Main Roads Western Australia

Coongan Gorge Realignment

Environmental Impact Assessment and Environmental Management Plan

January 2017

Executive summary

Main Roads Western Australia (Main Roads) is proposing to upgrade a section of Marble Bar Road at Coongan Gorge in the Shire of East Pilbara. The proposed project will include the realignment and reconstruction of approximately 5 km of Marble Bar Road, connecting Port Hedland to Marble Bar, to improve road safety. The associated works include significant road batter construction, minor floodways, culverts and off road drainage, possible development and use of a side track to divert traffic during stages of construction, and extraction of basecourse material from M030 material pit if excess cut material is not suitable for road base.

This report identifies and assesses the anticipated environmental impacts associated with the project. This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions and qualifications contained throughout the report.

Key environmental aspects and impacts

The environmental assessment concluded that many of the environmental aspects are low risk and can be appropriately managed through an EMP to prevent/minimise environmental harm. The key environmental impacts for this project are:

- The loss of up to 41.55 ha of native vegetation consisting of 31.55 ha within the Coongan Gorge footprint and up to 10 ha within the 113.72 ha of the proposed M030 material pit. Of the 31.55 ha within the Coongan Gorge footprint, approximately 4.45 ha will be temporarily cleared for the side track. All vegetation types within the project area are well represented at the local and regional scale
- The loss of 43.64 ha of fauna habitat consisting of approximately 41.55 ha of medium to high quality habitat including known and potential habitat for fauna species of conservation significance. The majority of the clearing and removal of habitat would occur along a ~5 km section of the Coongan Gorge project area consisting of the new realignment section of between SLK 321 and 319
- The loss of an estimated 41.55 ha of known and potential habitat for the Northern Quoll including hunting, denning and breeding habitat primarily from the Coongan gorge area
- The loss of an estimated 41.55 ha of potential habitat for the Pilbara Olive Python including hunting and breeding habitat primarily from the Coongan gorge area.

The risks associated with the potential presence of asbestiform minerals within the project area is unknown at this stage. It is recommended further investigation be considered to inform the necessity for more specific management action and precautionary measures to manage potential impacts from this environmental aspect.

Referral to the Department of the Environment and Energy

Referral to the DotEE under the EPBC Act is triggered if a proposed action has or potentially has a significant impact on any MNES. It is considered the project may have a negative impact on populations of the Northern Quoll and Pilbara Olive Python, therefore referral is recommended for these MNES.

Referral to the Environmental Protection Authority

This report has determined the project is unlikely to require referral to the EPA. This is due to the low significance of its impacts to the surrounding environment except for impacts to native vegetation and fauna habitats. The potential impacts from the loss of native vegetation clearing and loss of fauna habitat for the project may be effectively assessed through the Environmental

Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, with consideration of the environmental values discussed in the EIA report including MNES, it is considered unlikely that the project would require referral to the EPA under Section 38 of the EP Act.

Department of Environment Regulation

It is recommended the project be referred under Commonwealth legislation due to potential impacts to fauna species listed under the EPBC Act. If the project is deemed a Controlled Action, a project specific clearing permit will be applied for under the bilateral agreement entered into by the Commonwealth and State governments. If the project is deemed Not a Controlled Action, the most efficient approval pathway would be an assessment under CPS 818.

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1. Introduction

1.1 Project description

Main Roads Western Australia (Main Roads) is proposing to upgrade a section of Marble Bar Road at Coongan Gorge in the Shire of East Pilbara. The purpose of the proposed works is to improve safety on this section of Marble Bar Road, connecting Port Hedland to Marble Bar.

The Coongan Gorge Realignment Project (the project) is located on Marble Bar Road from 318.4-323.5 Straight Line Kilometre (SLK), approximately 30 kilometres (km) north of Marble Bar. Coongan Gorge is the lowest standard section of Marble Bar Road in the link between Great Northern Highway and the Ripon Hills turn off. The geometry of this section is well below acceptable standards with high rates of serious and fatal crashes when compared to the State average. The 4 km section of road through Coongan Gorge is a narrow, winding section of road with steep descents and restrictive sight distances that are safety hazards; particularly for overtaking opportunities.

The proposed project works will include:

- Realignment and reconstruction of approximately 5 km of Marble Bar Road between 318.4-323.5 SLK. Road formation width will vary significantly due to varying batter slope distances (at the narrowest road formation will be 10 metres (m) wide, and in isolated areas road formation will be up to 170 m wide)
- Associated works including significant road batter construction, minor floodways, culverts and off road drainage
- Development and use of a side track to divert traffic during stages of construction
- Extraction of basecourse material from M030 material pit if excess cut material is not suitable for road base. M030 material pit is located on the Marble Bar road at 356 SLK, approximately 70 km north of the Marble Bar townsite.

1.2 Project definitions

1.2.1 Study area

A study area was defined for the desktop database searches for the Environmental Impact Assessment (EIA) and includes a 40 km buffer of the project area.

1.2.2 Project area

The project area (the maximum area of disturbance) is 43.64 hectares (ha) and includes 33.64 ha of the Coongan Gorge realignment footprint and 10 ha of the M030 material pit footprint if required. The project area includes previously cleared areas and the clearing area for the proposed road upgrades.

The project area includes:

- Coongan Gorge realignment footprint covering 33.64 ha. This includes 31.55 ha of native vegetation and fauna habitat, and 2.09 of highly disturbed areas (excluding 5.63 ha of the existing Marble Bar Road and associated shoulder). This footprint also includes a temporary side track
- M030 material pit footprint (which may not be required) covering up to 10 ha. Main Roads intends to use the pit for material only if the excess cut material from the realignment section of the road cannot be developed into suitable road base. Main Roads intend to

limit disturbance to 10 ha adjacent to areas already cleared at the M030 material pit, although at this stage the location of this disturbance is undefined.

As the location of the material extraction from the pit is unknown this report provides a description of the environmental values for the entire material pit footprint (132.81 ha), whilst acknowledging that only up to 10 ha will be cleared and removed for the purpose of the project (if required). The entire material pit includes 113.72 ha of native vegetation and fauna habitat, and 19.08 ha of highly disturbed areas.

It should be noted that the project is only in the concept design phase. Minor changes in the design may occur in the detailed design process. The clearing footprint for the road upgrade is buffered by an additional 10 m to the planned clearing extent to account for any variations between the concept design and final design that is constructed.

The project area is shown in Figure 1, Appendix A.

1.2.1 Biological survey areas

Main Roads commissioned two supporting biological surveys for the project, which are provided in Appendix B. These assessments covered various survey areas which are described below. Information contained in these technical reports has been drawn upon to define the existing environment within the project area and assess potential impacts.

Coongan Gorge realignment

The Coongan Gorge biological survey area extended from 323-328 SLK, was 200 m in width (100 m either side of Marble Bar Road) and covered 89.60 ha. The survey area also included a side track that extended north and parallel of the existing Marble Bar Road, and covered 57.17 ha. The project area is contained within the Coongan Gorge biological survey area with the exception of 2.33 ha of the Coongan Gorge realignment footprint. The project area does not intersect the side-track biological survey area. The project area and biological survey areas for the Coongan Gorge realignment aspect of the project are shown in Figure 2, Appendix A.

M030 material pit

The M030 material pit biological survey area was located at 356 SLK and covered 132.81 ha. The project area is wholly contained within the M030 material pit biological survey area.

1.3 Purpose of this report

The purpose of this report is to describe the existing environment, based on desktop and field investigations, assess the potential environmental impacts of the proposed works and outline management measures.

1.4 Scope of works

This report has been prepared in accordance with Main Roads requirements and has been written to identify high level potential environmental constraints for the project. The following actions were completed to fulfil the scope:

- Using the results of the desktop and biological assessments, the potential impacts of the project on Matters of National Environmental Significance (MNES) and other environmental matters were assessed; including but not limited to threatened flora and fauna, significant fauna habitat, surface water, conservation estates, heritage sites and contamination
- Issues that would require consultation and/or State or Commonwealth referral and approval to facilitate the proposed clearing were identified and discussed

- An Environmental Management Plan (EMP) to minimise and manage the potential project environmental impacts on biodiversity values was developed.

1.5 Relevant legislative requirements

Key Commonwealth and Western Australian (WA) environmental legislation that may be relevant to the project are outlined in Table 1. This EIA identifies where approvals or permits are likely to be required under this legislation.

Table 1 Key environmental legislation relevant to the project

Legislation	Responsible Government agency	Aspect
Commonwealth Legislation		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Department of the Environment and Energy (DotEE)	MNES, including threatened flora and fauna
Native Title Act 1993	National Native Title Tribunal	Native title
State Legislation		
Aboriginal Heritage Act 1972 (AH Act)	Department of Aboriginal Affairs (DAA)	Archaeological and ethnographic sites
Biosecurity and Agricultural Management Act 2007 (BAM Act)	Department of Agriculture and Food WA (DAFWA)	Weeds and feral animals
Contaminated Sites Act 2003	Department of Environment Regulation (DER)	Management of contaminated sites
Environmental Protection Act 1986 (EP Act)	Environmental Protection Authority (EPA)	Environmental impact assessment and management
Environmental Protection (Noise) Regulations 1997	DER	Noise standards
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	DER	Clearing of native vegetation
Heritage of Western Australia Act 1990	Heritage Council of WA	European heritage protection
Rights in Water and Irrigation Act 1914 (RIWI Act)	Department of Water (DoW)	Access to and use of water resources; protection and management of river flows and drainage
Soil and Land Conservation Act 1945	DAFWA	Protection of soil and prevention/management of soil erosion
Wildlife Conservation Act 1950 (WC Act)	Department of Parks and Wildlife (DPaW)	Protection of native wildlife

1.6 Limitations

This report has been prepared by GHD for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Main Roads 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.

This EIA is based upon the project area provided by Main Roads and additional information provided by the Main Roads Project Manager, including the description of the project.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work.

GHD does not accept liability in connection with unverified information, including errors and omissions in the report which were caused by errors or omissions in the technical information sourced from outside GHD.

The following technical reports have assessed particular environmental aspects and potential impacts, and are therefore relied upon for inclusion in this report:

- GHD (2016a) Coongan Gorge Road Realigment, Biological Assessment
- GHD (2016b) Coongan Gorge Road Realigment – Report Recommendations
- GHD (2016c) M030 Material Pit Extraction Area 356 SLK, Biological Assessment
- GHD (2016d) M030 Material Pit Extraction Area 356 SLK – Report Recommendations

It should be noted that this EIA is based upon the project area as described in Section 1.2 and displayed in Figure 1, Appendix A. Further assessment may be required should the project area significantly change.

2. Methodology

2.1 Desktop assessment

A desktop assessment of the project was undertaken to identify potential environmental and heritage constraints. The desktop assessment involved a review of government agency managed databases and relevant spatial datasets (Table 2). Selected government desktop searches are reproduced in Appendix C.

Table 2 Information sources

Aspect	Information Source
Climate	Bureau of Meteorology (BoM) Climate Data Online (BoM 2016)
Land systems	van Vreeswyk *et al.* (2004)
Geology, landform and soils	Soil-landscape mapping (Tille 2006)
Acid Sulphate Soils	Australian Soil Resource Information Source (ASRIS) mapping (2016)
Land use and reserves	Shire of East Pilbara Town Planning Scheme No. 4 (2015) Pastoral Station information (Novelly and Warburton 2012) DPaW Estate spatial dataset
Environmentally Sensitive Areas	DER Native Vegetation Map Viewer (DER 2016b)
Hydrology	DoW Geographic Data Atlas (DoW 2016) van Vreeswyk *et al.* (2004)
Vegetation	Pre-European vegetation association mapping (Beard 1975) Statewide Vegetation Statistics (Government of Western Australia (GoWA) 2015) GHD (2016a, c)
Threatened and Priority Ecological Communities	DPaW Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) spatial datasets EPBC Act Protected Matters Search Tool (DotEE 2016)
Conservation Significant Flora and Fauna	DPaW *NatureMap* database (DPaW 2016) DPaW Threatened and Priority Flora (TPFL) and Fauna, and Western Australian Herbarium (WAHERB) spatial datasets GHD (2016a, c)
Contaminated sites	DER Contaminated Sites Database (DER 2016a)
Heritage	EPBC Act Protected Matters Search Tool (DotEE 2016) Heritage Council InHerit database (GoWA 2016)
Matters of National Environmental Significance	EPBC Act Protected Matters Search Tool (DotEE 2016)

2.2 Field assessment

A single season vegetation, flora and fauna field survey of the Coongan Gorge and side-track biological survey area (146.39 ha) was undertaken from 26-30 May 2016 (GHD 2016a) and of the M030 material pit biological survey area (132.81 ha) from 23-25 and 29 May 2016 (GHD 2016c).

The field surveys were undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Field survey methods involved a combination of sampling quadrats located in identified vegetation units and traversing the survey areas by foot. Twenty-three non-permanent quadrats were described throughout the Coongan Gorge and side-track biological survey area and twelve non-permanent quadrats were described throughout the M030 material pit biological survey area.

The fauna surveys were undertaken concurrently with the vegetation and flora surveys and were undertaken to verify the results of the desktop assessment, and delineate and characterise the fauna assemblages present in the survey area, identify and describe the dominant fauna habitat types and their condition, assess habitat connectivity, and identify and record fauna species within the survey areas. Motion sensor cameras were deployed adjacent to or within the survey areas to target the Northern Quoll (*Dasyurus hallucatus*) or other potential significant species.

The field surveys were based upon the requirements of the EPA's Guidance for the Assessment of Environmental Factors: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004a) and *Assessment of Environmental Factors for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b). The surveys also gave regards to the more recent *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and DPaW 2015) and *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and Department of Environment and Conservation (DEC) 2010).

Further information on survey methodology is provided in Appendix B.

3. Assessment of impacts

This section describes the project's physical, biological, heritage and social aspects based on desktop investigations and ecological surveys. It includes an assessment of potential environmental impacts of the proposed works on the receiving environment.

When considering the identified impacts it is assumed that Main Roads will implement management measures, including an EMP. Further details on management and mitigation measures are outlined in Section 4.

3.1 Physical environment

3.1.1 Climate

The project area is located in the Pilbara Region of Western Australia and experiences an arid tropical climate with two distinct seasons, a hot, wet summer (October to April) and a mild, dry winter (May to September) (BoM 2016). Beard (1990) noted the local influence of topography on the rainfall recordings with higher rainfall averages occurring on the more elevated areas.

The BoM Marble Bar station (site number: 004106) is the nearest, active weather station to the project area with continuous long-term data (approximately 40 km south from the project area). Climatic data from this site indicates the mean maximum temperature of the area ranges from 26.8 degrees Celsius (°C) in July to 41.8 °C in December, and the mean minimum temperature of the area ranges from 12.0 °C in July to 26.6 °C in January. The mean annual rainfall is 362.4 millimetres (mm), with an average of 27.4 rain days per year (BoM 2016).

3.1.2 Land systems

Land system mapping of the Pilbara was prepared by DAFWA for the purposes of land classification, mapping and resource evaluation (van Vreeswyk *et al.* 2004). One hundred and two land systems, grouped into 20 broad land types were described for the region, distinguished on the basis of topography, geology, soils and vegetation (van Vreeswyk *et al.* 2004). The project area intersects five land systems (Table 3).

Table 3 Land systems within the project area

Land system	Description	Extent within project area (ha)	
		Coongan Gorge	M030 Pit
Boolgeeda	Occupies 7,748 km^2 and consists of stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	-	114.53
Capricorn	Occupies 5,296 km^2 and consists of hills and ridges of sandstone and dolomite supporting shrubby hard and soft spinifex grasslands	2.57	18.28
River	Occupies 4,088 km^2 and consists of active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	0.30	-
Rocklea	Occupies 22,993 km^2 and consists of basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	4.38	-
Talga	Occupies 2,124 km^2 and consists of hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	26.39	-

3.1.3 Landform and soils

The project area is located within the Chichester Ranges Zone of the Fortescue Soil-landscape Province. This zone is characterised by hills and dissected plateaux (with some stony plains) on basalt and sedimentary rocks of the Hamersley Basin. The soils are described as stony with some red shallow loams and hard cracking clays, supporting spinifex grasslands with kanji and snappy gum (and some tussock grasslands) (Tille 2006).

3.1.4 Acid sulfate soils

A review of the ASRIS risk mapping (ASRIS 2016) indicates that the project area is mapped as 'Low Probability of Occurrence' and 'Extremely Low Probability of Occurrence' of Acid Sulfate Soils (ASS) with a very low degree of confidence.

3.1.5 Potential impacts

The project will potentially result in localised impacts to the physical environment. These impacts are expected to occur during the construction phase and are likely to be minor and temporary given appropriate management measures. Potential impacts include:

- Temporary risk of water and wind erosion within and adjacent to the project area as a consequence of the disturbance and exposure of soil due to clearing and/or construction works. Areas of the project area with lighter-textured soils (e.g. sandy soils) are likely to be more vulnerable to water and wind erosion. Areas of the project area with dispersive soils (e.g. clay soils) may also be prone to water erosion, particularly during rainfall events
- Undisturbed ASS do not pose a risk and is unlikely to become an issue even if excavation occurs below the water table or temporary lowering of the water table is required. However, consideration as to the requirement for dedicated ASS investigations should be based on the ongoing construction requirements for the project.

The impacts on the physical environment can be managed through existing Main Roads procedures. Once the site is stabilised, potential impacts are unlikely to pose long-term changes to the existing environment.

3.2 Land use

3.2.1 Land vesting

The project area is located within a designated State road reserve and within land zoned as rural according to the Shire of East Pilbara (2015) Town Planning Scheme No. 4. The closest sensitive receptors include private residential housing, located within the township of Marble Bar approximately 40 km south of the project area.

3.2.2 Current land use

The project area is located on Eginbah and Coongan Pastoral Stations. Eginbah Station covers approximately 224,662 ha and is primarily used for agriculture (cattle); the land tenure of this Station is classified as private leasehold. Coongan Station covers approximately 184,671 ha and is primarily used for agriculture; the land tenure of this Station is classified as Indigenous/Indigenous interests leasehold.

3.2.3 DPaW managed lands and conservation areas

No DPaW managed lands or conservation areas are located within the project area. One DPaW managed conservation area is located within the study area, approximately 36 km south-east of

the project area. This conservation area is former leasehold proposed for conservation – ex Meenthena Station.

3.2.4 Environmentally Sensitive Areas

No Environmentally Sensitive Areas (ESAs) are located within the project area. One ESA is located within the study area, approximately 36 km north of the project area. This ESA is aligned with the De Grey River.

3.2.5 Potential impacts

The project is not likely to result in significant impacts to the surrounding land use. The proposed works involve the realignment and reconstruction of approximately 5 km of road and the extraction of base material. The proposed works are largely along an existing road, with minor deviation from the existing road (within 500 m) for approximately 1 km. Excess cut material will be used for road base where possible or extraction of base material will occur adjacent to an existing material resource area approximately 30 km north-west of the realignment works.

The project will not directly or indirectly impact on any DPaW managed lands, conservation areas or ESAs.

3.3 Hydrology

Desktop searches of the DoW Geographic Data Atlas identified the water resource aspects present in the project area. These are detailed below in Table 4.

Table 4 DoW geographic atlas queries within the project area

Aspect	Details	Result
Groundwater Areas	Groundwater areas proclaimed under the RIWI Act.	Pilbara
Surface Water Areas	Surface water areas proclaimed under the RIWI Act.	Pilbara
Irrigation District	Irrigation Districts proclaimed under the RIWI Act.	None present
Rivers	Rivers proclaimed under the RIWI Act.	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947*.	None present
Waterway Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*.	None present

3.3.1 Groundwater

The groundwater in the Pilbara occurs in various hydrogeological environments ranging from superficial and sedimentary to weathered and fractured aquifers (van Vreeswyk *et al.* 2004). The project area is situated on the igneous fractured rock aquifers of the granitic and greenstone rocks of the Pilbara Craton. The groundwater occurs mainly in the upper weathered zone and where intruded by quartz and pegmatite veins. In these areas groundwater storage is limited, however, some large reserves can be found locally in solution voids. Groundwater salinity in the granite-greenstone aquifers ranges from less than 500 milligrams per litre (mg/L) along drainages to greater than 10,000 mg/L Total Dissolved Solids (van Vreeswyk *et al.* 2004).

3.3.2 Surface water

The project area intersects three watercourses, the Talga River in the eastern part of the Coongan Gorge footprint, the Coongan River in the western part of the Coongan Gorge footprint and an ephemeral watercourse along the eastern edge of the M030 material pit footprint. These watercourses were dry at the time of survey, but experience seasonal inundation.

No wetlands, springs or pools occur within or adjacent to the project area.

3.3.3 Potential impacts

The project may result in minor, short-term impacts to the physical environment. These impacts are expected to occur during the construction phase and are considered to be minor and temporary given appropriate management measures:

- Groundwater –there will be no dewatering, or requirement to construct bores for construction water. The existing hydrological regime (drainage patterns) will be maintained, hence there is no expectation that groundwater levels or quality will be impacted. Should dewatering or bores be required permits/licenses will be obtained from the DoW for installation of bores and groundwater abstraction
- Surface water – three watercourses intersect the project area, including the Talga and Coongan Rivers, as well as an unnamed ephemeral watercourse. It is expected the proposed works will utilise similar drainage features (floodways, culverts and off road drainage) as for the existing Marble Bar Road. It is expected the surface water hydrology can be maintained in its current regime with appropriate drainage design
- Erosion/sedimentation – during the clearing of vegetation and until soils have stabilised there is the potential for erosion and sedimentation. This is likely to be more pronounced in current drainage areas. Clearing and post-clearing management of floodways and culverys will be required in some areas, particularly where vegetation is removed on slopes
- Contamination and pollution generating activities – any anthropogenic contamination identified during works should be managed in accordance with the project EMP. Any pollution generating activities such as refuelling or storage of chemicals during works should also be managed in accordance with the EMP. All potentially hazardous materials used on site should be handled, used and disposed of in accordance with their Safety Data Sheet (SDS) and Main Roads standard procedures.

It is anticipated the potential impacts to hydrology can be adequately managed through the standard techniques to maintain existing environmental conditions in the EMP.

3.4 Vegetation and flora

The vegetation and flora of the project area was assessed through desktop and field surveys. Biological field surveys were completed in May 2016. A copy of the reports (GHD 2016a, 2016c) are provided in Appendix B.

3.4.1 Vegetation types

The flora and vegetation surveys (GHD 2016a, c) identified 14 vegetation types within the project area, as well as areas considered cleared/degraded. Coongan Gorge is dominated by spinifex steep on slopes, with small patches of woodland (riparian and floodplain) occurring at the eastern and western ends of the project area. Small patches of *Atalaya-Flueggea* Shrublands and *Terminalia-Atalaya* Low Woodland also occur on large stony scree and steep slopes respectively. Large parts of the Coongan Gorge footprint had been burnt (last fire within 5-10 years) with variable vegetation recovery observed.

The M030 material pit footprint is dominated by spinifex steep on lower slopes and *Corymbia* over spinifex on sandplains. Patches of Low Shrub and Spinifex and *Corymbia-Acacia* Thickets occur throughout the centre of the pit with Riparian Woodland and areas mapped as Rocky Outcrops covering less than 2 ha. Approximately 19 ha of the project area is mapped as cleared/degraded and includes areas completely/mostly devoid of native vegetation such as roads, access tracks and cleared spaces.

The vegetation types within the project area are further described in Appendix B and their extents shown in Table 5

Table 5 Vegetation types within the project area

Vegetation type (GHD 2016a, c)	Project area (ha)		Pre-European vegetation association (Beard 1975)
	Coongan Gorge	M030 Pit	
Corymbia over Spinifex Steppe on Sandplains	-	37.82	171
Corymbia-Acacia Thickets on Sandplains	-	12.24	93
Low Shrub and Spinifex on Sandy Flats	-	10.77	93
Floodplain Low Open Woodland	0.16		171
Riparian Woodland (type 1)	0.25		619
Riparian Woodland (type 2)	-	0.54	619
Spinifex Steppe on Stony Lower Slopes	-	51.75	93
Spinifex Steppe on Calcareous Stony Lower Slopes	1.73		93
Spinifex Steppe with Emergent Scrub on Sandy Lower Slopes	3.87		93
Spinifex Steppe on Stony Mid Slopes	8.28		93
Spinifex Steppe on Stony Upper Slopes with Emergents	16.12		171
Rocky Outcrops	-	0.60	93
Atalaya-Flueggea Shrublands on Large Stony Scree	0.95		-
Terminalia-Atalaya Low Woodland on Steep Slopes	0.19		-
Cleared/degraded	2.09	19.08	N/A
TOTAL	**33.64**	**132.81**	

3.4.2 Conservation significant ecological communities

No Commonwealth or State-listed TECs or DPaW-listed PECs were identified within study area. No TECs or PECs were identified within the project area during the field surveys.

3.4.3 Groundwater dependent vegetation

The project area intersects three watercourses, as described in Section 3.3.2. Vegetation that grows in association with these watercourses is considered groundwater dependent/ riparian vegetation and includes:

- Riparian Woodland (type 1) – this vegetation type covers 0.25 ha within the Coongan Gorge footprint and includes species *Eucalyptus camaldulensis* and *E. victrix*
- Riparian Woodland (type 2) – this vegetation type covers 0.54 ha within the M030 material pit footprint and includes species *E. camaldulensis*.

3.4.4 Vegetation condition

The vegetation condition of the project area ranged from Very Good (3) to Completely Degraded (7). The majority of vegetation in the Coongan Gorge footprint was rated condition 6; in these areas the vegetation had been recently burnt, and high weed infestation and disturbance by grazing cattle was noted in riparian areas. Better condition vegetation (condition 3) was associated with unburnt areas along the south facing slopes and gullies of the Coongan Gorge.

The majority of vegetation in the M030 material pit footprint was rated condition 4 and 5. Areas subject to greater disturbance–particularly due to grazing by cattle were rated condition 6. Better condition vegetation (condition 3) was associated with vegetation at higher elevations.

Table 6 Vegetation condition ratings within the project area

Vegetation condition (GHD 2016a, c)	Project area (ha)	
	Coongan Gorge	M030 Pit
3	0.17	25.07
4	2.31	35.47
5	4.92	38.66
6	24.01	14.52
7	0.14	-
Cleared/degraded	2.09	19.08
Not mapped (e.g. existing Marble Bar Road)	5.63	-
TOTAL	**39.27**	**132.81**

3.4.5 Floristic diversity

One hundred and twenty flora taxa (including subspecies and varieties) representing 39 families and 79 genera were recorded from the Coongan Gorge biological survey area during the field survey (GHD 2016a). This total comprised 110 native taxa and ten introduced and/or naturalised taxa.

Eighty-nine flora taxa representing 30 families and 55 genera were recorded from the M030 Pit biological survey area during the field survey. This total included 87 native species and two introduced and/or naturalised taxa.

All of the introduced and/naturalised taxa recorded within the project area are considered environmental weeds, although none are listed as Declared Pests under the BAM Act or as Weeds of National Significance (WoNS). Overall, the project area is considered to have a moderate floristic diversity.

3.4.6 Conservation significant flora

Searches of the EPBC Act PMST, DPaW *NatureMap* database and DPaW TPFL and WAHERB databases identified the presence/potential presence of 11 conservation significance flora taxa within the study area. The desktop searches recorded:

- Two Priority 1 taxa
- Two Priority 2 taxa
- Five Priority 3 taxa
- Two Priority 4 taxa.

No EPBC Act, WC Act or Priority listed flora taxa were recorded within the project area during the field surveys.

A likelihood of occurrence assessment conducted post-field survey concluded that *Euphorbia clementii* (P2) and *Nicotiana umbratica* (P3) are likely to occur within the Coongan Gorge footprint and *Bulbostylis burbidgeae* (P4) is likely to occur within the M030 Pit footprint.

Euphorbia clementii is an annual and is reported to grow in spinifex grassland communities on gravelly soils on slopes/ stony rises or on sandy soils on plains. The species is also thought to be stimulated by fire, with many collections reported to be growing in 'recently burnt' areas. *Euphorbia clementii* has been recorded 14 km east of the project area, and given the recent fires in the general area is considered likely to occur within the project area.

Nicotiana umbratica and *Bulbostylis burbidgeae* have been recorded within 10 km and 2 km of the project area respectively. Both species are annuals that grow in rocky outcrop areas and are considered likely to occur within the project area. The remaining eight taxa identified in desktop searches may possibly or are considered unlikely to occur in the project area. Given the survey effort and season (post-rain) if populations of these species were present it is expected they would have been identified in the field.

3.4.1 Regional and local significance of vegetation types

Comparison with other mapped vegetation

Ten of the vegetation types identified within the project area are broadly consistent with the pre-European vegetation associations (Beard 1975). The remaining two vegetation types as well as the cleared/degraded areas do not align/are not considered representative of any vegetation associations:

- Association 93: Hummock grasslands, shrub steppe; kanji over soft spinifex
- Association 171: Hummock grasslands, low tree steppe; snappy gum over soft spinifex & *Triodia brizoides*
- Association 619: Medium woodland; river gum (*Eucalyptus camaldulensis*).

Extent of vegetation types

The extents of the vegetation associations have been determined by the State-wide vegetation remaining extent calculations maintained by the DPaW (Current as of June 2015 (latest update May 2016) – GoWA 2015). The current extents of vegetation associations remaining are greater than 99 per cent (%) of the pre-European extent at all scales (e.g. State, IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA)), and are therefore above the 30 % threshold

level[1] (Table 7). Furthermore, there is less than 0.0164 % of the current extent of each vegetation association within the project area.

