Canning Bridge Structure Plan

Preliminary Environmental Impact Assessment Report

28 February 2014

Executive Summary

GHD Pty Ltd (GHD) has been commissioned by the City of Melville on behalf of the Project Partners to undertake a preliminary environmental impact assessment (PEIA) for the Canning Bridge Structure Plan ('the study area'). The PEIA builds on the environmental assessment (EA) report completed during Phase 1 of the project.

The PEIA ('this report') considers the impacts from those elements of the Structure Plan which could not avoid environmental constraints. Aspects and associated works taken into account for this report include:

- Development of the Canning Bridge transport hub;
- Upgrade of the Canning Bridge;
- Change to high density housing;
- Re-creation of wetlands along the foreshore; and
- Removal of existing buildings.

The key environmental impacts identified for this Project include the following:

- Potential impacts to vegetation and flora resulting from the structure plan are limited mainly to clearing for the transport hub and removal of fringing vegetation for the foreshore development areas. Vegetation in the transport hub area was identified as planted with some native species. The foreshore development areas were identified as mainly planted and native species in poor condition. Impacts are not expected to be significant as a result of vegetation clearing, and could be mitigated by the development of a rehabilitation and landscaping plan for both developments. The re-creation of the wetland habitats along the river is likely to improve the river ecosystem and should be undertaken as soon as practicable.
- Impacts to vegetation associated with the Swan and Canning River ESA may occur on a minor level during the construction of the foreshore development areas, transport hub and the new Canning Bridge. Very little native vegetation remains in these areas and impacts are not considered likely to be significant. In addition, the development of the re-created wetland areas are anticipated to result in improved vegetation within the ESA. Impacts to the ESA should be discussed with the DER and a Construction Environmental Management Plan (CEMP) developed for the Canning Bridge and transport hub projects to mitigate any impacts associated with construction.
- Some minimal impacts to bird habitat, particularly Black Cockatoo habitat, are considered likely to result from the works that will be undertaken as part of the structure plan. No fauna habitat was identified in the transport hub area, however some fauna habitat is present in the foreshore development area and a small area may be impacted by the new Canning Bridge construction. Impacts to fauna habitat are considered minimal in light of the re-creation of the foreshore wetland areas as part of the structure plan, which should provide increased fauna habitat in the area.
- Impacts to marine and estuarine diversity may occur as a result of the Canning Bridge construction, including sediment plumes from piling (if required) and should be taken into account during development of a CEMP for this construction. A more in-depth impact assessment is recommended for this project prior to construction.
- Impacts to the estuarine environment may also result from the transport hub, which is likely to include the development of a ferry terminal and jetty construction. The jetty construction may include piling, and cause sediment plumes and other impacts to

estuarine habitat. The development of the transport hub should be the subject of a separate impact assessment once the construction footprint and facility design has been established.

- Surface water impacts will need to be considered during the works associated with the structure plan, to prevent contaminated runoff entering the Swan River. A Local Water Management Strategy is currently being developed as part of the structure plan to treat general stormwater flows that currently come off the catchment area and directly into the Swan River, and have the potential to impact the marine and estuarine environment. This is largely proposed to be achieved through ensuring that all stormwater from constructed surfaces receives treatment through an appropriate water sensitive urban design measure prior to discharge, and through incorporation of current management practice into stormwater design and retrofit. Future developments are also required to identify and manage the risk of disturbance of acid sulfate soils, contaminated sites and dewatering where necessary, and liaise with the local government authority and appropriate agencies including DER, Department of Water and DPaW where required.
- There may be Native Title implications associated with use and development of land within the study area and discussions with the DAA and the Native Title Claimants at an early stage is recommended.
- The upgrade of Canning Bridge is proposed as part of the future works under the structure plan and any development/redevelopment of Canning Bridge will require consultation with the Heritage Council of Western Australia.
- The management of contamination should be undertaken in accordance with the *Contaminated Sites Act 2003* dependent upon the final use of the site under the structure plan. Contaminated sites will need to be taken into account during the development works and remediated as required.
- Hazardous materials, such as asbestos should also be taken into account during the upgrade or demolition of old buildings. Any hazardous materials that will be disturbed as a result of the structure plan should be removed and disposed of in an appropriate manner so as not to cause potential contamination.
- Although the modelling suggests the structure plan will allow an increase in movement overall, the type of movement appears to shift from private vehicle trips to other forms of transport or technology. In both the 2031 and 2051 scenarios, the use of private motor vehicles is predicted to be lower for the structure plan than the current zoning. The increase in movement is accommodated by public transport, walking, cycling and teleworking. The predicted shift to more sustainable forms of transport is likely to offset an increase in movement volume resulting in no net change in air quality.

Approvals

Referral to the Department of the Environment (DotE)

The impacts to Matters of National Environmental Significance are anticipated to be minimal as a result of the structure plan works and therefore referral is not considered necessary at this stage in the planning process.

Referral to the Environmental Protection Authority (EPA)

The Planning Legislation Amendment Act 1996 introduced the environmental assessment of land-use planning schemes in recognition that is it more appropriate to apply environmental valuation under Section 48 of the EP Act at the rezoning stage than during individual works. The

structure plan will require a scheme amendment to change the current local government zoning, and therefore impacts and compatibility with the surrounding area of the amendment will need to be environmentally assessed under Section 48 of the EP Act.

Clearing Permit

If the project is referred to the EPA as a scheme amendment and approved, a clearing permit may still be required under Part V of the EP Act for works that involve native vegetation clearing and for any clearing in the Swan Canning River ESA.

An assessment against the Ten Clearing Principles will be required to inform the clearing permit application.

Contamination Reclassification or Remediation

Contaminated sites have been identified in the Study area and these may be impacted during future works. Contaminated site investigations should be undertaken and where necessary, management/remediation of the site conducted. Discussions with the DER are recommended if contaminated sites are to be impacted, as reclassification of the site and approval for use following remediation may be required prior to undertaking the proposed development.

Acid Sulfate soils

If ASS are present at the site and occur in high concentrations, an acid sulfate soil management plan will need to be developed and approved by the DER.

Department or Parks and Wildlife (DPaW) and Swan River Trust

The Environment Minister recently announced that the Swan River Trust will be amalgamated with DPaW to provide better protection and management for the Swan and Canning river systems. Legislation to give effect to the amalgamation is currently being drafted and amendments will be made to both the *Conservation and Land Management Act 1984* and the *Swan and Canning Rivers Management Act 2006*. In the meantime, impacts to the Swan River will require consultation and development approval through the Swan River Trust, and it is expected that a similar approval will be required once the amalgamation of the trust and department is completed.

Department of Water

A permit to disturb bed and banks will be required from the Department of Water for any works that will disturb the Swan and Canning River bed or banks. Any dewatering required for construction will require a 5C Licence to Take Water.

Department of Aboriginal Affairs

There are a number of Aboriginal Heritage Sites listed within and around the Study area. The Swan and Canning Rivers are also listed Aboriginal Heritage sites and as such, any development along the foreshore will be required to consider Aboriginal Heritage issues. Consent of the Minister via a Section 18 application to the Department of Aboriginal Affairs will be required to impact these sites.

Native Title

There may be Native Title implications associated with use and development of land within the study area and discussions with the DAA and the Native Title Claimants at an early stage is recommended.

Heritage Council of WA

The Heritage Council of Western Australia is the State Government's advisory body, set up under the provisions of the *Heritage of Western Australia Act 1990*. The Act provides for the compilation of Western Australia's (State) Register of Heritage Places, a Statutory Database, and a Municipal Inventory for each Local Government Authority. Under the Act the State Register of Heritage Places carries legal implications over other government departments, municipal councils, developers and individual property owners. If any state heritage sites are to be removed or impacted by future works, a licence will be required. In particular, the upgrade of Canning Bridge is proposed as part of the future works under the structure plan and any development/redevelopment of Canning Bridge will require consultation with the Heritage Council of Western Australia to obtain a licence.

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1. Introduction

1.1 Purpose of this Report

GHD Pty Ltd (GHD) has been commissioned by the City of Melville on behalf of the Project Partners[1] to undertake a preliminary environmental impact assessment (PEIA) for the Canning Bridge Structure Plan ('the study area'). The PEIA builds on the environmental assessment (EA) report completed during Phase 1 of the project, which included a desktop review of available information (literature and databases) and site visits to identify the terrestrial and marine/estuarine flora and fauna and habitats within the footprint of the development.

The outcomes of the EA report was used to inform the Structure Plan in terms of the environmental constraints and opportunities associated with study area. These constraints and opportunities influenced the Structure Plan in terms of location and/or size of various elements, POS, areas to be avoided or managed for certain types of development and areas/sites which can be incorporated or enhanced for the Structure Plan.

The PEIA ('this report') considers the impacts from those elements of the Structure Plan which could not avoid environmental constraints. Aspects and associated works taken into account for this report include:

- Development of the Canning Bridge transport hub;
- Upgrade of the Canning Bridge;
- Change to high density housing;
- Re-creation of wetlands along the foreshore; and
- Removal of existing buildings.

The requirements for environmental approvals under State and Federal Acts are also discussed in this report. Due to the nature of the works (to occur in the future and involving multiple projects and agencies) impacts resulting from the project have been generalised, and recommendations and approvals are based on this. These may be required at the planning stages or at later construction phases. Further and more specific impact assessments are recommended for each individual element, particularly the development of the Canning Bridge transport hub and upgrade of the Canning Bridge.

1.2 Study Area

The study area is outlined in Figure 1 and can be broadly defined by a 1,000 m radius centred on the Canning Bridge train station, representing development within a short (approximately 15 minutes) walk to the station.

To the west of the study area, immediately across the river is the Canning Bridge commercial hub which is mixed use (commercial, residential, recreational, restaurants/cafes etc.). The area is generally well developed and includes the Raffles Hotel development amongst the medium to high-rise developments as well as a significant number of established, private homes. To the east of the study area, the suburbs of Como and Manning are generally comprised of established, private residential areas with low density housing.

[1] The City of Melville is the contracting party, with the client group inclusive of the City of Melville, The City of South Perth, the Department of Planning/Western Australian Planning Commission, the Department of Transport, the Public Transport Authority and Main Roads WA. The client group will be referred to as the Project Partners.

1.3 Report Limitations and Assumptions

This report has been prepared by GHD for the Project Partners and may only be used and relied on by the Project Partners for the purpose agreed between GHD and the Project Partners as set out in section 1.1 of this report, as provided in the project brief.

GHD otherwise disclaims responsibility to any person other than the Project Partners arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by the City of Melville and the City of South Perth and Government authorities, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based, in part, on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points. Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances, site contamination, species and communities of conservation significance) may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Methodology

2.1 Desktop Assessment

A desktop review was undertaken prior to the commencement of field surveys to identify any potentially sensitive areas. This included:

- A review of the Western Australian Department of Parks and Wildlife (DPaW) (formerly Department of Environment and Conservation (DEC)) Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC) databases to determine the potential for TECs or PECs present within the study area and surrounds;
- A review of the DPaW Flora Database for records of conservation significant species recorded within the study area and surrounds;
- A review of the Commonwealth Department of the Environment (DotE) (formerly the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)) Protected Matters Search Tool – to identify species or communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the study area and surrounds;
- A review of notable flora and fauna listed within the Commonwealth Directory of Important Wetlands in Australia for the Swan-Canning Estuary-WA091;
- A search of the Western Australian Museum NatureMap Database – to determine vertebrate fauna species and flora previously recorded within the study area and surrounds;
- A review of publications by Beard (1979) and Heddle *et al*. (1980) and vegetation mapping for the study area;
- A search of DPaW's Environmentally Sensitive Areas (ESA) Database to identify any ESAs in the study area;
- A search of DER's contaminated sites database to identify any contaminated sites in the study area;
- A search of the Western Australian Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System to identify any aboriginal heritage sites within the study area;
- A search of the Heritage Council of WA State Heritage Office InHerit database to identify any heritage places within the study area; and
- A search of the National Native Title Tribunal (NNTT) Native Title Vision database to identify any Native Title claims within the study area.

2.2 Field Methodology

Site visits were conducted by ecologists on 22 August and 20 September 2012. The area surveyed included only the areas accessible on foot along the Swan River which have the potential to be impacted by the proposed Canning Bridge Activity Centre Structure Plan.

2.2.1 Vegetation Field Survey

The vegetation assessment involved surveying the relevant areas of the study area on foot and recording the vegetation condition and any conservation significant plant species present (visible) at the time of the survey.

The methodology used to undertake the vegetation assessment included:

- Listing the dominant flora in each structural layer;
- Visual assessment of the vegetation condition along the Swan River. The vegetation conditions were assessed using a condition rating scale which recognises the completeness of the structural levels, extent of disturbance (i.e. weeds, clearing, development) and the potential for natural or assisted regeneration. The scale consisted of five rating levels including:
  - Native–Good condition;
  - Native–Medium condition;
  - Native–Poor condition;
  - Native vegetation with some planted species;
  - Planted vegetation;
- Opportunistic searches of the vegetation to identify flora species of conservation significance; and
- Species-specific search strategies to identify any areas of potential habitat for conservation significant species.

2.2.2 Fauna Field Survey

The fauna assessment was consistent with a Level 1 assessment (reconnaissance survey) in accordance with Guidance Statement No. 56, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*. Nomenclature used in the report follows that used by the Western Australian Museum NatureMap program, as it is deemed to contain the most up-to-date species information for Western Australia.

