i>revoluta</i>	Blueberry Lily	
Pittosporaceae	<i>Billardiera</i>	<i>heterophylla</i>	Australian Bluebell	
Poaceae	<i>Eriachne</i>	<i>ovata</i>		
Poaceae	sp.			
Polygalaceae	<i>Comesperma</i>	<i>virgatum</i>	Milkwort	
Proteaceae	<i>Adenanthos</i>	<i>barbiger</i>		
Proteaceae	<i>Banksia</i>	<i>grandis</i>	Bull Banksia	
Proteaceae	<i>Dryandra</i>	<i>bipinnatifida</i>		
Proteaceae	<i>Dryandra</i>	<i>lindleyana</i> var. <i>?mellicula</i>	Couch Honeypot	
Proteaceae	<i>Dryandra</i>	<i>praemorsa</i>	Urchin Dryandra	
Proteaceae	<i>Dryandra</i>	<i>sessilis</i> var. <i>sessilis</i>	Parrot Bush	
Proteaceae	<i>Grevillea</i>	<i>quercifolia</i>	Oak-leaf Grevillea	
Proteaceae	<i>Grevillea</i>	<i>synapheae</i> subsp. <i>synapheae</i>	Catkin Grevillea	
Proteaceae	<i>Hakea</i>	<i>amplexicaulis</i>	Prickly Hakea	
Proteaceae	<i>Hakea</i>	<i>lissocarpha</i>	Honey Bush	
Proteaceae	<i>Hakea</i>	<i>ruscifolia</i>	Candle Hakea	
Proteaceae	<i>Hakea</i>	<i>undulata</i>	Wavy-leaved Hakea	
Proteaceae	<i>Synaphea</i>	<i>acutiloba</i>	Granite Synaphea	
Ranunculaceae	<i>Clematis</i>	<i>aristata</i> var. <i>occidentalis</i>		



Family	Genus	Species	Common Name	Status
Restionaceae	<i>Desmocladus</i>	<i>asper</i>		
Restionaceae	<i>Loxocarya</i>	<i>cinerea</i>		
Rhamnaceae	<i>Trymalium</i>	<i>floribundum</i> Steud. subsp <i>floribundum</i>		
Rhamnaceae	<i>Trymalium</i>	<i>ledifolium</i> var. <i>rosmarinifolium</i>		
Rutaceae	<i>Philotheca</i>	<i>spicata</i>	Pepper and Salt	
Santalaceae	<i>Leptomeria</i>	<i>cunninghamii</i>		
Stylidiaceae	<i>Stylidium</i>	<i>amoenum</i>	Lovely Triggerplant	
Stylidiaceae	<i>Stylidium</i>	sp.		
Thymelaeaceae	<i>Pimelea</i>	sp.		
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>gracilis</i>	Graceful Grass Tree	
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>preissii</i>	Grasstree	
Zamiaceae	<i>Macrozamia</i>	<i>riedlei</i>	Zamia	

* Introduced species



Appendix C
Vegetation

Vegetation Community Descriptions at the Site



Appendix D

Fauna

*Environment Protection And Biodiversity Conservation Act
1999 Fauna Conservation Categories*

*Western Australian Wildlife Conservation Act 1950 Fauna
Conservation Codes*

DEC Priority Fauna Conservation Codes.

Fauna Species that may occur in the O'Connor Site



Table 7 Environment Protection And Biodiversity Conservation Act 1999 Fauna Conservation Categories

Conservation Category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Know)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

EPBC Act Categories

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- » Lead to a long-term decrease in the size of a population, or
- » Reduce the area of occupancy of the species, or
- » Fragment an existing population into two or more populations, or
- » Adversely affect habitat critical to the survival of a species, or
- » Disrupt the breeding cycle of a population, or
- » Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- » Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*, or
- » Interfere with the recovery of the species.



** Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- » Lead to a long-term decrease in the size of an important population of a species, or
- » Reduce the area of occupancy of an important population, or
- » Fragment an existing important population into two or more populations, or
- » Adversely affect habitat critical to the survival of a species, or
- » Disrupt the breeding cycle of an important population, or
- » Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- » Result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*, or
- » Interferes substantially with the recovery of the species.