Regional and local significance of vegetation types

The regional and local significance of the vegetation types was assessed by incorporating and adapting relevant characteristics as outlined in EPA Guidance Statement 51 (EPA 2004a). Characteristics considered included:

- Degree of degradation/clearing within Pilbara IBRA Bioregion, Chichester IBRA Sub-region and Shire of East Pilbara LGA
- Size of remnant and condition/intactness of vegetation
- Heterogeneity or complexity of vegetation
- Rarity of vegetation
- Presence of other significant vegetation
- Representation of ecological refuge or linkage
- Presence of Threatened, Priority or other significant flora taxa.

The vegetation types within the project area are not considered regional or locally significant. The vegetation present within the project area does not representative of any known TECs, PECs or other significant vegetation, nor is considered rare, an ecological refuge or part of a local or regional ecological linkage. The vegetation types identified within the project area are considered to be well represented outside the project area based on a review of the aerial photography. Furthermore, the vegetation within the project area is part of a contiguous, largely intact area of remnant vegetation within a largely intact LGA, IBRA Sub-region and IBRA Bioregion.

[1] The 30 per cent threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (EPA 2000).

Table 7 Extent of Pre-European vegetation associations within the project area

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
Pilbara IBRA Bioregion		17,808,657.06	17,733,583.89	99.58	10.16
Chichester IBRA Sub-region		8,374,326.82	8,361,217.36	99.84	6.57
Shire of East Pilbara		37,183,060.23	37,155,264.51	99.93	4.53
93	State: WA	3,044,309.54	3,040,641.00	99.88	1.96
	Bioregion: Pilbara	3,042,114.29	3,038,471.70	99.88	1.96
	Sub-region: Chichester	2,940,348.06	2,936,731.56	99.88	2.03
	LGA: Shire of East Pilbara	1,709,522.26	1,706,780.59	99.84	2.70
171	State: WA	331,951.73	330,643.10	99.61	10.92
	Bioregion: Pilbara	331,307.42	330,026.24	99.61	10.94
	Sub-region: Chichester	331,307.42	330,026.24	99.61	10.94
	LGA: Shire of East Pilbara	331,951.73	330,643.10	99.61	10.92
619	State: WA	119,373.78	118,205.02	99.02	0.20
	Bioregion: Pilbara	118,920.31	118,116.79	99.32	0.20
	Sub-region: Chichester	85,543.15	85,520.95	99.97	0.28
	LGA: Shire of East Pilbara	52,765.30	52,763.69	100.00	0.0

3.4.2 Potential impacts

The project will result in the direct loss of native vegetation including:

- Up to 41.55 ha of native vegetation consisting of 31.55 ha of native vegetation within the Coongan Gorge footprint and up to 10 ha's of native vegetation within the M030 Pit footprint. This includes clearing of up to 0.79 ha of groundwater dependent/riparian vegetation within the project area (Table 8). Of the 31.55 ha within the Coongan Gorge footprint, approximately 4.45 ha will be temporarily cleared for the side track.
- Clearing from within the Coongan Gorge area would result in the loss of up to 10.01 ha of association 93, 16.28 ha of association 171 and 0.25 ha of association 619. The clearing of vegetation within the material pit area would not exceed 10 ha for any one of the three vegetation associations, therefore regardless of the association, clearing would result in less than a 0.01% reduction at the local scale (Shire of East Pilbara) and less than a 0.01% reduction at the regional scale (Pilbara IBRA Bioregion).

The project could also potentially result in a range of impacts on vegetation including:

- Possible introduction and/or spread of weeds into adjacent vegetation. Hygiene management will be required to prevent impacts on adjacent vegetation
- Other short-term, indirect impacts such as dust and sedimentation of downstream drainage areas. These impacts are likely to be restricted to the clearing phase and localised areas only and can be managed through the project EMP.

The range of indirect impacts on vegetation are considered minor as the proposed works include realignment to an existing road, with minor diversion. Nevertheless, management will be required during design and construction to minimise both direct and indirect impacts. Clearing

will only be undertaken where it is required for road realignment and reconstruction, and for associated works (e.g. road batter construction, minor floodways, culverts and off road drainage). Excess cut material will be used for road base where suitable to reduce the need for extraction of basecourse material from the M030 material pit. No clearing is proposed for temporary work areas (e.g. site offices and storage areas); all lay down areas will exist within already disturbed areas.

Table 8 Vegetation clearing for the project

Vegetation type (GHD 2016a, c)	Project area (extent and condition)	
	Coongan Gorge	M030 Pit
Corymbia over Spinifex Steppe on Sandplains	-	3: 0.03 ha 4: 0.43 ha 5: 35.49 ha 6: 1.87 ha
Corymbia-Acacia Thickets on Sandplains	-	4: 10.52 ha 5: 0.30 ha 6: 1.42 ha
Low Shrub and Spinifex on Sandy Flats	-	4: 0.04 ha 5: 1.60 ha 6: 9.13 ha
Floodplain Low Open Woodland	6: 0.16 ha	
Riparian Woodland (type 1)	6: 0.25 ha	
Riparian Woodland (type 2)	-	5: 0.54 ha
Spinifex Steppe on Stony Lower Slopes	-	3: 24.54 ha 4: 24.38 ha 5: 0.73 ha 6: 2.10 ha
Spinifex Steppe on Calcareous Stony Lower Slopes	4: 0.20 ha 5: 0.22 ha 6: 1.30 ha	
Spinifex Steppe with Emergent Scrub on Sandy Lower Slopes	4: 0.81 ha 5: 1.00 ha 6: 2.06 ha	
Spinifex Steppe on Stony Mid Slopes	4: 1.27 ha 5: 3.08 ha 6: 3.91 ha 7: 0.01 ha	
Spinifex Steppe on Stony Upper Slopes with Emergents	3: 0.17 ha 4:0.03 ha 5: 0.36 ha 6: 15.44 ha 7: 0.12 ha	
Rocky Outcrops	-	3: 0.50 ha 4: 0.10 ha
Atalaya-Flueggea Shrublands on Large Stony Scree	5: 0.06 ha 6: 0.89 ha	
Terminalia-Atalaya Low Woodland on Steep Slopes	5: 0.19 ha	
Total native vegetation to be cleared	**31.55 ha, incl. 4.45 ha of temporary clearing**	**Up to 10 ha**

Vegetation type (GHD 2016a, c)	Project area (extent and condition)	
	Coongan Gorge	M030 Pit
Total native vegetation by condition rating	**3: 0.17 4: 2.31 ha 5: 4.92 ha 6: 24.01 ha 7: 0.14 ha**	**3: 25.07 ha 4: 35.47 ha 5: 38.66 ha 6: 14.52 ha**
Cleared/degraded	2.09 ha	19.08 ha
Not mapped (e.g. existing Marble Bar Road)	5.63 ha	-
TOTAL	**39.27 ha**	**Up to 10 ha**

3.5 Fauna

3.5.1 Fauna diversity

Desktop searches

A search of *NatureMap* identified 209 and 98 vertebrate fauna previously recorded within the Coongan Gorge and M030 material pit study areas, respectively. Table 9 provides a summary of the number of species for each fauna group recorded from *NatureMap* for each study area.

Table 9 *NatureMap* database (DPaW 2016) species search results

Group	Coongan Gorge	M030 Pit
Mammal	24 (2)	10
Reptile	58	32
Bird	122	56
Amphibian	3	-

Note: number in brackets = introduced fauna

Fields surveys

The field survey recorded 116 and 71 fauna species within or in close proximity to the Coongan Gorge and M030 material pit biological survey areas, respectively (GHD 2016a, 2016c). Table 10 provides a summary of the number of species for each fauna group recorded during the field survey. A full list of fauna recorded during the field survey is presented in Appendix B.

Three conservation significant fauna species were recorded in the survey areas during the field surveys. Fauna species of conservation significance recorded in each of the survey areas according to their location are presented in Section 3.5.4.

Table 10 Species recorded within each survey area during the field survey (GHD 2016a, c)

Group	Coongan Gorge	M030 Pit
Mammal	13 (6)	8 (4)
Reptile	20	16
Bird	67	43
Fish	4	-

Note: number in brackets = introduced fauna

3.5.2 Fauna habitats

Six broad fauna habitat types based on the broad landforms, soil and vegetation structure, were recorded in the biological survey areas (GHD 2016a, c). The extent and value of the fauna habitat within the project area is discussed below and summarised in Table 11. The project area contains up to 166.45 ha of fauna habitat of which 21.17 ha consists of cleared and degraded areas that have low habitat value for native fauna (e.g. existing roads, cleared tracks and roadside edges).

The majority (>95%) of the habitat occurring within the 132.8 ha area of M030 material pit footprint is hummock grassland (on sand plain or stony plain). It is most likely that given the location of the existing pit activity and requirement for up to 10 ha of further disturbance, that the potential impacts of the project would be within this habitat type rather than the historically disturbed areas.

Table 11 Habitat types within the project area

Habitat type (vegetation type)	Vegetation types	Area (ha) within Coongan Gorge	Area (ha) within M030 Pit	Total area of each habitat type within project area (ha)
Triodia hummock grassland on sand plain	Low Shrub and Spinifex on Sandy Flats/ *Corymbia* over Spinifex Steppe on Sandplains/ *Corymbia-Acacia* Thickets on Sandplains	-	60.83	60.83
Triodia hummock grassland on stony plain / *Triodia* hummock grassland on plain or undulating plain	Spinifex Steppe on Stony Lower Slopes/ Floodplain Low Open Woodland/ Spinifex Steppe on Calcareous Stony Lower Slopes	1.89	51.75	53.64
Minor drainage lines / Minor drainage lines with small dense patches of trees/shrubs and scattered trees	Riparian Woodland type 2 / Spinifex Steppe with Emergent Scrub on Sandy Lower Slopes/ *Terminalia-Atalaya* Low Woodland on Steep Slopes	4.06	0.54	4.6

Habitat type (vegetation type)	Vegetation types	Area (ha) within Coongan Gorge	Area (ha) within M030 Pit	Total area of each habitat type within project area (ha)
Eucalyptus camaldulensis and *Melaleuca argentia* along Talga and Coongan Rivers / Water bodies and riverine habitats along the Talga River	Riparian Woodland type 1	0.25	-	0.25
Rocky ridgelines or exposed rock or outcropping / Rocky ridgelines /rocky ranges (with scree) with hummock grasslands and scattered trees and shrubs	Rocky Outcrops/ Spinifex Steppe on Stony Mid Slopes/ Spinifex Steppe on Stony Upper Slopes with Emergents/ *Atalaya-Flueggea* Shrublands on Large Stony Scree	25.35	0.60	25.95
Disturbed area	Cleared/degraded	2.09	19.08	21.17
Total		**33.64**	**132.81**	**166.45**

The Coongan Gorge project area (including the associated ranges and riverine environments but excluding the existing Marble Road) provides a high level of habitat diversity and is important for some fauna species of conservation significance. The overall value of the habitat associated with the Coongan Gorge project area was considered to be high because of the diversity and quality of habitat types (e.g. good to excellent structural diversity within each habitat type), good connectivity, and for supporting known and potential habitat values for conservation significant fauna species (see Section 3.5.4). In particular, Coongan Range has large amounts of rocky habitat, known to support conservation significant species and are used as linkage to move through the landscape to utilise other areas and resources.

The M030 material pit footprint provides a moderate to high level of habitat diversity for many native fauna species, including species of conservation significance. The habitats within the M030 material pit footprint are mostly intact, variable in composition and well connected with habitats within the local area and the greater study area. The overall value of the habitat was considered to be moderate to high, because of the diversity and quality of habitat types, good connectivity and for supporting known and potential habitat values for conservation significant fauna species (see Section 3.5.4). In particular, the M030 material pit footprint lies at the base of and bisects several low hills that are part of a range, which appeared to have a large amount of breakaway and rocky habitat available. These habitat areas are known to support conservation species which are also likely to move over the landscape to utilise other areas.

The habitat types for the Coongan Gorge and M030 material pit survey area are described in detail in Appendix B.

It is considered unlikely the habitat within the project area provides the habitat requirements for all fauna species of conservation significance discussed in section 3.5.4. Following a review of aerial photography, corresponding native vegetation associations and observations during the

biological surveys (GHD 2016a, c) it is concluded the habitats of the project area are considered to be well represented within the local area and are probably well represented within the greater study area. However, it is difficult to determine the value (e.g. habitat quality) of the habitats for conservation significant fauna in the greater study area without survey effort (e.g. does the surrounding vegetation contain the necessary structure and microhabitats).

3.5.3 Ecological linkages and wildlife corridors

The fauna habitats of the Coongan Gorge project area are part of a contiguous largely intact area of remnant vegetation within leased land primarily used for cattle grazing. The fauna habitats are part of a much larger area of similar habitats within the local area and greater study area. The position of the Marble Bar Road is mostly on a plain with large flat to undulating expanses of hummock grassland with open woodland. The hummock grassland plain would be moderate to high significance because of it connectivity and use by fauna moving between environments (ranges to water bodies and riverine) within the Coongan Gorge project area and surrounds. If these areas are further impacted or fragmented, fauna movement maybe restricted and populations affected.

The ephemeral drainage lines associated with the Coongan Gorge project area drain into both the Coongan and Talga Rivers which are major watercourses in the region, ultimately draining into the much larger system of the De Grey River in the north. The Marble Bar Road provides the only artificial barrier to fauna moving north-south through the landscape including the Coongan Gorge project area. A natural barrier to movement of fauna is the large expanse of open sandy river bed of the Coongan and Talga Rivers where at some points were one kilometre across with little cover. Apart from the Marble Bar Road (and other minor access tracks) fauna movement is largely unrestricted. Overall, the habitats within Coongan Gorge project area are largely contiguous through the local area and mostly well connected with habitats through the greater study area.

The fauna habitats of the M030 project area are part of a contiguous largely intact area of remnant vegetation within leased land primarily used for cattle grazing. The fauna habitats of the survey area are part of a much larger area of similar habitats within the local area and the greater study area. The positioning of the project area is mostly on a plain at the base of low ranges and creek lines consisting of large flat to undulating expanses of hummock grassland with open woodland and low rocky rises, intersected by drainage lines and creek lines.

The ephemeral drainage lines within the survey area drain into a larger system south of the survey area which forms part of a larger network of watercourses which ultimately drain into the much larger tributaries of the Shaw River, west of the survey area and potentially Miralga Creek to the south.

The Marble Bar Road (500 m east of the survey area) provides the only barrier to fauna moving east-west through the landscape, including the survey area. This road experiences a high amount of heavy haulage vehicles moving resources to Port Hedland. This regular traffic would likely increase the rate of vehicle strike and potentially deter fauna in immediately adjacent areas. Several animal carcasses (macropods only- Red Kangaroo and Euro) were recorded during the survey along this section of the road and it is likely the road presents a moderate barrier to movement for ground dwelling species. This barrier may reduce the rate at which ground dwelling species (such as the Spectacled Hare-wallaby would move through the landscape.

3.5.4 Conservation significant fauna

Three fauna species of conservation significance were recorded during the field surveys within the Coongan Gorge survey area (Northern Quoll, Ghost Bat and Western Pebble-mound Mouse). A fourth species (Greater Bilby) may also be present within the Coongan Gorge survey area, however insufficient information was recorded to provide a confident decision regarding its presence within the survey area or project area. The Western Pebble-mound Mouse was the only fauna species of conservation significance to be recorded within the M030 material pit footprint.

Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll is listed as Endangered under the EPBC Act and under the WC Act and was recorded active in the Coongan Gorge project area and survey area. One individual (a female – due to visible neck fat rolls) was observed moving from the ranges onto the plain moving directly towards the Talga River north of the project area. It is likely that this species is routinely moving between the range and rivers (water bodies) for resources. The species was also captured 10 times on camera trap from five localities, four of which were from the project area. At least three males and seven females were recorded (see Plate 1 and Plate 2). Data records are mapped in Figure 3, Appendix A for the project area and Figure 5 of Appendix B for the survey area.

Plate 1 Male Northern Quoll from within the survey area

Plate 2 Female Northern Quoll from the survey area

Ghost Bat *(Macroderma gigas)*

The Ghost Bat is listed as Vulnerable under the EPBC Act and under the WC Act and was recorded north of the Coongan Gorge project area during spot lighting surveys. One individual was visually recorded flying within the *Melaleuca* Woodland presumably hunting. This location is mapped in Figure 5, Appendix B.

No caves suitable for Ghost Bat were recorded in the project area or Coongan Gorge survey area and broader searches in the study area failed to yield any large caves. However, this search was not exhaustive and additional surveys may identify cave systems. The complex and steep rocky slopes of habitat in the study area, outside the project area may contain caves that are suitable roosting and feeding habitat and may include maternity caves.

Greater Bilby (*Macrotis lagotis*)

The Greater Bilby is listed as Vulnerable under the EPBC Act and under the WC Act.

During the survey three sets of potential Bilby tracks were recorded in the bed of the Talga River north of the Coongan Gorge project area (see Figure 5, Appendix B). Bilby and Rabbit tracks are very similar and difficult to tell apart, thus the identification cannot be confidently determined. Broader searches were undertaken within the study area (but only up to 1 km from the Coongan Gorge survey area boundary) to locate any additional information from either the Bilby or Rabbit's presence. An old burrow system was located on the far side of the Talga River within the project area but due to the age and eroded nature of the system, it could not be confidently determined if it was Bilby or Rabbit. No other evidence was found from either species to make an informed decision on which species (if not both) are present in the project area or larger survey area. The survey area is within the northern most limit of Rabbit distribution with only one record in the study area. However, Bilby are known from the area with a recent population of Bilby identified approximately 20 km north of the Coongan Gorge survey area (Martin Dziminski pers comm, DPaW 19/06/2016) and an additional population recorded 20 km south (DPaW 2016).

Western Pebble-mound Mouse *(Pseudomys chapmani)*

The Western Pebble-mound Mouse is listed as Priority 4 under DPaW priority fauna listing. Evidence of the species was recorded in 19 locations consisting of active and inactive mounds within the Coongan Gorge survey area (see Figure 5, Appendix B) of which at least seven

locations occur within or in close proximity to the project area (Figure 3, Appendix A). Plate 3 shows one of the active mounds recorded.

Evidence of the species was also recorded in nine locations within the M030 material pit footprint (as shown in Figure 3, Appendix A). In total two active and seven unused/inactive mounds were recorded on low stony hills or undulating plains.

NatureMap records (DPaW 2016) indicate that this species is wide spread in the eastern Pilbara region. However, this species is known to be sensitive to external impacts and populations are known to decline in areas where disturbance has occurred.

Plate 3 An active Pebble Mouse mound amongst Triodia.

Likelihood of Occurrence

The results of the field survey were combined with the results of the desktop assessment to provide a likelihood of occurrence assessment for conservation significant fauna species identified during the desktop searches as occurring or potentially occurring within the project area. The assessment identified the likely presence of an additional nine other species of conservation significance (see Table 12) within the project area. The Likelihood of Occurrence assessment revealed that other fauna species of conservation significance could occasionally occur within the habitats of the project area (those species deemed 'unlikely' to occur). However, it is considered unlikely that the project area provides important habitat (e.g. breeding habitat or key foraging habitat) for any of these species deemed 'unlikely' to occur and that these other species may occasionally use the habitats of the survey area for temporary refuge and dispersal between other areas of habitat.

Table 13 provides a summary of the extent of suitable habitat recorded for each fauna species of conservation significance recorded or likely to occur within the project area.

Table 12 Fauna species of conservation significance Likelihood of Occurrence within the project area

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence – Coongan Gorge	Justification for Likelihood of Occurrence – M030 Pit
Northern Quoll *Dasyurus hallucatus* En, S2, En	**Present –** species recorded within project area during surveys	**Likely – regular visitor / opportunistic use of the project area** The project area provides suitable hunting habitat for the species. No potential breeding habitat was recorded in the project area, however the hills / slopes/ ridgelines and rocky areas surrounding the project area would be regarded as core habitat. The creek line to the south-east of the project area has *Eucalyptus camaldulensis* present with hollows and would also be regarded as core habitat. Seventy camera trapping nights (in rocky habitat) were undertaken in the survey area with no records of the species (an additional 100 camera nights was undertaken on plains habitat).
Ghost Bat *Macroderma gigas* Vu, S3, Vu	**Present -** species recorded within vicinity of project area during recent surveys	**Unlikely**
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Pilbara form) Vu, S3, Vu	**Likely – species is known from the study area and potential foraging habitat present** No caves for roosting or breeding were recorded in the project area or larger survey area nor were any identified during regional walks in study area. However the project area is potential foraging habitat for the species.	**Unlikely**
Pilbara Olive Python *Liasis olivaceus barroni* Vu, S3, Vu	**Likely – resident/regular visitor of the project area** The project area provides suitable habitat for the species, particularly where it intersects rock outcrops, and drainage lines and watercourses. The remainder of the habitat in the survey area is supportive only.	**Unlikely**
Greater Bilby *Macrotis lagotis*	**Likely – occasional visitor, opportunistic use of the project area**	**Unlikely**

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence – Coongan Gorge	Justification for Likelihood of Occurrence – M030 Pit
Vu, S3, Vu	The larger survey area provides suitable habitat for the species, however the habitat within the project area is most likely limited to the sand plains and drainage lines/watercourses. It is likely that the project area is part of the species broader home range and it probably passes through the project area during dispersal.	
Peregrine Falcon *Falco peregrinus* OS, S7	**Likely – regular visitor or resident to project area** The larger survey area provides suitable hunting and roosting habitat, however the habitat is limited within the project area. It is likely that the project area is part of the species broader home range, with potential breeding habitat within the riparian areas along the margins of the project area and includes large *E. camaldulensis* and *Melaleuca argentea* Woodland in the river. Important breeding habitat (e.g. steep cliffs) may be found in nearby ranges outside the project area but within the study area.	**Likely – regular visitor or resident to project area** The project area provides suitable hunting (foraging) habitat. The project area is probably part of the species broader home range; no breeding habitat occurs within the project area. Core breeding habitat (e.g. steep cliffs) may be found in surrounding ranges outside the project area.
Grey Falcon *Falco hypoleucos* Vu, S3	**Likely – regular visitor or resident to project area** The project area provides suitable hunting and limited roosting and breeding habitat for the species. The project area is probably part of the species broader home range, with potential breeding habitat within the riparian areas along the margins of the project area and includes large *E. camaldulensis* and *Melaleuca argentea* Woodland in the river.	**Likely – regular visitor or resident to project area** The project area provides suitable hunting, and limited breeding and roosting habitat for the species. The project area is probably part of the species broader home range. Limited breeding habitat occurs as scattered trees throughout the project area.
Lakeland Downs Mouse *Leggadina lakedownensis* P4	**Unlikely**	**Likely – regular visitor or resident to project area** The project area provides suitable habitat for the species particularly in drainage lines, and associated *Triodia* hummock grasslands on sandy plain. The project area is probably part of the species broader distribution, as typically this species responds to favourable environmental conditions fluctuating in range and abundance (and habitat use) depending on resources. There are historical records from 2

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence – Coongan Gorge	Justification for Likelihood of Occurrence – M030 Pit
		km east of the project area. This area was visited during the field survey and it was identified as cracking clay grasslands which is typical/core habitat for this species.
Brush-tailed Mulgara *Dasycercus blythi* P4	**Unlikely**	**Likely –resident to project area** The project area provides suitable habitat for the species particularly in *Triodia* hummock grasslands on sandy plain. The survey area is probably part of the species broader distribution, as typically this species is present in sandy plains (and dunes) in the region.
Long-tailed dunnart *Sminthopsis longicaudata* P4	**Likely –resident to project area, restricted to the rocky ranges** The project area provides limited suitable habitat for the species particularly in rocky ranges and associated rocky habitats. The species has been recorded within the study area.	**Unlikely**
Glossy Ibis (*Plegadis falcinellus*) - Miw, S5, IA / Wood Sandpiper (*Tringa glareola*) - Miw, S5, IA / Sharp-tailed Sandpiper (*Calidris acuminata*) - Miw, S5, IA / Common Sandpiper (*Actitis hypoleucos*) - Miw, S5, IA	**Unlikely** These species were determined as likely to occur within the Coongan Gorge survey area as a result of the biological assessment, however the area of potential habitat occurring within the project area has been significantly reduced and is considered to be limited within the project area	**Unlikely**

Table note:

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following: MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered

WC Act - Species listed as CR = critically endangered, En = endangered, Vu = Vulnerable, IA = international migratory agreement migratory birds, OS = other specially protected fauna

DPaW – Species listed as Priority (P) 1, 2, 3 or 4

Table 13 Habitat types and extent within the project area for fauna species of conservation significance

Habitat type	Fauna species of conservation significance	Area (ha) within Coongan Gorge	Area (ha) within M030 Pit	Total area of each habitat type within project area (ha)
Triodia hummock grassland on sand plain	Northern Quoll (hunting and corridor habitat) Pilbara Leaf-nosed Bat (potential foraging habitat) Peregrine and Grey Falcon (potential hunting habitat) Lakeland Downs Mouse (potential foraging and breeding habitat) Brush-tailed Mulgara (potential hunting and breeding habitat)	-	60.83	60.83
Triodia hummock grassland on stony plain / *Triodia* hummock grassland on plain or undulating plain	Northern Quoll (hunting and corridor habitat) Pilbara Leaf-nosed Bat (potential foraging habitat) Ghost bat (potential foraging habitat Coongan Gorge) Peregrine and Grey Falcon (potential hunting habitat) Greater Bilby (potential corridor and foraging habitat, limited breeding habitat) Lakeland Downs Mouse (potential foraging and breeding habitat in M030) Brush-tailed Mulgara (potential hunting and breeding habitat in M030)	1.89	51.75	53.64
Minor drainage lines / Minor drainage lines with small dense patches of trees/shrubs and scattered trees	Northern Quoll (hunting, corridor and breeding habitat within Coongan Gorge and potential hunting and corridor habitat within M030) Pilbara Leaf-nosed Bat (potential foraging habitat) Pilbara Olive Python (potential hunting and breeding habitat) Greater Bilby (potential corridor and foraging habitat, limited breeding habitat) Peregrine and Grey Falcon (potential hunting habitat)	4.06	0.54	4.6

Habitat type	Fauna species of conservation significance	Area (ha) within Coongan Gorge	Area (ha) within M030 Pit	Total area of each habitat type within project area (ha)
Eucalyptus camaldulensis and *Melaleuca argentia* along Talga and Coongan Rivers / Water bodies and riverine habitats along the Talga River	Northern Quoll (hunting, corridor and breeding habitat) Pilbara Leaf-nosed Bat and Ghost Bat (potential foraging habitat) Pilbara Olive Python (potential hunting and breeding habitat) Greater Bilby (potential corridor and foraging habitat, limited breeding habitat) Peregrine and Grey Falcon (potential hunting habitat for both species and breeding habitat for the Grey Falcon)	0.25	-	0.25
Rocky ridgelines or exposed rock or outcropping / Rocky ridgelines /rocky ranges (with scree) with hummock grasslands and scattered trees and shrubs	Northern Quoll (hunting, corridor and breeding habitat) Pilbara Leaf-nosed Bat (potential foraging habitat) Ghost bat (potential foraging habitat Coongan Gorge) Pilbara Olive Python (potential hunting and breeding habitat) Peregrine and Grey Falcon (potential hunting habitat) Long-tailed dunnart (breeding and foraging habitat)	25.35	0.60	25.95
Disturbed area		2.09	19.08	21.17
Total		**33.64**	**132.81**	**166.45**

3.5.5 Potential impacts

Loss of habitat – construction phase

Clearing for the project would result in the permanent loss of up to 43.64 ha of fauna habitat consisting of approximately 41.55 ha of medium to high quality habitat including known and potential habitat for fauna species of conservation significance (Table 13 and 14). The majority of the clearing and removal of habitat would occur along a 4-5 km section of the Coongan Gorge project area consisting of the new realignment section of between SLK 321 and 319. It will also be necessary to widen parts of the existing Marble Bar Road through the Coongan Gorge area to accommodate design changes which would also account for a portion of the habitat clearing. The remaining 7.72 ha of the project area is already largely modified (e.g. existing cleared areas and roads) and provides limited fauna habitat.

In addition to the loss of habitat, clearing would also reduce the functionality of the remaining habitat alongside Marble Bar Road, areas adjacent the realignment section and in the local area. The potential loss of habitat for each fauna species of conservation significance resulting from clearing for the project area is summarised in Table 14.

Table 14 Summary of key potential impacts for fauna species of conservation significance within the project area

Species of conservation significance	Key potential impacts
Northern Quoll	Loss of an estimated 41.55 ha of known and potential habitat including hunting and breeding habitat primarily from the Coongan gorge area. The core area of habitat for this species is within the Coongan Gorge section of the project area. Approximately 31.55 ha hunting, corridor, denning and breeding habitat will be removed along a corridor for the road realignment. The area within the material pit (up to 10 ha) lacks denning and breeding habitat and is limited to hunting and corridor habitat.
Pilbara Leaf-nosed Bat	Loss of an estimated 41.55 ha of potential foraging/hunting habitat. The majority of this habitat occurs within the Coongan Gorge area.
Ghost Bat	Loss of an estimated 31.55 ha of potential foraging/hunting habitat within the Coongan Gorge area.
Pilbara Olive Python	Loss of an estimated 41.55 ha of potential habitat including hunting and breeding habitat. The core area of habitat for this species is within the Coongan Gorge section of the project area. Approximately 31.55 ha hunting, corridor and denning and breeding habitat will be removed along a corridor for the road realignment. The remaining area (up to 10 ha) within the material pit lacks breeding habitat and is limited to hunting and corridor habitat.
Greater Bilby	Loss of an estimated 6.25 ha of potential habitat including foraging, corridor and breeding habitat within the Coongan Gorge section of the project area.
Peregrine Falcon	Loss of an estimated 41.55 ha of potential hunting habitat. The main area of habitat for this species is within the Coongan Gorge section of the project area.
Grey Falcon	Loss of an estimated 41.55 ha of potential habitat including hunting and limited breeding habitat. The main area of habitat for this species is within the Coongan Gorge section of the project area of which only 0.25 ha is considered potential breeding habitat. The remaining area is hunting habitat.