The methodology used to undertake the fauna assessment included:

- Opportunistic searches across all habitat types within the study area. This ensured the maximum suite of species potentially occurring at the study area was observed. This involved searching through microhabitats including turning over logs or rocks, turning over leaf litter and examining hollow logs;
- Opportunistic visual and aural surveys. This accounted for many bird species potentially utilising the study area;
- The study area was searched for tracks, scats, bones, diggings and feeding areas for both native and feral fauna;
- Species specific search strategies were used to identify any protected species in the area or signs that they utilise the study area; and
- Domestic animals that were present at the study area through recreational activities were discounted in the species diversity results for this Report.

The fauna assessment only included the areas bordering the Swan River that were accessible on foot, and as such only these areas were surveyed for potential habitat. Fauna species were opportunistically recorded during the field survey; however a detailed fauna assessment was not included due to the already developed and highly degraded nature of the study area.

2.2.3 Marine and Estuarine Assessment

The methodology used to undertake the vegetation assessment included:

- Assessment of the estuarine littoral zone;
- Opportunistic visual survey for evidence of shore birds;

- Opportunistic visual survey for marine macroalgae (including algal bloom assessment), marine macroflora and marine megafauna;
- Opportunistic visual survey for EPBC Act Threatened and Migratory species, or evidence of existence, such as turtle tracks; and
- Assessment of dominating anthropogenic influences on the estuarine littoral zone.

The marine and estuarine assessment only included areas of the littoral zone, and as such is not a full marine assessment. Marine and estuarine macroalgae, flora and macrofauna were opportunistically recorded during the survey

2.3 Limitations

2.3.1 Desktop Investigation Limitations

Desktop investigations used a variety of online resources (such as the NatureMap and the EPBC Protected Matter Database) the responsibility for the accuracy of such data remains with the issuing authority, not with GHD. The DotE Protected Matters Search Tool is used to identify species listed under the EPBC Act; this database draws on various sources to report on the potential of the species occurrence within the area. The DotE search tool is broad-scale in its reporting and often the specific habitat requirements of the species do not occur within project sites and are unlikely to occur within the area. For this reason not all species reported by the search tool need to be considered in management decisions. The NatureMap database reports on actual records of the species within the designated area and can provide more accurate information of the likelihood of species presence.

2.3.2 Fauna Survey Limitations

The fauna assessment undertaken was an explorative survey only and thus only sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings etc. Many cryptic and nocturnal species would not have been identified through this type of survey and seasonal variation within species often requires targeted surveys at a particular time of the year.

The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the study area. There was no sampling for invertebrates or aquatic species. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.

This survey was carried out during only one season and in one year. Complete faunal surveys often require multiple surveys, at different times of year, and over a period of a number of years, to enable full survey of all species present.

2.3.3 Marine and Estuarine Survey Limitations

The marine and estuarine survey was an explorative survey only, and thus only sampled those species that could easily be seen or have distinctive signs, such as turtle tracks or evidence of habitat utilisation, i.e. roosting, nesting etc. Marine, cryptic and nocturnal species have not been included during this explorative survey and a targeted, repeated survey would be required to provide a full marine and estuarine survey. This assessment was aimed at identifying marine and estuarine flora, fauna and algae in the study area estuarine littoral zone only.

2.3.4 Impact Assessment Limitations

The impact assessment was undertaken based on the general structure plan and did not include a specific assessment of the future individual works proposed for areas within the

structure plan. Further impact assessments may be required at the planning stages or at later construction phases. Further and more specific impact assessments are recommended for each individual element, particularly the development of the Canning Bridge transport hub and upgrade of the Canning Bridge.

3. Results and Discussion

3.1 Vegetation and Flora

3.1.1 Vegetation Type

Broadscale vegetation mapping of the area (Beard, 1979 and Shepherd *et al*., 2002) identified the following vegetation association within the study area:

- Medium woodland; tuart & jarrah [*E. marginata*] (association 6)

In addition, the Heddle *et al*. (1980) mapping identified the following two broad vegetation complexes of the Swan Coastal Plain within the study area (Government of Western Australia, 2000):

- Karrakatta complex – central and south (complex 49): Predominantly open forest of *E. gomphocephala – E. marginata – C. calophylla* and woodland of *E. marginata – Banksia* species
- Bassendean complex – Central and South (complex 44): Vegetation ranges from woodland of *E. marginata - C. fraseriana – Banksia* spp. To low woodland of Melaleuca species, and sedgelands on the moister sites.

3.1.2 Broad Vegetation Extent and Status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia, 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia's Biological Diversity (ANZECC, 2000) and in EPA Position Statement No. 2 on environmental protection of native vegetation in Western Australia (EPA, 2000).

From a purely biodiversity perspective and taking no account of any other land degradation issues, there are a number of key criteria now being applied to the clearing of native vegetation in Western Australia (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 extent of the vegetation type.
- A level of 10% of the original extent is regarded as being a level representing *Endangered*.
- Clearing which would increase the threat level into the class below should be avoided.
- Stream reserves should generally be in the order of at least 200 metres (m) wide.

Within the Swan Coastal Plain, EPA Position Statement No. 9 (EPA, 2006b) identifies vegetation complexes with 30 percent or less or their pre-clearing extent remaining in a bioregion, or 10 percent or less of their pre-clearing extent remaining in constrained areas (i.e. areas of urban development in cities and major town) on the Swan Coastal Plain, to be critical assets. The study area is considered to be within a constrained area of the Swan Coastal Plain.

The extent of remnant native vegetation has been assessed by Shepherd *et al*. (2002) and the Government of Western Australia (2014), based on broadscale vegetation association mapping by Beard (1979). The EPA Guidance Statement No. 10 (EPA, 2006a) also assesses the extent

of Heddle *et al*. (1980) vegetation complexes currently present against presumed pre-European extents. The assessment is reproduced for the Beard vegetation association 6 and Heddle *et al*. vegetation complex 44 and 49 Table 1 and Table 2, respectively.

On the basis the study area is considered to be within a constrained area, the Beard (1979) vegetation association and both Heddle *et al*. (1980) vegetation complexes (except at a local government scale) have more than 10 percent of their pre-European/pre-1750 extents remaining at all scales and are therefore not considered to be critical assets.

However, at the local government scale (City of South Perth and City of Melville) the Beard (1979) vegetation association 6 and Heddle *et al*. (1980) vegetation complex 44 and 49 have less than 10 percent of their pre-European extents remaining within this region and are considered to be *Endangered* and be critical assets.

Table 1 Extent of Beard (1979) vegetation associations within the study area

Vegetation association description	Vegetation association	Region	Pre-European extent (ha)	Current extent (ha)	Percent remaining	Percent current extent protected (IUCN I–IV) for conservation (proportion of pre-European extent)
Medium woodland; tuart & jarrah [*E. marginata*]	6	State	56,343.01	14,018.02	24.88	3.33
		IBRA bioregion				
		IBRA sub-region				
		City of Melville	3,687.76	159.52	4.33	0.20
		City of South Perth	1,397.31	30.72	2.20	0.06

Table 2 Extent of Heddle et al. (1980) vegetation complexes within the study area

Vegetation complex description	Vegetation complex	Region	Total pre-European extent (ha)	Present extent (ha)	Percent of pre-European extent remaining	Percent of pre-European extent with formal and informal protection
Bassendean complex – Central and South	44	Swan Coastal Plain [i]	87,392.73	24,206.24	27.70	8.56
		City of South Perth[ii]	1,670	49.44	2.96	0.00
		City of Melville	2,211	183.27	8.29	0.80
Karrakatta Complex – Central and South	49	Swan Coastal Plain	49,786.04	11,905.85	23.91	9.07
		City of South Perth	190	0.64	0.33	0.00
		City of Melville	2,609	124.21	4.76	1.61

[1] Local Biodiversity Program (2013)

[1] Perth Biodiversity Project (2010)

> 30 percent of pre-1750 extent remaining

10–30 percent of pre-1750 extent remaining

< 10 percent of pre-1750 extent remaining

3.1.3 Vegetation Condition

Due to the highly developed and altered nature of the study area, a broad condition rating scale was used to classify the vegetation within the study area. This scale included the following condition ratings:

1. *Good*-few weeds and planted species;
2. *Medium*-some weeds and degradation; and
3. *Poor*-weeds, degradation, disturbed.

Large portions of vegetation within the study area are also planted, either with native or non-native species; these areas were classified as *Planted* and were not assessed using the rating scale above.

Field Assessment

The majority of vegetation in the study area along the Swan River is in either poor condition or is planted (Figure 4). There are small patches of medium condition native vegetation, and one small area of native vegetation in good condition, which is included in a Bush Forever Site located on the south-eastern side of the Swan River (Figure 3; Table 11, Appendix E).

3.1.4 Significant Flora Species

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have significant impact on species that are recognised by the EPBC Act, and/or the *Wildlife Conservation Act 1950* (WC Act) can warrant referral to the DotE and/or the EPA. In Western Australia the term Declared Rare Flora (DRF) is applied to threatened flora due to the laws regarding threatened flora conservation. The WC Act is the primary wildlife conservation legislation in the State and the Minister for the Environment can declare taxa (species, subspecies or variety) as “Rare Flora” if they are considered to be in danger of extinction, rare or otherwise in need of special protection.” For the purposes of this report, flora listed by the WC Act as DRF is described as *Threatened*.

In Western Australia, the DPaW also maintains a list of Priority Listed Flora species. Conservation codes for Priority species are assigned by DPaW to define the level of conservation significance. Priority species are not currently protected under the WC Act.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant. Further information on the conservation codes relevant to this report is provided in Appendix B.

Desktop assessments identified 22 flora species of conservation significance as potentially occurring within 5 km of the study area (Table 9, Appendix C).

No species of conservation significance were recorded during the GHD field assessment.

Likelihood of Occurrence

Due to the highly degraded nature of the study area, and the lack of suitable habitat, it is unlikely that any of the conservation significant flora species identified through the desktop investigations would occur within the study area.

3.1.5 Potential Impacts

Fringing (or riparian) vegetation is an integral part of a riverine ecosystem and comprises both the terrestrial and emergent vegetation that borders and is influenced by the waterway. Fringing

vegetation supports a diversity of fauna, providing food and shelter for many bird species and other small animals. A dense network of roots enables fringing vegetation to stabilise riverbanks and protect them against erosion from boat wash, river flow and surface water run-off.

Clearing in riparian zones and fringing vegetation can have a variety of impacts. Grasses and weeds often replace native fringing vegetation. In many cases these have only shallow roots making the banks more vulnerable to the hydraulic forces that cause erosion. Bank undercutting and slumping can occur which contribute to increased sedimentation of waterways. Loss of vegetation leads to more rapid overland runoff enabling more nutrients and sediment to enter the waterways. In-stream light availability and temperature increase without overstorey shading and, where nutrients are available, this encourages the growth of submerged aquatic plants, periphyton and filamentous algae. Where plant growth is excessive it can increase the amount of decomposing organic matter in-stream and result in reduced oxygen levels. In-stream plant growth also helps to trap sediments moving downstream, promoting channel infilling and smothering habitat. Reduction in terrestrial insects, woody debris and leaf litter in-stream and increased growth of submerged plants, periphyton and filamentous algae also changes the available habitat and food resources to fish and invertebrate communities. This reduces diversity, with degraded waterways often being dominated by fewer species.

Potential impacts to vegetation and flora resulting from the structure plan are limited mainly to clearing for the transport hub and removal of fringing vegetation for the foreshore development areas. Vegetation in the transport hub area was identified as planted with some native species. The foreshore development areas were identified as mainly planted and native species in poor condition. Impacts are not expected to be significant as a result of vegetation clearing, and could be mitigated by the development of a rehabilitation and landscaping plan for both developments. The re-creation of the wetland habitats along the river is likely to improve the river ecosystem and should be undertaken as soon as practicable.

3.2 Bush Forever

The Bush Forever Strategy is a 10 year strategic plan which formally commenced in 2000 to protect approximately 51, 200 hectares (ha) of regionally significant bushland across approximately 290 Bush Forever Sites. This strategy represents, where achievable, a target of at least 10% of each of the original 26 vegetation complexes of the Swan Coastal Plain portion of the Perth Metropolitan Region (The Government of Western Australia, 2000).

There is one Bush Forever site located adjacent to the Study Area (Figure 3):

- Bush Forever Site No. 227 (Mount Henry Bushland, Salter Point): This Site covers an area of 11.9 ha and is located within the City of South Perth along the Canning River foreshore and adjacent to the Kwinana Freeway reserve. This site includes estuary – sandy bluff, vegetated uplands and vegetated wetlands. The site has been entered into the Register of the National Estate and is subject to protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The Site meets the selection criteria for providing a representation of ecological communities, rarity, maintaining ecological processes or natural systems, scientific or evolutionary importance and general criteria for the protection of wetland, streamline, and estuarine fringing and coastal vegetation. The Bush Forever recommendation for Site No. 227 is:
  - Site with some existing protection;
  - The existing care, control and management the reserve is endorsed by Bush Forever mechanisms; and
  - The purpose of the reserve should be amended to include conservation and appropriate mechanisms applied.

There is also one other Bush Forever Site located in close proximity to the study area:

- Bush Forever Site No. 329 (Point Heathcote Foreshore, Applecross): This site is approximately 400 m to the north-west of the study area. The site contains a wetland (estuary water body) and is listed on the Directory of Important Wetlands in Australia (Swan-Canning Estuary). The existing care, control and management intent of the reserve is endorsed by the Bush Forever mechanisms.