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- » Key source populations either for breeding or dispersal,
- » Populations that are necessary for maintaining genetic diversity, and/or
- » Populations that are near the limit of the species range.

** Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.*

Table 8 Western Australian Wildlife Conservation Act 1950 Fauna Conservation Codes

Conservation Code	Description
Schedule 1	"...fauna that is rare or likely to become extinct, are declared to be fauna that is in need of special protection."
Schedule 2	"...fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection."
Schedule 3	"...birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection."
Schedule 4	"...fauna that is in need of special protection, otherwise than for the reasons mentioned [in Schedule 1 – 3]"



Table 9 DEC Priority Fauna Conservation Codes. (Species not listed under the Wildlife Conservation Act 1950, but for which there is some concern).

Conservation Code	Description
Priority 1	Taxa with few, poorly known populations on threatened lands.
Priority 2	Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc.
Priority 3	Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
Priority 4	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.
Priority 5	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.



Table 10 Fauna Species that may occur in the O'Connor Site (Source: Western Australian Museum *Faunabase* Search of the Mundaring area); and those recorded during the opportunistic fauna surveys.

Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Birds					
Acanthizidae	Acanthiza	<i>chrysorrhoa</i>	Yellow-rumped Thornbill		
Accipitridae	<i>Accipiter</i>	<i>fasciatus fasciatus</i>	Brown Goshawk		
Accipitridae	<i>Aquila</i>	<i>audax</i>	Wedge-tailed Eagle		
Aegothelidae	<i>Aegotheles</i>	<i>cristatus cristatus</i>	Australian Owlet Nightjar		
Anatidae	<i>Chenonetta</i>	<i>jubata</i>	Australian Wood Duck		
Ardeidae	<i>Ixobrychus</i>	<i>minutus dubius</i>	Little Bittern	P2	
Campephagidae	<i>Coracina</i>	<i>maxima</i>	Ground Cuckoo-shrike		
Columbidae	<i>Phaps</i>	<i>chalcoptera</i>	Common Bronzewing		+
Corvidae	<i>Corvus</i>	<i>bennetti</i>	Little Crow		
Corvidae	<i>Corvus</i>	<i>coronoides</i>	Australian Raven		+
Cracticidae	<i>Cracticus</i>	<i>tibicen dorsalis</i>	Australian Magpie		+
Cracticidae	<i>Strepera</i>	<i>versicolor</i>	Grey Currawong		
Cuculidae	<i>Chrysococcyx</i>	<i>lucidus plagosus</i>	Shining Bronze-cuckoo		
Cuculidae	<i>Cuculus</i>	<i>pallidus</i>	Pallid Cuckoo		
Dicruridae	<i>Rhipidura</i>	<i>fuliginosa preissi</i>	Grey Fantail		+
Falconidae	<i>Falco</i>	<i>berigora berigora</i>	Brown Falcon		
Falconidae	<i>Falco</i>	<i>longipennis longipennis</i>	Australian Hobby		
Halcyonidae	<i>Dacelo</i>	<i>novaeguineae</i>	Laughing Kookaburra	*	+
Hirundinidae	<i>Hirundo</i>	<i>nigricans</i>	Tree Martin		



Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Maluridae	<i>Malurus</i>	<i>elegans</i>	Red-winged Fairy-wren		
Meliphagidae	<i>Acanthorhynchus</i>	<i>superciliosus</i>	Western Spinebill		+
Meliphagidae	<i>Lichmera</i>	<i>indistincta</i>	Brown Honeyeater		+
Meliphagidae	<i>Phylidonyris</i>	<i>novaehollandiae</i>	New Holland Honeyeater		+
Motacillidae	<i>Anthus</i>	<i>australis australis</i>	Richard's Pipit		
Pachycephalidae	<i>Pachycephala</i>	<i>pectoralis fuliginosa</i>	Golden Whistler		
Pardalotidae	<i>Pardalotus</i>	<i>punctatus punctatus</i>	Spotted Pardalote		
Pardalotidae	<i>Pardalotus</i>	<i>punctatus xanthopyge</i>	Yellow-rumped Pardalote		
Pardalotidae	<i>Pardalotus</i>	<i>striatus</i>	Striated Pardalote		
Passeridae	<i>Neochmia</i>	<i>temporalis temporalis</i>	Red-browed Finch		
Passeridae	<i>Stagonopleura</i>	<i>oculata</i>	Red-eared Firetail		
Petroicidae	<i>Petroica</i>	<i>multicolor campbelli</i>	Scarlet Robin		+
Phasianidae	<i>Pavo</i>	<i>cristatus</i>	Common Peafowl (Indian Peafowl)	*	
Podargidae	<i>Podargus</i>	<i>strigoides brachypterus</i>	Tawny Frogmouth		
Psittacidae	<i>Calyptorhynchus</i>	<i>banksii</i>	Red-tailed Black Cockatoo		
Psittacidae	<i>Calyptorhynchus</i>	<i>banksii naso</i>	Forest Red-tailed Black Cockatoo	Schedule 1 / Vulnerable (DEC)	
Psittacidae	<i>Calyptorhynchus</i>	<i>baudinii</i>	Baudin's Cockatoo	Schedule 1 / Endangered (DEC) (EPBC - Vulnerable)	
Psittacidae	<i>Calyptorhynchus</i>	<i>latirostris</i>	Carnaby's Cockatoo	Schedule 1 / Endangered	+
Psittacidae	<i>Calyptorhynchus</i>	<i>sp</i>			



Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Psittacidae	<i>Melopsittacus</i>	<i>undulatus</i>	Budgerigar		
Psittacidae	<i>Neophema</i>	<i>elegans</i>	Elegant Parrot		
Psittacidae	<i>Platycercus</i>	<i>icterotis</i>	Western Rosella		
Psittacidae	<i>Platycercus</i>	<i>spurius</i>	Red-capped Parrot		
Psittacidae	<i>Platycercus</i>	<i>zonarius</i>	Australian Ringneck (Ring-necked Parrot)		
Psittacidae	<i>Platycercus</i>	<i>zonarius torquatus</i>	Twenty-eight Parrot		+
Psittacidae	<i>Polytelis</i>	<i>anthopeplus anthopeplus</i>	Regent Parrot		
Rallidae	<i>Porzana</i>	<i>pusilla palustris</i>	Baillon's Crake		
Rallidae	<i>Porzana</i>	<i>tabuensis</i>	Spotless Crake		
Strigidae	<i>Ninox</i>	<i>connivens</i>	Barking Owl	P2 (<i>N. connivens connivens</i>)	
Strigidae	<i>Ninox</i>	<i>novaeseelandiae</i>	Boobook Owl		
Strigidae	<i>Ninox</i>	<i>novaeseelandiae boobook</i>	Boobook Owl		
Turnicidae	<i>Turnix</i>	<i>varia varia</i>	Painted Bustard-Quail		
Turdidae	<i>Petroica</i>	<i>multicolor</i>	Scarlet Robin		+
Mammals					
Burramyidae	<i>Cercartetus</i>	<i>concinnus</i>	Western Pygmy-possum / Mundarda		
Dasyuridae	<i>Antechinus</i>	<i>flavipes</i>	Yellow-footed Antechinus		
Dasyuridae	<i>Antechinus</i>	<i>flavipes leucogaster</i>	Mardo		
Dasyuridae	<i>Dasyurus</i>	<i>geoffroi</i>	Western Quoll / Chuditch	Schedule 1 / Vulnerable	
Dasyuridae	<i>Phascogale</i>	<i>tapoatafa tapoatafa</i>	Brush-tailed Phascogale / Wambenger	P3	



Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Dasyuridae	<i>Sminthopsis</i>	<i>gilberti</i>	Gilbert's Dunnart		
Felidae	<i>Felis</i>	<i>catus</i>	Cat	*	
Macropodidae	<i>Macropus</i>	<i>eugenii derbianus</i>	Tammar Wallaby	P5	
Macropodidae	<i>Macropus</i>	<i>fuliginosus</i>	Western Grey Kangaroo		+
Macropodidae	<i>Macropus</i>	<i>irma</i>	Western Brush Wallaby	P4	
Macropodidae	<i>Setonix</i>	<i>brachyurus</i>	Quokka	Schedule 1 / Vulnerable	
Muridae	<i>Hydromys</i>	<i>chrysogaster</i>	Water Rat	P4	
Muridae	<i>Mus</i>	<i>musculus</i>	House Mouse	*	
Muridae	<i>Rattus</i>	<i>rattus</i>	Black Rat	*	
Mustelidae	<i>Mustela</i>	<i>putorius</i>	European Polecat / Ferret	*	
Myrmecobiidae	<i>Myrmecobius</i>	<i>fasciatus</i>	Numbat / Walpurti	Schedule 1 / Vulnerable	
Peramelidae	<i>Isoodon</i>	<i>obesulus fusciventer</i>	Quenda / Southern Brown Bandicoot	P5	
Phalangeridae	<i>Trichosurus</i>	<i>vulpecula vulpecula</i>	Common Brushtail Possum		
Tachyglossidae	<i>Tachyglossus</i>	<i>aculeatus</i>	Short-beaked Echidna		
Tarsipedidae	<i>Tarsipes</i>	<i>rostratus</i>	Honey Possum / Noolbenger		
Thylacomyidae	<i>Macrotis</i>	<i>lagotis</i>	Bilby	Schedule 1 / Vulnerable	
Vespertilionidae	<i>Chalinolobus</i>	<i>gouldii</i>	Gould's Wattled Bat		
Vespertilionidae	<i>Nyctophilus</i>	<i>geoffroyi</i>	Lesser Long-eared Bat		
Vespertilionidae	<i>Nyctophilus</i>	<i>timoriensis timoriensis</i>	Greater Long-eared Bat		
Vespertilionidae	<i>Vespadelus</i>	<i>regulus</i>	Southern Forest Bat		



Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Reptiles					
Agamidae	<i>Ctenophorus</i>	<i>ornatus</i>	Ornate Rock Dragon		
Agamidae	<i>Pogona</i>	<i>minor minor</i>	Western Bearded Dragon		
Agamidae	<i>Rankinia</i>	<i>adelaidensis</i>	Western Heath Dragon		
Boidae	<i>Antaresia</i>	<i>stimsoni stimsoni</i>	Western Stimson's Python		
Boidae	<i>Morelia</i>	<i>spilota imbricata</i>	Southern Carpet Python	Schedule 4	
Cheluidae	<i>Chelodina</i>	<i>oblonga</i>	Oblong Turtle		
Elapidae	<i>Acanthophis</i>	<i>antarcticus</i>	Southern Death Adder	P3	
Elapidae	<i>Brachyuropsis</i>	<i>semifasciata</i>	Southern Shovel-nosed Snake		
Elapidae	<i>Notechis</i>	<i>scutatus</i>	Tiger Snake		
Elapidae	<i>Parasuta</i>	<i>gouldii</i>	Gould's Snake		
Elapidae	<i>Parasuta</i>	<i>nigriceps</i>	Black-backed Snake		
Elapidae	<i>Pseudechis</i>	<i>australis</i>	Mulga Snake		
Elapidae	<i>Pseudonaja</i>	<i>affinis affinis</i>	Dugite		
Elapidae	<i>Pseudonaja</i>	<i>modesta</i>	Ringed Brown Snake		
Elapidae	<i>Pseudonaja</i>	<i>nuchalis</i>	Gwardar		
Gekkonidae	<i>Christinus</i>	<i>marmoratus</i>	Marbled Gecko		
Gekkonidae	<i>Diplodactylus</i>	<i>granariensis granariensis</i>	Wheatbelt Stone Gecko		
Gekkonidae	<i>Diplodactylus</i>	<i>polyopthalmus</i>	Speckled Stone Gecko		
Gekkonidae	<i>Gehyra</i>	<i>variegata</i>	Variiegated Tree Dtella		
Gekkonidae	<i>Strophurus</i>	<i>spinigerus</i>	Western Spiny-tailed Gecko		



Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Gekkonidae	<i>Strophurus</i>	<i>spinigerus inornatus</i>	Western Spiny-tailed Gecko		
Gekkonidae	<i>Underwoodisaurus</i>	<i>milii</i>	Barking Gecko		
Pygopodidae	<i>Aprasia</i>	<i>pulchella</i>	Granite Worm Lizard		
Pygopodidae	<i>Aprasia</i>	<i>repens</i>	Sandplain Worm Lizard		
Pygopodidae	<i>Lialis</i>	<i>burtonis</i>	Burton's Legless Lizard		
Pygopodidae	<i>Pygopus</i>	<i>lepidopodus</i>	Common Scaly-foot		
Scincidae	<i>Acritoscincus</i>	<i>trilineatum</i>	Southwestern Cool Skink		
Scincidae	<i>Cryptoblepharus</i>	<i>plagiocephalus</i>	Fence or Wall Skink		
Scincidae	<i>Ctenotus</i>	<i>delli</i>	Dell's Skink	P4	
Scincidae	<i>Ctenotus</i>	<i>fallens</i>	-		
Scincidae	<i>Ctenotus</i>	<i>labillardieri</i>	Red-legged Skink		
Scincidae	<i>Egernia</i>	<i>kingii</i>	King's Skink		
Scincidae	<i>Egernia</i>	<i>napoleonis</i>	Southwestern Crevice Skink		
Scincidae	<i>Eremiascincus</i>	<i>richardsonii</i>	Banded Skink		
Scincidae	<i>Hemiergis</i>	<i>initialis</i>	Five-toed Earless Skink		
Scincidae	<i>Hemiergis</i>	<i>initialis initialis</i>	Five-toed Earless Skink		
Scincidae	<i>Lerista</i>	<i>distinguenda</i>	-		
Scincidae	<i>Lerista</i>	<i>elegans</i>	-		
Scincidae	<i>Lerista</i>	<i>microtis</i>	-		
Scincidae	<i>Menetia</i>	<i>greyii</i>	Common Dwarf Skink		
Scincidae	<i>Morethia</i>	<i>lineocellata</i>	-		



Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Scincidae	<i>Morethia</i>	<i>obscura</i>	Woodland Flecked Skink		
Scincidae	<i>Tiliqua</i>	<i>rugosa rugosa</i>	Southwestern Bobtail		
Typhlopidae	<i>Ramphotyphlops</i>	<i>australis</i>	-		
Typhlopidae	<i>Ramphotyphlops</i>	<i>pinguis</i>	-		
Typhlopidae	<i>Ramphotyphlops</i>	<i>waitii</i>	-		
Varanidae	<i>Varanus</i>	<i>gouldii</i>	Gould's Sand Monitor		
Varanidae	<i>Varanus</i>	<i>tristis tristis</i>	Black-headed Monitor		
Amphibia					
Hylidae	<i>Litoria</i>	<i>adelaidensis</i>	Slender Tree Frog		
Hylidae	<i>Litoria</i>	<i>moorei</i>	Motorbike Frog or Bell Frog		
Myobatrachidae	<i>Crinia</i>	<i>georgiana</i>	Quacking Frog		+
Myobatrachidae	<i>Crinia</i>	<i>glauerti</i>	Glauerts' Froglet		
Myobatrachidae	<i>Crinia</i>	<i>pseudinsignifera</i>	Bleating Froglet		
Myobatrachidae	<i>Geocrinia</i>	<i>leai</i>	Lea's Frog		
Myobatrachidae	<i>Heleioporus</i>	<i>albopunctatus</i>	Western Spotted Frog		
Myobatrachidae	<i>Heleioporus</i>	<i>barycragus</i>	Western Marsh Frog		
Myobatrachidae	<i>Heleioporus</i>	<i>eyrei</i>	Moaning Frog		
Myobatrachidae	<i>Heleioporus</i>	<i>inornatus</i>	Whooping Frog		
Myobatrachidae	<i>Heleioporus</i>	<i>psammophilus</i>	Sand Frog		
Myobatrachidae	<i>Limnodynastes</i>	<i>dorsalis</i>	Bullfrog or Banjo Frog		
Myobatrachidae	<i>Myobatrachus</i>	<i>gouldii</i>	Turtle Frog		



Family	Genus	Species	Common Name	Status	Recorded During the Field Survey
Myobatrachidae	<i>Pseudophryne</i>	<i>guentheri</i>	Crawling Frog or Gunther's Toadlet		
Fish					
Poeciliidae	<i>Gambusia</i>	<i>affinis</i>	Mosquito Fish / Plague Minnow	*	



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