Species of conservation significance	Key potential impacts
Lakeland Downs Mouse	Loss of an estimated 10 ha of potential habitat including foraging and breeding habitat from the M030 component of the project area.
Brush-tailed Mulgara	Loss of an estimated 10 ha of potential habitat including foraging and breeding habitat from the M030 component of the project area.
Long-tailed dunnart	Loss of an estimated 23.35 ha of potential habitat including foraging and breeding habitat within the Coongan Gorge section of the project area and is largely limited to rocky ridgelines or exposed rock or outcropping.

Injury and mortality during the construction phase

Habitat removal may result in the injury or death of fauna. Some species are more susceptible than others (e.g. can more readily evade injury such as birds). The Pilbara Olive Python is susceptible to injury / death given its crepuscular behaviour (i.e. most activity occurs at night). Furthermore, many species including the Lakeland Downs Mouse, Brush-tailed Mulgara and Long-tailed Dunnart are not able to cover large distances rapidly making them more susceptible to injury / death during the clearing phase of the project. Other species including the Northern Quoll may also be susceptible to injury or death during clearing; particularly during the breeding season when mother and young are in the den.

Secondary impacts from dust, noise and vibration are also likely to occur during clearing of vegetation and habitat. This will temporarily scare fauna away from the project area but is unlikely to have a permanent impact on fauna use of the road corridor.

Mortality due to vehicle collision (road kill) – operational phase

The detrimental impacts of roads on wildlife have been documented in Australia (Andrews 1990; Taylor and Goldingay 2003; Bond and Jones 2008; Chambers and Bencini 2010; Hobday and Minstrell 2008; Klöcker et al. 2006; Dique et al. 2003; Coulson, 1982).

During the operational phase of the project, the local wildlife populations including Northern Quoll may be impacted as a result of the new road. The proposed road realignment between SLK 321 and 319 would create a new and additional barrier to the movement of fauna, consequently increasing the likelihood of fauna and vehicle collisions. Therefore, it is likely that the project may contribute to the cumulative loss of fauna in the locality, considering the existing road mortality (e.g. macropod carcasses recorded along marble Bar Road during the survey) and additional risk of road kill. However, the magnitude of this impact is likely to reduce, as Main Roads will close and rehabilitate the existing Marble Bar Road section north of the proposed realignment, which will effectively remove the additional barrier effect with time.

Gradual and cumulative impacts including fragmentation – operational phase

The proposed project may reduce the overall connectivity of habitat available to the fauna including conservation significant fauna (e.g. the Pilbara Olive Python and Northern Quoll) in the locality. It is likely to exacerbate existing barrier effects by creating an additional barrier to the movement of fauna in the local landscape for the section between SLK 321 and 319. The proposed project will remove and divide areas of fauna habitat, however these impacts are likely to be short term and temporary and limited to the local area because Main Roads will close and rehabilitate the existing Marble Bar Road section north of the realignment between SLK 321 and 319, which will effectively remove the additional barrier effect with time.

Furthermore, it is important to note that the design of the road (e.g. raised or not, presence of walls and fences, fauna underpasses) influence rates of road kill (Taylor and Goldingay 2003). Main Roads should consider wildlife friendly design options (e.g. fauna underpasses) to assist with facilitating the safe movement of fauna in order to reduce the potential risk of fauna and vehicle collisions, fragmentation effects and cumulative loss of fauna in the locality.

3.6 Air quality, noise and vibration

3.6.1 Air quality

Traffic along existing Marble Bar Road will contribute to the local airshed, with motor vehicle emissions including air pollutants such as carbon monoxide (CO), particles, oxides of nitrogen (NO_x) and volatile organic compounds (VOCs). Other contributors to the local airshed include dust from unsealed road use and limited agricultural activities. The project is unlikely to significantly alter vehicle air emissions within the project area.

Asbestiform mineral has been recorded in close proximity to the Coongan Gorge project area, which could have air quality implications if it becomes air borne as a result of construction activities. This is discussed further, including the potential health impacts, in Sections 3.8 and 3.8.1.

3.6.2 Noise and vibration

The project is located along the existing Marble Bar Road (with minor deviations) within a pastoral area. It is expected that noise emissions in the local area limited and primarily associated with vehicle movement, typical of a regional road in an isolated area. Depending on the construction technique employed (particularly for cutting) there is a high probability there will be significant construction noise. However, it is not anticipated there will be any significant changes to the traffic related noise or vibration levels during operation.

3.6.3 Potential impacts

There are no sensitive receptors in close proximity to the project area. The potential impacts are expected to be minor and restricted to the construction phase of the project, with the exception of ongoing noise/vehicle emissions from the road. These are not expected to be significantly different to existing noise emissions.

Project activities that may result in air and noise emissions and vibration include:

- Physical disturbance of the land – such as removal of vegetation, excavation of roots, major cutting and minor road rehabilitation works
- Transportation – haulage of materials and machinery, vehicle movements
- Dust from dry, cleared areas and from vehicle movements.

Air, noise and vibration impacts are expected to be restricted to the immediate proximity of the project area. These aspects can be adequately managed (with the potential exception of naturally occurring asbestiform mineral) through standard techniques to maintain existing environmental conditions in the EMP.

3.7 Visual amenity

The project area is located in a pastoral area, with existing areas of native, as well as pastoral vistas. Marble Bar Road is not considered to be tourist route and there are no significant, or signposted tourist destinations along, or overlooking any parts of the project area. The proposed works will be largely adjacent to and visible from the existing Marble Bar Road.

3.7.1 Potential impacts

Construction and operation of the project has the potential to impact on the amenity of the local area as a consequence of:

- Loss of native vegetation which provides visual amenity
- Temporary vehicle and machinery movements.

Residual amenity impacts from the loss of native vegetation is expected to be permanent, however not significant given the project area setting. The design of the project is aimed at improving the geometry and sight distances to increase safety for road users.

3.8 Contamination and hazardous substances

A search of DER's contaminated sites database identified no contaminated sites within the study area.

Hazardous materials, including hydrocarbons, will be used during construction. Spills and discharges of these hazardous materials may result in small scale contamination of soil, or may result in contamination of adjacent land and waterways.

Asbestiform minerals are widely distributed in WA and can be major components of the mafic and ultramafic rocks hosting gold and base metal deposits located in WA's greenstone belts which contains the State's major gold and base material deposits. Amphibole minerals may also be encountered in the banded iron formations of the Hamersley Basin (Department of Mines and Petroleum (DMP) 2015). Parts of the project area are located within Talga land system which consist of ridges of greenstone and chert (van Vreeswyk *et al.* 2004). According to mapping available from the Geological Survey of Western Australia (cited in DMP 2013) the project area is within the Pilbara Cratons/Pilbara region which has a medium probability of encountering asbestos material of the chrysotile (white asbestos), anthophyllite, tremolite and actinolite variety.

Asbestiform mineral (most likely Chrysotile) has been recorded approximately 1.2 km north of the Coongan Gorge project area, adjacent to the Talga River during the biological surveys. The mineral was recorded as a vein in a cutting rock face, facing the Talga River, as well as in smashed up rocks along the surface of an old railway causeway (Figure 5). The finding was reported to Main Roads following the survey. The concentration and distribution of Asbestiform mineral within the project area is unknown.

3.8.1 Potential impacts

Contaminated sites and materials

The project involves standard road construction so the use and storage of hazardous substances will be limited. Materials used on site should be handled, used and disposed of in accordance with their SDS and Main Roads standard procedures.

Any anthropogenic contamination identified during works should be managed in accordance with the project EMP. Furthermore, any pollution generating activities such as refuelling or storage of chemicals during works should also be managed in accordance with the EMP.

Asbestos risks

Asbestiform minerals are commonly found in veins, many of which are lens shaped. They may be covered by deep soil or a thick layer of weathered rock and are often small and isolated. Therefore, they may be present but unnoticed. Asbestiform minerals can be weathered to produce harmless secondary minerals (e.g. talc, chlorite, clay, iron oxides and hydroxides, and various silicates) (DMP 2015). Consequently, even if there is no near surface evidence of

asbestiform mineralisation, the probability of encountering asbestiform minerals increases with depth of ground penetration (or cut).

During the construction phase of the project there may (or may not) be a potential to release hazardous asbestos material which may become airborne creating a health and safety risk for construction workers and commuters using the Marble Bar Road in the vicinity of the construction area.

It is recommended further consideration be given to the potential risk associated with naturally occurring asbestos material and its impacts during the construction and operational phases of the project. It is important to first identify if naturally occurring asbestos material is in fact present within the project area. If present, the type and extent of the material will need to be understood to enable appropriate procedures, controls and management actions to be developed for the project.

3.9 Heritage

3.9.1 Aboriginal heritage

An archaeological and ethnographic Aboriginal heritage survey was undertaken by Terra Rosa with participation of Njamal Traditional Owners in October 2016. One isolated object comprising background archaeological material (BAM) was identified during the survey. It was subsequently determined the BAM identified did not require the completion and submissions of a heritage information submission form (HISF).

No Registered Aboriginal sites, Other Heritage Places or newly identified heritage places were found to exist within the survey area (Terra Rosa, 2016).

No further Heritage consultation is required, providing project impacts remain within the area surveyed.

3.9.2 European heritage

A search of the EPBC Protected Matters Search Tool identified no Commonwealth listed heritage sites within 40 km of the project.

A search of the Western Australian State Heritage Office Inherit database identified 14 known site of heritage significance within the study area. The closest site is Eginbah Tanks (Place Number: 14202), located approximately 1.4 km north of the project area.

3.9.3 Potential impacts

No impacts on heritage aspects are expected.

3.10 Construction phase potential impacts

In addition to the potential construction phase impacts discussed in the previous Section, there are other environment and safety hazards that require consideration and management during the construction phase of the project. These construction hazards include:

- Fire ignition
- Waste, litter and hazardous materials
- Traffic management requirements.

These hazards are expected to be short term and likely to be limited to the project area and its near surroundings. These aspects can be adequately managed through standard techniques to maintain existing environmental conditions in the EMP.

3.10.1 Fire

Fire can pose a threat to human life, property and livestock as well as flora and fauna. The vegetation adjacent to the project area is considered to be susceptible to fire. Vegetation clearing, as well as construction works and vehicle movement can provide ignition sources for fire, which can be a high risk during dry conditions. Construction management actions should give consideration to fire risk activities and where relevant, should be incorporated through an EMP.

3.10.2 Waste, litter and hazardous materials

Vegetation clearing and construction works are likely to generate a minimal amount of general and construction wastes. Poor management of waste materials may lead to litter and/or contamination (as a result of fuel or chemical spills) of the project and surrounds, impacts to fauna and increased fire risk. This in turn may impact on the aesthetics of the area (e.g. visual amenity) and the health of terrestrial ecosystems.

Consequently, waste, litter and hazardous materials will require management during construction. Management of these issues should be clearly outlined in an EMP for the project.

3.10.3 Traffic management requirements

Construction along and adjacent to Marble Bar Road may result in some localised, short-term adverse impacts on local and regional traffic movements.

The following potential impacts have been identified:

- Injury to road users due to vehicles operating for the project
- Potential damage to roads and spillage of carted materials
- Altered public access.

Although there is no obvious environmental need for a traffic management plan during construction, this may be required from a road user safety perspective.

4. Environmental management

The aim of environmental management is to minimise the environmental impacts associated with the proposed works as well as to identify areas of responsibility for the implementation of management strategies. A project specific EMP has been developed to manage environmental impacts associated with the project. The EMP is provided in Appendix D.

The project is expected to be delivered through a contract with environmental management measures outlined in an EMP. The environmental management measures listed in the EMP in Appendix D relate to the environmental aspects listed below and should form the basis for this plan.

Key environmental aspects

The key environmental aspects and impacts for the proposed project were identified through the EIA process. The key relevant environmental aspects identified during this process and addressed in this EIA include:

- Flora and vegetation – impacts to native vegetation
- Terrestrial fauna – impacts to fauna species of conservation significance.

Other environmental factors have been identified as requiring less detailed assessment as they pose a lower risk and can be readily managed through Main Roads' procedures and adherence to regulations. These factors include:

- Watercourses and drainage
- Soils and ASS
- Dust, noise and vibration
- Visual amenity
- Waste and hydrocarbon management
- Aboriginal heritage – it should be noted that although briefly discussed in this EIA and EMP, heritage has been assessed (and where required) and managed under the AH Act.

The risks associated with the potential presence of asbestiform minerals within the project area is unknown at this stage. It is recommended further investigation be considered to inform the necessity for more specific management action and precautionary measures to manage potential impacts from this environmental aspect.

5. Commonwealth aspects and impacts

MNES are factors that require legislated protection in order to conserve biodiversity, protect World Heritage and National Heritage Places, and comply with international treaties. MNES are listed and protected under the EPBC Act. An assessment was undertaken to determine whether the project will impact upon MNES and require referral to DotEE. The outcome of this assessment is summarised in Table 15.

As a result of this assessment it is considered the project may have a negative impact on populations of the Northern Quoll and Pilbara Olive Python, therefore referral is recommended for these MNES.

Table 15 Assessment of MNES and likely impacts

MNES	Existing Environment and Likely Impact
Nationally listed threatened species or ecological communities	***Fauna*** The results of the field survey were combined with the results of the desktop assessment to provide a likelihood of occurrence assessment (see Section 3.5.4). One EPBC Act-listed fauna species was recorded within the project area and three additional EPBC Act-listed species were determined likely to occur based on the presence of suitable habitat and nearby records. These are: • Northern Quoll (*Dasyurus hallucatus*) – Endangered under the EPBC Act. Species was recorded within the project area • Ghost Bat and Pilbara Lea-nosed Bat (*Macroderma gigas*) – Vulnerable under the EPBC Act. The Ghost Bat was recorded near the project area during the current field surveys and there is suitable foraging habitat within the project area for both species • Pilbara Olive Python (*Liasis olivaceus barroni*) - Vulnerable under the EPBC Act. Potential breeding and hunting habitat within the project area • Greater Bilby (*Macrotis lagotis*) – Vulnerable under the EPBC Act – there is potential habitat and recent nearby records however conclusive evidence was not recorded within the project area to determine presence during the survey.
Justification of likely impact	Project activities will directly or indirectly impact the following species: **Northern Quoll** The project activities are associated with the loss of an estimated 41.55 ha of known and potential habitat including hunting and breeding habitat primarily from the Coongan gorge project area. Approximately 31.55 ha hunting, corridor, denning and breeding habitat will be removed along a corridor for the road realignment from the Coongan Gorge area. The area within the material pit (up to 10 ha) lacks denning and breeding habitat and is limited to hunting and corridor habitat. A review of the Significant Impact Guidelines (Department of the Environment (DotE) 2013) and the species specific Northern Quoll referral guidelines (Commonwealth of Australia (CoA) 2016) was undertaken to consider the need for referral to DotEE for the Northern Quoll. Referral is recommended for the Northern Quoll because: • The species was recorded during current surveys at numerous locations within the project area and adjacent areas of habitat to the project area including observations of both male and females indicating the presence of a breeding population • There is significant habitat present for the species and a portion of this habitat may be impacted by the project. The habitat within the project area is considered part of an area of habitat critical to the survival for a population of the Northern Quoll • The Northern Quoll was recorded moving in-between the range to the riverine environment in search of resources. The project proposes to realign a section of Marble Bar Road and create a new barrier which

MNES	Existing Environment and Likely Impact
	potentially removes and divides important habitat for the Northern Quoll creating additional barrier effects (albeit probably temporary). **Ghost Bat and Pilbara Leaf-nosed Bat** The project activities are associated with the loss of an estimated 31.55 ha of potential foraging/hunting habitat within the Coongan Gorge area for the Ghost Bat and 41.55 ha of potential foraging/hunting habitat within the project area for the Pilbara Leaf-nosed Bat. A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotEE for the Ghost Bat and Pilbara Leaf-nosed Bat. Referral is unlikely because: • No core habitat for the species was recorded during the current survey, foraging habitat is present only • There is a low risk of a substantial impact to important habitat for a population of either species of bat, no cave habitats were recorded in the survey area. Only foraging habitat is present in the project area. **Pilbara Olive Python** The project activities are associated with the loss of an estimated 41.55 ha of potential habitat including hunting and breeding habitat. The core area of habitat for this species is within the Coongan Gorge project area. Approximately 31.55 ha hunting, corridor and denning and breeding habitat will be removed along a corridor for the road realignment. The remaining area (up to 10 ha) within the material pit lacks breeding habitat and is limited to hunting and corridor habitat. A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotEE for the Pilbara Olive Python. Referral is recommended for the Pilbara Olive Python because: • Habitat recorded in the project area is considered important to the species including the rocky ranges, drainage lines, riverine and water bodies • There is a known population within the region and numerous specimens recorded within 80 km of the project area • The species is likely to move in-between the range and riverine environment in search of resources. The proposed project is to put a road through these areas bisecting habitat potentially causing additional barrier effects. **Greater Bilby** The project activities are associated with the loss of an estimated 6.25 ha of potential habitat including foraging, corridor and breeding habitat within the Coongan Gorge section of the project area. A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotEE for the Greater Bilby. Referral is unlikely for the Greater Bilby because: • The area of potential impact and subsequent habitat loss since the biological surveys was undertaken has been significantly reduced, particularly in the Coongan Gorge area

MNES	Existing Environment and Likely Impact
	• The majority of suitable habitat for the species is located outside the project area, with limited potential breeding habitat within the project area • Although no direct conclusive evidence was collected for this species, the relevant evidence was recorded from habitats outside the project area.
Methodology	Reference to a number of sources was made to provide the relevant information for assessment of impact. These are: • DotEE Protected Matters Search Tool Report October 2016 • DotE 2013, Matters of National Environmental Significance Significant Impact Guidelines 1.1: *Environment Protection and Biodiversity Act 1999* Commonwealth of Australia. • CoA 2016, Referral guideline for the Northern Quoll (*Dasyurus hallucatus*) under the EPBC Act. Commonwealth of Australia. • GHD (2016a) Coongan Gorge Road Realigment, Biological Assessment • GHD (2016c) M030 Material Pit Extraction Area 356 SLK, Biological Assessment
Migratory species	The assessment identified the likely presence of four EPBC listed migratory wetland fauna species within the survey area: • Glossy Ibis (*Plegadis falcinellus*) • Wood Sandpiper (*Tringa glareola*) • Sharp-tailed Sandpiper (*Calidris acuminata*) • Common Sandpiper (*Actitis hypoleucos*) A review was undertaken to determine the likelihood of occurrence within the project area and it was determined that all four species were unlikely to occur.
Justification of likely impact	**Referral unlikely** A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotEE for the Migratory birds. These species are nomadic utilising habitats as required. Much of the habitat available to the wading species is restricted to the riverine environment and unlikely to be impacted by the proposed works. None of the four species discussed are likely to rely on the habitats present within the project area and clearing of habitat for the project is unlikely to significantly impact a population of these species.
Methodology	Reference to a number of sources was made to provide the relevant information for assessment of impact. These are: • DotEE Protected Matters Search Tool Report October 2016 • DotE 2013, Matters of National Environmental Significance Significant Impact Guidelines 1.1: *Environment Protection and Biodiversity Act 1999* Commonwealth of Australia. • GHD (2016a) Coongan Gorge Road Realigment, Biological Assessment

MNES	Existing Environment and Likely Impact
	• GHD (2016c) M030 Material Pit Extraction Area 356 SLK, Biological Assessment
Wetlands of International Importance	No Wetlands of International Importance with 40 km of project area.
Justification of likely impact	N/A
Methodology	DotEE Protected Matters Search Tool Report October 2016
World Heritage Properties	No world heritage properties within 40 km of the project area
Justification of likely impact	N/A
Methodology	DotEE Protected Matters Search Tool Report October 2016
National Heritage Places	No world heritage properties within 40 km of the project area.
Justification of likely impact	N/A
Methodology	DotEE Protected Matters Search Tool Report October 2016
Commonwealth Land or Marine Areas	Project activities are not located on or near Commonwealth land or marine areas. Commonwealth land or marine areas will not be impacted by the activities associated with the project.
Justification of likely impact	N/A
Methodology	DotEE Protected Matters Search Tool Report October 2016
Nuclear Actions	Not relevant to the proposed activity.
Justification of likely impact	No project actions involve nuclear actions. Therefore no project impact on this matter.
Methodology	N/A
Water Resource	Not relevant to the proposed activity.
Justification of likely impact	No project actions involve a significant water resource. Therefore no project impact on this matter.
Methodology	N/A.

6. Stakeholder consultation

Njamal Traditional Owners were consulted in the form of Aboriginal heritage surveys, completed in October 2016. The Traditional Owners raised no concerns and no further consultation will be required as long as project scope remains within the heritage survey area.

DPaW were consulted in December 2016 to source further information on impacts of native vegetation clearing to Northern Quoll and Pilbara Olive Python. The consultation included a discussion of other Pilbara projects that have had successful mitigation and management actions regarding Northern Quoll. DPaW also advised Main Roads that Northern Quoll are known to use dry, rectangular culverts, with associated rock protection, as fauna underpasses to linear infrastructure corridors. DPaW comments will be taken into consideration in the management plan and referral documentation.

7. Environmental approvals

This section details the requirements for environmental approvals for the project.

7.1 Referral to the Department of the Environment and Energy

The Commonwealth EPBC Act provides legislative protection for MNES, including all nationally threatened fauna and flora species and ecological communities. An action must be referred to DotEE under the EPBC Act if it will have, or is likely to have, a significant impact on any of the MNES.

The EIA has determined that the project may have a negative impact on a population of the Northern Quoll and Pilbara Olive Python therefore referral is recommended for these MNES.

7.2 Referral to the Environmental Protection Authority

In deciding whether a proposal will be subject to the formal environmental impact assessment process under the EP Act, the EPA takes into account the environmental significance of any potential impacts that may result from the implementation of the scheme or proposal.

This report has determined the project is unlikely to require referral to the EPA, due to the low significance of its impacts to the surrounding environment except for impacts to native vegetation and fauna habitats[2]. The potential impacts from the loss of native vegetation clearing and loss of fauna habitat for the project may be effectively assessed through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, with consideration of the environmental values discussed in the EIA report including MNES, it is considered unlikely that the project would require referral to the EPA under Section 38 of the EP Act.

7.3 Department of Environment Regulation

Assessment bilateral agreement between the State and Commonwealth governments

The clearing of native vegetation in WA requires a permit under Part V of the EP Act, unless an exemption applies. Main Roads has been granted a State-wide vegetation clearing permit (Clearing Permit CPS 818) which allows it to clear native vegetation for road realignment projects and associated activities. The Main Roads Purpose Permit (CPS 818) requires an assessment of the project clearing against the Ten Clearing Principles and, where at variance, an environmental offset may be required.

The State and Commonwealth Governments have entered into a bilateral agreement under the EPBC Act relating to environmental assessment (assessment bilateral agreement). Specifically, this agreement now includes the clearing permit assessment process under Part V Division 2 of the EP Act. Under the assessment bilateral agreement, if a native vegetation clearing permit is required and the clearing will have or is likely to have an impact on a MNES, the assessment of the clearing application including the potential impacts to the MNES can be conducted by the DER under delegation.

It is recommended the project be referral to DotEE due to potential impacts to fauna species listed under the EPBC Act. If the project is deemed a Controlled Action, a project specific clearing permit will be applied for under the bilateral agreement entered into by the

[2]. It is recommended further consideration be given to the potential risk associated with naturally occurring asbestos material and its impacts during the construction and operational phases of the project. It is important to first identify if naturally occurring asbestos material is in fact present within the project area. If present, the type and extent of the material will need to be understood to enable appropriate procedures, controls and management actions to be developed for the project.

Commonwealth and State governments. If the project is deemed Not a Controlled Action, the most efficient approval pathway would be an assessment under CPS 818.

8. References

Andrews, A. 1990. Fragmentation of Habitat by Roads and Utility Corridors: A Review. Australian Zoologist 26, pp. 130-141.

ASRIS 2016. *Australian Soil Resource Information Viewer*, retrieved October 2016, from http://www.asris.csiro.au/index_ie.html.

Beard, JS 1975. *Vegetation Survey of Western Australia: Pilbara*, map and explanatory memoir 1:1,000,000 series, Nedlands, University of Western Australia Press.

Beard, JS 1990. Plant Life of Western Australia, Perth, Kangaroo Press.

BoM 2016. *Climatic statistics for Australian locations*, retrieved October 2016, from http://www.bom.gov.au/climate/averages/tables.

Bond, A. R. and Jones, D. N. 2008. Temporal trends in use of fauna-friendly underpasses and overpasses. Wildlife Research 35, pp. 103–112.

Chambers, B. and Bencini, R. 2010. Road mortality reduces survival and population growth rates of tammar wallabies on Garden Island, Western Australia. Wildlife Research 37, pp.588–596.

Coulson, G. M. 1982. Road-Kills of Macropds on a Section of Highway in Central Victoria. Australian Wildlife Research 9, pp. 21–26.

CoA 2016, Referral guideline for the Northern Quoll (*Dasyurus hallucatus*) under the EPBC Act. Commonwealth of Australia.

DER 2016a. *Contaminated Sites Database*, retrieved October 2016, from https://secure.dec.wa.gov.au/idelve/css/.

DER 2016b. *Clearing Permit System*, retrieved October 2016, from https://cps.der.wa.gov.au/main.html

Dique, D. S., Thompson, J., Preece, H. J., Penfold, G. C., de Villiers, D. L. and Leslie, R. S. 2003. Koala mortality on roads in south-east Queensland: the koala speed-zone trial. Wildlife Research 30, pp. 419–426.

DMP 2013. *Managing fibrous material during exploration – toolbox presentation information powerpoint presentation.* Resources Safety, Department of Mines and Petroleum, Western Australia.

DMP 2015. *Management of fibrous minerals in Western Australian mining operations – guideline* (2nd edition): Resources Safety, Department of Mines and Petroleum, Western Australia, 47 pp.

DotE 2013, Matters of National Environmental Significance Significant Impact Guidelines 1.1: Environment Protection and Biodiversity Act 1999 Commonwealth of Australia.

DotEE 2016. *Environment Protection and Biodiversity Act 1999 Protected Matters Report,* retrieved October 2016, from http://www.environment.gov.au/epbc/pmst/.

DPaW 2016. *NatureMap: Mapping Western Australia's Biodiversity*, retrieved October 2016, from http://naturemap.dpaw.wa.gov.au/default.aspx/.

DoW 2016. Geographic Data Atlas, retrieved October 2016 from, http://www.water.wa.gov.au/idelve/dowdataext/index.jsp.

EPA 2000. *Environmental Protection of Native Vegetation in Western Australia, Clearing ofnative vegetation, with particular reference to the agricultural area*, Position Statement No. 2, Perth, EPA

EPA 2004a. Guidance of the Assessment of Environmental Factors, Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, Guidance Statement No. 51, Perth, Environmental Protection Authority.

EPA 2004b. Guidance of the Assessment of Environmental Factors, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, Guidance Statement No. 56, Perth, Environmental Protection Authority.

EPA and DEC 2010. *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (eds BM Hyder, J Dell and MA Cowan), Perth, WA.

EPA and DPaW 2015. *Technical Guide–Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (eds. K Freeman, G Stack, S Thomas and NWoolfrey), Perth,WA.

GHD 2016a. Coongan Gorge Road Realignment, Biological Assessment, unpublished report prepared for Main Roads, August 2016.

GHD 2016b. Coongan Gorge Road Realignment – Report Recommendations, unpublished memorandum prepared for Main Roads, July 2016.

GHD 2016c. M030 Material Pit Extraction Area 356 SLK, Biological Assessment, unpublished report prepared for Main Roads, September 2016.

GHD 2016d. M030 Material Pit Extraction Area 356 SLK – Report Recommendations, unpublished memorandum prepared for Main Roads, September 2016.

GoWA 2015. *2015 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report)*, Current as of June 2015, Perth Western Australia, Department of Parks and Wildlife, retrieved October 2016, from https://www2.landgate.wa.gov.au/web/guest/downloader.

GoWA 2016. *Heritage Council InHerit database*, retrieved October 2016, from http://inherit.stateheritage.wa.gov.au.

Hobday, A. J. and Minstrell, M. L. 2008. Distribution and abundance of roadkill on Tasmanian highways: human management options. Wildlife Research 35, pp.712–726.

Klöcker, U., Croft, D. B., and Ramp, D. 2006. Frequency and causes of kangaroo–vehicle collisions on an Australian outback highway. Wildlife Research 33, pp.5–15.

Novelly, PE and Warburton, D 2012. *A Report on the Viability of Pastoral Leases in the Northern Rangelands Region Based on Biophysical Assessment*, Perth, DAFWA.

Shire of East Pilbara 2015. *Town Planning Scheme No. 4*

Taylor, B. D. and Goldingay, R. L. 2003. Cutting the carnage: wildlife usage of road culverts in north-eastern New South Wales. Wildlife Research 30, pp.529–537.

Terra Rosa Consulting 2016. Report on an archaeological and ethnographic site identification heritage survey of Coongan Gorge Realignment at Marble Bar, conducted by the Njamal Traditional Owners and Terra Rosa Consulting for Njamal Heritage, and prepared for Main Roads Western Australia, October 2016.