3.2.1 Potential Impacts

Both Bush Forever sites were taken into account during earlier planning and are outside the structure plan impact area. Impacts to these sites are expected to be minimal and limited to potential surface water impacts which could be mitigated as part of the Local Water Management Strategy (See Section 3.7).

3.3 Threatened Ecological Communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English & 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*.

TECs are listed under both State and Federal legislation; Federally listed TECs are protected under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) administered by DotE. The Department of Environment and Conservation (DEC) maintains a list of TECs for Western Australia; some of these TECs are also protected under the EPBC Act.

DEC also maintains a Priority Ecological Community (PEC) List. PECs are not listed under any formal Federal or State legislation but are considered by DEC as important as whole ecosystems (including their processes and communities). Priorities 1, 2 and 3 PECs are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs 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.

Further information on the conservation codes is provided in Appendix B.

A search of the EPBC Act Protected Matters Search Tool and DEC TEC/PEC database identified one PEC within 5 km of the study area. This PEC is Booragoon Lake and is located approximately 1.5 km to the south-west of the study area. It is classified as Priority 2 and is described as:

- Wooded wetlands that support colonial waterbird nesting areas (Booragoon); and
- Stands of *Casuarina obesa* and *Melaleuca strobophylla*

It should be noted that DPaW provides locations for TECs and PECs that have a buffer placed typically at a 500 m radius around the community. As such, the PEC may not be present within the entire extent of the buffer area, and in this case the PEC is not located within the study area (Figure 2).

3.3.1 Potential Impacts

The structure plan is not expected adversely impact the nearby PEC.

3.4 Environmentally Sensitive Areas

A search of the DER Native Vegetation Map for Environmentally Sensitive Areas (ESA) revealed that the Swan and Canning Rivers are classified as an ESA, due to being geomorphic wetlands (Figure 2).

3.4.1 Potential Impacts

Impacts to vegetation associated with the Swan and Canning River ESA may occur on a minor level during the construction of the foreshore development areas, transport hub and the new Canning Bridge. Very little native vegetation remains in these areas and impacts are not considered likely to be significant. In addition, the development of the re-created wetland areas are anticipated to result in improved vegetation within the ESA. Impacts to the ESA should be discussed with the DER and a Construction Environmental Management Plan (CEMP) developed for the Canning Bridge and transport hub projects to mitigate any impacts associated with construction.

Potential impacts to surface water quality in the ESA may result from the proposed developments; these are discussed in Section 3.7.

3.5 Fauna

3.5.1 Fauna Diversity

The NatureMap search reported 257 fauna species previously recorded within 5 km of the Study Area (DEC, 2012b). This included 190 birds, 41 reptiles, 16 mammals and 10 amphibians. This 5 km buffer area includes a range of habitats not present within the study area.

3.5.2 Fauna Habitat

The majority of the study area is moderately developed and as a result there is limited habitat available for fauna species. There are, however, some areas of the river bank along the Swan River which would provide suitable habitat for transitory wading birds. These areas are where there has predominantly been no development or alteration of the river bank, i.e. where there are no retaining walls or mesh matting used to protect the river bank from erosion (Figure 5). In these areas there are grasses and sedges along the water's edge, which waders may use as feeding and roosting grounds (Figure 5). Most of these areas are on the western side of the river (Figure 5; Table 11, Appendix E).

Other parts of the study area may also be used opportunistically by fauna species; however it is most likely that the available habitat is mostly used by wading and migratory birds.

3.5.3 Significant Fauna Species

The Federal conservation level of fauna species and their significance status is assessed under the 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).

The State conservation level of fauna species and their significance status is assessed under State the WC Act (*Wildlife Conservation (Specially Protected Fauna) Notice 2010(2)*). The WC Act uses a set of Schedules but also classifies species using some of the IUCN categories. Schedule 3 fauna species are those which are "subject to an agreement between the Government of Australia and the Governments of Japan, China and the Republic of Korea relating to the protection of migratory birds, are declared to be fauna that is in need of special protection" (Government of Western Australia, 2010)

Additionally, in Western Australia, DPaW produces a supplementary list of Priority Fauna, these being species that are not considered threatened under the WC Act but for which the Department feels there is a cause for concern. These species have no special legislative protection, but their presence would normally be considered relevant to an assessment of the conservation status of an area. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

There were 46 fauna species reported through desktop investigations of the State and Federal databases to occur or potentially occur within 5 km of the study area. This includes 15 birds, 5 mammals, 2 reptiles, one insect and 23 migratory birds (Table 10, Appendix D). No species of conservation significance were recorded during the GHD field assessment.

Reports of conservation significant marine fauna species were generated by desktop investigations as the study area is approximately 10 km from the coastline. These species are omitted from further evaluation because the study area does not have marine habitats.

Likelihood of Occurrence

Due to the developed and degraded nature of the study area, there is a lack of suitable habitat for the majority of the conservation significant fauna species identified through the desktop investigations (Table 11, Appendix E). However, it is possible that the Cockatoo species, including all three Black Cockatoo species, utilise some of the site for feeding. There are several known roosting sites for Carnaby's Black Cockatoo within 5 km of the study area and this species may forage on trees (e.g. pine trees) within the study area.

There is also habitat present for transitory bird waders. Where there are grasses and sedges along the water's edge and where the shore remains unaltered, waders may use this habitat as feeding grounds; therefore, this habitat may be suitable for the 21 species of migratory waders identified in the desktop investigations.

The study area may also provide habitat for the other migratory species identified during the desktop investigations, however, these species are transient and can utilise other areas of similar habitat around the Swan River and, therefore, do not rely on the habitat in the study area.

3.5.4 Potential Impacts

Human activity in the Study area and its catchments has contributed to habitat loss and degradation through:

- clearing for urban, agricultural and industrial development
- loss of fringing vegetation
- weed and invasive species introduction
- drainage discharge
- nutrient and contaminant pollution
- erosion and accretion
- impoundments and changes to flow
- dredging, and
- climate change

Some minimal impacts to bird habitat, particularly Black Cockatoo habitat, are considered likely to result from the works that will be undertaken as part of the structure plan. No fauna habitat was identified in the transport hub area, however some fauna habitat is present in the foreshore

development area and a small area may be impacted by the new Canning Bridge construction. Impacts to fauna habitat are considered minimal in light of the re-creation of the foreshore wetland areas as part of the structure plan, which should provide increased fauna habitat in the area.

3.6 Marine and Estuarine Assessment

3.6.1 Marine and Estuarine Diversity

Desktop reviews of the EPBC Protected Matters Search Tool reported four marine and estuarine faunal species recorded within 5 km of the study area (EPBC, 2012). This included three species of marine turtle and one migratory fish.

The Swan-Canning Estuary is listed within the Directory of Important Wetlands as being nationally important and is noted as being a major nursery area for recreationally and commercially important fish species (Hoeksema & Potter, 2006), a major migration stop-over area for shorebirds and a vital feeding ground for thousands of cormorants (DSEWPaC, 2010).

Species that are noted in the estuary include:

- 137 fish species (breeding zone for Perth herring (*Nematolosa vlaminghi*), pouched lamprey (*Geotria australis*), sea mullet (*Mugil cephalus*), cobbler (*Cnidoglanus macrocephalus*), garfish (*Hyporhampus* spp.) and yellow-eye mullet (*Aldrichetta forsteri*). Used all year round by 12 species; nursery area for 38 species, 55% marine vagrants, e.g. sharks, rays);
- Prevalent moon jellyfish (*Aurelia aurita*);
- Invertebrates (97 species of molluscs, e.g. barnacles, prawns and copepods);
- Dolphins (Holyoake *et al*., 2010);
- Seagrass (*Halophila ovalis*) (Hilman *et al*.1995); and
- 35 macroalgal species (Allender, 1981) (including the green algae *Chaetomorpha linum*, red algae *Graciliaria comosa*, green algae *Ulva flexuosa*, brown algae *Colpomenia sinuos).*

The Swan-Canning Estuary has historically experienced toxic algal blooms and fish kills since the 1870s caused by nutrient-enhanced seasonal variation and land-use change. The most prolific macroalgal species in the estuary has been noted to be the red algae *G.comosa* that can accumulate above shallow soft sediments on soft embayments that can in turn lead to decreased oxygenation and malodour (River Science, 2010), in addition to planktonic cyanobacteria (blue-green algae). The last major toxic blue-green algal bloom occurred in the Swan-Canning Estuary system in January 2000, resulting in unprecedented closure of the whole estuary and its rivers to fishing and recreation for 12 days (DSEWPaC, 2011).

3.6.2 Field Survey Results

The majority of the estuarine littoral zone within the Canning Bridge study area is highly disturbed and altered for human use (Figure 6, Appendix G). Species encountered during the opportunistic survey include the following:

- Pagurid hermit crabs;
- Moon jellyfish (*Aurelia aurita*);
- Blue mussels (*Mytilus edulis*);
- Barnacles (*Balanus variegatus*);

- Macroalgae
- Green macroalgae (*Chaetomorpha linum)*;
- Red macroalgae (*Graciliaria comosa*);
- *Amphipoda* sp;
- Fish (small schooling groups); and
- Infaunal worms.

During the opportunistic site survey, there was no visual evidence to suggest activity of the three species of marine turtle or one migratory fish noted by the EPBC Protected Matters Search Tool or of majority of the species detailed in Section 3.6.1.

Intertidal sand areas were typically found with native and commonly found hermit crabs, jellyfish, mussels, barnacles, infaunal worms and small schooling fish groups that may in turn sustain further marine fauna species detailed in Section 3.6.1.

Areas of the littoral zone that have been subject to significant alteration by either solid rock wall revetment and/or stormwater outfalls provide additional hard substrate that was colonised by macroalgae and amphipod crustaceans. In addition, the stormwater outfalls were typically found to have increased macroalgal growth indicating nutrient enrichment (Appendix G).

During the site survey, evidence was found of recent macroalgal growth and decomposition upon fringing *Juncus* sp. vegetation, however there were no current indications to suggest increasing levels of algae or plankton associated with algal blooms (Appendix G).

3.6.3 Potential Impacts

Impacts to marine and estuarine diversity may occur as a result of the Canning Bridge construction, including sediment plumes from piling (if required) and should be taken into account during development of a CEMP for this construction. A more in-depth impact assessment is recommended for this project prior to construction.

Impacts to the estuarine environment may also result from the transport hub, which is likely to include the development of a ferry terminal and jetty construction. The jetty construction may include piling, and cause sediment plumes and other impacts to estuarine habitat. The development of the transport hub should be the subject of a separate impact assessment once the construction footprint and facility design has been established.

Surface water impacts will need to be considered during the works associated with the structure plan, to prevent contaminated runoff entering the Swan River.

A Local Water Management Strategy is currently being developed as part of the structure plan to treat general stormwater flows that currently come off the catchment area and directly into the Swan River, and have the potential to impact the marine and estuarine environment. The aim of the Strategy is to implement a number of stormwater treatment areas to prevent an increase in storm water flows and contamination as a result of the structure plan, and generally improve the quality of water currently discharging into the Swan River (see Section 3.7).

3.7 Surface Water

Under natural conditions the coarse textured nature of the soils within the study area would limit runoff from undisturbed areas, with rainfall infiltrating to groundwater, topping up aquifers and provide runoff to vegetation. Urbanisation and particularly road development increase the impervious surfaces within a catchment and increase the quantity and rate of runoff generated from these catchments.

As part of the structure plan a Local Water Management Strategy is being developed that proposes a range of water management strategies and design criteria that will improve water quality within the stormwater system, while maintaining the existing stormwater flow volumes and peak flow rates for the Study area.

There is currently no water quality treatment of stormwater prior to discharge into the Swan or Canning Rivers. The Local Water Management Strategy proposes to improve water quality leaving the study area through a hierarchy of principles including:

- Implementation of controls at or near the source to prevent pollutants entering the system and/or treatment of stormwater;
- Install in-transit measures to treat stormwater and mitigate pollutants that have entered the system; and
- Implement end-of-pipe controls to treat stormwater, addressing any remaining pollutants prior to discharging to the river.

This is largely proposed to be achieved through ensuring that all stormwater from constructed surfaces receives treatment through an appropriate water sensitive urban design measure prior to discharge, and through incorporation of current management practice into stormwater design and retrofit. Future developments are also required to identify and manage the risk of disturbance of acid sulfate soils, contaminated sites and dewatering where necessary, and liaise with the local government authority and appropriate agencies including DER, Department of Water and DPaW where required.

3.7.1 Potential Impacts

There are potential impacts to surface water as a result of the structure plan, however the development of a Local Water Management Strategy will aim to identify and manage these impacts. Furthermore, in some instances these design features and management measures may improve on the current situation.

3.8 Geomorphic Wetlands

The Swan and Canning Rivers are classified as “Conservation Category Wetlands”. The objective for Conservation Category wetlands is to preserve the natural attributes and functions of the wetlands. These wetlands can attract buffers of between 50–100 m, depending on the threat to and nature of the wetlands.

3.8.1 Potential Impacts

Minimal impacts to the Swan and Canning Rivers are expected due to the degraded nature of the Study area. However development of the foreshore area, Canning Bridge and the transport hub may impact buffer areas of designated Conservation Category wetlands and therefore discussions with the DER and/or DPaW are recommended.