Tille, P 2006. *Soil-landscapes of Western Australia's Rangelands and Arid Interior*, Resource Management Technical Report 313, Perth, DAFWA.

van Vreeswyk, AM, Leighton, KA, Payne, AL and Hennig, P 2004. *An inventory and condition survey of the Pilbara region, Western Australia*, Technical Bulletin No. 92, Department of Agriculture and Food, Western Australia.

Appendices

Appendix A – Figures

BIDYADANGA COMMUNITY

GREAT NORTHERN HIGHWAY

PORT HEDLAND

POINT SAMSON

DAMPIER

WICKHAM

ROEBOURNE

KARRATHA

MARBLE BAR

MARBLE BAR ROAD

NORTH WEST COASTAL HIGHWAY

ONSLOW

PANNAWONICA

PANNAWONICA ROAD

ROEBOURNE WITTENOOM ROAD

ONSLOW ROAD

MARBLE BAR ROAD

MUNJINA ROY HILL ROAD

KARIJINI DRIVE

TOM PRICE

BURKETT ROAD

MANUTARRA WITTENOOM ROAD

PARABURDOO

NEWMAN

Paper Size A3

0 20 40 60 80 100

Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

LEGEND

- Town
- Major Road
- Minor Road
- M030 Pit Footprint
- Coongan Gorge Footprint

Main Roads Western Australia
Coongan Gorge EIA, EMP and EPBC Referral

Job Number	61-34579
Revision	0
Date	14 Nov 2016

Project Location

Figure 1

G:\61\35039\GIS\Maps\MXD\6135039_001_Rev0_Fig1Locality.mxd

Data source: Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Coongan Gorge Realignment Footprint - 20161014, M030 Material Pit Expansion Survey Area - 20160913; Landgate: Aerial Imagery - Site Inset (Virtual Mosaic). Created by:afeeney

999 Hay Street Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

790,000 791,000 792,000 793,000 794,000 795,000

7,686,000 7,685,000 7,684,000 7,683,000

324 323 322 321 320 319 318

Marble Bar Rd

Paper Size A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

- Road
- Track
- Coongan Gorge footprint
- Side-track biological survey area
- Coongan Gorge biological survey area

GHD

mainroads WESTERN AUSTRALIA

SLIP

Main Roads Western Australia
Coongan Gorge EIA, EMP and EPBC Referral

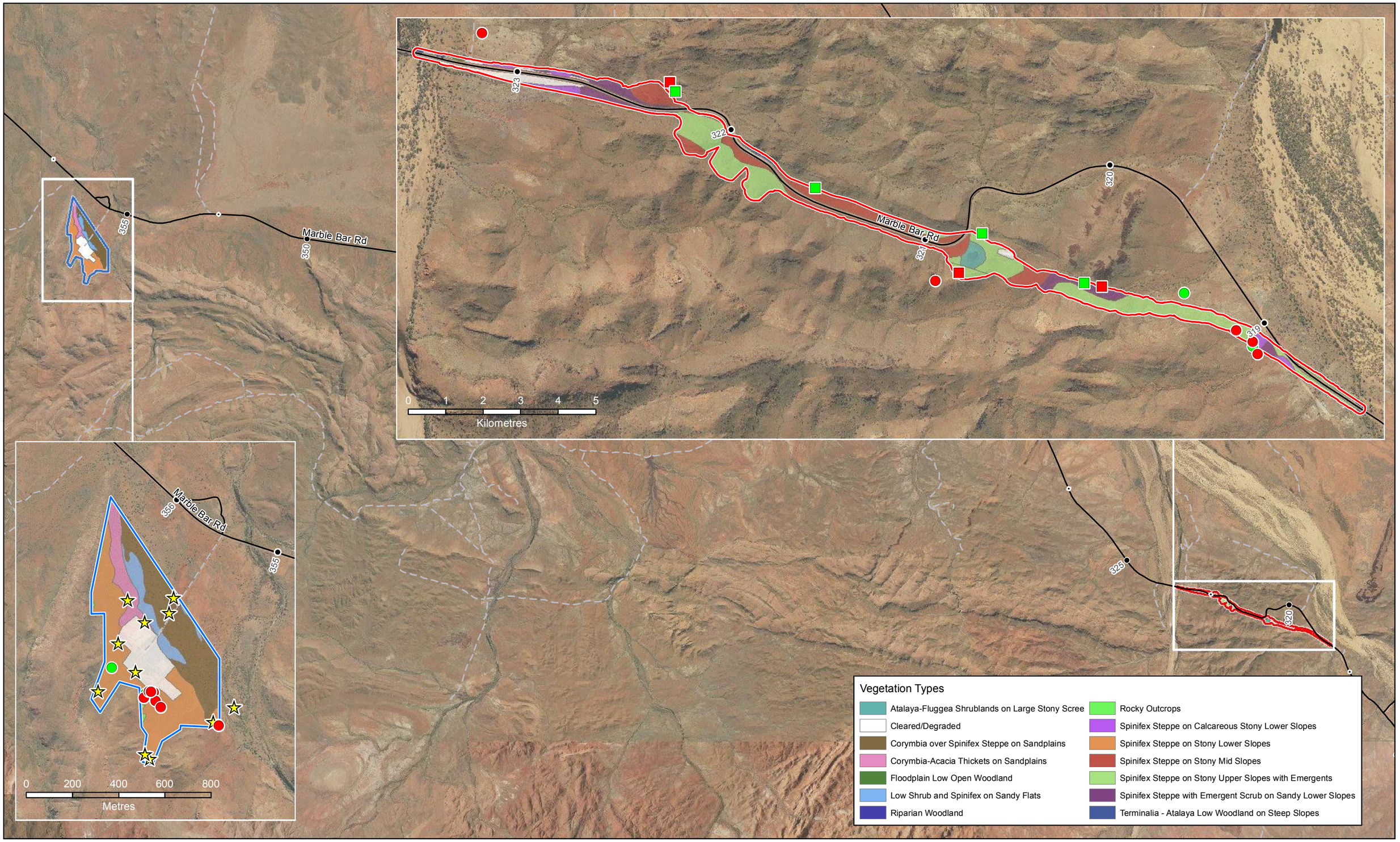
Job Number	61-34579
Revision	0
Date	14 Nov 2016

Project Area and Survey Area Figure 2

G:\61\35039\GIS\Maps\MXD\6135039_002_Rev0_Fig2ProjectAreaAndSurveyArea.mxd

999 Hay Street 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: GHD: Roads (Edited Landgate data) - 20161012; Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Side-track Biological Survey Area - 20160414, Coongan Gorge Biological Survey Area, Coongan Gorge Footprint - 20161014; Landgate: Aerial Imagery (Virtual Mosaic). Created by:afeeney



Paper Size A3

0 1 2 3 4 5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

- Northern Quoll (Camera Capture)
- Northern Quoll (Scats)
- Pebble Mound (Active Mound)
- Pebble Mound (Inactive Mound)
- Rainbow Bee-eater (Sighting)
- Road
- Track
- M030 Pit Footprint
- Coongan Gorge footprint

GHD

mainroads WESTERN AUSTRALIA

SLIP

Main Roads Western Australia
Coongan Gorge EIA, EMP and EPBC Referral

Job Number	61-34579
Revision	0
Date	14 Nov 2016

Vegetation Types and Conservation Significant Fauna Locations Figure 3

G:\61\35039\GIS\Maps\MXD\6135039_003_Rev0_Fig3VegTypesAndConSigFauna.mxd

999 Hay Street 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: GHD: Roads (Edited Landgate data) - 20161012; Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Side-track Biological Survey Area - 20160414, Coongan Gorge Biological Survey Area, Coongan Gorge Footprint - 20161014; Landgate: Aerial Imagery (Virtual Mosaic). Created by:afeeney

Paper Size A3

0 1 2 3 4 5
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

- Road
- Track
- M030 Pit Footprint
- Coongan Gorge footprint

Main Roads Western Australia
Coongan Gorge EIA, EMP and EPBC Referral

Job Number	61-34579
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Date	14 Nov 2016

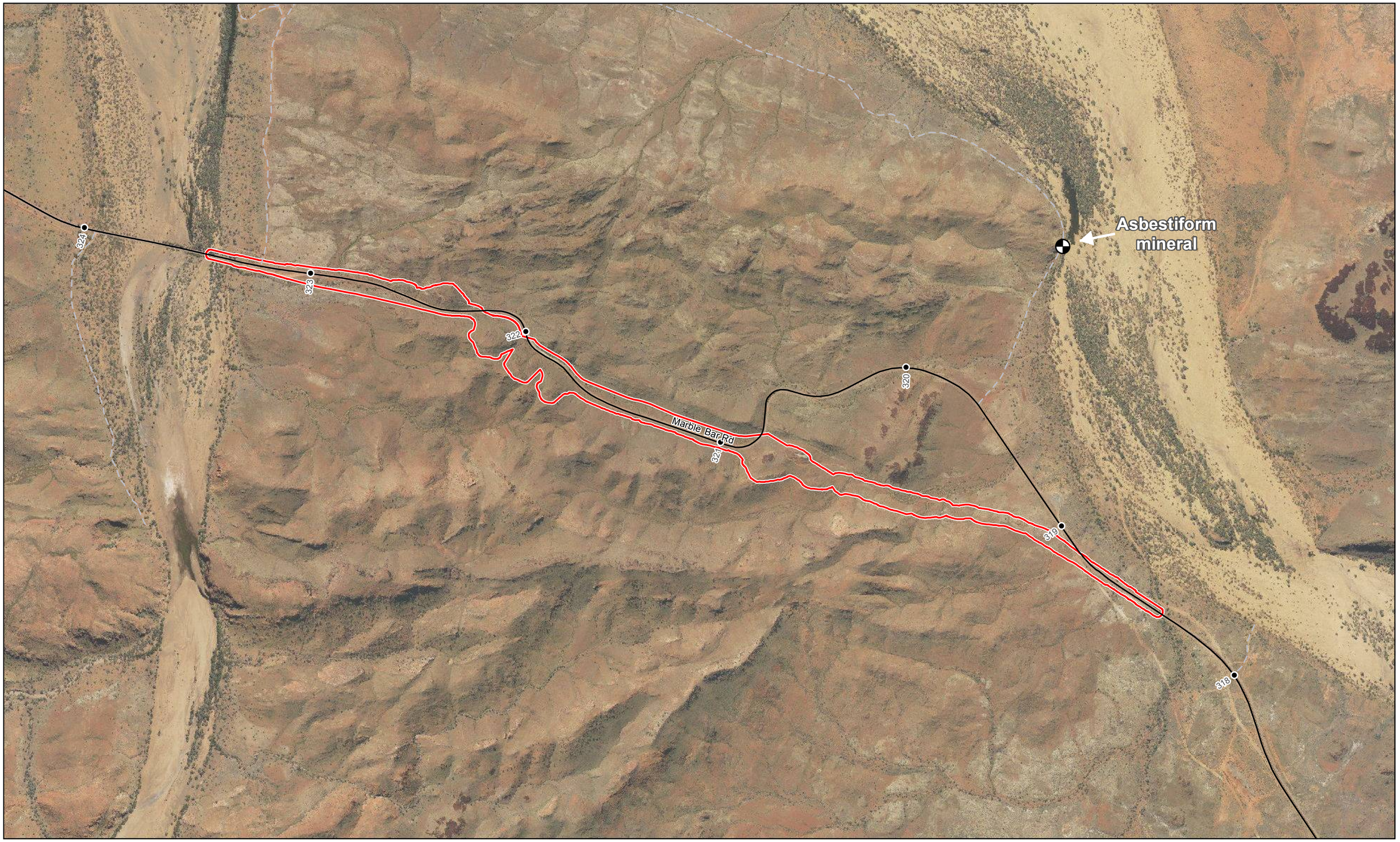
Vegetation Condition

Figure 4

G:\61\35039\GIS\Maps\MXD\6135039_004_Rev0_Fig4VegCondition.mxd

999 Hay Street 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: GHD: Roads (Edited Landgate data) - 20161012; Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Side-track Biological Survey Area - 20160414, Coongan Gorge Biological Survey Area, Coongan Gorge Footprint - 20161014; Landgate: Aerial Imagery (Virtual Mosaic). Created by:afeeney



Paper Size A3

0 200 400 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

- Asbestiform mineral location
- Coongan Gorge footprint
- Road
- Track

Main Roads Western Australia
Coongan Gorge EIA, EMP and EPBC Referral

Job Number	61-34579
Revision	0
Date	14 Nov 2016

Contamination

Figure 5

G:\61\35039\GIS\Maps\MXD\6135039_005_Rev0_Fig5Contamination.mxd

Data source: GHD: Roads (Edited Landgate data) - 20161012; Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Side-track Biological Survey Area - 20160414, Coongan Gorge Biological Survey Area, Coongan Gorge Footprint - 20161014; Landgate: Aerial Imagery (Virtual Mosaic). Created by:afeeney

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Appendix B – Technical Studies

Coongan Gorge Road Realigment, Biological Assessment (GHD 2016a)

M030 Material Pit Extraction Area 356 SLK, Biological Assessment (GHD 2016c)

Main Roads Western Australia

M030 Material Pit Extraction area 356 SLK

Biological Assessment

September 2016

Executive summary

Introduction

Main Roads Western Australia requires access to a strategic source of basecourse material on the northern end of Marble Bar Road. Material is required for future projects, minor capital works and maintenance activities.

The proposed project includes the expansion of an existing material pit (M030 Material Pit – Straight Line Kilometre (SLK) 356) dependent on the availability of basecourse grade material. Clearing extent of the material pit is currently unknown but is estimated to be between 60 to 80 ha.

GHD Pty Ltd was commissioned by Main Roads to undertake a biological assessment of the survey area.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions and qualifications contained throughout the report.

Key results

- Seven vegetation associations were identified and described from the survey area. A review of the aerial photography illustrates there is representation of this vegetation outside the survey area
- The survey area is in a largely disturbed condition with signs of obvious disturbance from flooding, grazing and material extraction activities
- No EPBC Act, WC Act or Priority listed flora was recorded during the survey
- The Likelihood of Occurrence assessment post-field survey concluded that four conservation significant flora may occur within the survey area and one species is considered likely to occur
- Two introduced flora were recorded within the survey area during the field survey. No introduced species listed as a Declared Pest under Section 22 of the BAM Act or a WoNS (DotE 2016) were recorded within the survey area
- The Priority 4 listed Western Pebble-mound Mouse (*Pseudomys chapmani*) was recorded during the survey
- The Likelihood of Occurrence assessment post-field survey concluded that five additional conservation significant fauna may possibly occur within the survey area.

Potential project constraints – biological aspects

Preliminary environmental approvals and referrals advice are based on the biological constraints identified within the survey area. As the project is in concept design there may be opportunities to avoid and minimise the impacts on these biological constraints through design refinement. Furthermore, if the biological constraints can be avoided or impacts to these minimised it may negate the need for referral to Federal/State environmental agencies.

Key biological values identified within survey area

Biological aspect	Survey area
Flora of conservation significance	• The Likelihood of Occurrence assessment post-field survey concluded that four conservation significant flora may possibly occur within the survey area and one taxon is considered likely to occur.
Fauna of conservation significance	Presence of one fauna species: • Western Pebble-mound Mouse (*Pseudomys chapmani*) – recent evidence of active mounds was recorded within the survey area including two inactive mounds. Potential presence of five species and their habitats within the survey area are: • Northern Quoll (*Dasyurus hallucatus*) – The rocky habitats would be regarded as core habitat for the species with denning opportunities also available in *Eucalyptus camaldulensis* in the creekline just outside the survey area. The remainder is potential foraging habitat. Over 70 camera nights were undertaken in rocky habitat with no quoll recorded • Grey Falcon (*Falco hypoleucos*) – Records within the survey area and the species is a potential resident with breeding and hunting habitat present • Peregrine Falcon (*Falco peregrinus*) – Records in the region and potential breeding habitat present in creek lines, hunting (foraging) habitat available for the species throughout the survey area • Lakeland Downs Mouse (*Leggadina lakedownensis*) – Records in the region and habitat available for the species • Brush-tailed Mulgara *(Dasycercus blythi)* - Records in the region and habitat available for the species.

Matters of National Environmental Significance

It was considered the Northern Quoll is unlikely to rely on the habitats present within the survey area and clearing of habitat for the project is unlikely to significantly impact a population of this species. Core habitat is present within the study area but very little within the survey area for Northern Quoll. No specimens were recorded during the field survey or via camera traps. It is considered unlikely the project would require referral to the DotE for impacts on these species.

Environmental Protection Authority

The potential impacts from the loss of native vegetation and loss of fauna habitat can be effectively assessed through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, with consideration of the biological values discussed in this report, it is considered unlikely that the project would require referral to the EPA under Section 38 of the *Environmental Protection Act 1986*.

Department of Environment and Regulation

There are five conservation significant flora considered to likely or possibly occur in the survey area. Six fauna of conservation significance are considered to occur or likely to occur in survey area. As such, any clearing permit application should assess the significance of any potential impacts of the proposed clearing area on these species.

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Appendices

1. Introduction

1.1 Background

Main Roads Western Australia (Main Roads) requires access to a strategic source of basecourse material at the northern end of Marble Bar Road. Material is required for future projects, minor capital works and maintenance activities.

The proposed project includes the expansion of an existing material pit (M030 Material Pit – Straight Line Kilometre (SLK) 356) dependent on the availability of basecourse grade material. The clearing extent of the material pit is currently unknown but is estimated to be between 60 to 80 hectares (ha).

1.2 Purpose of this report

GHD Pty Ltd (GHD) was commissioned by Main Roads to undertake a biological assessment of the survey area. The purpose of the assessment was to delineate key flora, vegetation, fauna, soil, groundwater and surface water values within the survey area and the potential impact to areas of sensitivity. The outcomes of the assessment will be used in the environmental assessment and approvals process.

1.3 Location

1.3.1 Study area

A study area[1] was defined for the desktop based searches of the biological assessment and includes a 20 kilometre (km) buffer of the survey area.

1.3.2 Biological survey area

The survey area is located on the Marble Bar Road at SLK 356, approximately 70 km north of Marble Bar townsite in the Pilbara Region of Western Australia. The survey area is 132.81 ha in size and is located in the Shire of East Pilbara. The location of the survey area is mapped in Figure 1, Appendix A.

1.4 Scope of works

The scope of works, as detailed in the Main Roads Consultants Brief was to undertake a desktop assessment and biological survey for the M030 Material Pit Expansion project located on Marble Bar Road SLK 356. Upon completion of the biological survey the consultant was required to supply to Main Roads a constraints assessment highlighting areas of significance (i.e. locations of Priority flora, Threatened fauna, etc.).

The following actions were completed to fulfil the scope:

- A desktop assessment of the study area was completed prior to the field survey work to identify all biological constraints, which may be in, or nearby the survey area
- Existing relevant environmental reports were identified and reviewed
- Significant flora, vegetation/ecological communities, fauna, soil, groundwater and surface water values and potential sensitivity to impact were identified

[1] The 20 km radius boundary of the study area has been defined by the Main Roads brief for the project

- Broad pre-European vegetation type(s) using Beard mapping for the Pilbara were identified
- A field survey (done by an environmental specialist) was conducted to verify / ground truth the desktop assessment findings through targeted and comprehensive survey
- Vegetation condition mapping was undertaken referring to the Environmental Protection Authority (EPA) and Department of Parks and Wildlife (DPaW) 2015)
- Ecological community mapping was undertaken according to National Vegetation Information System (NVIS) structural and floristics (Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003)
- Relevant environmental constraints mapping was undertaken using Geographic Information Systems (GIS) mapping software
- The survey area was assessed for plant species diversity, density, composition, structure and weed cover, recording the percentage of each in nominated quadrats
- A targeted flora and fauna survey was undertaken, to a level deemed necessary according to results of *NatureMap* database searches
- Fauna habitat assessment and mapping was undertaken
- Biological aspects likely to require referral of the project to the EPA were assessed
- Matters of National Environmental Significance (MNES) were assessed and impacts on MNES as protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) likely to require referral of the project to the Commonwealth Department of the Environment (DotE) were indicated. Justification of decision was provided as to whether referral to DotE is likely to be required. All references relevant to Commonwealth significant impact guidelines were provided.
- Legislative context of environmental aspects required for the assessment were determined
- A concise report on the findings of the biological survey (this report) was provided
- Raw survey data at project completion in electronic form including but not limited to flora/fauna records, ecological community and condition mapping was provided
- Any conservation significant flora recorded during the survey were submitted to the Western Australia (WA) Herbarium and a DPaW Threatened/Priority Flora Report Form submitted.

For all collections of conservation listed taxa, the appropriate DPaW monitoring form and WA Herbarium specimen must be completed and appended in the final report.

The biological survey was conducted in accordance with the requirements of Main Roads Statewide Purpose Clearing Permit (CPS 818). The biological survey aspects that relate to flora were undertaken having regard to the EPA and DPaW (2015) Technical Guide and those aspects that relate to fauna were undertaken having regard to EPA Guidance Statement No. 56 (EPA 2004a) and the subsequent Technical Guide (EPA and Department of Environment and Conservation (DEC) 2010).

Method as per GHD Section 2 response

The biological assessment will be undertaken in accordance with Part B of the Scope of Works provided by Main Roads. The biological assessment includes a Level 1 vegetation and flora assessment and targeted single seasonal flora of conservation significance survey. The Level 1 flora and vegetation survey will be undertaken with regard to the EPA Guidance Statement No.

51 (EPA 2004b) and the subsequent Flora & Vegetation Technical Guide (EPA & DPaW 2015). In addition to this, the biological assessment includes a Level 1 fauna assessment including a targeted habitat assessment for fauna species of conservation significance and camera trap surveys. The Level 1 fauna assessment will be undertaken with regard to the EPA Guidance Statement No. 56 (EPA 2004a) and the subsequent Technical Guide (EPA and DEC 2010).

1.5 Relevant legislation, conservation codes and background information

In WA some ecological communities, flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.6 Report limitations and assumptions

This report has been prepared by GHD for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Main Roads 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 (including species listings). 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 Main Roads and others who provided information to GHD (including 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 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 access tracks, operational works, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions 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.

This report has assessed the flora and fauna within the survey area (Figure 1, Appendix A). Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identity relevant environmental information pertaining to the area and to assist in survey design. The search parameters used were a 20 km radius of a centre point at 119° 30' 30" East, 20° 50' 00" South. This included a review of:

- The DotE Protected Matters Search Tool (PMST) to identify communities and species listed under the EPBC Act potentially occurring within the study area (DotE 2016a) (Appendix C)
- The DPaW Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) database to determine the potential for TECs or PECs to be present within the study area
- The DPaW *NatureMap* database for flora and fauna species previously recorded within the study area (DPaW 2016) (Appendix C)
- The DPaW Threatened (Declared Rare) and Priority Flora (TPFL) database, the DPaW Threatened and Priority Fauna database, and the WA Herbarium database for Threatened flora and fauna species listed under the *Wildlife Conservation Act 1950* (WC Act) and listed as Priority by the DPaW, previously recorded within the study area
- Existing datasets including previous vegetation mapping of the survey area (Beard 1975), aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora and fauna species.

2.2 Field survey

2.2.1 Vegetation and flora

As part of the biological survey a Level 1 single season vegetation and flora assessment of the survey area was conducted by botanist Joshua Foster (SL011812) from the 23 to 25 May, and 29 May 2016. The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant ecological communities and flora taxa were also undertaken.

The survey methodology employed for the survey was undertaken with reference to the EPA and DPaW *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and DPaW 2015).

Data collection

Field survey methods involved a combination of sampling quadrats located in identified vegetation units and traversing the survey area by foot. Twelve non-permanent quadrats were described throughout the survey area. To sample all the apparent vegetation units across the survey area, the location of quadrats was made primarily on the basis of aerial photographic maps. Additional sites were selected *in situ*, based on observations of vegetation units during the field assessment.

Quadrats (measuring 50 metre (m) x 50 m) were located within each identified vegetation unit, where possible. In situations where vegetation community size or shape (e.g. drainage

channels) precluded establishing sites of the standard dimension, an area of equivalent size (i.e. 2500 m^2) was assessed. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Quadrat data is provided to Main Roads in Excel format.

Table 1 Data collected during the flora and vegetation field survey

Aspect	Measurement
Collection attributes	Personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in WGS84 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale relevant to the Pilbara region (EPA and DPaW 2015).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including average height and percentage cover (ESCAVI 2003).

A flora inventory was compiled from taxa listed in described quadrats and from opportunistic floristic records throughout the survey area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow the NVIS and are consistent with NVIS Level V (Association). At Level V, three (or occasionally more) taxa per stratum are used to describe the association (ESCAVI 2003).

Vegetation mapping has been undertaken at a scale suitable for this project (1:10,000).

Vegetation condition

The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (EPA and DPaW, 2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined in Appendix B.

Flora identification and nomenclature

Species well known to the survey botanist were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All plant specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Plant species were identified by the use of taxonomic literature, electronic keys and online electronic databases. Where necessary, plant taxonomists considered to be authorities on particular plant groups were consulted.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 2016) and the EPBC Act List of Threatened Flora (DotE 2016b).

Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 2016).

Surveys for conservation significant flora

Prior to the field survey, information from the desktop assessments (e.g. aerial photography, geology, soils and topography data, EPBC Act PMST, TPFL and *NatureMap*) was reviewed to determine conservation significant flora taxa potentially present within the survey area. Additionally, ecological information (e.g. habitat, associated flora taxa and phenology) was sourced from *FloraBase* (WA Herbarium, 2016) and other relevant publications where available, to provide further details.

Potential habitats were searched for the presence of conservation significant flora. Locations within the survey area with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

When any known or potential threatened, priority or significant flora was located, the following data was collected: GPS location, height, number of plants and corresponding area of population, reproductive state and plant condition.

2.2.2 Fauna

As part of the biological survey, zoologist (Glen Gaikhorst) undertook a single season Level 1 fauna survey (reconnaissance survey) of the survey area from the 23 to 25 May 2016 and 29 May 2016. The fauna survey was undertaken concurrently with the vegetation and flora assessment and with reference to the EPA Guidance Statement No. 56 T*errestrial Fauna Survey for Environmental Impact Assessment in Western Australia* (EPA 2004a). The purpose of the reconnaissance survey was to verify the accuracy of the desktop study, and delineate and characterise the fauna assemblages present in the survey area.

The majority of the survey area was traversed on foot over the course of four days to identify and describe the dominant fauna habitat types and their condition, assess habitat connectivity, identify and record fauna species within the survey area. A Likelihood of Occurrence assessment for conservation significant fauna and their habitats occurring within the survey area was also undertaken.

Habitat assessment

A field data checklist was used to document the type, condition and extent of habitats within the survey area. The following information was collected for six (20 m x 20 m) habitat assessment quadrats located within the survey area:

- Habitat structure (e.g. vegetation type, presence/absence of structural layers such as ground cover and mid storey)
- Presence/absence of refuge including: density of ground covers, fallen timber, hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways including type, extent and habitat quality within waterways
- Location of the habitat within the survey area in comparison to the habitat within the surrounding landscape
- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey area
- Current land use and disturbance history
- Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance

- Evaluation of the Likelihood of Occurrence of conservation significant fauna within the habitat (based on presence of suitable habitat and observations)
- A representative photograph of each habitat type.

In addition to the habitat assessments, rapid habitat assessments were undertaken at six locations within the survey area to assist with documenting the extent and quality of the different habitat types. Habitat assessment locations are displayed in Figure 5, Appendix A.

Opportunistic fauna searches

Opportunistic fauna searches were also conducted across the survey area. The majority of opportunistic searches were undertaken at habitat assessment locations and focussed on the following:

- Searching the survey area for tracks, scats, bones, diggings and feeding areas for both native and feral fauna. For each scat found, the location, date, brief habitat description and GPS coordinate was recorded
- Searching through microhabitats including turning over rocks and ground debris (e.g. leaf litter) and examining tree hollows and hollow logs for reptile and other small vertebrate fauna
- Visual and aural surveys. This accounted for many bird species potentially utilising the survey area
- A visual assessment of the water bodies to identify any fish species observed
- Recording GPS locations of any conservation significant fauna species.

Camera trap survey

Cameras (Reconyx-Hyperfire) were deployed for a period of at least 35 nights each at five locations within or bordering the survey area. Cameras were positioned in areas where Northern Quoll (*Dasyurus hallucatus*) habitat or other potential significant species maybe recorded. Cameras were baited with sardines to attract fauna species, particularly carnivorous marsupials (e.g. Dasyuridae) within and adjacent to the survey area. For each camera location, the time and date deployed and recovered, a GPS coordinate, and brief habitat description were recorded. Camera locations are displayed in Figure 5, Appendix A.

Data from the cameras was downloaded to a computer and analysed for the presence of animals following the field survey.

Table 2 Camera trap location and effort during the survey

Sites	Easting	Northing	Deployed	Collected	Total Nights	Comment
Camera 2	760343	7693555	24 May	27 June	35	Rocky ridgeline
Camera 3	760408	7693639	24 May	27 June	35	Rocky ridgeline
Camera 15	761287	7693559	25 May	27 June	34	Stony plain
Camera 22	760980	7694482	25 May	27 June	34	Sand plain
Camera 30	761143	7694050	25 May	27 June	34	Sand plain

Bat survey

A Songmeter SM2BAT+ recorder (Wildlife Acoustics Inc., USA) was deployed at one location for one night to record ultrasonic echolocation calls emitted by microchiropteran bats. The detector location for the survey area is displayed in Figure 5, Appendix A.

Data from the detector was downloaded to a computer and analysed for the presence of bat calls by Craig Grabham of GHD following the field survey (see Appendix E).

Fauna Species Identification

Fauna species were identified in the field using available field and electronic guides (e.g. Morcombe 2014). Where identification was not possible, photographs of specimens were collected to be later identified.

Nomenclature follows that used by the WA Museum (as shown on *NatureMap)*, as it is deemed to contain the most up-to-date species information for WA, with the exception of birds, where Christidis and Boles (2008) was used.

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DPaW searches of threatened flora and fauna provide more accurate information for the general area. However, some collection, sighting or trapping records cannot be dated and often misrepresent the current range of threatened species.

New Wildlife Conservation (Rare Flora) and Wildlife Conservation (Specially Protected Fauna) Notices were gazetted on 3 November 2015. The format of these Notices has been changed to align with the EPBC Act threatened species lists. To date information contained in publically available databases such as *NatureMap* does not reflect the most recent gazetted Notices. This report has been updated to reflect the conservation status of flora and fauna listed in these Notices. However, the outputs of database searches contained in this report such as *NatureMap*, may not reflect the conservation status of flora and fauna listed in these Notices.

2.3.2 Field survey limitations

The EPA and DPaW (2015) Technical Guide and Guidance Statement No. 56 (EPA 2004a) states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 3.

Table 3 Survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area, this includes: • Broad scale (1:1,000,000) vegetation mapping by Beard (1975) and digitised by Shepherd *et al*. (2002) • Regional biogeography (Kendrick and McKenzie 2001) • Regional vegetation (1:3,000,000) mapping by Beard *et al.* (2013) • Land system mapping (van Vreeswyk *et al.* 2004).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not assessed as part of survey, although opportunistic records were taken of invertebrate and aquatic fauna during the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Moderate	The vegetation and flora survey was a single season survey only and was undertaken in late May 2016. The optimal time to undertake flora and vegetation surveys in the Pilbara region is 6-8 weeks post wet season from March to June (EPA and DPaW 2015). Most of the conservation significant flora identified in the desktop assessment flower from April to June. The flora recorded from the field survey is detailed in Section 4.4 and a full flora species list is provided in Appendix D. The portion of flora collected and identified was considered poor; with few annual flora present due to lower than average rainfall received by the survey area prior to the field assessment; and that the majority of the survey area was subject to grazing pressure by livestock. The fauna survey was undertaken in late May 2016 and was a reconnaissance survey only. The fauna assessment sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Many cryptic (e.g. invertebrate species) and nocturnal species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year. Camera traps were used to supplement information captured by the reconnaissance survey. In total 172 camera nights were undertaken over five cameras in key habitat features in and around the survey area, (rocky habitats and plains). The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the survey area. No sampling for invertebrates or aquatic species occurred. Where terrestrial invertebrate fauna were recorded opportunistically, these findings were mentioned in this report. However, this report is limited to an assessment of terrestrial vertebrate fauna, as the information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.

Aspect	Constraint	Comment
Flora determination	Moderate	Flora determination was undertaken by Joshua Foster in the field and utilising specimens confirmed at the WA Herbarium. Two flora collections could only be identified to genus due to lack of flowering and fruiting material required for identification. These collections showed no resemblance to any conservation significant flora identified in the desktop assessment. Additionally, some species, particularly grasses and sedges, may have been overlooked due to lack of material. This is likely to have affected the results of the survey as there are conservation significant flora known from the desktop assessment that occur within the vicinity of the survey area that are annual taxa and/or sedges. The taxonomy and conservation status of the Western Australian flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation of Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The survey area covers an existing material pit and surrounds and was easily accessed by vehicle and on foot over the course of the field survey. Information gained from the survey was extrapolated across those sections of the survey area not accessed on foot during the field survey to assist with determining the vegetation and habitat types for the entire survey area.
Mapping reliability	Nil	High resolution Environmental Systems Research Institute aerial imagery was available. Data was recorded in the field using hand-held GPS tools (e.g. Nomad Juno and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ±5 m on average. Therefore the data points consisting of coordinates recorded from the GPS may contain inaccuracies.
Timing/weather/ season/cycle	Major	The field survey was conducted in late May. In the four months prior to the survey (January to April), Marble Bar weather station (No. 004106, Bureau of Meteorology (BoM) 2016) recorded a total of 2.4 millimetres (mm) of rainfall. This rainfall is well below the long term average (LTA) for the same period (January to April; 272.2 mm) (BoM 2016). An assessment of the flowering times of conservation significant flora taxa shows that April to June is the optimum time to capture a majority of the conservation significant flora in flower (Appendix D).
Disturbances (e.g. fire, flood, accidental human intervention)	Moderate	The majority of the survey area has been impacted to some degree by past disturbances including minor roads, mineral extraction and cattle grazing. Minor tracks used for access to material pits or material exploration occurs within the survey area. Cattle grazing was evident throughout the survey area, in particular along drainage lines and creeks.
Intensity (in retrospect, was the intensity adequate)	Nil	The vascular flora of the survey area was sampled in accordance with the EPA and DPaW (2015) Technical guide and terrestrial fauna sampled in accordance to EPA (2004a) as required by the scope of works. The survey area was sufficiently covered by two ecologists during the survey.
Resources	Nil	Adequate resources were employed during the field survey. Eight person days were spent undertaking the survey using one dedicated botanist and one zoologist.

Aspect	Constraint	Comment
Access restrictions	Nil	No access problems were encountered during the survey. The survey area was easily accessed by vehicle and on foot.
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields. Glen Gaikhorst (zoologist) is a Senior Ecologist with over 20 years' experience in undertaking ecological surveys, most of which is undertaking surveys in WA, including projects in the Pilbara and Kimberley. Joshua Foster is an Ecologist (botanist) with over 18 years' experience in undertaking ecological surveys in WA, including over 12 years in the Pilbara and Kimberley.

3. Desktop assessment results

3.1 Climate

The survey area is located in the Pilbara Region of WA and experiences an arid tropical climate with summer rain, with an annual precipitation of 250-300 mm (Beard 1990). Beard (1990) noted the local influence of topography on the rainfall recordings with higher rainfall averages occurring on the more elevated areas. The other major climatic influence on the flora and vegetation in the Pilbara Region is the heavy rains that occur during and immediately following cyclonic events. Cyclones develop off the northwest coast and often cross the coastline between Karratha and Port Headland, resulting in cyclonic rainfall events inland.

The BoM Marble Bar station (site number: 004106) is the nearest active weather station to the study area with continuous long-term data (approximately 40 km south from the study area). Climatic data from this site indicates the mean maximum temperature of the area ranges from 26.8 degrees Celsius (°C) in July to 41.8 °C in December, and the mean minimum temperature of the area ranges from 12.0 °C in July to 26.6 °C in January. The long-term average rainfall (LTA) annual rainfall is 362.4 mm, with an average of 27.4 rain days per year (BoM 2016).

Rainfall and temperature data for Marble Bar in the 12 months preceding the survey are summarised in Plate 1 (BoM 2016). In the four months prior to the survey (January to April), Marble Bar weather station recorded a total of 2.4 mm of rainfall. This rainfall total is well below the LTA for the same period (January to April; 272.2 mm) (BoM, 2016).

The weather conditions recorded during the field survey included (BoM 2016):

- Maximum temperature range: 31.4 °C – 34.4 °C
- Minimum temperature range: 17.5 °C – 21.0 °C
- Rainfall 0.0 mm.

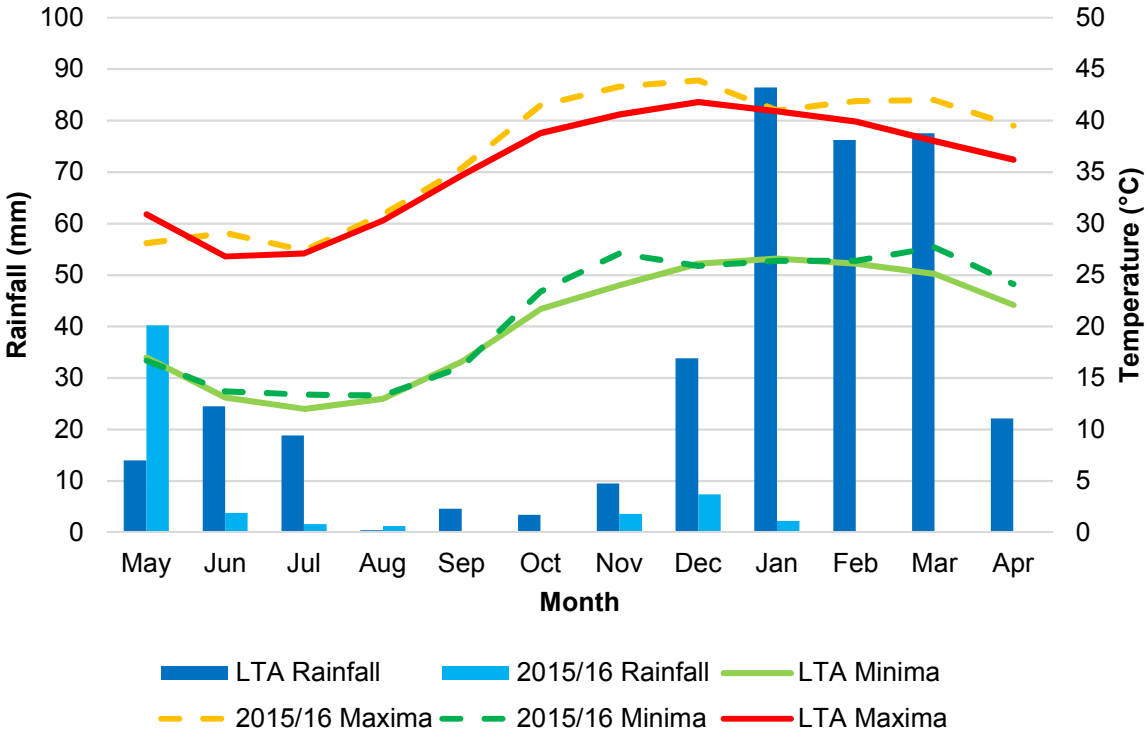

Plate 1 Rainfall and temperature data for Marble Bar (BoM 2016)

3.2 Landforms and soils

The survey area is located within the Chichester Ranges Zone of the Fortescue Soil-landscape Province. This zone is characterised by hills and dissected plateaux (with some stony plains) on basalt and sedimentary rocks of the Hamersley Basin. Stony soils with some red shallow loams and hard cracking clays, supporting spinifex grasslands with kanji and snappy gum (and some tussock grasslands) (Tille 2006).

3.3 Land systems

Land system mapping of the Pilbara has been prepared by the Department of Agriculture and Food Western Australia (DAFWA) (van Vreeswyk *et al.,* 2004). The purpose of the rangelands survey was to provide a comprehensive description and map of the biophysical resources of the region, together with an evaluation of the condition of the soils and vegetation throughout. Lands within the Pilbara area have been described and mapped into 20 broad land types comprised of 102 land systems according to a combination of landforms, soils, vegetation and drainage patterns (van Vreeswyk *et al,.* 2004).

The mapping by van Vreeswyk *et al.* (2004) indicates that one land system is present within the survey area, the Boolgeeda Land System with stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.

3.4 Hydrology

A summary of the Department of Water (DoW) Geographic Data Atlas (DoW 2016) queries for the survey area is provided in Table 4. The study area is located within the Pilbara Groundwater Area and the Pilbara Surface Water Area as listed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

3.4.1 Wetlands

No wetlands occur within the survey area.

3.4.2 Watercourses

No major river systems intersect the survey area (Figure 2; Appendix A). One minor un-named creekline intersects the eastern boundary of the survey area.

Table 4 Department of Water geographic atlas queries for the survey area

Aspect	Details	Result
Groundwater areas	Groundwater areas proclaimed under the RIWI Act.	Pilbara
Surface water areas	Surface water areas proclaimed under the RIWI Act.	Pilbara
Irrigation district	Irrigation Districts proclaimed under the RIWI Act.	None present
Rivers	Rivers proclaimed under the RIWI Act.	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947*.	None present
Waterway Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*.	None present

3.4.3 Groundwater Dependent Ecosystems

No groundwater dependent ecosystems (GDEs) occur within the survey area, as mapped by the BoM GDE Atlas (BoM 2016a).

3.5 Land use

The survey area occurs within Coongan Pastoral Station.

3.5.1 Conservation reserves and estate

No DPaW managed conservation areas are located within the study area. The closest DPaW managed conservation area is located approximately 65 km to the east of the survey area, associated with Meentheena Pastoral Station excised for conservation.

3.5.2 Environmentally Sensitive Areas

One ESA is located within the study area. The nationally important wetland is associated with the Fortescue Marsh located approximately 17 km south of the survey area. No ESAs are located within the survey area.

3.6 Regional biogeography

The survey area is situated in the Eremaean Botanical Province (Beard 1990), within the Pilbara Bioregion and Chichester Sub-region as described by the Interim Biogeographic Regionalisation of Australia (IBRA) (DotE 2016c).

The Pilbara Bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses (Kendrick and McKenzie 2001).

The Chichester Sub-region comprises the northern section of the Yilgarn Craton. It is characterised by undulating Archaean granite and basalt plains that include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (formerly *T. pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule, Sherlock) (Kendrick and McKenzie 2001).

3.7 Conservation significant ecological communities

A search of the EPBC Act PMST database did not identify any Australian Government-listed TECs within the study area (Appendix C). Similarly, a search of the DPaW TEC database did not identify any TECs within the study area (DPaW ref: 24-0156EC).

No DPaW-listed PECs were identified within the study area. The nearest PEC is located over 85 km to the south of the survey area.

3.8 Vegetation

3.8.1 Pre-European vegetation associations and extent

Broad scale (1:1,000,000) pre-European vegetation mapping of the Pilbara area was completed at an association level (Beard 1975). The mapping indicates that two vegetation associations are present within the survey area:

- Association 93: Hummock grasslands, shrub steppe; kanji over soft spinifex
- Association 171: Hummock grasslands, low tree steppe; snappy gum over soft spinifex & Triodia brizioides.

The pre-European mapping has been adapted and digitised by Shepherd *et al.* (2002). The extents of the vegetation associations have been determined by the State-wide vegetation remaining extent calculations maintained by the DPaW (latest update May 2016 – Government of Western Australia (GoWA) 2015). As shown in Table 5, the current extent remaining of vegetation associations are greater than 99 per cent (%) of the pre-European extent at all scales (e.g. State, IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA), and are therefore above the 30 % threshold level[2].

Table 5 Pre-European vegetation extents (GoWA 2015)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
93	State: Western Australia	3,044,309.54	3,040,641.00	99.88	1.96
	IBRA Bioregion: Pilbara	3,042,114.29	3,038,471.70	99.88	1.96
	IBRA Sub-region: Chichester	2,940,348.06	2,936,731.56	99.88	2.03
	LGA: Shire of East Pilbara	1,709,522.26	1,706,780.59	99.84	2.70
171	State: Western Australia	331,951.73	330,643.10	99.61	10.92
	IBRA Bioregion: Pilbara	331,307.42	330,026.24	99.61	10.94
	IBRA Sub-region: Chichester	331,307.42	330,026.24	99.61	10.94
	LGA: Shire of East Pilbara	331,951.73	330,643.10	99.61	10.92

[2] The 30 per cent threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (EPA 2000).

3.9 Flora

3.9.1 Flora diversity

A search of the *NatureMap* database identified 77 plant taxa, representing 19 families which have previously been recorded within the study area. This total comprised 76 native flora and one naturalised (non-native) flora species. Dominant families included:

- Fabaceae (25 taxa)
- Goodeniaceae (7 taxa)
- Amaranthaceae (7 taxa)
- Cyperaceae (7 taxa)
- Malvaceae (5 taxa).

The *NatureMap* database search is provided in Appendix C.

3.9.2 Conservation significant flora

Desktop searches of the EPBC Act PMST database, *NatureMap* database, and the DPaW TPFL and WA Herbarium databases identified the presence/potential presence of nine conservation significant flora taxa within the study area.

The desktop searches recorded:

- No taxa listed under the EPBC Act or WC Act
- Two Priority 1 taxa
- One Priority 2 taxon
- Four Priority 3 taxa
- Two Priority 4 taxa.

The locations of conservation significant flora registered on the DPaW databases are provided in Figure 2, Appendix A. A Likelihood of Occurrence assessment for the conservation significant flora is provided in Appendix D.

3.9.3 Introduced flora

A search of the *NatureMap* database identified one introduced flora taxon previously recorded within the study area. This taxon is not listed as a Declared Pest (s22) under the *Biosecurity and Management Act 2007* (BAM Act) or as a Weed of National Significance (WoNS) (DotE 2016c).

3.10 Fauna

3.10.1 Fauna diversity

A search of *NatureMap* identified 98 vertebrate native fauna previously recorded within the study area. This total included 10 native mammals (none introduced), 56 birds and 32 reptiles. The EPBC Act PMST indicated the potential presence of 13 additional fauna taxa within the study area.

3.10.2 Conservation significant fauna

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 16 conservation significant fauna species (Appendix E). Species identified by the PMST as marine, migratory marine and migratory wetland were excluded from this assessment

as no marine or wetland habitats were present within or nearby the survey area, however species identified by the PMST as migratory terrestrial were considered as part of this assessment.

In addition to the 19 species identified by the database searches, five additional species were also considered for this assessment as a result of a review of the species listed under Schedules 1-3 and 5-7 of the WC Act (revised 20 November 2015) to occur within the DPaW Pilbara region (DPaW 2015).

4. Field results

4.1 Hydrology

4.1.1 Wetlands

There are no wetlands within the survey area. There are areas of broad sheetwash that may hold water for a period following rain.

Semi-permanent pools may occur within the existing material pits and on the adjacent creekline that immediately abuts the survey area.

4.1.2 Watercourses

One ephemeral watercourse identified as part of the desktop assessment occurs within the survey area.

4.2 Vegetation

4.2.1 Vegetation types

Seven vegetation types (VT) were identified and described from the survey area (Table 6 and Figure 3, Appendix A). The survey area was dominated by VT03 and VT05. The VT having the smallest area was VT06, associated with small rocky outcrops on the boundary of the survey area.

The soils within the survey area are considered to be similar to that as identified in the desktop assessment. The majority are rocky soils, with sandier soils associated with areas of water flow (sheetwash and run-on zones). The vegetation types are closely allied with the landform feature in which they occur.

The vegetation types identified within the survey area are considered to be well represented outside the survey area. A review of the aerial photography illustrates that there is representation of the defined vegetation types outside the survey area. The vegetation is also consistent with vegetation associations identified in the vegetation mapping for the area (Beard 1975; Payne and Schoknecht 2011).

4.3 Conservation significant ecological communities

No Australian Government or State-listed TECs or DPaW-listed PECs were identified within the survey area during the field survey.

4.3.1 Other significant vegetation

No other significant vegetation as defined by the EPA and DPaW (2015) was identified within the survey area during the field survey.

Table 6 Vegetation types recorded during the field survey

Vegetation type	Description	Landform and substrate	Extent (ha)	Representative photograph
VT01 Cleared/Degraded	Areas mostly devoid of native vegetation – covering roads, access tracks and material pits. Flora taxa present include representation from adjacent vegetation types and includes disturbance response taxa.	Various – existing pit, roads, tracks etc.	19.08	
VT02 Low Shrub and Spinifex on Sandy Flats	Low Open Shrubland of *Pluchea tetranthera, Acacia stellaticeps* with *A. inaequilatera* over Open Hummock Grassland of *Triodia epactia* with Very Open Sedgeland of *Fimbristylis macrocarpa* and Tussock Grasses of *Eriachne helmsii* with Scattered Herbs of *Trianthema* spp.	Broad sheetwash / minor temporary pools (approximately 50% bare ground) on sandy soils.	10.77 Q3, Q4	
VT03 *Corymbia* over Spinifex on Sandplain	Low Open Woodland of *Corymbia flavescens* with *C. hamersleyana* over Scattered Tall Shrubs of *Acacia tumida, A. ancistrocapa, A. ampliceps* with *A. inaequilatera, Grevillea wickhamii* over Shrubland to Low Open Shrubland of *Gossypium australe, Indigofera monophylla, Corchorus parviflorus* over Hummock Grassland to Open Hummock Grassland of *Triodia epactia, T. schinzii,* with Open Tussock Grassland of *Eragrostis eriopoda, Eriachne helmsii* and *Aristida latifolia.*	Broad sandplain.	37.82 Q7, Q8, R4	

Vegetation type	Description	Landform and substrate	Extent (ha)	Representative photograph
VT04 *Corymbia-Acacia* Thickets on Sandplains	Low Open Woodland of *Corymbia hamersleyana* over Tall Shrubland to Tall Open Scrub of *Acacia tumida*, *Grevillea wickhamii* over Scattered Low Shrubs of *Pluchea tetranthera*, *Indigofera monophylla*, over Open Hummock Grassland of *Triodia epactia* with *T. schinzii* over Mixed Herbs.	Run-off zone below stony lower slopes. Sandy soils.	12.24 Q4, Q6	
VT05 Spinifex Steppe on Stony Lower Slopes	Hummock Grassland to Closed Hummock Grassland of *Triodia epactia* with emergent Scattered Low Trees of *Corymbia hamersleyana*, Open Shrubland to Tall Shrubland of *Acacia inaequilatera*, *Grevillea wickhamii*, *A. tumida, Hakea lorea*, Low Shrubland of *Acacia spondylophylla, A. ptychophylla, Pluchea tetranthera, Corchorus parviflorus, Solanum phlomoides, Ptilotus calostachyus, Dampiera incana* with Scattered Herbs of *Goodenia stobbsiana.*	Stony lower slopes.	51.75 Q1, Q2, Q10, Q11, Q12, R1,	
VT06 Rocky Outcrops	Scattered Shrubs to Low Shrubs of *Acacia inaequilatera, Grevillea wickhamii* over *Tephrosia* sp. B Kimberley Flora (C.A. Gardner 7300), *Corchorus parviflorus* over Hummock Grasses of *Triodia epactia* with Tussock Grasses of *Eriachne mucronata*.	Small Outcrops.	0.60 R2, R3	

Vegetation type	Description	Landform and substrate	Extent (ha)	Representative photograph
VT07 Riparian Woodland	Low Woodland of *Eucalyptus camaldulensis* over Shrubland to Tall Open Shrubland of *Acacia trachycarpa, Melaleuca linophylla, A. inaequilatera, A. tumida* over Low Open Shrubland of *A. trachycarpa, A. stellaticeps, Corchorus parviflorus, Terminalia circumalata* over Open Tussock Grassland ofiwith Open Sedgeland of Cyperus vaginalis with Very Open Hummock Grassland of *Triodia epactia, T. schinzii*.	Creekline with stony and sandy soils.	0.54 Q9	

4.3.1 Vegetation condition

The vegetation condition within the survey area was rated as between condition 3 and 7. The majority of vegetation throughout the survey area was rated as between condition 4 and 5. Areas subject to greater disturbance – particularly due to grazing by cattle were rated as condition 6.

The areas mapped as condition 7 are due to the presence of historical material extraction and the access tracks. The better condition vegetation (condition 3) was associated with vegetation in higher elevations.

The extents of the vegetation condition ratings mapped within the survey area are provided in Table 7 with the vegetation condition of the survey area mapped in Figure 4, Appendix A.

Table 7 Extent of vegetation condition ratings within the survey area

Condition rating	Extent (ha)
3	25.07
4	36.22
5	38.66
6	21.32
7	11.53

4.4 Flora

4.4.1 Flora diversity

Eighty-nine taxa (including subspecies and varieties) representing 30 families were recorded from the survey area during the field survey. This total comprised 87 native species and two introduced (exotic) species. Due to the absence of adequate flowering parts and/or fruiting bodies required for identification, two taxa could only be tentatively identified to genera, however none of these taxa are considered to be introduced or conservation significant taxa.

Dominant families recorded from the survey area included:

- Fabaceae (19 taxa)
- Poaceae (16 taxa)
- Myrtaceae (4 taxa)
- Boraginaceae (4 taxa).

The average species richness for the 12 quadrats was 13, with a range of five to 21 species per quadrat.

A flora list for the survey area is provided in Appendix D.

4.4.2 Conservation significant flora

No EPBC Act, WC Act or Priority listed flora taxa were recorded within the survey area during the 2016 survey.

Likelihood of Occurrence

A Likelihood of Occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species.

The Likelihood of Occurrence assessment post-field survey concluded that one taxon may be considered as likely to occur, four taxa may possibly occur and the remaining four taxa are unlikely to occur within the survey area. Four of the taxa considered possible or likely are annual species and may not have been present due to the low rainfall. One taxon (*Bulbostylis burbidgeae*) that is considered likely to occur has been recorded within 2 km of the survey area and some suitable habitat (rocky outcrops) occurs within the survey area. A summary of the outcomes of species considered as known, likely or possible to occur is provided below (Table 8).

Table 8 Summary of Likelihood of Occurrence Assessment

Species	State (WC Act/ DPaW listing)	Likelihood of Occurrence
Acacia cyperophylla var. *omearana*	P1	Possible
Rothia indica subsp. *australis*	P1	Possible
Acacia glaucocaesia	P3	Possible
Nicotiana umbratica	P3	Possible
Bulbostylis burbidgeae	P4	Likely

4.4.1 Other significant flora

No other significant flora as defined by the EPA and DPaW (2015) was identified within the survey area during the field survey.

4.4.2 Introduced flora

Two introduced taxa were recorded within the survey area during the field survey (Appendix D). The two recorded weed species in the survey area include: **Cenchrus ciliaris* and **Calotropis procera*.

Weeds of National Significance and Declared Pests

No introduced species listed as a Declared Pest under Section 22 of the BAM Act or a WoNS (DotE 2016d), were recorded within the survey area.

4.5 Fauna

4.5.1 Fauna habitat

Six main fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation types described in section 4.1.1 and mapped in Figure 3, Appendix A and include:

- *Triodia* hummock grassland on sand plain
- *Triodia* hummock grassland on stony plain
- Minor drainage lines
- Low rocky rises / slopes / hills with hummock grasslands and scattered trees and shrubs
- Rocky ridgelines or exposed rock or outcropping
- Disturbed area

The topography of the survey area ranges from flat to undulating with small hills present. There are minor drainage lines present, which drain to the south into a creek system (outside of the survey area) around the undulating and hills/ranges surrounding the survey area. Soils were predominantly red or red-brown stony-sandy loams with surface gravels, however one area through the eastern portion of the survey area was sandy and looked to be part of a minor drainage line. Low rises and small hills were characterised by small to large red quartzite rocks or outcropping.

The habitat types for the survey area are described in Table 9.

Habitat connectivity

The fauna habitats of the survey area are part of a contiguous largely intact area of remnant vegetation within leased land primarily used for cattle grazing.

The fauna habitats of the survey area are part of a much larger area of similar habitats within the local area and the greater study area. The positioning of the survey area is mostly on a plain at the base of low ranges and creek lines consisting of large flat to undulating expanses of hummock grassland with open woodland and low rocky rises, intersected by drainage lines and creek lines.

The ephemeral drainage lines within the survey area drain into a larger system south of the survey area which forms part of a larger network of watercourses which ultimately drain into the much larger tributaries of the Shaw River, west of the survey area and potentially Miralga Creek to the south.

The Marble Bar Road (500 m east of the survey area) provides the only major barrier to fauna moving east-west through the landscape, including the survey area. This road experiences a high amount of heavy haulage vehicles moving resources to Port Hedland. This regular traffic would likely increase the rate of vehicle strike and potentially deter fauna in immediately adjacent areas. Several animal carcasses (macropods only- Red Kangaroo and Euro) were recorded during the survey along this section of the road and it is likely the road presents a moderate barrier to movement for ground dwelling species. This barrier may reduce the rate at which ground dwelling species (such as the Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)) would move through the landscape.

Disturbance

The central portion of the survey area has been previously utilised for material extraction with other impacts throughout the survey area to some degree associated with past disturbances including minor roads and cattle grazing. Minor roads make up a very small area of impact and are either maintained by pastoralism, mineral exploration or access to material pits. Cattle grazing was evident throughout the survey area with heavy usage along drainage lines and sandy plain.

There was only small areas impacted by recent fire with the majority of the survey area being unburnt (> 5 years) or a mosaic of old fire scars.

Habitat value

The survey area provides a moderate to high level of habitat diversity for many native fauna species, including species of conservation significance. The habitats within the survey area are mostly intact, variable in composition and well connected with habitats within the local area and the greater study area, with the exception of the Marble Bar Road which does provide an existing barrier to the movement of some fauna.

The overall value of the habitat was considered to be moderate to high, because of the diversity and quality of habitat types (e.g. good to excellent structural and floristic diversity within each

habitat type), good connectivity and for supporting known and potential habitat values for conservation significant fauna species (see Table 9). In particular, the survey area lies at the base and bisects several low hills that are part of a range which appeared to have a large amount of breakaway and rocky habitat available. These habitat areas are known to support conservation species which are also likely to move over the landscape to utilise other areas.

Following a review of aerial photography and corresponding native vegetation associations, and review of habitat types whilst driving along the Marble Bar Road, the habitats of the survey area are considered to be well represented within the local area and are probably well represented within the greater study area. However, it is difficult to determine the value (e.g. habitat quality) of the habitats for conservation significant fauna in the greater study area (e.g. does the surrounding vegetation contain the necessary structure and microhabitats for breeding?).