3.9 Native Title

The *Aboriginal Heritage of the Canning Bridge Activity Centre Structure Plan* includes desktop review of issues related to Native Title in the study area.

Native Title describes the rights of Aboriginal people in land that survived the acquisition of sovereignty by the Crown. It is not a title in the sense of ownership but refers to a package of rights which indigenous people may enjoy in the land.

A search of the National Native Title Tribunal (NNTT) Native Title Vision database identified that a single Noongar Native Title Claim (WC03/06) exists over the Perth metropolitan area (NNTT 2012). This application is pending a decision and may have implications on reserve land and unallocated Crown land within the Study area.

3.9.1 Potential Impacts

There may be Native Title implications associated with use and development of land within the study area and discussions with the DAA and the Native Title Claimants at an early stage is recommended.

3.10 Aboriginal Heritage

The *Aboriginal Heritage of the Canning Bridge Activity Centre Structure Plan* includes desktop review of issues related to sites of Aboriginal heritage in the study area.

Where an activity disturbs an Aboriginal site or an object an application for permission to disturb those sites will need to be submitted under Section 18 of the *Aboriginal Heritage Act 1972* (AH Act). This includes all land in the state, not just areas on the Aboriginal Heritage Site Register.

Where an area of land is to be disturbed, even if it has been previously disturbed, it is advisable that a detailed anthropological and archaeological heritage survey is undertaken to find out if there are any sites or objects of significance in the area. If any are found, permission to disturb must be obtained.

A search of the DAA Aboriginal Heritage Inquiry System (DAA, 2012) was conducted to determine the likelihood of development in the study area impacting on a listed Aboriginal Heritage Site. A number of Aboriginal heritage sites were identified as shown on Figure 2.There are a number of Aboriginal Heritage Sites listed within and around the Study area. The Swan and Canning Rivers are also listed Aboriginal Heritage sites and as such, any development along the foreshore will be required to consider Aboriginal Heritage issues. A separate Aboriginal Heritage survey report is being prepared to address these issues.

There may be unregistered aboriginal heritage sites in the project area and it is recommended that before any specific development aspect proceed liaison with the DAA and potentially the Native Title Claimants occur concerning potential unregistered sites.

3.11 European Heritage

A search of the Heritage Council of Western Australia (HCWA, 2012) Heritage Places database and Municipal Heritage Inventories from the Cities of Melville and South Perth were conducted to identify Heritage Listed sites within the Study Area.

Canning Bridge is listed on the City of South Perth Municipal Heritage Inventory as a 'Category A' listed property, which means that the bridge is worthy of the highest level of protection. Canning Bridge is also contained on the State Register of Heritage Places (placed on the permanent register 28 March 2012). This listing provides statutory protection of the bridge and as such has implications for the development/redevelopment of the Canning Bridge site.

The Raffles Hotel and Raffles Precinct are listed on the State Heritage Register and are afforded statutory protection. The City of Melville Municipal Heritage Inventory lists the Raffles Hotel site as having an "A+" management category, which means that any development/redevelopment of the site requires consultation with the Heritage Council of WA and the City.

The Applecross District Hall (known locally as the 'Tivoli') is listed on the State Heritage Register and afforded statutory protection. The hall is also listed on the Municipal Heritage

Inventory and is afforded an “A+” management category under this inventory, which means that any development/redevelopment of the site requires consultation with the Heritage Council of WA and the City of Melville.

A Depression Era Campsite, located on the Cloisters Foreshore in Salter Point, just outside the Study Area is another European heritage site of interest. The site is located just to the south of the study area and is listed under the City of South Perth Municipal Heritage Inventory. The campsite was first established in 1930, and was inhabited by unemployed people who had become destitute and homeless.

The site can be accessed by a fly-over across the Kwinana Freeway, which takes people to a public boat ramp and car park. The campsite is now earmarked by a commemorative plaque. The site has a “Category B” classification under the City’s Municipal Heritage Inventory, which states that the site is worthy of a high level of protection.

The Neil McDougall Park and Hazel McDougall House (one site) is listed on the City of South Perth Heritage Inventory and is located within the study area. The sites has a “Category B” classification under the City’s Municipal Heritage Inventory, which states that the site is worthy of a high level of protection.

3.11.1 Potential Impacts

Four European Heritage sites are present within the Study Area, with an additional site located just south of the Study Area.

The upgrade of Canning Bridge is proposed as part of the future works under the structure plan and any development/redevelopment of Canning Bridge will require consultation with the Heritage Council of Western Australia.

Minimal impacts to the other heritage sites are expected. Design guidelines that address the retention of heritage values will be developed as part of the structure plan. Any works undertaken near the Raffles Hotel and Raffles Precinct, Applecross District Hall or Neil McDougall Park and Hazel McDougall House should include management measures put in place to prevent impacts resulting from construction activities such as vibration.

3.12 Acid Sulfate Soils

Acid sulfate soils (ASS) are naturally occurring soils and sediments containing sulphide minerals, predominantly pyrite (an iron sulphide). In an undisturbed state below the water table, these soils are benign and not acidic. However if the soils are drained, excavated or exposed by lowering of the water table, the sulphides will react with oxygen to form sulphuric acid. Inappropriate disturbance of these soils can generate large amounts of sulphuric acid and leaching of contaminants naturally occurring in soils (CSIRO, 2012).

The majority of the study area is not at risk of containing acid sulfate soils; however, the river bed itself contains a high to moderate risk of containing ASS (less than 3 m from the surface), and the river banks have a moderate to low risk of containing ASS (less than 3 m from the surface) (CSIRO, 2012). Impact Assessment

Any development along the foreshore will require approved management measures to be developed prior to any earthworks commencing.

McDougall Park contains a wetland which has a high to moderate risk of containing acid sulfate soils; however, this park is not likely to be subject to development pressure.

High story buildings may require stabilising earthworks and therefore result in disturbance of ASS. If ASS is found during works, these will need to be appropriately treated and disposed of to prevent contamination of soil and water.

3.13 Contaminated Sites

A search of the DER's contaminated sites database was undertaken to determine if there were any potential contaminated sites located within the Study area. The search identified three potential contaminated sites within and in proximity to the Study Area (DEC, 2012c) (Figure 3).

848 Canning Highway (corner of Reynolds Road) - Under the *Contaminated Sites Act 2003*, this site has been classified as "Contaminated - remediation required". The contamination is due to the site being used as a service station for approximately 36 years (since 1976) and continues to operate as a service station.

A contamination assessment was conducted in 1999 and found that:

"*Hydrocarbons (such as from petrol and diesel) were present in soils at concentrations exceeding Ecological Investigation Levels and potentially exceeding Health-based Investigation Levels for commercial and industrial sites, as published in 'Assessment Levels for Soil, Sediment and Water' (DEC, 2010). Hydrocarbon-impacted soils were identified beneath fuel dispensing equipment to a depth of 0.9 - 3.0 metres below ground level. DEC understands that soil remediation has not been undertaken and that hydrocarbon-impacted soils remain on site. DEC notes that additional soil investigations undertaken in 2009 did not detect any potential contaminants within the soils of the site above Health or Ecological Investigation Levels"* (DEC Report, generated at 30/07/2012).

918 Canning Highway - Under the Contaminated Sites Act 2003, this site has been classified as "Contaminated - remediation required". The contamination is due to the site being used as a service station since 1981 (DEC, 2012c), however anecdotal evidence suggests this dates further back to 1959.

A contamination assessment was conducted between 2005 and 2006 and found that:

"*Petroleum hydrocarbons (such as from petrol or diesel) were present in the soil and groundwater. The soil and groundwater investigations carried out prior to 2006 however were limited and do not meet the standard required as outlined in the DEC "Contaminated Sites Management Series" of guidelines. The soil impact is present in sub-surface soils in the central portion of the site.*" (DEC report, generated at 30/07/2012).

73 Manning Road - - Under the *Contaminated Sites Act 2003*, this site has been classified as "Contaminated - remediation required". The contamination is due to the site being used as a service station since 1989.

A contamination assessment was conducted in 1999, followed by a series of subsequent contamination assessments undertaken up until 2009. These assessments found that:

"*Hydrocarbons (such as from petrol or diesel) were present in soils at concentrations exceeding Ecological Investigation Levels and Health-based Investigation Levels for commercial and industrial Sites, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment, 2003). The soil impact is present in isolated patches in sub-surface soils in the central portion of the site."* (DEC Report, generated at 30/07/2012).

3.13.1 Impact Assessment

The management of contamination should be undertaken in accordance with the *Contaminated Sites Act 2003* dependent upon the final use of the site under the structure plan. Contaminated sites will need to be taken into account during the development works and remediated as required.

Hazardous materials, such as asbestos should also be taken into account during the upgrade or demolition of old buildings. Any hazardous materials that will be disturbed as a result of the

structure plan should be removed and disposed of in an appropriate manner so as not to cause potential contamination.

3.14 Air Quality

Regional traffic modelling indicates that Canning Bridge may experience an increase in regional flows in the order of 36 percent to 2031, irrespective of the implementation of the structure plan as the current zoning of the area facilitates similar levels of growth to 2031. This assumes there are no major interventions to increase capacity in the regional network. With the implementation of the Canning Bridge structure plan and achieving mode share targets provided in the local transport strategy, growth within Canning Bridge will broadly represent only 12 percent of 2031 indicative regional volumes.

3.14.1 Impact Assessment

Although the modelling suggests the structure plan will allow an increase in movement overall, the type of movement appears to shift from private vehicle trips to other forms of transport or technology. In both the 2031 and 2051 scenarios, the use of private motor vehicles is predicted to be lower for the structure plan than the current zoning. The increase in movement is accommodated by public transport, walking, cycling and teleworking. The predicted shift to more sustainable forms of transport is likely to offset an increase in movement volume resulting in no net change in air quality.

4. Approvals and Licences

4.1 Commonwealth Approvals

4.1.1 Referral to the Department of the Environment (DotE)

The Commonwealth EPBC Act provides legislative protection for Matters of National Environmental Significance (MNES), including all nationally threatened fauna and flora species and ecological communities. An action must be referred to the Commonwealth Department of the Environment under the EPBC Act if it will have, or is likely to have, a significant impact on any of the MNES. The structure plan may impact on MNES as detailed below in Table 3. The impacts to MNES are anticipated to be minimal as a result of the structure plan works and therefore referral is not considered necessary at this stage in the planning process. It is recommended the need to refer be review as each aspect of the structure plan becomes more defined.

Table 3 Assessment of the Proposal against Matters of National Environmental Significance

Matters of National Environmental Significance	Present	Impact
Commonwealth Threatened Ecological Communities	A search of the EPBC Act Protected Matters Search Tool and DEC TEC/PEC database identified one PEC within 5 km of the study area. This PEC is Booragoon Lake and is located approximately 1.5 km to the south-west of the Study area.	No impact is expected.
Threatened Species	A number of EPBC listed terrestrial fauna species have been identified in the desktop assessment (6 flora species of conservation significance and 10 fauna species within 5 km of the Study area). Due to the developed and degraded nature of the Study area, there is a lack of suitable habitat for the majority of the conservation significant fauna species identified through the desktop investigations. However, it is possible that the Cockatoo species, including all three Black Cockatoo species, utilise some of the site for feeding.	Impacts to threatened species are considered to be minimal as very little fauna habitat is present in the Study area. Some impacts to Black Cockatoo foraging areas may result but are likely to be less than the referral trigger levels.
Migratory Species	Twenty one species of migratory waders were identified in the desktop investigations.	The study area may provide habitat for migratory species. However, habitat in this area is degraded and these species can utilise other areas of similar habitat around the Swan River. Furthermore, improvements to the foreshore environment are proposed as part of the structure plan.
Wetlands of International Significance	One wetland of international significance, Forrestdale and Thomsons lakes are within 10 km of the Study area but not within the	No impact expected.

Matters of National Environmental Significance	Present	Impact
	structure plan impact area.	
Commonwealth Marine Areas	None present	No impact expected.
World Heritage Properties	None present	No impact expected.
National Heritage Places	None present	No impact expected.
Nuclear Actions	This is not a nuclear action	No impact expected.
Great Barrier Reef Marine Park	Not present	No impact expected.
Protection of water resources from coal seam gas development and large coal mining development	This is not a coal development.	No impact expected.

4.1 State Approvals

4.1.1 Referral to the Environmental Protection Authority (EPA)

Section 48

The *Planning Legislation Amendment Act 1996* introduced the environmental assessment of land-use planning schemes in recognition that is it more appropriate to apply environmental valuation under Section 48 of the EP Act at the rezoning stage than during individual works. The structure plan will require a scheme amendment to change the current local government zoning, and therefore impacts and compatibility with the surrounding area of the amendment will need to be environmentally assessed under Section 48 of the EP Act.

Further approvals and environmental controls may then be undertaken under Part V of the EP Act as detailed below.

4.1.2 Department of Environment Regulation (DER)

Clearing Permit

If the project is referred to the EPA as a scheme amendment and approved, a clearing permit may still be required under Part V of the EP Act for works that involve native vegetation clearing and for any clearing in the Swan Canning River ESA.

An assessment against the Ten Clearing Principles will be required to inform the clearing permit application.

Contamination Reclassification or Remediation

Contaminated sites have been identified in the Study area and these may be impacted during future works. Contaminated site investigations should be undertaken and where necessary, management/remediation of the site conducted. Discussions with the DER are recommended if contaminated sites are to be impacted, as reclassification of the site and approval for use following remediation may be required prior to undertaking the proposed development.