Table 9 Fauna habitat types within survey area

Description	Indicative photograph
***Triodia* hummock grassland on sand plain** Vegetation types: VT02, VT03, VT04 This habitat type occurs across the eastern part of the survey area on the plain. This habitat type is mostly dominated by a *Triodia* hummock grassland (30 % cover) on sandy soils. The majority of the grassland area appeared long unburnt (> 5 years) given the density and size of the grass hummocks recorded. The overstorey consist of open woodland of scattered trees and small clumps of trees including *Corymbia* and *Eucalyptus* species (<2 %). These trees were often small (to 8 m) and provided few hollows. The shrub/mid-storey layer was sparse but sometimes moderate to dense in small patches and consisted of a *Acacia*, *Hakea* and *Grevillea* species (<10 %). The grassland provides good foraging and breeding opportunities for small native ground mammals and reptiles. Small skinks and dragons were observed active during the survey. Animal tracks, digs and occasional small burrows were recorded in this habitat type, most of which were varanid digs/burrows. A good number of Bustard prints were scattered throughout this area also. Fallen branches were sparse in this habitat type and restricted to isolated *Corymbia* and *Eucalyptus* trees. Leaf-litter and other forms of ground cover of dead plant material was localised beneath small clumps of trees but was uncommon. Evidence of cattle use (trampling and grazing) was present particularly under the larger trees. *Habitat value for fauna species of conservation significance* Moderate to high value Part of a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat provides for the Brush-tailed Mulgara (*Dasycercus blythi*) and the Lakeland Downs Mouse (*Leggadina lakedownensis*). Potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). Northern Quoll (*Dasyurus hallucatus*) has also been historically recorded on plains; however, this is due to movement between areas rather than use within a core area.	

Description	Indicative photograph
***Triodia* hummock grassland on stony plain** Vegetation type: VT05 This habitat type occurs across the majority of the survey area on the plain or with slight undulation where there is association to low hills. This habitat type is mostly dominated by a *Triodia* hummock grassland (varied but up to 50 % cover) on stony soils. The majority of the native grassland area appeared long unburnt (> 5 years) given the density and size of the grass hummocks recorded. However some areas were a mosaic of burn ages with the most recent <1 year. The overstorey consist of open woodland of scattered trees and small clumps of trees including *Corymbia* and *Eucalyptus* species (<10 %). These trees were often small (to 6 m) and provided few hollows. The shrub/mid storey layer was sparse but sometimes moderate to dense in small patches and consisted of a *Acacia, Hakea and Grevillea* species (<10 %). Fallen branches were sparse in this habitat type-which is probably an artefact of the fire history and the open scattered over storey. Leaf-litter and other forms of ground cover of dead plant material was localised beneath small clumps of trees but was uncommon. The grassland provides good foraging and breeding opportunities for specialised *Triodia* species such as some reptiles. Small skinks and dragons were observed active during the survey. *Habitat value for fauna species of conservation significance* Moderate to high value Part of a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat provides for the Western Pebble-mound mouse (*Pseudomys chapmani*) and potential hunting and foraging opportunities for the Northern Quoll (*Dasyurus hallucatus*), Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*).	

Description	Indicative photograph
Creek lines / drainage lines Vegetation type: VT07 This habitat type occurs in the southern and eastern area of the survey area in the flatter plains, primarily consisting of small drainage line corridors towards a larger creekline in the south. Some of these drainage lines appeared artefacts of the access road and pit construction run off. This habitat type had little riparian vegetation association and was dominated by *Triodia* hummock grassland (30 % cover) with a good coverage of *Acacia*/*Grevillia* to 10 % which thins as you move away from the bed. Incursion by *Triodia* hummock grassland also occurs at some drainage lines up to 20 %, with Buffel Grass also invading into some lines forming up to <10 % coverage (particularly as you move south toward the creek). The majority of the habitat area appeared long unburnt (> 5 years) given the density and size of the grass hummocks recorded. However, some areas were a mosaic of burn ages. The drainage lines provide good foraging opportunities for small native ground mammals and reptiles as well as small birds such as honey eaters, wrens and whistlers. Small skinks (*Menetia* and *Morethia*) and dragons (*Amphibolurus*) were observed moving amongst the associated dense grassland during the survey. Animal tracks, digs and occasional small burrows were recorded in this habitat type, most of which were probably varanid digs/burrows and Kangaroo browsing or using the dense foliage as cover. Some lines were also well utilised by cattle for the same purpose. Evidence of camel use was obvious in this area. Fallen timber were very occasionally recorded in this habitat type-which is probably an artefact of the fire and the scattered overstorey. Leaf-litter and other forms of ground cover of dead plant material was localised to each side of the bed and provided good layering where lapped (by flowing water) into piles. *Habitat value for fauna species of conservation significance* Moderate to high value Patchy in the landscape but part of a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). Northern Quoll (*Dasyurus hallucatus*) has also been historically recorded in drainage lines; however this is due to movement between areas or foraging rather than use within a core habitat area.	

Description	Indicative photograph
Rocky ridgelines or exposed rock or outcropping Vegetation type: VT06 This habitat type occurs along the top of the range with small areas encroaching into the survey area. All of this habitat was along the western boundary of the survey area and was closely associated to the low rocky rises / slopes / hills with hummock grasslands and scattered trees and shrubs habitat described below. This habitat type is mostly dominated by exposed rock (to 80 %) with *Triodia* hummock grassland (20 % cover) where vegetation was able to grow or within stony soils and scattered *Grevillea* and *Acacia* shrubs was also recorded in some areas. No large shrubs or trees were recorded. The majority of the native grassland area appeared burnt (< 2 years) given the density and size of the grass hummocks recorded. However, some areas were a mosaic of burn ages. No woody debris was present, however exfoliating rock and crevices amongst boulders provide refuge for (Dunnart, *Pseudoantechinus* and reptiles). Leaf-litter and other forms of ground cover of dead plant material was localised beneath *Grevillea* and *Acacia* but was uncommon. Few birds were recorded in these areas, however rock/*Triodia* ranging specialist such as Spinifex Pigeon and Spinifex birds were observed. This area had the least noticeable impact by cattle due to the location and limited resources to be exploited. *Habitat value for fauna species of conservation significance* High value A small area of habitat that joins to or is a part of a larger area of continuous remnant vegetation extending beyond the survey area. This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). This habitat is regarded as core for the Northern Quoll (*Dasyurus hallucatus*) which is known to require this habitat to persist.	

Description	Indicative photograph
Low rocky rises / slopes / hills with hummock grasslands and scattered trees and shrubs Vegetation type: VT05 This habitat type occurs across a small portion of the survey area along the western edge, where the survey area intersects low hills and undulation is present in association to low hills. This habitat type is mostly dominated by *Triodia* hummock grassland (30 % cover) with open areas in between on stony soils. The majority of the native grassland area appeared burnt (< 5 years) and recently burnt in some areas (<1 year) given the density and size of the grass hummocks recorded. However, some areas were a mosaic of burn ages. The grassland provides good foraging and breeding opportunities for small native ground mammals and reptiles. Small skinks and dragons were observed active during the survey. Animal digs and occasional small burrows were recorded in this habitat type, most of which were varanid digs/burrows. Some low hills had associated exfoliation on the ridge which also provide habitat to a different array of species (Dunnart, *Pseudoantechinus* and reptiles). No overstorey or mid storey was present and the understorey shrub layer was sparse but sometimes moderate to <10 % and primarily consisted of a low *Grevillea* and *Acacia* species. Fallen branches were very sparse in this habitat type-which is probably an artefact of the fire history and the open scattered under storey and lack of over and mid storey. Leaf-litter and other forms of ground cover of dead plant material was localised and uncommon. *Habitat value for fauna species of conservation significance* Moderate to high value A small area of habitat that joins to or is a part of a contiguous remnant vegetation extending beyond the survey area. This habitat provides for the Western Pebble-mound mouse (*Pseudomys chapmani*) and potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). Northern Quoll (*Dasyurus hallucatus*) has also historically been recorded utilising rocky areas of habitat associated with this environment; however the amount and isolated nature or these areas in the survey area make it unlikely a population would persist.	

Description	Indicative photograph
Disturbed area Vegetation type: VT01 This habitat type occurs in approximately 15 % of the survey area and comprises predominantly cleared areas. However, due to the staggered nature of material extraction, some areas are rehabilitated and proves some habitat to fauna. Where rehabilitation has occurred *Triodia* hummock grasslands over *Acacia* and *Grevillea* shrubland is dominant. Impacts from fire in this area is a mosaic with some areas appeared burnt (< 5 years) and recently burnt in some areas (<1 year) given the density and size of the grass hummocks recorded. Due to the varying condition of vegetation in this area, vegetation composition was not attained. No fallen branches, logs or hollows were present in this habitat type. Leaf-litter and other forms of ground cover of dead plant material was localised to pushed up spoil heaps. The spoil heaps provided good cover to some species and *Gehyra*, *Ctenotus* and Burton's Legless Lizard were all recorded in this area. Honey-eaters were also abundant as the *Grevillea* were flowering providing a foraging resource. *Habitat value for fauna species of conservation significance* Low to Moderate value Patchy in the landscape but part of a larger area of contiguous remnant vegetation extending beyond the survey area. The Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*) may also utilise these areas for foraging.	

4.5.2 Fauna diversity

Seventy-one fauna species were recorded within or in close proximity to the survey area during the survey, these included:

- 43 native birds
- 12 mammals which includes four introduced mammals
- 16 native reptiles.

NatureMap records indicate 98 vertebrate fauna taxa within the study area, many of which occur in the same and similar habitats that occur within and adjoining the survey area. The species diversity recorded during the current survey is considered to be high and it is likely with additional survey effort a greater number of native vertebrate fauna would be recorded within the survey area.

Of the 71 species recorded during this survey all have been previously recorded within the locality of the east Pilbara area (ALA 2016 and DPaW 2016). It is important to note that the low numbers of species identified during desktop assessment is due to the lack of general survey effort within 20 km of the survey area.

A full list of fauna recorded during the field survey is presented in Appendix E.

Introduced fauna

During the survey, evidence for four introduced fauna species was recorded in the survey area and adjoining areas:

- Cat (**Felis catus*) – cat tracks were recorded at one location along a drainage line
- Dingo/dog (**Canis lupus dingo*) – scats and tracks were recorded
- Camel (**Camelus dromedaries*) – resting points, dust bath point and scats
- Cow (**Bos taurus*) – scats and tracks everywhere.

4.5.3 Conservation significant fauna

One fauna species of conservation significance were recorded during the field surveys within the survey area.

Western Pebble-mound Mouse (Pseudomys chapmani)

The Western Pebble-mound Mouse is listed as Priority 4 under DPaW priority fauna listing.

The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the species can be found on stony hillsides with hummock grasslands. It constructs large mounds of pebbles on stony slopes which cover an area of 0.5-9.0 square metres. ‘Active’ mounds are characterized by volcano-like cones capped by ‘craters’ that mark occluded entrances to subterranean burrow systems in which the mice live, often gregariously (Van Dyck and Strahan 2008).

Evidence of the species was recorded in nine locations within the survey area (as shown in Figure 5, Appendix A). In total two active and seven unused/inactive mounds were recorded on low stony hills or undulating plains. *NatureMap* records (DPaW 2016) indicate that this species is wide spread in the eastern Pilbara region. However, this species is known to be sensitive to external impacts and populations are known to decline in areas where disturbance has occurred. Plate 2 shows a small active mound amongst *Triodia*.

Plate 2 An active mound amongst *Triodia*.

Likelihood of Occurrence

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 21 conservation significant fauna species. An assessment on the Likelihood of Occurrence for conservation significant fauna species in the survey area was conducted (Appendix E). This assessment was based on species biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the survey area and the surrounding area (e.g. DPaW 2016).

The assessment identified the likely presence of an additional five other species of conservation significance (see Table 10). The Likelihood of Occurrence assessment revealed that other fauna species of conservation significance could occasionally occur within the habitats of the survey area (those species deemed 'unlikely' to occur). However, it is considered unlikely that the survey area provides important habitat (e.g. breeding habitat or key foraging habitat) for any of these species deemed 'unlikely' to occur and that these other species may occasionally use the habitats of the survey area for temporary refuge and/or dispersal between other areas of habitat.

Table 10 Summary of fauna species of conservation significance determined likely to occur within the survey area

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence
Northern Quoll *Dasyurus hallucatus* En, S2, En	**Likely – regular visitor, opportunistic use in/to the survey area** The survey area provides suitable hunting and foraging habitat for the species. The hills / slopes/ ridgelines and rocky areas would be regarded as core habitat for the species with denning opportunities available in rocky habitat where crevices, cavities and hollows are present. The creek line to the south has *Eucalyptus camaldulensis* present with hollows available both on the ground and aerial would also be regarded as core habitat and sits alongside the survey area. The remainder of the habitat in the survey area is supportive only. Seventy camera trapping nights (in rocky habitat) were undertaken in the survey area with no Quoll recorded (an additional 100 camera nights was undertaken on plains habitat). There are no historical records within the survey area and four records within 40 km. Numerous records approximately 20 km south at Coongan Gorge were made during recent surveys for Main Roads (GHD 2016).
Peregrine Falcon *Falco peregrinus* OS, S7	**Likely – regular visitor or resident to survey area** The survey area provides suitable hunting (foraging) habitat. The survey area is probably part of the species broader home range; no breeding habitat occurs within the survey area. Core breeding habitat (e.g. steep cliffs) may be found in surrounding ranges outside the survey area. Three records exist surrounding the survey area - 50 km south, 40 km east and 60 km north east (DPaW 2016).
Grey Falcon *Falco hypoleucos* Vu, S3	**Likely – regular visitor or resident to survey area** The survey area provides suitable hunting, roosting and breeding habitat for the species. The survey area is probably part of the species broader home range, limited breeding habitat occurs within the survey area (breeding potentially could occur in scattered trees throughout the survey area). The species is known from the area with one record approximately 20 km south at Coongan Gorge.
Lakeland Downs Mouse *Leggadina lakedownensis* P4	**Likely – regular visitor or resident to survey area** The survey area provides suitable habitat for the species particularly in drainage lines, and associated *Triodia* hummock grasslands on sandy plain. The survey area is probably part of the species broader distribution, as typically this species responds to favourable environmental conditions fluctuating in range and abundance (and habitat use) depending on resources. There is no historical records from within the survey area, however several records exist 2 km east of the survey area. This area was visited during the field survey and it was identified as cracking clay grasslands which is typical/core habitat for this species.
Brush-tailed Mulgara *Dasycercus blythi* P4	**Likely –resident to survey area** The survey area provides suitable habitat for the species particularly in *Triodia* hummock grasslands on sandy plain. The survey area is probably part of the species broader distribution, as typically this species is present in most sandy plains (and dunes) in the region. There are no historical records from within the survey area, however one record is within 20 km of the survey area.

Table note:

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following: MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered

WC Act - Species listed as CR = critically endangered, En = endangered, Vu = Vulnerable, IA = international migratory agreement migratory birds, OS = other specially protected fauna

DPaW – Species listed as Priority (P) 1, 2, 3 or 4

5. Project constraints and approvals

This section provides preliminary environmental referral advice based on the biological constraints identified within the survey area. As the project is in concept design there may be opportunities to avoid and minimise the impacts on these biological constraints through design refinement. If the biological constraints can be avoided or impacts to them minimised it may negate the need for environmental approvals or referral to Australian Government or State environmental agencies.

5.1 Key biological constraints

The key biological constraints identified within the survey area during the biological assessment are summarised below in Table 11.

Table 11 Key biological constraints within the survey area

Biological aspect	Survey area
Flora of conservation significance	No flora taxa of conservation significance were recorded during the field assessment. The Likelihood of Occurrence assessment indicates that one taxon is considered likely to be present within the survey area, and four may possibly occur: • *Acacia cyperophylla* var. *omearana* – Priority 1 • *Rothia indica* subsp. *australis* – Priority 1 • *Acacia glaucocaesia* – Priority 3 • *Nicotiana umbratica* – Priority 3 • *Bulbostylis burbidgeae* – Priority 4
Fauna of conservation significance	Presence of one fauna species: • Western Pebble-mound Mouse (*Psudomys chapmani*) – recent evidence of active mounds was recorded within the survey area including two inactive mounds. Potential presence of five species and their habitats within the survey area are: • Northern Quoll (*Dasyurus hallucatus*) – The rocky habitats would be regarded as core habitat for the species with denning opportunities also available in *Eucalyptus camaldulensis* in the creekline just outside the survey area. The remainder is potential foraging habitat. Over 70 camera nights were undertaken in rocky habitat with no quoll recorded • Grey Falcon (*Falco hypoleucos*) – Records within the survey area and the species is a potential resident with breeding and hunting habitat present • Peregrine Falcon (*Falco peregrinus*) – Records in the region and potential breeding habitat present in creek lines, hunting (foraging) habitat available for the species throughout the survey area • Lakeland Downs Mouse (*Leggadina lakedownensis*) – Records in the region and habitat available for the species • Brush-tailed Mulgara *(Dasycercus blythi)* - Records in the region and habitat available for the species.

5.2 Environmental approvals and referrals

5.2.1 Federal approvals

Referral to the DotE under the EPBC Act is triggered if a proposed action has or potentially has a significant impact on any MNES. Table 12 shows an assessment of the survey area against key biological MNES.

Table 12 Assessment of the key biological Matters of National Environmental Significance for the survey area

Key biological MNES	Present	Need for referral to DotE under EPBC Act
Listed Threatened Species and Ecological Communities	No EPBC listed flora species, or ecological communities were identified during the current survey or are considered likely to occur. The assessment identified the presence or likely presence of one EPBC listed fauna species: Northern Quoll (*Dasyurus hallucatus*).	**Northern Quoll** **Referral unlikely** A review of the Significant Impact Guidelines (DotE 2013) and the species specific Northern Quoll referral guidelines (Commonwealth of Australia (CoA) 2016 – see Table 13) was undertaken to consider the need for referral to the DotE for the Northern Quoll. Referral is unlikely for the Northern Quoll because: • The species was not recorded during current surveys camera traps and latrine/scat searches. Over 70 camera nights were undertaken in rocky habitat with no quoll recorded • There is a low risk of a substantial impact to critical habitat for a population of the Northern Quoll If the Northern Quoll did occur within the survey area it would probably be part of a low-density population.
Migratory Species	No EPBC listed migratory fauna species were recorded.	Not required

Table 13 Review of the Referral Guidelines for the Northern quoll

Aspect	Information	Outcome and risk assessment
Modelled distribution of northern quoll	Map 1 and Map 4 of the guideline (CoA 2016) DPaW 2016	Modelling indicates the species is known/likely to occur within the survey area. The survey area occurs within the Pilbara mainland region distribution of the species and is part of the area of the Pilbara regional population as described in the guideline. There are no records of the species in the survey area however 4 records are present within 40 km and GHD identified the species 20 km south of the survey

		area during recent surveys for Main Roads.
Habitat critical to the survival of the Northern Quoll	Habitat critical to the survival of the species is listed on page 16 of the guidelines (CoA 2016). Despite undertaking scat searches and camera trapping the Northern Quoll was not confirmed to occur within the survey area during the field investigation. The fauna assessment determined that habitat within the survey area could be considered potential habitat for the species. The survey area provides suitable hunting, refuge and denning habitat, (particularly on the rocky hillslopes and creek lines). The drainage and rocky areas provide connectivity with habitats adjacent the survey area. The survey area may be part of the home range for one or more individuals.	Given the results of the survey it is unlikely that the survey area is habitat critical to the survival of the regional population, however it may be considered part of a broader area of habitat for one or more individuals. It is considered that there is a low risk of a substantial impact to critical habitat for a population of the Northern Quoll.
Populations important for the long-term survival of the Northern Quoll	High density populations are described by the guideline (page 16). The survey did not record any evidence of Northern Quoll with the exception of potential habitat.	Considering the level of survey effort, lack of evidence and lack of previous records in the immediate area, it is unlikely that the survey area is considered to be part of a high density quoll population, and therefore it is considered that if the Northern Quoll did occur within the survey area it would probably be part of a low-density population.

5.2.2 State approvals

Environmental Protection Authority

Significant proposals must be referred to the EPA under Section 38 of the EP Act. In deciding whether a proposal will be subject to the formal environmental impact assessment process, the EPA takes into account the environmental significance of any potential impacts that may result from the implementation of the scheme or proposal.

In the absence of a broader environmental assessment, the majority of the likely biological impacts associated with the project are linked to native vegetation clearing and loss of fauna habitat. The potential impacts from the loss of native vegetation and loss of fauna habitat can be effectively assessed through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, with consideration of the biological values discussed in this report,

it is considered unlikely that the project would require referral to the EPA under Section 38 of the EP Act.

Department of Environment and Regulation

The clearing of native vegetation in WA requires a permit under Part V of the EP Act, unless an exemption applies. Main Roads has been granted a Statewide Purpose Clearing Permit (CPS 818) which allows Main Roads to clear native vegetation for road projects and associated activities.

The Australian and WA governments have entered into a bilateral agreement under the EPBC Act relating to environmental assessment (assessment bilateral agreement). Specifically, this agreement now includes the clearing permit assessment process under Part V Division 2 of the EP Act. Under the assessment bilateral agreement, if a native vegetation clearing permit is required and the clearing will have or is likely to have an impact on a MNES, the assessment of the clearing application including the potential impacts to the MNES can be conducted by DER under delegation.

There are five conservation significant flora considered to likely or possibly occur in the survey area. Six fauna of conservation significance are considered to occur or likely to occur in survey area. As such, any clearing permit application should assess the significance of any potential impacts of the proposed clearing area on these species.

6. Conclusions

6.1 Key findings

6.1.1 Vegetation and flora

Seven vegetation associations were identified and described from the survey area. A review of the aerial photography illustrates there is representation of this vegetation outside the survey area. The vegetation is also consistent with vegetation associations identified in the vegetation mapping for the area (Beard 1975; Payne and Schoknecht 2011).

The survey area is in a largely disturbed condition with signs of obvious disturbance, including flood, grazing and material extraction activities.

No EPBC Act, WC Act or Priority listed flora taxa were recorded within the survey area during the survey. The Likelihood of Occurrence assessment post-field survey concluded that four conservation significant flora taxa may possibly occur within the survey area and one taxon considered likely to occur.

Two introduced taxa were recorded within the survey area during the field survey. No introduced species listed as a Declared Pest under Section 22 of the BAM Act or a WoNS (DotE 2016) were recorded within the survey area.

6.1.2 Fauna

The Priority 4 listed Western Pebble-mound Mouse (*Pseudomys chapmani*) was recorded during the current survey.

The Western Pebble-mound Mouse is endemic to the Pilbara region and regarded as common in most of its range. Only nine mounds were located in the survey area of which 2 were active. Typically this species is sedentary and restricted to stony habitats on hill slope or on undulating plain. The species is known to be susceptible to disturbance and will disappear from areas once this occurs. The habitat within the survey area is probably well represented in the local area and within the larger study area. It is also most likely that the larger study area contains additional resources for this species. It is considered unlikely that the habitats within the survey area form a substantial portion or an important component of habitat for the species.

Five other species, Peregrine Falcon, Grey Falcon, Lakeland Downs Mouse, Brush-tailed Mulgara and including the EPBC Act listed Northern Quoll (*Dasyurus hallacatus*) are likely to occur within the survey area.

The Peregrine Falcon, Grey Falcon, Lakeland Downs Mouse and Brush-tailed Mulgara are known from the region and habitat is present for the species, however the habitat available is not critical to the survival of the species and generally restricted to only small portions of the survey area having little impact on the species.

A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotE for the Northern Quoll.

Referral is unlikely for the Northern Quoll because the species was not recorded during current surveys using targeted survey methods (camera traps and latrine/scat searches). Furthermore, it is considered there is a low risk of the project causing a substantial impact to critical habitat for a population of the Northern Quoll and if the Northern Quoll did occur within the survey area it would probably be part of a low-density population.

7. References

ALA 2016, Atlas of Living Australia, retrieved May 2016, from http://lists.ala.org.au/iconic-species?fq=kvp+group%3ABirds.

Australian Soil Resource Information System (ASRIS) 2016, *Australian Soil Resource Information Viewer*, retrieved April 2016, from http://www.asris.csiro.au/index_ie.html.

Beard, JS 1975, *Pilbara, 1:1 000,000 vegetation series: explanatory notes to sheet 5 – the vegetation of the Pilbara area*, Nedlands, WA, University of Western Australia Press.

Beard, JS 1990, *Plant Life of Western Australia*, Perth, Kangaroo Press.

Beard, JS, Breeston, GR, Harvey, JM, Hopkins, AJM, and Shepherd, DP 2013, *The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir.* Conservation Science Western Australia 9 (1) : 1-152.

BoM 2016, *Climatic statistics for Australian locations*, retrieved April 2016, from http://www.bom.gov.au/climate/averages/tables/cw_012320.shtml.

BoM 2016a, Atlas of Groundwater Dependent Ecosystems, retrieved June 2016, from http://www.bom.gov.au/water/groundwater/gde/map.shtml.

Christidis, L and Boles, WE 2008, *Systematics and Taxonomy of Australian Birds*, Melbourne, CSIRO Publishing.

CoA 2016, Referral guideline for the Northern Quoll (Dasyurus hallucatus) under the EPBC Act. CoA.

DPaW 2015, *Threatened and Priority Fauna Rankings*, retrieved April 2016, from http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals?view=categories&id=109.

DPaW 2016, *NatureMap: Mapping Western Australia's Biodiversity*, retrieved April 2016, from http://naturemap.dpaw.wa.gov.au/.

DotE 2013, *Matters of National Environmental Significance Significant Impact Guidelines 1.1: Environment Protection and Biodiversity Act 1999* Commonwealth of Australia.

DotE 2016a *Environment Protection and Biodiversity Act 1999 Protected Matters Report*, retrieved April 2016, from http://www.environment.gov.au/epbc/pmst/

DotE 2016b, *Environment Protection and Biodiversity Act 1999 List of Threatened Flor*a, retrieved April 2016, from http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora

DotE 2016c, *Interim Biogeographic Regionalisation of Australia*, Version 7, retrieved April 2016, from http://www.environment.gov.au/topics/land/nrs/science-maps-and-data/australiasbioregions- ibra.

DotE 2016d, *Weeds of National Significance*, retrieved April 2016, from http://www.environment.gov.au/node/14156

DoW 2016, *Geographic Data Atlas*, retrieved April 2016 from, http://www.water.wa.gov.au/idelve/dowdataext/index.jsp.

EPA 2000, *Environmental Protection of Native Vegetation in Western Australia, Clearing of native vegetation, with particular reference to the agricultural area*, Position Statement No. 2, Perth, EPA

EPA 2004a, *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, Perth, EPA.

EPA 2004b, *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Impact Assessment in Western Australia*, Perth, EPA.

EPA and DEC 2010, *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (eds BM Hyder, J Dell and MA Cowan), Perth, WA.

EPA and DPaW 2015, *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (eds. K Freeman, G Stack, S Thomas and N Woolfrey), Perth, WA.

ESCAVI 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*, Canberra, Department of the Environment and Heritage.

GHD 2016, Coongan Gorge Realignment: Biological Survey. Unpublished Report for Main Roads Western Australia, August 2016.

GoWA 2015, Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report), Current as of May 2016, Perth Western Australia, Department of Environment and Conservation, retrieved June 2016, from https://www2.landgate.wa.gov.au/web/guest/downloader.

Kendrick, P and McKenzie, N 2001, *Pilbara 1 (PIL1 – Chichester subreigon) A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002,* Western Australian Government Department of Environment and Conservation, Perth, Western Australia.

Morcombe, M 2004, *Field Guide to Australian Birds*, Steve Parish Publishing Archer Field Queensland Australia.

Morcombe 2014, *Morcombe eGuide to Australian Birds V1.4. PDA Solutions.*

Shepherd, DP, Beeston, GR and Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status*, Resource Management Technical Report 249, Perth, Department of Agriculture, WA.

Tille, P 2006, *Soil-landscapes of Western Australia's Rangelands and Arid Interior*, Resource Management Technical Report 313, Perth, Department of Agriculture and Food.

Triggs, B 2004, *Tracks, Scats and Other Traces: A field guide to Australian Mammals (revised edition),* Oxford University Press.

van Vreeswyk, AM, Leighton, KA, Payne, AL and Hennig, P 2004, *An inventory and condition survey of the Pilbara region, Western Australia*, Technical Bulletin No. 92, DAFWA.

WA Herbarium 2016, *FloraBase—the Western Australian Flora*, Department of Parks and Wildlife, retrieved April 2016, from http://florabase.dpaw.wa.gov.au/.

Van Dyck, S and Strahan, R 2008, The Mammals of Australia, New Holland, Sydney, NSW.

Appendices

Appendix A – Figures

BIDYADANGA COMMUNITY

GREAT NORTHERN HIGHWAY

PORT HEDLAND

DAMPIER

WICKHAM

POINT SAMSON

ROEBOURNE

KARRATHA

MARBLE BAR

ONSLOW

NORTH WEST COASTAL HIGHWAY

PANNAWONICA

PANNAWONICA ROAD

ROEBOURNE WITTENOOM ROAD

ONSLOW ROAD

MARBLE BAR ROAD

MUNJINA ROY HILL ROAD

KARIJINI DRIVE

TOM PRICE

BURKETT ROAD

NANUTARRA WITTENOOM ROAD

PARABURDOO ROAD

TOM PRICE ROAD

PARABURDOO

NEWMAN

Paper Size A3

0 20 40 60 80 100

Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

LEGEND

Town

Survey area

Major Road

Minor Road

GHD

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Main Roads Western Australia
M030 Material Pit Expansion 356 SLK
Biological Assessment

Job Number 61-34569
Revision 0
Date 09 Sep 2016

Project Location

Figure 1

G:\61\34569\GIS\Maps\MXD\6134569_001_Rev0_Fig1Locality.mxd

Data source: Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Survey Area 20160530; Landgate: Aerial Imagery - Site Inset (Virtual Mosaic). Created by:mmikkonen

999 Hay Street Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

730,000 740,000 750,000 760,000 770,000 780,000 790,000 800,000

7,710,000 7,700,000 7,690,000 7,680,000 7,670,000

EAST STRELLEY RIVER
PEAR CREEK
COONGAN RIVER
Marble Bar Road
WARRALONG CREEK
TALGA RIVER
SIX MILE CREEK
MIRALGA CREEK

Threatened (Declared Rare) & Priority Fauna

- *Ardea modesta*
- *Dasyurus hallucatus*
- *Falco hypoleucos*
- *Lagorchestes conspicillatus leichardti*
- *Leggadina lakedownensis*
- *Macroderma gigas*
- *Merops ornatus*
- *Plegadis falcinellus*
- *Pseudomys chapmani*
- *Rhinonicteris aurantia*
- *Rhinonicteris aurantia* (Pilbara)
- *Tringa glareola*

Paper Size A3

0 2 4 6 8 10

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

Threatened (Declared Rare) & Priority Flora

- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa
- Major Road
- Minor Road
- Major Watercourse
- Minor Watercourse
- Survey area
- Waterbody

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Biological Assessment

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Biological Constraints

Figure 2

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Data source: Geoscience Australia: Landsat Imagery, GeoData Topo 250k Series III; MRWA: Survey Area 20160530, Roads - 20140723; DPaW: Rare and Priority Flora - 2060523, Rare and Priority Fauna - 20160516. Created by:mmikkonen

760,000 760,600 761,200 761,800

7,695,600 7,695,000 7,694,400 7,693,800 7,693,200 7,692,600

Marble Bar Road

Farrel Well Access Road

Q6 Q7 Q5 Q4 Q3 Q12 Q1 Q9 Q8 Q2 Q10 Q11

R2 R4 R1 R3

1 2 3 4 5 6 7

LEGEND

Quadrat — Road

Relevé — Survey area

Vegetation Association

1, Cleared/Degraded

2, Low Shrub and Spinifex on Sandy Flats

3, Corymbia over Spinifex Steppe on Sandplains

4, Corymbia-Acacia Thickets on Sandplains

5, Spinifex Steppe on Stony Lower Slopes

6, Rocky Outcrops

7, Riparian Woodland

Paper Size A3

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Biological Assessment

Job Number	61-34569
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Vegetation Associations

Figure 3

G:\61\34569\GIS\Maps\MXD\6134569_003_Rev0_Fig3VegAssociation.mxd

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Data source: MRWA: Survey Area 20160530, Roads - 20140723; Landgate: Imagery (Virtual Mosaic); GHD: Quadrat and Relevé Locations, Vegetation Associations - 20160615. Created by:mmikkonen

760,000 761,000 762,000

7,695,000 7,694,000 7,693,000

Marble Bar Road

Farrel Well Access Road

4 5 6 7 6 6 5 3 4 4

LEGEND

Road

Survey area

Vegetation Condition (EPA and DPaW, 2015)

3 4 5 6 7

Paper Size A3

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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M030 Material Pit Expansion 356 SLK
Biological Assessment

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Vegetation Condition

Figure 4

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Data source: MRWA: Survey Area 20160530, Roads - 20140723; Landgate: Imagery (Virtual Mosaic); GHD: Vegetation Condition - 20160615. Created by:mmikkonen

760,000 761,000 762,000

7,695,000 7,694,000 7,693,000

Marble Bar Road

Farrel Well Access Road

habitat sheet 4

habitat sheet 3

habitat sheet 2

habitat sheet 1

habitat sheet 5

cam 22

cam 30

cam 3

cam 2

cam 15

bat detector

LEGEND

Fauna Method

- Bat detector
- Camera
- Habitat Assessment Point

Fauna Results

- Pebble Mound (Active Mound)
- Pebble Mound (Inactive Mound)
- Rainbow Bee-eater (Sighting)

- Road
- Survey area

Paper Size A3

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Fauna Methods and Results

Figure 5

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Data source: MRWA: Survey Area 20160530, Roads - 20140723; Landgate: Imagery (Virtual Mosaic); GHD: Fauna Method, Fauna Results - 20160627. Created by:mmikkonen

Appendix B – Relevant legislation, conservation codes and background information

Legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not take an action that has, will have, or is likely to have a significant impact MNES, without approval from the Federal Minister for the Environment.

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Australian Government Minister for the Environment.

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. It provides for an Environmental Protection Authority (EPA), for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the above.

Clearing of native vegetation in Western Australia requires a permit from the Department of Environment Regulation (DER) (formerly the Department of Environment and Conservation – DEC), unless exemptions apply. Native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native, but not vegetation planted in a plantation or planted with commercial intent.

In the EP Act Section 51A, clearing is defined as the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage of some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above.

When making a decision to grant or refuse a permit to clear native vegetation the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.

c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

g) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

There are a number of Environmentally Sensitive Areas (ESAs) within Western Australia where exemptions in regulations do not apply. ESAs include locations of threatened communities and species.

State *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

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

Aspects of Environmentally Sensitive Areas

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the *Environment Protection and Biodiversity Conservation Act 1999* (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*.

State *Wildlife Conservation Act 1950*

The *Wildlife Conservation Act 1950* (WC Act) provides for the conservation and protection of wildlife. It is administered by the Department of Parks and Wildlife (DPaW) (formerly the DEC) and applies to both flora and fauna. Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

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 Areas, 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, districts, individual properties or even paddocks. Categories of control are defined below. 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* (ARRP Act).

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.

Background information and conservation codes

Reserves and conservation areas

Department of Parks and Wildlife managed lands and waters

DPaW manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DPaW managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DPaW managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DPaW managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DPaW managed lands will generally be referred to DPaW throughout the assessment process.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance” (DotE 2016a). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DotE 2016a).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DotE 2016b):

- 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 one percent 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

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 Environmental Protection Authority (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 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.
- From a biodiversity perspective, stream reserves should generally be in the order of at least 200 metres (m) wide.

Vegetation condition

The vegetation condition in the Victoria Bonaparte IBRA bioregion can be assessed in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (devised by Trudgen (1988) and adapted by EPA and DPaW (2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale

Class	Eremaean and Northern Botanical Provinces description
2	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
3	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
4	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
5	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
6	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
7	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act administered by the Department of the Environment (DotE) (formerly Department of Sustainability, Environment, Water, Population and Communities – DSEWPaC). The DPaW also maintains a list of TECs for Western Australia; some of which are also protected under the EPBC Act. 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.

Possible TEC that do not meet survey criteria are added to the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These 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. PECs are not listed under any formal Federal or State legislation.

Conservation codes and definitions for Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment and listed under the *Environment Protection and Biodiversity Conservation Act 1999*

Western Australia conservation categories		Federal Government Conservation Categories (EPBC Act)	
Presumed Totally Destroyed (PD)	The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.	Critically Endangered (CR)	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated	Endangered (EN)	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.	Vulnerable (VU)	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.		

Conservation categories and definitions for Priority Ecological Communities as listed by the Department of Parks and Wildlife

Category	Description
Priority 1	**Poorly known ecological communities.** Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	**Poorly known ecological communities.** Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	**Poorly known ecological communities.** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	**Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.** (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Category	Description
Priority 5	**Conservation Dependent ecological communities.** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Other significant vegetation

Vegetation may be significant for a range of reasons, other than a statutory listing as TEC or because the extent is below a threshold level. The EPA (2004) states that significant vegetation may include vegetation that includes the following:

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

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DotE and/or the EPA.

The Federal conservation level of flora and 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).

Threatened species have been published as Specially Protected under the WC Act 1950, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora. The schedules align with the categories of the EPBC Act. Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant.

Conservation categories and definitions for *Environment Protection and Biodiversity Conservation Act 1999* listed flora & 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

Conservation codes and descriptions for Western Australian flora and fauna

Code	Conservation category	Description
Wildlife Conservation Act 1950		
T	Threatened species	Published as Specially Protected under the *Wildlife Conservation Act 1950,* and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). ***Threatened fauna*** is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. ***Threatened flora*** is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	Critically endangered species	Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	Endangered species	Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	Vulnerable species	Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	Presumed extinct species	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	Migratory birds protected under an international agreement	Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	Conservation dependent fauna	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.
OS	Other specially protected fauna	Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Code	Conservation category	Description
DPaW Priority Listed		
1	Priority One: Poorly-known taxa	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	Priority Two: Poorly-known taxa	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	Priority Three: Poorly-known taxa	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Migratory species listed under the EPBC Act

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)

- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

Other significant flora and fauna

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than as Threatened (Declared Rare) Flora or Priority Flora. The EPA (2004) states that significant flora may include taxa that have:

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

The application of the degree of significance may apply at a range of scales.

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007.*

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 2014).

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Australian Government 2014, *Weeds in Australia*, retrieved 2016, from http://www.environment.gov.au/biodiversity/invasive/weeds/index.html.

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

DotE 2016a, *The Ramsar Convention on Wetlands*, retrieved 2015, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/ramsar-convention-wetlands.

DotE 2016b, *Criteria for determining nationally important wetlands*, retrieved 2015, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important.

English, V and Blyth, J 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, Perth, Department of Conservation and Land Management.

EPA 2000, *Environmental Protection of Native Vegetation in Western Australia. Clearing of native vegetation, with particular reference to the agricultural area. Position Statement No. 2*, Perth, Environmental Protection Authority.

EPA 2004, *Guidance Statement No. 51, Guidance for the Assessment of Environmental Factors: Vegetation and Flora Surveys for Environmental Impact Assessment in Western Australia*, Perth, Environmental Protection Authority.

EPA and DPaW 2015, *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment*, (ed. K Freeman, G Stack, S Thomas and N Woolfrey), Perth, WA.

Keighery, BJ 1994, Bushland Plant Survey: a Guide to Plant Community Survey for the Community, Nedlands, Wildflower Society of WA (Inc.).

Western Australian Herbarium 1998–, *FloraBase—the Western Australian Flora*. Department of Parks and Wildlife, retrieved 2015, from http://florabase.dpaw.wa.gov.au/.

Appendix C – Desktop searches

EPBC Act PMST Report (20 km buffer)

NatureMap Flora Report (20 km buffer)

NatureMap Fauna Report (20 km buffer)

Australian Government

Department of the Environment

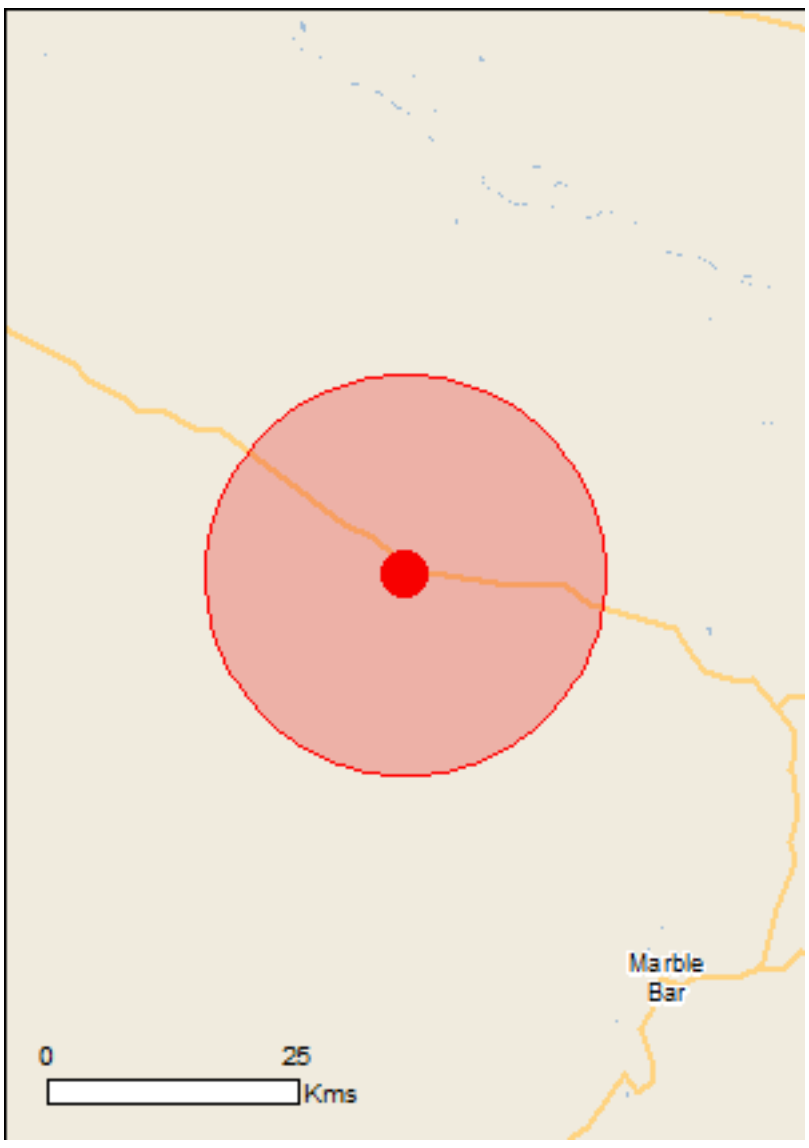
EPBC Act Protected Matters Report

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

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

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

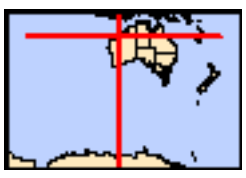
Report created: 11/05/16 16:52:57



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

Coordinates

Buffer: 20.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	7
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Breeding likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		

Name	Status	Type of Presence
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-20.83205 119.5085

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Canberra ACT 2601 Australia
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NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 11/05/2016

Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	119° 30' 30" E,20° 50' 00" S
Buffer	20km
Group By	Family

Family	Species	Records
Acarosporaceae	1	1
Accipitridae	3	3
Actinopodidae	1	1
Aeolosomatidae	1	3
Agamidae	4	16
Amaranthaceae	7	11
Ameiridae	2	2
Anatidae	1	4
Anhingidae	1	2
Ardeidae	4	9
Artamidae	1	1
Asteraceae	1	1
Bdelloidea	1	5
Boraginaceae	1	1
Burhinidae	1	1
Cacatuidae	1	5
Campephagidae	2	8
Candonidae	3	7
Canthocamptidae	1	3
Centropodidae	2	3
Charadriidae	3	7
Chenopodiaceae	2	2
Cleomaceae	2	2
Columbidae	4	16
Convolvulaceae	3	3
Copepoda	2	3
Corvidae	2	7
Cracticidae	2	4
Cuculidae	1	1
Cucurbitaceae	1	1
Cyperaceae	7	7
Dasyuridae	4	27
Dicruridae	2	11
Diplodactylidae	4	17
Elapidae	1	1
Enchytraeidae	1	3
Estrildidae	2	12
Euphorbiaceae	3	3
Fabaceae	25	33
Falconidae	1	2
Gekkonidae	3	12
Goodeniaceae	7	11
Halcyonidae	3	7
Limnocytheridae	2	6
Macropodidae	1	1
Maluridae	1	1
Malvaceae	5	5
Meliphagidae	3	8
Melitidae	1	2
Meropidae	1	6
Microcerberidae	1	2
Muridae	5	17
Myrtaceae	2	12
NO FAMILY	1	2
Naididae	1	2
Nematoda	2	2
Nyctaginaceae	1	1
Ostracoda	1	2
Pachycephalidae	2	2
Paramelitidae	1	1
Pardalotidae	1	1
Pelecanidae	1	2
Phalacrocoracidae	2	4
Phasianidae	1	2
Philosciidae	1	2
Phreodrilidae	2	4
Poaceae	2	4
Podargidae	1	1
Podicipedidae	1	2
Portulacaceae	3	3
Psittacidae	4	6
Pygopodidae	2	2
Rallidae	1	1
Scincidae	17	74
Solanaceae	4	7
Strigidae	1	1
Sylviidae	3	9

Threskiornithidae	1	1
Turnicidae	1	3
Varanidae	1	2
Zygophyllaceae	1	2
TOTAL	**206**	**484**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acarosporaceae					
1.		*Acarospora sp.*			
Accipitridae					
2.	25536	*Accipiter fasciatus (Brown Goshawk)*			
3.	24289	*Circus assimilis (Spotted Harrier)*			
4.	24295	*Haliastur sphenurus (Whistling Kite)*			
Actinopodidae					
5.		*Missulena rutraspina*			
Aeolosomatidae					
6.		*Aeolosoma sp. 3 (PSS)*			
Agamidae					
7.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
8.	24865	*Ctenophorus caudicinctus subsp. caudicinctus (Ring-tailed Dragon)*			
9.	24876	*Ctenophorus isolepis subsp. isolepis (Crested Dragon, Military Dragon)*			
10.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
Amaranthaceae					
11.	2645	*Achyranthes aspera (Chaff Flower)*			
12.	2680	*Gomphrena cunninghamii*			
13.	2698	*Ptilotus auriculifolius*			
14.	2704	*Ptilotus calostachyus (Weeping Mulla Mulla)*			
15.	2711	*Ptilotus clementii (Tassel Top)*			
16.	11236	*Ptilotus gomphrenoides var. gomphrenoides*			
17.	2734	*Ptilotus incanus*			
Ameiridae					
18.		*Stygonitocrella bispinosa*			
19.		*Stygonitocrella trispinosa*			
Anatidae					
20.	24316	*Anas superciliosa (Pacific Black Duck)*			
Anhingidae					
21.		*Anhinga novaehollandiae*			
Ardeidae					
22.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
23.	24341	*Ardea pacifica (White-necked Heron)*			
24.		*Egretta novaehollandiae*			
25.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
Artamidae					
26.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
Asteraceae					
27.	8170	*Pluchea tetranthera*			
Bdelloidea					
28.		*Bdelloidea sp.*			
Boraginaceae					
29.	11750	*Trichodesma zeylanicum var. zeylanicum*			
Burhinidae					
30.	24359	*Burhinus grallarius (Bush Stone-curlew)*			
Cacatuidae					
31.		*Eolophus roseicapillus*			
Campephagidae					
32.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
33.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
Candonidae					
34.		*'Leicacandona' 'halsei' (PSS)*			Y
35.		*'Leicacandona' 'jimi' (PSS)*			Y
36.		*Areacandona cf. sp. 1 (PSS)*			
Canthocamptidae					
37.		*Elaphoidella humphreysi*			
Centropodidae					
38.	25600	*Centropus phasianinus (Pheasant Coucal)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
39.	24430	*Centropus phasianinus subsp. highami (Pheasant Coucal)*			
Charadriidae					
40.	24373	*Charadrius melanops (Black-fronted Dotterel)*			
41.		*Elseyornis melanops*			
42.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
Chenopodiaceae					
43.	33596	*Dysphania melanocarpa forma leucocarpa*			
44.	2604	*Sclerolaena costata*			
Cleomaceae					
45.	2987	*Cleome uncifera*			
46.	29101	*Cleome uncifera subsp. uncifera*			
Columbidae					
47.	24401	*Geopelia cuneata (Diamond Dove)*			
48.	25585	*Geopelia striata (Zebra Dove)*			
49.	24404	*Geophaps plumifera (Spinifex Pigeon)*			
50.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
Convolvulaceae					
51.	6606	*Bonamia media*			
52.	6653	*Polymeria ambigua (Morning Glory)*			
53.	17513	*Polymeria lanata*			
Copepoda					
54.		*Calanoida sp.*			
55.		*Cyclopoida sp.*			
Corvidae					
56.	25593	*Corvus orru (Torresian Crow)*			
57.		*Corvus sp.*			
Cracticidae					
58.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
59.	25595	*Cracticus tibicen (Australian Magpie)*			
Cuculidae					
60.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
Cucurbitaceae					
61.	41721	*Cucumis variabilis*			
Cyperaceae					
62.	751	*Bulbostylis burbidgeae*		P4	
63.	798	*Cyperus iria*			
64.		*Cyperus sp.*			
65.	814	*Cyperus squarrosus*			
66.	858	*Fimbristylis leucocolea*			
67.	862	*Fimbristylis microcarya*			
68.	12159	*Fimbristylis simulans*			
Dasyuridae					
69.	24091	*Dasykaluta rosamondae (Little Red Kaluta)*			
70.	24095	*Ningaui timealeyi (Pilbara Ningaui)*			
71.	24116	*Sminthopsis macroura (Stripe-faced Dunnart)*			
72.	24120	*Sminthopsis youngsoni (Lesser Hairy-footed Dunnart)*			
Dicruridae					
73.	24443	*Grallina cyanoleuca (Magpie-lark)*			
74.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
Diplodactylidae					
75.	24926	*Diplodactylus conspicillatus (Fat-tailed Gecko)*			
76.	24944	*Diplodactylus savagei (Southern Pilbara Beak-faced Gecko)*			
77.	30933	*Lucasium stenodactylum*			
78.	30934	*Lucasium wombeyi*			
Elapidae					
79.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
Enchytraeidae					
80.		*Enchytraeus Pilbara sp. 1 (PSS)*			
Estrildidae					
81.	24631	*Emblema pictum (Painted Finch)*			
82.	30870	*Taeniopygia guttata (Zebra Finch)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Euphorbiaceae					
83.	4626	*Euphorbia drummondii (Caustic Weed, Piwi)*			
84.	4630	*Euphorbia inappendiculata*			
85.		*Euphorbia sp.*			
Fabaceae					
86.	3241	*Acacia bivenosa*			
87.	14087	*Acacia cyperophylla var. omearana*		P1	
88.	3300	*Acacia dictyophleba (Sandhill Wattle, Ngarkalya)*			
89.	19305	*Acacia melleodora*			
90.	3501	*Acacia ptychophylla*			
91.	29135	*Acacia sericophylla*			
92.		*Acacia sp.*			
93.	3553	*Acacia spondylophylla*			
94.	3579	*Acacia trachycarpa (Minni Ritchi, Balgali)*			
95.	3585	*Acacia tumida (Pindan Wattle, Walgali)*			
96.	20319	*Acacia tumida var. pilbarensis*			
97.	19641	*Acacia tumida var. tumida*			
98.	19398	*Crotalaria ramosissima*			
99.	17120	*Cullen pogonocarpum*			
100.	3982	*Indigofera monophylla*			
101.	17645	*Senna artemisioides*			
102.	12280	*Senna artemisioides subsp. oligophylla*			
103.	12312	*Senna notabilis*			
104.	12356	*Swainsona formosa*			
105.	4281	*Tephrosia simplicifolia*			
106.	42442	*Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)*			
107.	4287	*Tephrosia virens*			
108.	30716	*Vachellia farnesiana (Mimosa Bush)*	Y		
109.	4323	*Vigna lanceolata (Maloga Vigna, Wega)*			
110.	31391	*Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)*			
Falconidae					
111.	25622	*Falco cenchroides (Australian Kestrel)*			
Gekkonidae					
112.	24958	*Gehyra punctata*			
113.	24959	*Gehyra variegata*			
114.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
Goodeniaceae					
115.	7424	*Dampiera candicans*			
116.	7509	*Goodenia forrestii*			
117.	7521	*Goodenia lamprosperma*			
118.	7526	*Goodenia microptera*			
119.	12574	*Goodenia prostrata*			
120.		*Goodenia sp.*			
121.	10982	*Goodenia stobbsiana*			
Halcyonidae					
122.	25547	*Dacelo leachii (Blue-winged Kookaburra)*			
123.	42351	*Todiramphus pyrrhopygius (Red-backed Kingfisher)*			
124.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
Limnocytheridae					
125.		*Gomphodella 'hirsuta' (PSS)*			
126.		*Limnocythere sp. 1 (PSS)*			
Macropodidae					
127.	24122	*Lagorchestes conspicillatus subsp. leichardti (Spectacled Hare-wallaby)*		P3	
Maluridae					
128.	25656	*Stipiturus ruficeps (Rufous-crowned Emu-wren)*			
Malvaceae					
129.	4895	*Abutilon lepidum*			
130.	4862	*Corchorus parviflorus*			
131.		*Sida sp.*			
132.	31859	*Sida sp. Articulation below (A.A. Mitchell PRP 1605)*			
133.	14942	*Triumfetta maconochieana*			
Meliphagidae					
134.	25661	*Lichmera indistincta (Brown Honeyeater)*			
135.	24583	*Manorina flavigula (Yellow-throated Miner)*			
136.	42310	*Sugomel niger (Black Honeyeater)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Melitidae					
137.		*Melitidae sp. 1 (PSS)*			
Meropidae					
138.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
Microcerberidae					
139.		*Microcerberidae sp.*			
Muridae					
140.	24217	*Leggadina lakedownensis (Short-tailed Mouse, Karekanga)*		P4	
141.	24233	*Pseudomys chapmani (Western Pebble-mound Mouse, Ngadji)*		P4	
142.	24235	*Pseudomys desertor (Desert Mouse)*			
143.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
144.	24248	*Zyzomys argurus (Common Rock-rat)*			
Myrtaceae					
145.	17093	*Corymbia hamersleyana*			
146.	5923	*Melaleuca lasiandra*			
NO FAMILY					
147.		*No invertebrates*			
Naididae					
148.		*Monopylephorus n. sp. WA29 (ex Pristina WA3) (PSS)*			
Nematoda					
149.		*Nematoda sp. 14 (PSS)*			
150.		*Nematoda sp. 2 (PSS)*			
Nyctaginaceae					
151.	2769	*Boerhavia burbidgeana*			
Ostracoda					
152.		*Ostracoda (unident.)*			
Pachycephalidae					
153.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
154.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
Paramelitidae					
155.		*Paramelitidae sp.*			
Pardalotidae					
156.	24627	*Pardalotus rubricatus (Red-browed Pardalote)*			
Pelecanidae					
157.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
Phalacrocoracidae					
158.		*Microcarbo melanoleucos*			
159.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
Phasianidae					
160.	25701	*Coturnix ypsilophora (Brown Quail)*			
Philosciidae					
161.		*Philosciidae sp.*			
Phreodrilidae					
162.		*Phreodrilid with dissimilar ventral chaetae*			
163.		*Phreodrilid with similar ventral chaetae*			
Poaceae					
164.	414	*Eriachne obtusa (Northern Wandarrie Grass)*			
165.	681	*Triodia brizoides*			
Podargidae					
166.	25703	*Podargus strigoides (Tawny Frogmouth)*			
Podicipedidae					
167.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
Portulacaceae					
168.	2878	*Portulaca conspicua*			
169.	2884	*Portulaca oleracea (Purslane, Wakati)*			
170.		*Portulaca sp.*			
Psittacidae					
171.	25716	*Cacatua sanguinea (Little Corella)*			
172.	24736	*Melopsittacus undulatus (Budgerigar)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
173.	24742	*Nymphicus hollandicus (Cockatiel)*			
174.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
Pygopodidae					
175.	24998	*Delma elegans*			
176.	25002	*Delma pax*			
Rallidae					
177.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
Scincidae					
178.	25015	*Carlia munda (Shaded-litter Rainbow Skink)*			
179.	25036	*Ctenotus duricola*			
180.	25045	*Ctenotus helenae*			
181.	25064	*Ctenotus pantherinus subsp. ocellifer (Leopard Ctenotus)*			
182.	25062	*Ctenotus piankai*			
183.	25070	*Ctenotus robustus*			
184.	25072	*Ctenotus rubicundus*			
185.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
186.	25125	*Lerista bipes*			
187.	30929	*Lerista jacksoni*			
188.	42411	*Lerista timida*			
189.	30925	*Lerista verhmens*			
190.	25184	*Menetia greyii*			
191.	25187	*Menetia surda subsp. surda*			
192.	25193	*Morethia ruficauda subsp. exquisita*			
193.	25197	*Notoscincus ornatus subsp. ornatus*			
194.	25199	*Proablepharus reginae*			
Solanaceae					
195.	6998	*Solanum cleistogamum*			
196.	7002	*Solanum diversiflorum*			
197.	7014	*Solanum horridum*			
198.	7029	*Solanum phlomoides*			
Strigidae					
199.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
Sylviidae					
200.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
201.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
202.	24837	*Eremiornis carteri (Spinifex-bird)*			
Threskiornithidae					
203.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Turnicidae					
204.	24851	*Turnix velox (Little Button-quail)*			
Varanidae					
205.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
Zygophyllaceae					
206.	4381	*Tribulus platypterus (Cork Hopbush)*			

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

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

Appendix D – Flora Data

Flora species list

Flora Likelihood of Occurrence assessment guidelines

Flora Likelihood of Occurrence assessment

Quadrat data

Flora taxa recorded in the survey area

Family	*Genus*	*Species*	Status
Aizoaceae	*Trianthema*	*pilosum*	
Aizoaceae	*Trianthema*	*triquetrum*	
Amaranthaceae	*Ptilotus*	*astrolasius*	
Amaranthaceae	*Ptilotus*	*calostachyus*	
Amaranthaceae	*Ptilotus*	*fusiformis*	
Apiaceae	*Trachymene*	sp. (insufficient material)	
Apocynaceae	*Calotropis*	*procera*	*
Apocynaceae	*Carissa*	*lanceolata*	
Asteraceae	*Chrysocephalum*	*pterochaetum*	
Asteraceae	*Pluchea*	*ferdinandi-muelleri*	
Asteraceae	*Pluchea*	*tetranthera*	
Bignoniaceae	*Dolichandrone*	*heterophylla*	
Boraginaceae	*Ehretia*	*saligna*	
Boraginaceae	*Heliotropium*	*heteranthum*	
Boraginaceae	*Heliotropium*	*ovalifolium*	
Boraginaceae	*Heliotropium*	*skeleton*	
Caryophyllaceae	*Polycarpaea*	*longiflora*	
Combretaceae	*Terminalia*	*circumalata*	
Convolvulaceae	*Bonamia*	*erecta*	
Convolvulaceae	*Evolvulus*	*alsinoides*	
Convolvulaceae	*Operculina*	*aequisepala*	
Cyperaceae	*Cyperus*	*squarrosus*	
Cyperaceae	*Cyperus*	*vaginatus*	
Cyperaceae	*Fimbristylis*	*microcarya*	
Elatinaceae	*Bergia*	*pedicellaris*	
Elatinaceae	*Bergia*	*perennis*	
Euphorbiaceae	*Euphorbia*	*australis*	
Euphorbiaceae	*Euphorbia*	*tannensis*	
Euphorbiaceae	*Euphorbia*	*trigonosperma*	
Fabaceae	*Acacia*	*ampliceps*	
Fabaceae	*Acacia*	*ancistrocarpa*	
Fabaceae	*Acacia*	*inaequilatera*	
Fabaceae	*Acacia*	*ptychophylla*	
Fabaceae	*Acacia*	*sericophylla*	
Fabaceae	*Acacia*	*spondylophylla*	
Fabaceae	*Acacia*	*stellaticeps*	
Fabaceae	*Acacia*	*synchronicia*	
Fabaceae	*Acacia*	*trachycarpa*	
Fabaceae	*Acacia*	*tumida*	
Fabaceae	*Indigofera*	*linifolia*	
Fabaceae	*Indigofera*	*monophylla*	
Fabaceae	*Senna*	*notabilis*	