Acid Sulfate soils

If ASS are present at the site and occur in high concentrations, an acid sulfate soil management plan will need to be developed and approved by the DER.

4.1.3 Department or Parks and Wildlife (DPaW) and Swan River Trust

The Environment Minister recently announced that the Swan River Trust will be amalgamated with DPaW to provide better protection and management for the Swan and Canning river systems. Legislation to give effect to the amalgamation is currently being drafted and amendments will be made to both the *Conservation and Land Management Act 1984* and the *Swan and Canning Rivers Management Act 2006*. In the meantime, impacts to the Swan River will require consultation and development approval through the Swan River Trust, and it is expected that a similar approval will be required once the amalgamation of the trust and department is completed.

4.1.4 Department of Water

A permit to disturb bed and banks will be required from the Department of Water for any works that will disturb the Swan and Canning River bed or banks. Any dewatering required for construction will require a 5C Licence to Take Water.

4.1.5 Department of Aboriginal Affairs

There are a number of Aboriginal Heritage Sites listed within and around the Study area. The Swan and Canning Rivers are also listed Aboriginal Heritage sites and as such, any development along the foreshore will be required to consider Aboriginal Heritage issues. Consent of the Minister via a Section 18 application to the Department of Aboriginal Affairs will be required to impact these sites.

4.1.6 Native Title

There may be Native Title implications associated with use and development of land within the study area and discussions with the DAA and the Native Title Claimants at an early stage is recommended.

4.1.7 Heritage Council of WA

The Heritage Council of Western Australia is the State Government's advisory body, set up under the provisions of the *Heritage of Western Australia Act 1990*. The Act provides for the compilation of Western Australia's (State) Register of Heritage Places, a Statutory Database, and a Municipal Inventory for each Local Government Authority. Under the Act the State Register of Heritage Places carries legal implications over other government departments, municipal councils, developers and individual property owners. If any state heritage sites are to be removed or impacted by future works, a licence will be required. In particular, the upgrade of Canning Bridge is proposed as part of the future works under the structure plan and any development/redevelopment of Canning Bridge will require consultation with the Heritage Council of Western Australia to obtain a licence.

5. References

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Appendices

Appendix A Figures

391,000 392,000 393,000

6,459,000 6,458,000 6,457,000

THELMA ST

KWINANA FWY

MANNING RD

CANNING HWY

REYNOLDS RD

LEGEND

Roads

Study Area

1: 10,000 (at A3)

0 50 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

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City of Melville
Canning Bridge - Environment and Heritage

Job Number 61-2837304
Revision 0
Date 04 Mar 2014

Locality Map

Figure 1

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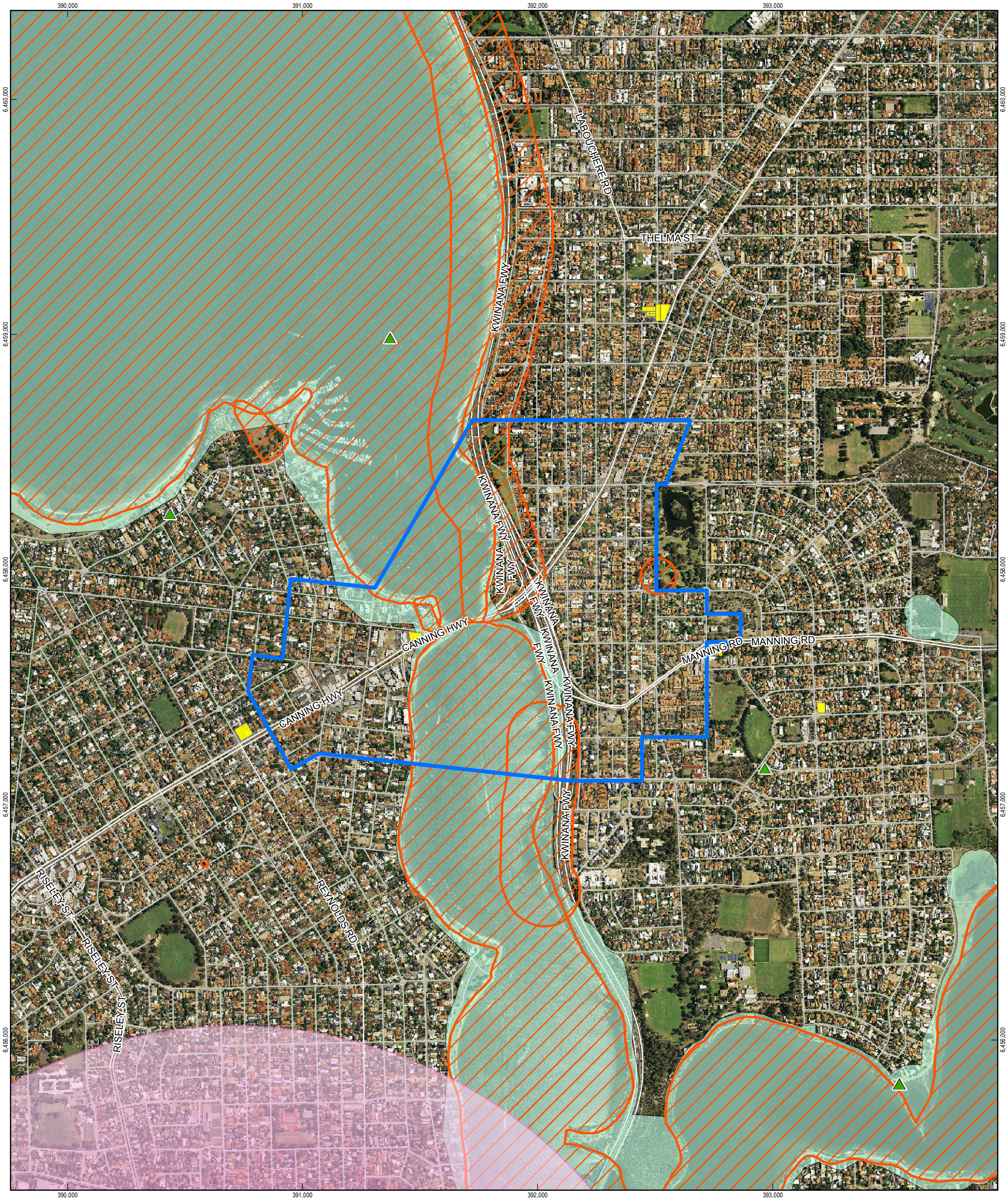
239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: GA: Topo 250k Series III - 2006; Landgate: Metro Central Feb 2012 Mosaic - 20120717, Roads - 20120717; GHD: Study Area - 20120809. Created by: bflorczak



LEGEND

Threatened and Priority Species

- (T) Threatened Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa
- Priority 5 - Conservation Dependent Taxa

- Roads
- Study Area
- Contaminated Sites
- Aboriginal Heritage Sites
- Environmentally Sensitive Areas

Threatened and Priority Ecological Communities

- E- Threatened Ecological Communities
- P2- Priority Ecological Communities

1: 15,000 (at A3)

0 75 150 300 450 600 750

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

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Environmental Constraints

Figure 2

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239 Adelaide Terrace Perth WA 6004 Australia **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

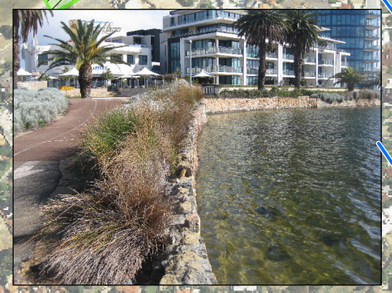
Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120814, Roads - 20120717; DIA: Aboriginal Heritage Sites - 20120720; DEC: Threatened and Priority Species - 20120801, Threatened and Priority Ecological Communities - 20120801, Environmentally Sensitive Areas - 20120814; GHD: Study Area - 20120809, Contaminated Sites - 20120724. Created by: bflorczak

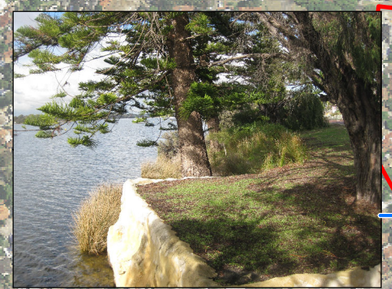
390,250 391,000 391,750 392,500

6,458,250

6,457,500












1 2 3 4 5 6 7 8 9 10 11 12

1:7,500 (at A3)

0 37.5 75 150 225 300 375

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- Photo Points
- Study Area
- Bush Forever Sites

City Of Melville
Canning Bridge - Environment and Heritage

Job Number	61-2837304
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Date	04 Mar 2014

Study Area and Photo Points

Figure 3

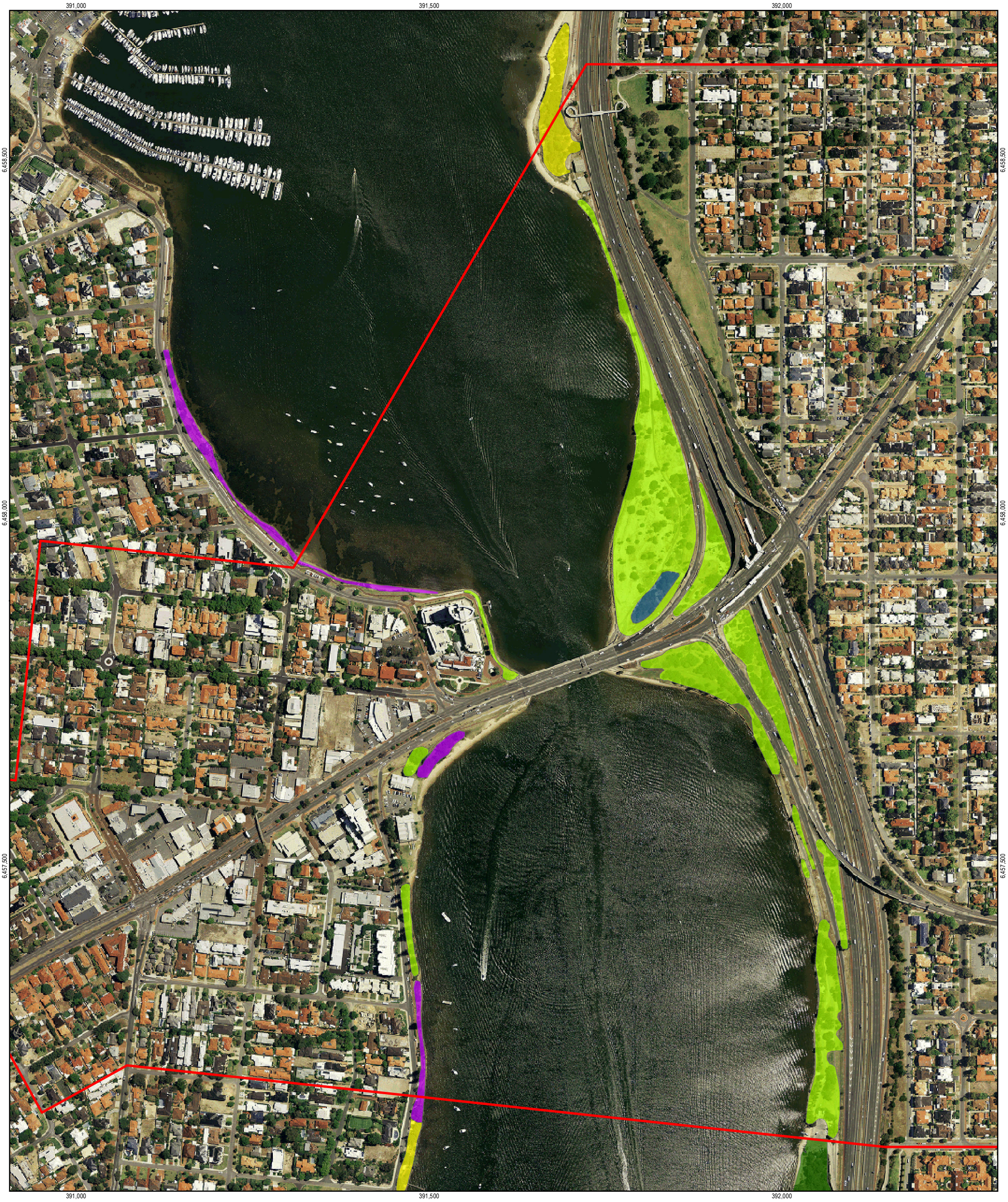
G:\61\28373\GIS\Maps\MXD\612837304_G002_Fig3__Rev0.mxd

Data source: Landgate: Metro Cnetral Feb 2012 Mosaic - 20120809; DPI: Bush Forever Sites - 20120718; GHD: Study Area - 20120809, Photo Points - 20120808. Created by: bflorczak

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

391,000 391,500 392,000

6,458,500 6,458,000 6,457,500



391,000 391,500 392,000

LEGEND

Study Area

Vegetation Condition

- Native (Good)
- Native (Medium)
- Native (Poor)
- Native with some Planted
- Planted

1: 5,000 (at A3)

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

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Vegetation Condition

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Revision	0
Date	04 Mar 2014

Figure 4

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239 Adelaide Terrace Perth WA 6004 Australia **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120810; GHD: Study Area - 20120809, Vegetation Condition - 20120809. Created by: bflorczak

391,000 391,500 392,000

6,458,500 6,458,000 6,457,500

391,000 391,500 392,000

LEGEND

Study Area

Fauna Habitat

1: 5,000 (at A3)

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

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Job Number 61-2837304
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Date 04 Mar 2014

Fauna Habitat

Figure 5

G:\61\28373\GIS\Maps\MXD\612837304_G004_Fig5_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120810; GHD: Study Area - 20120809, Fauna Habitat - 20120809. Created by: bflorczak

390,250 391,000 391,750 392,500

6,458,250

6,457,500

1 2 3 4 5 6 7 8 9

1:7,500 (at A3)

0 37.5 75 150 225 300 375

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

Photo Point

Study Area

City Of Melville
Canning Bridge - Environment and Heritage

Job Number	61-2837304
Revision	0
Date	04 Mar 2014

Study Area and Marine / Estuarine Photo Points

Figure 6

G:\61\28373\GIS\Maps\MXD\612837304_G015_Fig6_Rev0.mxd

Data source: Landgate: Metro Cnetral Feb 2012 Mosaic - 20120809; GHD: Study Area - 20120809, Photo Points - 20120927. Created by: bflorczak

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Appendix B - Background for Environmental Aspects and Conservation Codes

Acid Sulphate Soils

ASS are soils containing naturally-occurring, fine-grained metal sulfides typically pyrite (FeS2), formed under saturated, anoxic/reducing conditions. They generally occur in Quaternary (1.8 Ma – Present) marine or estuarine sediments, predominantly confined to coastal lowlands (elevations generally below 5 m Australian Height datum (AHD)). Within these sediments, the majority of soils that present an environmental risk are generally confined to Holocene aged material (<10 000 years). Where these materials have oxidised, they commonly have a mottled appearance (orange and yellow discolouration) due to the presence of oxidised iron minerals.

Although soils described above represent typical conditions where ASS occurs, the presence of ASS materials is not limited to these soil types. In Western Australia, ASS materials have been identified in other soil types such as leached sands and silts. Accordingly, for areas where no data is available, the extent of ASS materials should be established through field investigations.

The classification of ASS includes both actual acid sulfate soils (AASS) and potential acid sulfate soils (PASS). AASS are soils that are generating acidity and may still have residual potential acidity, whereas PASS are soils that have the potential to generate acidity. Acid sulphate soils are typically considered to be a management issue.

Contaminated Sites

Contaminated sites in Western Australia are regulated under the *Contaminated Sites Act 2003*. Under this Act contaminated sites must be reported to the Department of Environment Regulation (DER), investigated and, if necessary, remediated. The Contaminated Sites Database records information on sites classified as:

- contaminated - remediation required
- contaminated - restricted use
- remediated for restricted use.

The Contaminated Sites Database holds information on all other sites reported to DER, including sites awaiting classification. Additional contaminated sites may be present in the area but have not been reported to the DER and therefore may not be on the register.

Surface Water and Groundwater

Proclaimed Surface and Groundwater Areas

The DoW manages the use of water from Proclaimed Groundwater Areas (PGAs) and Proclaimed Surface Water Areas (PSWAs) through appropriate licencing under the *Rights in Water and Irrigation Act 1914*. In proclaimed areas under the Rights in Water and Irrigation Act 1914 it is illegal to take water from a watercourse or groundwater aquifer without a licence.

Water can be taken from watercourses in unproclaimed areas without a licence so long as the flow is not 'sensibly' diminished, affecting the rights of downstream users.

Water can be taken from an underground water source in an unproclaimed area without a licence, where the original water source is non-artesian.

Public Drinking Water Source Areas

The protection of Public Drinking Water Source Areas (PDWSAs) from pollution is managed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* (MWSSD Act) in the Perth region. These acts are administered under the *Water & Rivers Commission Act 1995*. The by-laws of the MWSSD Act apply in proclaimed PDWSAs.

Wetlands

Environmental Protection Policy Lakes

Certain lakes within the Swan Coastal Plain (SCP) have been classified as Environmental Protection Policy (EPP) lakes under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*, developed under Part III of the EP Act in order to protect the environmental values of the selected lakes. The policy makes it an offence to fill, drain, excavate, pollute or clear the listed lake areas.

Geomorphic Wetlands

A wetland is an area of seasonally, intermittently or permanently waterlogged or inundated land, whether natural or otherwise, and includes a lake, swamp, marsh, spring, dampland, tidal flat or estuary. Geomorphic wetlands are classified as wetlands requiring protection on the Swan Coastal Plain between Wedge Island and Dunsborough.

There are three main management categories of wetlands that have been derived by the DER, these are:

- Conservation wetlands – which support high levels of attributes and functions
- Resource Enhancement wetlands – which have been partly modified but still support substantial functions and attributes
- Multiple Use wetlands – which have few attributes but still provide important wetland functions.

Ramsar Wetlands

The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources (The Ramsar Convention on Wetlands 2012).

A 'declared Ramsar wetland' is an area that has been designated under Article 2 of the Ramsar Convention or declared by the Minister to be a declared Ramsar wetland under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Wetlands of International Importance (or Ramsar wetlands) are one of eight Matters of National Environmental Significance to which the EPBC Act applies.

Nationally Important Wetlands

The Directory of Important Wetlands in Australia identifies nationally important wetlands which meet criteria agreed to by the ANZECC Wetlands Network in 1994.

A wetland may be considered nationally important if it meets at least one of the following criteria:

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex

- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports 1% or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance.

Reserves and Conservation Areas

Conservation areas are managed under the *Conservation and Land Management Act 1984 (CALM Act).*

Class A Reserves

Class A reserves are the most protected type of Crown (public) land in Western Australia. Class A reserves can be created in both land and marine areas. Class A reserves on land can include such areas as nature reserves, conservation parks and national parks. Class A reserves on land are proposed by the Minister for Lands and created under the *Land Administration Act 1997*.

Bush Forever

The Bush Forever policy is a ten year strategic plan (2000-2010) to protect some 51,200 hectares of regionally significant bushland in 287 Bush Forever Sites, representing, where achievable, a target of at least 10% of each of 26 original vegetation complexes of the SCP portion of the Perth Metropolitan Region. *State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region* now addresses the protection and management of Bush Forever sites, as identified in the original Bush Forever policy.

The policy recognises the protection and management of significant bushland areas as a fundamental consideration in the planning process, while also seeking to integrate and balance wider environmental, social and economic considerations. In general terms, the policy does not prevent development where it is consistent with the measures in this policy and other planning and environmental considerations.

Environmentally Sensitive Areas

ESA are declared by a notice under Section 51B of the EP Act. The aspects of areas declared as ESA (under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 – Reg 6) are detailed below.

- A declared World Heritage property as defined in Section 13 of the EPBC Act
- An area that is registered on the Register of the National Estate (RNE), because of its natural values, under the *Australian Heritage Commission Act 1975* of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012)
- A defined wetland and the area within 50 m of the wetland
- The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located
- The area covered by a TEC
- A Bush Forever Site
- The areas covered by the following policies:

a. The *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*

b. The *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002*

- The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (SCPL) (EPP Lakes) 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 1997*.

Beard Vegetation Mapping

The extent of remnant native vegetation has been assessed by Shepherd et al. (2002) through the National Land and Water Resources audit and the Government of Western Australia (2013) in *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis*, based on broad-scale vegetation association mapping by Beard (1979).
Beard (1979) conducted a vegetation survey of Western Australia with the objective of creating a state-wide plant inventory. Beard produced seven 1:1,000,000 scale maps of the vegetation and 24 1:250,000 maps for the south-west between Shark Bay and Esperance. All maps attempted to depict pre-European vegetation type and extent. The results of this inventory are used to formulate guidelines for the assessment of land clearing applications as well as multiple other land-use planning activities.

Heddle Vegetation Mapping

The Local Biodiversity Program (2013) and Perth Biodiversity Project (2010) assess the extent of Heddle et al. (1980) vegetation complexes currently present against presumed pre-European extents. At the regional scale, information is available on 2013 native vegetation extent by vegetation complexes and administrative planning categories on the Swan Coastal Plain, Jarrah Forest and Warren IBRA regions (Local Biodiversity Program, 2013). At the local scale, information is available on 2010 remnant vegetation extent by vegetation complexes, administrative planning categories and land use categories for each Local Government in the Perth Metropolitan and Peel Region Scheme areas and for the Region Scheme areas (Perth Biodiversity Project, 2010).

Vegetation Extent and Status

The *National Objectives and Targets for Biodiversity Conservation 2001–2005* (Commonwealth of Australia, 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia's Biological Diversity (ANZECC, 2000) and in EPA Position Statement No. 2 on environmental protection of native vegetation in Western Australia (EPA, 2000c).

From a purely biodiversity perspective and taking no account of any other land degradation issues, there are a number of key criteria now being applied to the clearing of native vegetation in Western Australia (EPA, 2000c).

The "threshold level" below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30 percent of the pre-European extent of the vegetation type. A level of 10 percent of the original extent is regarded as being a level

representing Endangered. Clearing which would put the threat level into the class below should be avoided.

Within the Swan Coastal Plain, EPA Position Statement No. 9 (EPA, 2006b) identifies vegetation complexes with 30 percent or less of their pre-clearing extent remaining in a bioregion, or 10 percent or less of their pre-clearing extent remaining in constrained areas (i.e. areas of urban development in cities and major town) on the Swan Coastal Plain, to be critical assets.

The extent of remnant native vegetation has been assessed by Shepherd et al. (2002) and the Government of Western Australia (2013), based on broad-scale vegetation association mapping by Beard (1979).

The EPA Guidance Statement No. 10 (EPA, 2006a) assesses the extent of Heddle et al. (1980) vegetation complexes currently present against presumed pre-European extents. It is important to note that the "*remnant native vegetation mapping used in the Region is derived from dated aerial photography (in this case 1998) with limited ground-truthing. As a consequence, the percentages of ecological communities remaining are generally an overestimate of the native vegetation remaining at present and at the date of this Guidance (2006). The principal factors contributing to this overestimation are:*

- *The preferential mapping of treed landscapes, leading to some mapping of areas that are parkland cleared or completely degraded.*
- *The inclusion of areas that are approved for clearing through development approvals and/or clearing permits.*
- *Some areas that have been cleared since the time of the aerial photography.*

It is therefore important to bear these issues in mind when the percentage of the vegetation complexes remaining is approaching 30 percent" (EPA, 2006a). Furthermore, as a result of the clearing of the Swan Coastal Plain since 1998, it is likely that the actual percentage remaining of each vegetation type is less.

Conservation Significant Flora

Significant flora species are protected under both State and Commonwealth legislation. Any activities that are deemed to have a substantial impact on flora species that are recognised by the EPBC Act or the *Wildlife Conservation Act 1950* (WC Act) can trigger referral to the Department of the Environment (DotE) and/or the EPA.

Significant flora in Western Australia that are protected under the WC Act are listed as Threatened (Declared Rare) flora. Also the DPaW produces a supplementary list of Priority Flora, these being species that are not considered Threatened under the WC Act but for which the DPaW feels there is a cause for concern. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened flora. As such these species have no special legislative protection, but their presence would normally be considered relevant to an assessment of the conservation status of an area.

Threatened and Priority 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. TECs are not formally protected under the

WC Act. However the loss of, or disturbance to, listed TECs triggers the EPBC Act and would be a consideration in determining the need to assess under the EP Act.

Possible TECs that are insufficiently surveyed or known are placed in the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are inadequately known, are rare but not threatened, or meet criteria for Near Threatened. They would also be a consideration in determining the need to assess under the EP Act.

PECs 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.

Weeds and Pathogens

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012 (Australian Government, 2012). Individual landowners and managers are ultimately responsible for managing WoNS. State and territory governments are responsible for overall legislation and administration.

WoNS have been selected as they require coordination among all levels of government, organisations and individuals with weed management responsibilities. The development of a strategic plan for each WoNS helps define responsibilities and identify strategies and actions to control the species.

There are three phases of national management for WoNS. In phases one and two, each WoNS has a Management Coordinator and a National Management Group/Steering Committee to oversee implementation of the goals and actions of the WoNS strategic plans and to develop and coordinate priority actions. In phase three, state and territory governments take responsibility for national coordination within their jurisdictions. The responsible government agencies report to the Australian Weeds Committee on progress against any remaining actions under the strategic plans.

State Biosecurity and Agriculture Management Act 2007

Under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), a Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) is in force. The Department of Agriculture and Food Western Australia (DAFWA) maintains a list of Declared Pests for Western Australia. If a Pest is declared for the whole of the State or for particular

Local Government Area, all landholders are obliged to comply with the specific category of control. Declared plants are gazetted under categories, which define the action required. The category may apply to the whole of the State, district, individual properties or even paddocks. Categories of control are defined in Table A. Among the factors considered in categorising Declared Pests are:

The impact of the plant on individuals, agricultural production and the community in general

Whether it is already established in the area

The feasibility and cost of possible control measures

The BAM Act replaces the repealed *Agriculture and Related Resources Protection Act 1976*.

Table 4 Department of Agriculture and Food (Western Australia) Categories for Declared Pests under the *Biosecurity and Agriculture Management Act 2007*

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Conservation Significant Fauna

The Federal conservation level of fauna species and their significance status is currently assessed under the 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) and reviewed by Mace and Stuart (1994).

The State conservation level of fauna species and their significance status is currently assessed under the WC Act (Wildlife Conservation (Specially Protected Fauna) Notice 2010(2)). The WC Act uses a set of Schedules but also classifies species using some of the IUCN categories. Schedule 3 fauna species are those which are subject to agreements between the government of Australia and the governments of Japan, China and the Republic of Korea relating to the protection of migratory birds and are declared to be fauna that is in need of special protection.

The DPaW produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the WC Act but for which the Department feels there is a cause for concern. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. These species have no special legislative protection, but their presence would normally be considered relevant to an assessment of the conservation status of an area.

Black Cockatoos

The Department of Sustainability, Environment, Water, Populations and Communities considers that an action is likely to have a significant impact on one or more of the three black cockatoo species if there is a real chance or possibility that it will result in one or more of the following:

- Any clearing of breeding habitat in woodland stands of 0.5 ha or more that contains 3 or more breeding trees of suitable size (i.e. a DBH greater than 500 mm)
- Any clearing of known breeding trees of suitable size (i.e. a DBH greater than 500 mm)
- Clearing of more than 1 ha of foraging habitat

- Creation of a new gap of more than 4 km between patches of black cockatoo habitat
- Clearing of a known roosting site (including individual trees used for roosting)
- Shooting of birds or taking of eggs or chicks from the wild
- Introduction of invasive species such as honey bees that creates competition for hollows
- Spreading of known plant diseases such as Phytophthora
- Altering hydrology or fire regimes so that black cockatoo habitat of more than 1 ha would become degraded or destroyed.

Migratory Species

The EPBC Act legislates protective status to all species that migrate to Australia (and/or its territories), and/or fly over/travel through Australia's marine waters. Specifically, any species listed under international agreements and conventions pertaining to migratory species are protected under the Act. Such agreements include:

- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
- Japan-Australia Migratory Bird Agreement (JAMBA)
- China-Australia Migratory Bird Agreement (CAMBA)
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Migratory species are identified using the EPBC Protected Matters Search Tool and are also often identified as "International Agreement" species on the state Naturemap search tool.

Heritage

Commonwealth Aboriginal and Non-Aboriginal Heritage

At the Commonwealth level, protection of significant places is provided under the EPBC Act; the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* and the *Historic Shipwrecks Act 1976*.

The Australian Heritage Database contains information about Australian places that have natural, historic and indigenous value. This database contains information on heritage matters of national environmental significance, which are protected under the EPBC Act. This database includes places listed on the following databases:

- World Heritage List – a list of places that are important to all the peoples of the world. World Heritage sites are recognised under the World Heritage Convention as being of international significance because of their outstanding natural and/or cultural values
- National Heritage List – comprises natural, historic and indigenous places that are of outstanding heritage value to the Australian nation.

State Aboriginal Heritage

In Western Australia, the Aboriginal Heritage Act 1972 protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they have been entered on the register or not. Registered heritage sites are sites that have been assessed and approved by the Department of Aboriginal Affairs. "Other heritage places" are sites that do not meet the requirements for registration but may still be protected under the Act and still require Section 18 approval.

State Non-Aboriginal Heritage

The Heritage Council of Western Australia is a state government agency responsible for the management of the historic resource. The *Heritage of Western Australia Act 1990* makes a provision for the preservation of places of historic significance. This significance is based on aesthetic, social and scientific principles. Under the Act, a Heritage Place refers only to a building, a definable piece of land and contents relevant to the building.

A heritage agreement is formed between the Minister and the owner of a heritage place based on a voluntary agreement but this is then enforced by the Heritage Council on successive owners and mortgages, government departments, municipal councils and developers. Protection from inappropriate development of a heritage place is granted under the *Heritage of Western Australia Act 1990*, which requires all applications to modify a place to be referred to the Heritage Council. This protection is bestowed to buildings registered on the interim or permanent lists under sections 50 and 51 of the Act.

The State Heritage Office keeps a heritage register “InHerit” that contains comprehensive information about cultural heritage places listed in the State Register of Heritage Places, local government inventories and other lists, the Australian Government's heritage list, and other non-government lists and surveys.

Conservation categories and significant impact criteria

Listed threatened species and ecological communities

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following conservation categories:

- extinct in the wild
- critically endangered
- endangered
- vulnerable.

Critically endangered and endangered species

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
- reduce the area of occupancy of the species
- fragment an existing population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of a population
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*
- 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.*

Vulnerable species

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
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*
- 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
- 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.*

Listed migratory species

The EPBC Act protects lands and migratory species that are listed under International Agreements.

- Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a Range State under the Convention;
- The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA)
- The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA)
- The Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA)
- Other international agreements approved by the Commonwealth Environment Minister.

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a listed migratory species. Note that some migratory species are also listed as threatened species.

The criteria below are relevant to migratory species that are not threatened.

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

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species
- result in invasive species that is harmful to the migratory species becoming established* in an area of important habitat of the migratory species
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

- habitat utilized by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat utilized by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an ecologically significant proportion of the population varies with the species (each circumstance will need to be evaluated).

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

Table 5 Conservation categories and definitions for EPBC Act listed flora and fauna species

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 known)	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

Table 6 Conservation categories and descriptions for DPaW Declared Rare and Priority flora species

Conservation Code	Definition
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 7 Western Australian Wildlife Conservation Act 1950 Conservation Codes for fauna

Conservation categories	Definition
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]"
IA – International Agreement	Birds that are subject to an agreement between governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.

Table 8 DPaW Priority Fauna Categories

Conservation Code	Definition
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.

Appendix C Terrestrial Flora Data

Conservation Significant Flora species list from desktop investigations

Table 9 Conservation Significant Flora Species identified during desktop investigations

Family	Genus	Species	Common Name	Status (State; Federal)	NatureMap	EPBC
Araliaceae	Hydrocotyle	lemnoides	Aquatic Pennywort	P4; -	X	
Araliaceae	Hydrocotyle	striata		P1; -	X	
Asteraceae	Angianthus	micropodioides		P3; -	X	
Centrolepidaceae	Centrolepis	caespitosa		P4; En		X
Cyperaceae	Lepidosperma	rostratum	Beaked Lepidosperma	T; En		X
Cyperaceae	Schoenus	capillifolius		P3; -	X	
Dilleniaceae	Hibbertia	spicata subsp. leptotheca		P3; -	X	
Ericaceae	Andersonia	gracilis	Slender Andersonia	T; En		X
Fabaceae	Acacia	benthamii		P2; -	X	
Fabaceae	Acacia	horridula		P3; -	X	
Fabaceae	Dillwynia	dillwynioides		P3; -	X	
Fabaceae	Jacksonia	sericea	Waldjumi	P4; -	X	
Menyanthaceae	Villarsia	calthifolia	Mountain Villarsia	T; En		X
Myrtaceae	Darwinia	foetida	Muchea Bell	T; CE		X
Myrtaceae	Eucalyptus	x mundijongensis		P1; -	X	
Orchidaceae	Caladenia	huegelii	Grand Spider Orchid	T; En	X	X
Orchidaceae	Diuris	drummondii	Tall Donkey Orchid	T; -	X	
Orchidaceae	Thelymitra	variegata	Queen of Sheba	P3; -	X	
Orchidaceae	Thelymitra	manginii K.Dixon & Batty ms.		-;En		X
Restionaceae	Hypolaena	robusta		P4; -	X	
Rosaceae	Rubus	laudatus		P3; -	X	
Sapindaceae	Dodonaea	hackettiana	Hackett's Hopbush	P4; -	X	

CE Critically Endangered (*Environmental Protection and Biodiversity Conservation Act 1999* – EPBC Act)

En Endangered (EPBC Act)

Vu Vulnerable (EPBC Act)

T Threatened Flora (*Wildlife Conservation Act 1950* – WC Act)

P1 Priority 1 (Department of Environment and Conservation – DEC)

P2 Priority 2 (DEC)

P3 Priority 3 (DEC)

P4 Priority 4 (DEC)

See Appendix B for Conservation Codes

Appendix D Terrestrial Fauna Data

Conservation Significant Fauna Species list

Table 10 Conservation Significant Fauna Species identified during desktop investigations

Family	Genus	Species	Common Name	Status (State; Federal)	Nature Map	EPBC
Birds						
Ardeidae	Botaurus	poiciloptilus	Australasian Bittern	-;En		X
Ardeidae	Ixobrychus	minutus dubius	Australian Little Bittern	P4; -	X	
Charadriidae	Charadrius	rubricollis	Hooded Plover	P4; -	X	
Falconidae	Falco	peregrinus macropus	Australian Peregrine Falcon	S; -	X	
Laridae	Anous	tenuirostris melanops	Australian Lesser Noddy	T; -	X	
Laridae	Sternula	nereis nereis	Fairy Tern (Australian)	-;Vu		X
Megapodiidae	Leipoa	ocellata	Malleefowl	-;Vu, Mi		X
Otididae	Ardeotis	australis	Australian Bustard	P4; -	X	
Procellariidae	Macronectes	giganteus	Southern Giant Petrel	T; -	X	
Psittacidae	Cacatua	leadbeateri	Major Mitchell's Cockatoo	S; -	X	
Psittacidae	Calyptorhynchus	banksii naso	Forest Red-tailed Black-Cockatoo	T; Vu	X	X
Psittacidae	Calyptorhynchus	baudinii	Baudin's Cockatoo	T; Vu	X	
Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	T; En	X	X
Rostratulidae	Rostratula	australis	Australian Painted Snipe	-;Vu, Mi		X
Scolopacidae	Numenius	madagascariensis	Eastern Curlew	P4; -	X	
Mammals						
Dasyuridae	Dasyurus	geoffroii	Chuditch	T; Vu	X	X
Dasyuridae	Phascogale	calura	Red-tailed Phascogale	-; En		X
Macropodidae	Setonix	brachyurus	Quokka	-; Vu		X
Muridae	Hydromys	chrysogaster	Water-rat	P4; -	X	
Peramelidae	Isoodon	obesulus fusciventer	Quenda	P5; -	X	
Insects						
Castniidae	Synemon	gratiosa	Graceful Sun Moth	P4		X
Reptiles						
Elapidae	Neelaps	calonotos	Black-striped Snake	P3; -	X	
Scincidae	Lerista	lineata	Perth Lined Lerista	P3; -	X	

Migratory Birds						
Accipitridae	Haliaeetus	leucogaster	White-bellied Sea-Eagle	-; Mi		X
Charadriidae	Charadrius	bicinctus	Double-banded Plover	-; Mi		X
Charadriidae	Charadrius	leschenaultii	Greater Sand Plover	-; Mi		X
Charadriidae	Charadrius	mongolus	Lesser Sand Plover	-; Mi		X
Charadriidae	Pluvialis	fulva	Pacific Golden Plover	-; Mi		X
Charadriidae	Pluvialis	squatarola	Grey Plover	-; Mi		X
Meropidae	Merops	ornatus	Rainbow Bee-eater	-; Mi		X
Scolopacidae	Actitis	hypoleucos	Common Sandpiper	-; Mi		X
Scolopacidae	Arenaria	interpres	Ruddy Turnstone	-; Mi		X
Scolopacidae	Calidris	acuminata	Sharp-tailed Sandpiper	-; Mi		X
Scolopacidae	Calidris	alba	Sanderling	-; Mi		X
Scolopacidae	Calidris	canutus	Red Knot	-; Mi		X
Scolopacidae	Calidris	ferruginea	Curlew Sandpiper	-; Mi		X
Scolopacidae	Calidris	ruficollis	Red-necked Stint	-; Mi		X
Scolopacidae	Calidris	tenuirostris	Great Knot	-; Mi		X
Scolopacidae	Heteroscelus	brevipes	Grey-tailed Tattler	-; Mi		X
Scolopacidae	Limosa	lapponica	Bar-tailed Godwit	-; Mi		X
Scolopacidae	Limosa	limosa	Black-tailed Godwit	-; Mi		X
Scolopacidae	Numenius	minutus	Little Curlew	-; Mi		X
Scolopacidae	Numenius	phaeopus	Whimbrel	-; Mi		X
Scolopacidae	Tringa	nebularia	Common Greenshank	-; Mi		X
Scolopacidae	Tringa	stagnatilis	Marsh Sandpiper	-; Mi		X
Scolopacidae	Xenus	cinereus	Terek Sandpiper	-; Mi		X

En Endangered (*Environmental Protection and Biodiversity Conservation Act 1999* – EPBC Act)

Vu Vulnerable (EPBC Act)

Mi Migratory (EPBC Act)

T Threatened Fauna (*Wildlife Conservation Act 1950* – WC Act)

P3 Priority 3 (Department of Environment and Conservation – DEC)

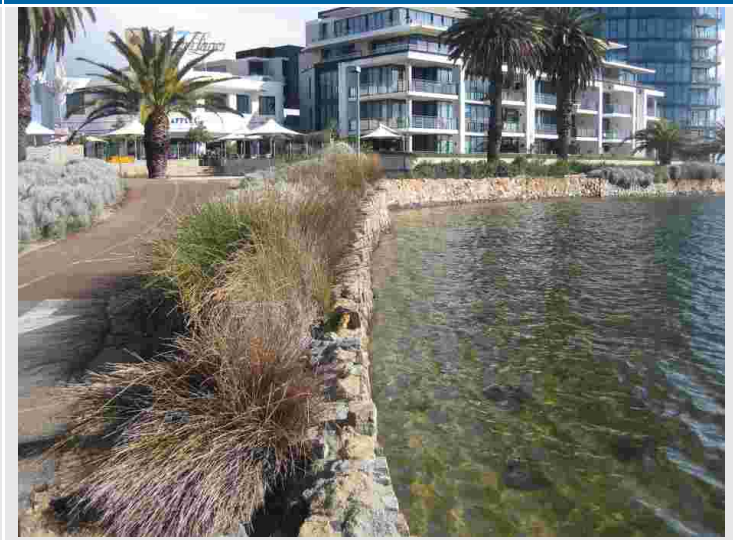
P4 Priority 4 (DEC)

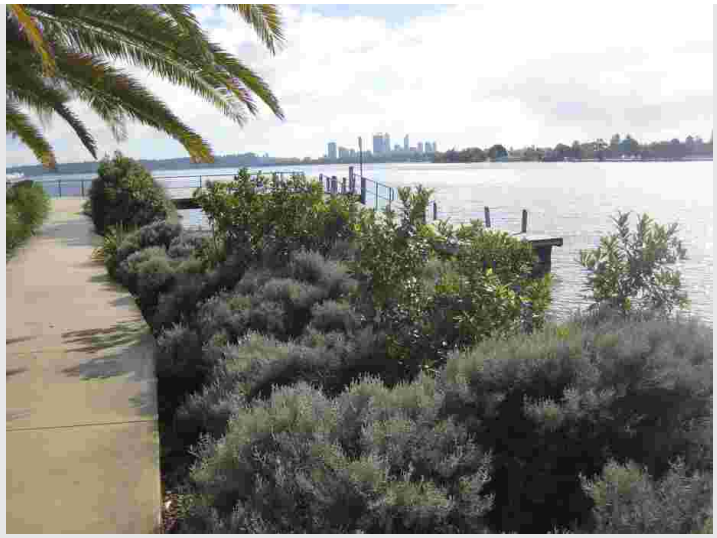
P5 Priority 5 (DEC)

See Appendix B for Conservation Codes

Appendix E Terrestrial Field Assessment Summary

Table 11 Field observations, vegetation condition and photo points (2/08/2012)

Location	Coordinates	Observations	Vegetation	Photo point number	Photo
North, west	391629, 6457773		Planted	1	
		Osprey pair	-	2	

	391584, 6457838		Planted	3	
	391582, 6457870		Planted	4	

	391552, 6457889	Seagulls wading	Planted	5	
	391480, 6457888	Juncus sp., weeds, grasses	Some remnant vegetation in poor condition	6	

	391440, 6457890	Lots of weeds, Casuarina obesa	Some remnant vegetation in poor condition	7	
	391386, 6457899		Some remnant vegetation in poor condition	8	

	391365, 6457908		Some remnant vegetation in poor condition	9	 

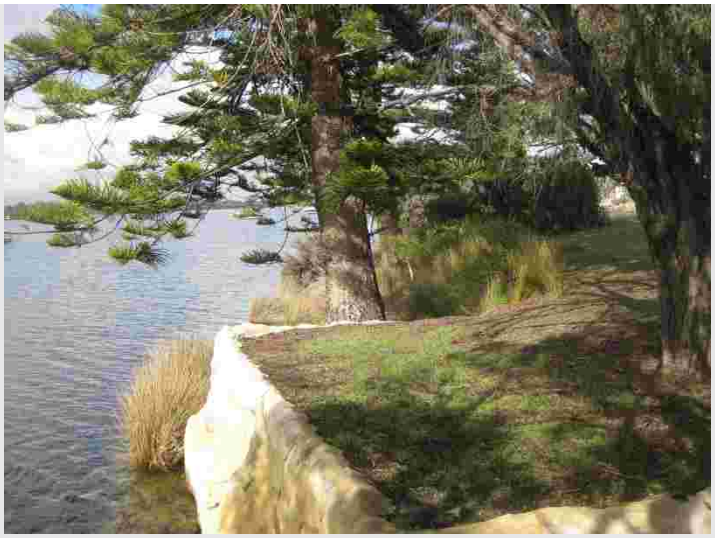
	391303, 6457947	Melaleuca cuticularis. Brown honeyeater	Some remnant vegetation in poor condition	10	
	391266, 6457981	Planted Cyperus sp., trees on bank native, on verge planted	Some remnant vegetation in poor condition	11	

	391237, 6458006	Scaevola crassifolia, Olearia axillaris	Planted	12	
	391214, 6458034	Limestone & matting – erosion prevention?	Some remnant vegetation in poor condition	13	

	391197, 6458065		Some remnant vegetation in poor condition	14	
	391170, 6458110		Some remnant vegetation in poor condition	15	

South, west	391630, 6457726	Little Pied Cormorant	-	16	
	391545, 6457678		Some remnant native vegetation in poor condition	17	

	391489, 6457546		Planted	18	
	391474, 6457413		Mostly planted	19	

	391477, 6457378	Agonis flexuosa	Mostly planted	20	
	391480, 6457345	Agonis flexuosa, Scaevola crassifolia	Some remnant (and planted) native vegetation in poor condition	21	

	391491, 6457234		Some remnant (and planted) native vegetation in poor condition	22	
	391486, 6457173		Some remnant (and planted) native vegetation in poor condition	23	

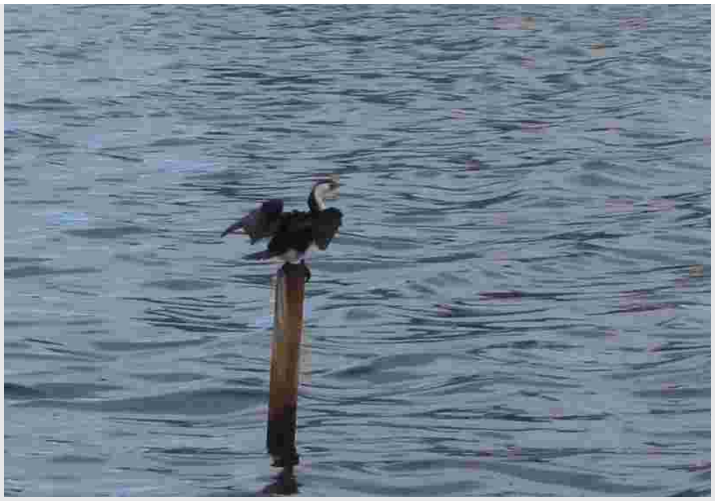
	391470, 6457072	Melaleuca teretifolia, non-native pines	Native & non-native vegetation in medium-poor condition	24	
North, east	391771, 6457892	Eucalyptus rudis	Planted native vegetation in poor condition	25	

	391788, 6457982	Callitris preissii	Planted native vegetation in poor condition	26	
	391796, 6458138		Planted native vegetation in poor condition	27	

	391813, 6458176	Acacia cyclops	Planted native vegetation in poor condition	28	
	391801, 6458230		Planted native vegetation in poor condition	29	

	391771, 6458325		Planted native vegetation in poor condition	30, 31	 

	391690, 6458484	Juncus sp. & other sedges	Remnant vegetation in medium condition	32	
		Eucalyptus rudis, Jacksonia furcellata, Banksia sessilis, Callitris preissii, Jacksonia sternbergiana, Acacia saligna, Rhagodia baccata	Remnant vegetation in good condition	33	

	391773, 6458305	Little Pied Cormorant	-	34	
	391852, 6458033	Corymbia calophylla	Planted native vegetation in poor condition	35	

South, east	391798, 6457779		Planted	36	
	391962, 6457687		Planted	37	

	392061, 6457365		Planted	38	
	392047, 6457157	Sedges	Planted	39	

	392010, 6457587		Planted	40	

Appendix F Marine and Estuarine

Conservation Significant Marine and Estuarine Species

Table 12 Conservation significant marine fauna species identified during desktop investigations

Family	Genus	Species	Common Name	Status (State; Federal)	EPBC
Reptiles					
Cheloniidae	Caretta	caretta	Loggerhead Turtle	-; En	X
Cheloniidae	Chelonia	mydas	Green Turtle	-;Vu	X
Dermochelyidae	Dermochelyidae	coriacea	Leatherback Turtle	-;En	X
Migratory Fish					
Lamnidae	Lamna	nasus	Porbeagle, Mackerel Shark	-;-	X

En Endangered (Environmental Protection and Biodiversity Conservation Act 1999 – EPBC Act)

Vu Vulnerable (EPBC Act)

Mi Migratory (EPBC Act)

T Threatened Fauna (Wildlife Conservation Act 1950 – WC Act)

P3 Priority 3 (Department of Environment and Conservation – DEC)

P4 Priority 4 (DEC)

P5 Priority 5 (DEC)

See Appendix B for Conservation Codes

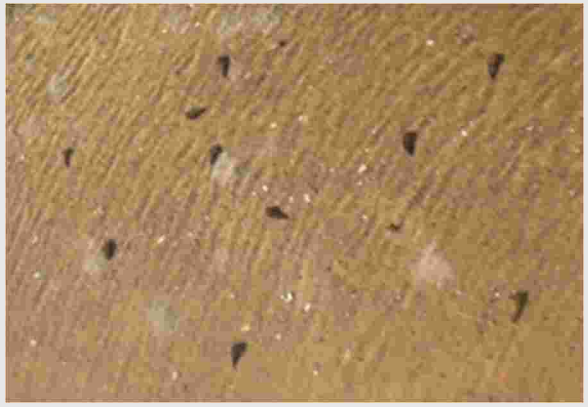
Appendix G Marine and Estuarine Field Assessment Summary

Table 13 Field observations, marine and estuarine species and photo points (20/09/2012)

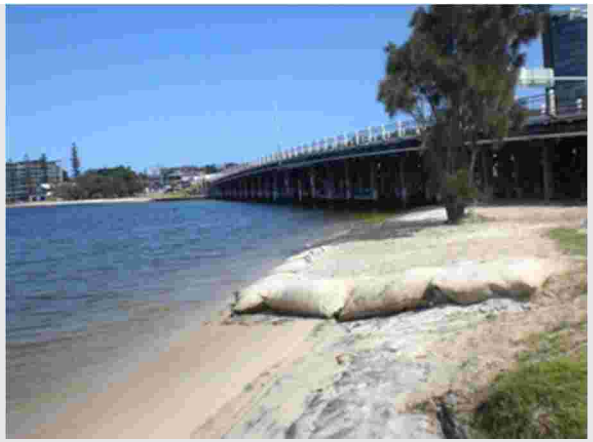
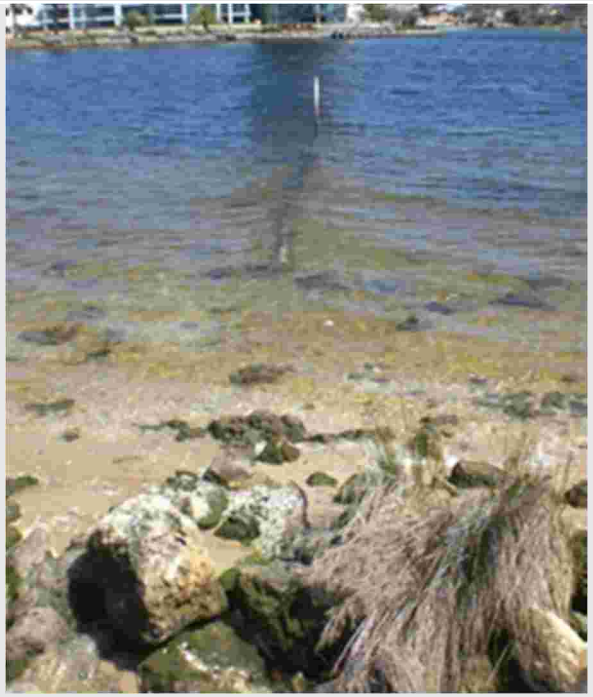
Location	Coord.	Photo point number	Human Influences	Species Noted	Environmental Observations	Photo
Northerly extent, west side of Canning River	391245 6457983	1		Pagurid hermit crabs; Moon jellyfish (Aurelia aurita); Blue mussel (Mytilus edulis); Barnacle (Balanus variegatus).	Narrow (1 metre) sandflat. Various organic detritus at waters edge. Heavy macroalagae layer on Juncus sp.	 

	391319 6457930	2	Stormwater outfall Recreational fishing		Wide(10m) sandflat	 

	391398 6457896	3	Stormwater outfall	Pagurid hermit crabs; Moon jellyfish (Aurelia aurita)	Pebble accretion	
Raffles Hotel	391580 6457869	4	Artificial rock wall Small wooden jetty	Green macroalgae Chaetomorpha linum; Red macroalgae (Graciliaria comosa); Amphipoda sp.	Reduced water flow	

						
Southerly extent, west side of Canning River	391500 6457624	5	Stormwater outfall	Green macroalgae; Chaetomorpha linum; Fish (small schooling groups noted); Pagurid hermit crabs; Infaunal worm activity noted; Macroalgal beds observed in deeper water.	Wide sandflat (7m). Nutrient enriched stormwater outfall noted resulting in increased algal growth.	 

Southerly extent east side of Canning River	392016 6457550	6	Solid rock wall No intertidal area noted	Moon jellyfish (Aurelia aurita); Red macroalgae (Graciliaria comosa); Fish (small schooling groups noted); Macroalgal beds observed in deeper water.		 

	391790 6457771	7	Sand bagged area			
	391766 6457867		Artificial rock wall Stormwater outfall	Green macroalgae	Nutrient enriched stormwater outfall noted resulting in increased algal growth.	

Northerly extent east side of Canning River	391797 6458133		Artificial rock wall			

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