Family	*Genus*	*Species*	Status
Fabaceae	*Senna*	*symonii*	
Fabaceae	*Templetonia*	*hookeri*	
Fabaceae	*Tephrosia*	*rosea* var. *clementii*	
Fabaceae	*Tephrosia*	sp. B Kimberley Flora (C.A. Gardner 7300)	
Fabaceae	*Tephrosia*	sp. Bungaroo Creek (M.E. Trudgen 11601)	
Fabaceae	*Tephrosia*	*uniovulata*	
Goodeniaceae	*Dampiera*	*candicans*	
Goodeniaceae	*Goodenia*	*lamprosperma*	
Goodeniaceae	*Goodenia*	*stobbsiana*	
Lauraceae	*Cassytha*	sp. (insufficient material)	
Malvaceae	*Corchorus*	*parviflorus*	
Malvaceae	*Gossypium*	*australe*	
Malvaceae	*Sida*	sp. Pilbara (A.A. Mitchell PRP 1543)	
Marsileaceae	*Marsilea*	*hirsuta*	
Molluginaceae	*Mollugo*	*molluginea*	
Moraceae	*Ficus*	*brachypoda*	
Myrtaceae	*Corymbia*	*flavescens*	
Myrtaceae	*Corymbia*	*hamersleyana*	
Myrtaceae	*Eucalyptus*	*camaldulensis*	
Myrtaceae	*Melaleuca*	*linophylla*	
Phyllanthaceae	*Sauropus*	*lissocarpus*	
Plantaginaceae	*Stemodia*	*grossa*	
Poaceae	*Aristida*	*contorta*	
Poaceae	*Aristida*	*latifolia*	
Poaceae	*Cenchrus*	*ciliaris*	*
Poaceae	*Chrysopogon*	*fallax*	
Poaceae	*Cymbopogon*	*ambiguus*	
Poaceae	*Enneapogon*	*caerulescens*	
Poaceae	*Eragrostis*	*eriopoda*	
Poaceae	*Eragrostis*	*tenellula*	
Poaceae	*Eriachne*	*aristidea*	
Poaceae	*Eriachne*	*helmsii*	
Poaceae	*Eriachne*	*mucronata*	
Poaceae	*Eriachne*	*obtusa*	
Poaceae	*Eulalia*	*aurea*	
Poaceae	*Themeda*	*australis*	
Poaceae	*Triodia*	*epactia*	
Poaceae	*Triodia*	*schinzii*	
Portulaceae	*Portulaca*	*conspicua*	
Proteaceae	*Grevillea*	*pyramidalis*	
Proteaceae	*Grevillea*	*wickhamii*	
Proteaceae	*Hakea*	*lorea*	
Sapindaceae	*Dodonaea*	*coriacea*	
Solanaceae	*Solanum*	*cleistogamum*	

Family	*Genus*	*Species*	Status
Solanaceae	*Solanum*	*phlomoides*	
Violaceae	*Hybanthus*	*aurantiacus*	
Zygophyllaceae	*Tribulus*	*suberosus*	

Refer to Appendix A for conservation codes; * denotes introduced species

Flora Likelihood of Occurrence assessment guidelines

Likelihood of Occurrence	Guideline
Known	Species recorded within study area from field survey results.
Likely	Species previously recorded within 10 km and large areas of suitable habitat occur in the study area.
Possible	Species previously recorded within 10 km and areas of suitable habitat occur/may occur in the study area.
Unlikely	Species previously recorded within 10 km, but suitable habitat does not occur in the study area.
Highly unlikely	Species not previously recorded within 10 km, suitable habitat does not occur in the study area and/or the study area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Definitions

Study area = a 20 km buffer around the survey area

Source information - desktop searches

PMST – DotE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area
DPaW – DPaW (2016) records of threatened flora, database search within the study area (accessed May 2016)
NM – DPaW NatureMap (accessed May 2016)
Survey – recorded within the survey area during the 2016 survey

References

Craven, LA 1996, A Taxonomic Revision of Heliotropium (Boraginaceae) in Australia, Australian Systematic Botany, vol. 9, pp 521-657.

Flora Likelihood of Occurrence assessment

Taxon	Status DPaW	Source NM	Description	Preferred Habitat	Preferred Flowering Time	NatureMap Counts	Nearest Record	Within Known Range	Within Known Habitat	Likelihood
Acacia cyperophylla var. *omearana*	P1	x	Tree, 4-10 m high, 'minni-ritchi' bark.	Stony and gritty alluvium. Along drainage lines.	Fl. yellow, Mar to Apr.	22	5 km south	Yes	Yes	Possible - not recorded during field survey.
Rothia indica subsp. *australis*	P1	x	Prostrate annual, herb, to 0.3m high, densely covered in spreading hairs.	Sandy soils. Sandhills and sandy flats.	Fl. Apr to Aug.	19	21 km north	Yes	Yes	Possible - not recorded during field survey.
Euphorbia inappendiculata var. *inappendiculata*	P2	x	Spreading, procumbent herb, to 0.4 m high.	Fl. Pink, Aug.	Clay soils. Among broken rocky screes.	5	21 km north	Yes	No	Unlikely - not recorded during field survey
Acacia glaucocaesia	P3	x	Dense, glabrous shrub or tree, 1.8-6 m high.	Fl. Yellow, Jul to Sep.	Red loam, sandy loam, clay. Floodplains.	49	21 km north	Yes	Yes	Possible - not recorded during field survey.
Eragrostis crateriformis	P3	x	Annual, grass-like or herb, 0.17-0.42m high.	Fl. Jan to May or Jul.	Clayey loam or clay. Creek banks, depressions.	28	21 km north	Yes	No	Unlikely - not recorded during field survey
Heliotropium murinum	P3	x	Short-lived perennial, herb, up to 0.4 m high.	Fl. May or Sep.	Red sand. Plains.	14	21 km north	Yes	No	Unlikely - not recorded during field survey
Taxon	Status DPaW	Source NM	Description	Preferred Habitat	Preferred Flowering Time	NatureMap Counts	Nearest Record	Within Known Range	Within Known Habitat	Likelihood

Nicotiana umbratica	P3	x	Erect, short-lived annual or perennial, herb, 0.3-0.7m high.	Fl. White, Apr to Jun.	Shallow soils. Rocky outcrops.	30	27 km east	Yes	Yes	Possible - not recorded during field survey.
Bulbostylis burbidgeae	P4	x	Tufted, erect to spreading annual, grass-like or herb (sedge), 0.03 - 0.25 m high, spikelets in a simple umbel or rarely solitary; stamens 3; involucral bracts long, hairy.	Fl. Brown, Mar or Jun to Aug.	Granitic soils. Granite outcrops.	31	1.7 km west	Yes	Yes	Likely - not recorded during field survey.
Ptilotus mollis	P4	x	Compact, perennial shrub, to 0.5 m high, soft, grey foliage.	Fl. White/pink, May or Sep.	Stony hills and screes.	37	21 km north	Yes	No	Unlikely - not recorded during field survey

Site	Q1	**project**			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	south of existing pit			**Easting:**	760610	**Northing:**	7693825	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3496	**Camera:**	NW	
Site Disturbance:	cattle, gravel pit <100m	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	no					
Veg Condition:	4	**Field Vegetation Type:**	Spinifex Steppe on stony flats/lower slopes					
Drainage:	Good							
Fire Frequency:	Mod 1-5 yr	**Fire Intensity:**	Most killed					
Surface Component:	20% soil, 60% gravel (20-60 mm) 20% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Loam			**Minor:**	Sandy	
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Lower Slope/Plain							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	
Hummock Grass	G1	**Sedge**	
Vine		**Herbs**	G2
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
% cover	<2			<2	2-10	10-30	>70	<2
Ht range (m)	3			2-3	1-2	0.4-0.8	0.3-1.2	0.4
Av ht (m)	3			3	1.8	0.6	1.0	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	3
Grevillea	*wickhamii*		M1	<2T	3
Acacia	*tumida*		M1	<2N	2.6
Acacia	*inaequilatera*		M1	<2T	2.1
Grevillea	*wickhamii*		M2	<2N	1.7
Acacia	*tumida*		M2	2-10	1.9
Ptilotus	*calostachyus*		M2	<2T	1.3
Acacia	*spondylophylla*		M3	10-30	0.6
Ptilotus	*calostachyus*		M3	<2N	0.9
Acacia	*ptychophylla*		M3	<2N	0.6
Grevillea	*wickhamii*		M3	2-10	0.7
Tephrosia	sp. Bungaroo Creek (M.E. Trudgen 11601)		M3	<2T	0.9
Solanum	*phlomoides*		M3	<2T	0.8
Triodia	*epactia*		G1	>70	1.2
Goodenia	*stobbsiana*		G2	<2T	0.5
Dampiera	*candicans*		M3	<2T	0.6
Ptilotus	*astrolasius*		M3	<2T	0.6

Site	Q2	**project**			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	south of existing pit			**Easting:**	760862	**Northing:**	7693479	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			nil	**Camera:**	NW	
Site Disturbance:	cattle, gravel pit nearby	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	no					
Veg Condition:	3	**Field Vegetation Type:**	Spinifex Steppe on stony flats/lower slopes					
Drainage:	Good							
Fire Frequency:	Mod 1-5 yr to old >5 yr	**Fire Intensity:**	Most killed					
Surface Component:	20% soil, 20% gravel (20-60 mm) 60% cobbles (60-200 mm)	**Soil Type:** **Major Component:**	Loam			**Minor:**	Sandy	
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Lower Slope/Plain							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						
STRATUM	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
% cover				<2	<2	<2	30-70	<2
Ht range (m)				2.2-3	1.1-1.9	0.8	0.3-1.4	0.5
Av ht (m)				2.2	1.1	0.8	1.0	0.5

No Photograph

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Grevillea	*wickhamii*		M1	<2T	3
Grevillea	*wickhamii*		M2	<2T	1.9
Grevillea	*wickhamii*		M3	<2T	0.8
Solanum	*phlomoides*		M3	<2T	0.7
Ptilotus	*calostachyus*		M3	<2T	0.5
Pluchea	*tetranthera*		M3	<2T	0.8
Triodia	*epactia*		G1	30-70	1.3
Goodenia	*stobbsiana*		G2	<2T	0.5

Site	Q3	project			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	sandy flats			**Easting:**	760884	**Northing:**	7694247	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3533	**Camera:**	NW	
Site Disturbance:	cattle, gravel pit nearby, flood?	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water, wind					
Veg Condition:	6	**Field Vegetation Type:**	Flats, scaled					
Drainage:	poor, seasonally wet							
Fire Frequency:	nil	**Fire Intensity:**	nil					
Surface Component:	80% soil, 20% clay	**Soil Type: Major Component:**	Sand and Clay			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Plain, Drainage Depression							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**						
Shrub 1-2 m		**Shrub <1 m**	M1					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover				<2			10-30	2-10
Ht range (m)				2-3			0.3-1.0	0.05-0.15
Av ht (m)				3			0.7	0.1

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Pluchea	*tetranthera*		M1	2-10	0.8
Triodia	*epactia*		G1	10-30	1
Eriachne	*aristidea*		G2	2-10	0.1
Trianthema	*triquetra*		G2a	<2N	0.1
Fimbristylis	*microcarya*		G2b	2-10	0.1

Site	Q4	project			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	run on zone			**Easting:**	760725	**Northing:**	7694454	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3542	**Camera:**	NW	
Site Disturbance:	cattle, gravel pit nearby, flood?	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	4	**Field Vegetation Type:**	Corymbia over dense Acacias					
Drainage:	Good							
Fire Frequency:	nil	**Fire Intensity:**	nil					
Surface Component:	60% soil, 25% litter, 5% pebbles (6-20mm)	**Soil Type: Major Component:**	Sand			**Minor:**		
Leaf Litter:	Plentiful	**Wood Litter:**	Moderate					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Plain							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	2-10			30-70	2-10	<2	2-10	<2
Ht range (m)	4-6			2-4	1-2	0.1-1	0.2-1.1	0.4
Av ht (m)	5			3.5	1.9	0.7	0.8	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	2-10	6
Acacia	*tumida*		M1	30-70	6
Acacia	*tumida*		M2	10-30	1.9
Indigofera	*monophylla*		M2	<2T	1.3
Templetonia	*hookeri*		M2	<2T	1.5
Grevillea	*wickhamii*		M2	<2T	1.4
Tephrosia	sp. B Kimberley Flora (C.A. Gardner 7300)		M2	<2T	1.3
Acacia	*inaequilatera*		M2	<2T	1.9
Acacia	*tumida*		M3	<2N	0.9
Sida	sp. Pilbara (A.A. Mitchell PRP 1543)		M3	2-10	0.8
Indigofera	*linifolia*		M3	<2T	0.2
Heliotropium	*skeleton*		M3	<2N	0.5
Pluchea	*tetranthera*		M3	<2T	0.3
Evolvulus	*alsinoides*		M3	<2T	0.2
Triodia	*epactia*		G1	10-30	1
Eragrostis	*eriopoda*		G2	<2T	0.3
Aristida	*latifolia*		G2	<2T	0.2
Cyperus	*squarrosus*		G2	<2T	0.6
Aristida	*latifolia*		G2	<2T	0.7
Goodenia	*stobbsiana*		G2	<2T	0.5
Heliotropium	*ovalifolium*		G2	<2T	0.3
Tephrosia	sp. Bungaroo Creek (M.E. Trudgen 11601)		M2	<2T	1.1
Grevillea	*wickhamii*		M3	<2T	0.9
Acacia	*inaequilatera*		M3	<2T	0.3
Dampiera	*candicans*		M3	<2T	0.5
Acacia	*trachycarpa*		M3	<2T	0.7

Site	Q5	project			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	pan			**Easting:**	760719	**Northing:**	7694667	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3546	**Camera:**	NW	
Site Disturbance:	cattle, gravel pit nearby, flood?	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water,					
Veg Condition:	6	**Field Vegetation Type:**	pan, flood area					
Drainage:	Poor							
Fire Frequency:	nil	**Fire Intensity:**	nil					
Surface Component:	100% loose soil	**Soil Type:** **Major Component:**	Sand			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Plain, Drainage depression							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**						
Shrub 1-2 m	M1	**Shrub <1 m**						
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover				2-10			10-30	<2
Ht range (m)				0.6-0.9			0.2-1.0	0.2
Av ht (m)				0.8			0.7	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Acacia	*stellaticeps*		M1	2-10	0.8
Acacia	*inaequilatera*		M1	<2T	0.7
Pluchea	*tetranthera*		M1	<2T	0.9
Triodia	*epactia*		G1	10-30	0.9
Eragrostis	*eriopoda*		G2	<2T	0.3
Eriachne	*helmsii*		G2	<2N	0.1
Fimbristylis	*microcarya*		G2	<2N	0.1
Trianthema	*triquetrum*		G2a	<2N	0.05
Trianthema	*pilosum*		G2a	<2N	0.05

Site	Q6	project			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	NW corner			**Easting:**	760594	**Northing:**	7694800	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3547	**Camera:**	NW	
Site Disturbance:	cattle, gravel pit nearby, flood?	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	?water					
Veg Condition:	4	**Field Vegetation Type:**	Corymbia over dense Acacia					
Drainage:	Good							
Fire Frequency:	Old >5 yrs	**Fire Intensity:**	Few trees killed, most resprouting					
Surface Component:	70% soil, 10% litter, 10% pebbles (6-20mm), 10 gravel 20-60 mm)	**Soil Type:** **Major Component:**	Sand			**Minor:**		
Leaf Litter:	Moderate	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Plain, lower slope							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	0.2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	2-10			10-30	10-30	<2	30-70	<2
Ht range (m)	4.5-6			2-4	1-2	0.7	0.15-1.0	0.2
Av ht (m)	6			3.5	1.8	0.7	1.0	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	2-10	5
Acacia	*tumida*		M1	10-30	3.5
Acacia	*tumida*		M2	10-30	1.9
Acacia	*sericophylla*		M2	<2T	1.9
Acacia	*tumida*		M3	<2T	0.8
Dampiera	*candicans*		M3	<2T	0.4
Acacia	*ptychophylla*		M3	<2N	0.6
Ptilotus	*calostachyus*		M3	<2T	0.8
Grevillea	*wickhamii*		M3	<2T	0.5
Bonamia	*erecta*		M3	<2T	0.3
Triodia	*schinzii*		G1	10-30	1
Triodia	*epactia*		G1	2-10	1
Evolvulus	*alsinoides*		G2	<2T	0.2
Goodenia	*stobbsiana*		G2	<2T	0.3
Sida	sp. Pilbara (A.A. Mitchell PRP 1543)		M3	<2T	0.3
Solanum	*phlomoides*		M3	<2T	0.4

Site	Q7	project			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	NW corner			**Easting:**	760837	**Northing:**	7694751	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3549	**Camera:**	NW	
Site Disturbance:	cattle, exotic weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	5	**Field Vegetation Type:**	Corymbia over Spinifex on sandplain					
Drainage:	Good							
Fire Frequency:	Old >5 yrs	**Fire Intensity:**	no damage					
Surface Component:	90% soil, 10% litter	**Soil Type: Major Component:**	Sand			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Plain							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	2-10			<2	2-10	2-10	30-70	2-10
Ht range (m)	4-8			2.2	1-2	0.4-1	0.1-1.3	0.4-1.1
Av ht (m)	7			2.2	1.1	0.8	1.2	0.7

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	2-10	7
Corymbia	*flavescens*		U1	2-10	8
Acacia	*ancistrocarpa*		M1	<2T	2.5
Acacia	*ampliceps*		M1	<2T	3.5
Acacia	*tumida*		M1	<2T	2.5
Indigofera	*monophylla*		M2	10-30	1.2
Acacia	*trachycarpa*		M2	<2T	1.1
Acacia	*ampliceps*		M2	<2T	1.6
Gossypium	*australe*		M3	<2T	0.3
Indigofera	*monophylla*		M3	2-10	0.8
Hakea	*lorea*		M3	<2T	0.4
Corchorus	*parviflorus*		M3	<2T	0.4
Triodia	*schinzii*		G1	30-70	1.3
Triodia	*epactia*		G1	<2N	1.2
Cenchrus	*ciliaris*	*	G2	<2N	0.1
Eragrostis	*eriopoda*		G2	<2N	0.7
Chrysopogon	*fallax*		G2	<2N	1.1
Eulalia	*aurea*		G2	<2N	0.4

Site	Q8	project			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	SE corner			**Easting:**	761272	**Northing:**	7693626	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3555	**Camera:**	NW	
Site Disturbance:	cattle, gravel test pits	**Frequency:**	current and >10yr					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	5	**Field Vegetation Type:**	Corymbia over Spinifex on sandplain					
Drainage:	Good							
Fire Frequency:	Old >5 yrs	**Fire Intensity:**	no damage					
Surface Component:	80% soil, 5% litter, 5% pebbles (6-20mm), 10% gravel (20-60mm)	**Soil Type:** **Major Component:**	Sand			**Minor:**		
Leaf Litter:	Moderate	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Plain							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	2-10			2-10	2-10	2-10	10-30	2-10
Ht range (m)	5-8			2-4.5	1-2	0.4-1	0.1-1.2	0.1-1.0
Av ht (m)	8			3	2	0.7	1.0	0.7

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*flavescens*		U1	2-10	8
Corymbia	*hamersleyana*		U1	<2T	5
Acacia	*tumida*		M1	2-10	3
Grevillea	*wickhamii*		M1	2-10	3.5
Acacia	*inaequilatera*		M1	2-10	3.5
Acacia	*trachycarpa*		M1	<2T	4
Acacia	*inaequilatera*		M2	10-30	1.9
Grevillea	*wickhamii*		M2	<2T	1.9
Acacia	*tumida*		M2	2-10	1.7
Acacia	*sericophylla*		M2	<2T	1.1
Corchorus	*parviflorus*		M3	2-10	0.8
Pluchea	*tetranthera*		M3	2-10	0.9
Pluchea	*ferdinandi-muelleri*		M3	<2T	0.6
Triodia	*epactia*		G1	10-30	1.2
Triodia	*schinzii*		G1	<2T	1
Triodia	*epactia*		G1	<2T	0.7
Aristida	*latifolia*		G2	<2N	1
Eriachne	*obtusa*		G2	2-10	0.7
Cenchrus	*ciliaris*	*	G2	<2T	0.1
Chrysopogon	*fallax*		G2	2-10	0.2

Site	Q9	**project**			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	creekline			**Easting:**	761478	**Northing:**	7693663	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	25 x 100	**Photo:**			p3564	**Camera:**	NW	
Site Disturbance:	cattle, flood, weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	5	**Field Vegetation Type:**	Riparian Woodland					
Drainage:	Good							
Fire Frequency:	nil	**Fire Intensity:**	no damage					
Surface Component:	25% soil, 25% pebbles (6-20mm), 25% gravel (20-60mm), 25% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sand and rocks			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Moderate					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Creekline, Bank							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
% cover	10-30			<2	10-30	2-10	10-30	2-10
Ht range (m)	6-10			2.5	1-2	0.4-1	0.1-1.2	0.1-1.0
Av ht (m)	8.5			2.5	1.8	0.8	0.7	0.7

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Eucalyptus	*camaldulensis*		G1	10-30	10
Acacia	*trachycarpa*		M1	<2T	2.5
Acacia	*tumida*		M1	<2T	3
Melaleuca	*linophylla*		M1	<2T	2.1
Eucalyptus	*camaldulensis*		M1	2-10	2
Acacia	*sericophylla*		M1	<2T	3
Acacia	*trachycarpa*		M2	2-10	1.9
Acacia	*inaequilatera*		M2	<2T	1.3
Grevillea	*wickhamii*		M2	<2T	1.1
Acacia	*trachycarpa*		M3	<2N	0.9
Acacia	*stellaticeps*		M3	<2N	0.6
Corchorus	*parviflorus*		M3	2-10	1
Acacia	*inaequilatera*		M3	<2T	0.9
Terminalia	*circumalata*		M3	<2T	0.9
Chrysocephalum	*pterochaetum*		M3	<2T	0.8
Triodia	*epactia*		G1	2-10	1.1
Triodia	*epactia*		G1	<2N	0.9
Cymbopogon	*ambiguus*		G2	<2T	0.9
Eragrostis	*eriopoda*		G2	<2N	0.4
Aristida	*latifolia*		G2	2-10	0.4
Eriachne	*obtusa*		G2	2-10	1.1
Themeda	*australis*		G2	<2T	0.7
Stemodia	*grossa*		G2a	2-10	0.5
Cyperus	*vaginatus*		G2a	10-30	0.7
Cassytha	sp. (insufficient material)		G2a	<2T	climber
Hybanthus	*aurantiacus*		M3	<2T	0.2

Site	Q10	**project**			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	SE corner			**Easting:**	761432	**Northing:**	7693299	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3569	**Camera:**	NW	
Site Disturbance:	cattle,	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	5	**Field Vegetation Type:**	Spinifex Steppe on stony soils					
Drainage:	Good							
Fire Frequency:	nil	**Fire Intensity:**	no damage					
Surface Component:	10% soil, 10% fines (2-6mm), 20% pebbles (6-20mm), 40% gravel (20-60mm), 20% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	negligible					
Landform:	Plain							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
% cover	<2			2-10	2-10	2-10	>70	<2
Ht range (m)	5			2-3	1-2	0.4-1	0.2-1.3	0.4
Av ht (m)	5			2.3	1.5	0.6	1.1	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	5
Grevillea	*wickhamii*		M1	10-30	2.2
Hakea	*lorea*		M1	<2T	2.2
Grevillea	*wickhamii*		M2	2-10	1.5
Acacia	*tumida*		M2	<2T	1.3
Pluchea	*tetranthera*		M3	<2N	0.8
Grevillea	*wickhamii*		M3	2-10	0.8
Acacia	*stellaticeps*		M3	2-10	0.5
Acacia	*spondylophylla*		M3	<2T	0.9
Triodia	*epactia*		G1	>70	1.2
Eriachne	*helmsii*		G2	<2T	0.4

Site	Q11	project			M030 SLK 356 Bio			
Date:	24/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Sthn end			**Easting:**	760897	**Northing:**	7693052	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3570	**Camera:**	NW	
Site Disturbance:	cattle, ?flood	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	3	**Field Vegetation Type:**	Spinifex Steppe on stony soils,					
Drainage:	Good							
Fire Frequency:	nil, old >5yr	**Fire Intensity:**	no damage					
Surface Component:	20% soil, 20% pebbles (6-20mm), 30% gravel (20-60mm), 20% cobbles (60-200mm), 10% stones (200-600mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	negligible (drainage line nearby)					
Landform:	Plain- drainage line nearby							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			10-30	2-10	2-10	30-70	2-10
Ht range (m)	4.5			2-4	1-2	0.4-1	0.4-1.3	0..1-0.9
Av ht (m)	4.5			3	1.8	0.9	1.1	0.3

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	4.5
Grevillea	*wickhamii*		M1	10-30	3.5
Acacia	*tumida*		M1	<2T	4
Acacia	*inaequilatera*		M1	<2T	2.5
Templetonia	*hookeri*		M1	<2T	2.2
Grevillea	*wickhamii*		M2	2-10	1.9
Acacia	*inaequilatera*		M2	<2T	1.9
Acacia	*spondylophylla*		M2	<2T	1.2
Corchorus	*parviflorus*		M2	<2T	1.3
Tephrosia	sp. B Kimberley Flora (C.A. Gardner 7300)		M2	<2T	1.2
Grevillea	*wickhamii*		M3	2-10	0.9
Dampiera	*candicans*		M3	<2T	0.8
Solanum	*phlomoides*		M3	<2T	0.4
Tephrosia	sp. B Kimberley Flora (C.A. Gardner 7300)		M3	<2T	0.8
Triodia	*epactia*		G1	30-70	1.3
Eriachne	*mucronata*		G2	2-10	0.4

Site	Q12	project			M030 SLK 356 Bio			
Date:	29/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	west of pit			**Easting:**	760897	**Northing:**	7693052	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3788	**Camera:**	NW	
Site Disturbance:	cattle, ,tracks	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	4	**Field Vegetation Type:**	Spinifex Steppe on stony soils,					
Drainage:	Good							
Fire Frequency:	mod 1-5 yr, old >5yr	**Fire Intensity:**	scars on trees, minor					
Surface Component:	20% soil, 20% fines (2-6mm), 20% pebbles (6-20mm), 40% gravel (20-60mm)	**Soil Type: Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Negligible					
Landform:	Plain, Lower Slope							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			2-10	2-10	10-30	>70	2-10
Ht range (m)	4-5			2-4	1-2	0.1-1	0.1-1.1	0.5
Av ht (m)	5			3	1.5	0.7	0.9	0.5

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	5
Grevillea	*wickhamii*		M1	<2N	4
Acacia	*inaequilatera*		M1	<2N	3
Grevillea	*wickhamii*		M2	2-10	1.8
Acacia	*inaequilatera*		M2	<2T	1.5
Ptilotus	*calostachyus*		M2	2-10	1.2
Grevillea	*wickhamii*		M3	<2N	0.9
Acacia	*inaequilatera*		M3	<2T	0.9
Acacia	*spondylophylla*		M3	<2N	0.8
Acacia	*ptychophylla*		M3	2-10	0.8
Dampiera	*candicans*		M3	2-10	0.8
Grevillea	*pyramidalis*		M3	<2T	0.9
Triodia	*epactia*		G1	>70	1
Goodenia	*stobbsiana*		G2	2-10	0.5
Solanum	*phlomoides*		M3	<2T	0.4
Corchorus	*parviflorus*		M3	<2T	0.3

Appendix E – Fauna Data

Fauna species list

Fauna Likelihood of Occurrence assessment guidelines

Fauna Likelihood of Occurrence assessment

Fauna recorded during GHD survey

Family	Genus	Species	Common Name	Status	Observed
Birds					
Accipitridae	*Accipiter*	*fasciatus fasciatus*	Brown Goshawk		1
Accipitridae	*Aquila*	*audax*	Wedge-tailed Eagle		1
Accipitridae	*Circus*	*assimilis*	Spotted Harrier		2
Accipitridae	*Haliastur*	*sphenurus*	Whistling Kite		1
Accipitridae	*Milvus*	*migrans*	Black Kite		1
Aegothelidae	*Aegotheles*	*cristatus*	Australian Owlet-nightjar		1
Artamidae	*Artamus*	*cinereus*	Black-faced Woodswallow		6
Artamidae	*Cracticus*	*nigrogularis*	Pied Butcherbird		4
Cacatuidae	*Cacatua*	*sanguinea westralensis*	Little Corella		30
Cacatuidae	*Eolophus*	*roseicapilla*	Galah		8
Cacatuidae	*Nymphicus*	*hollandicus*	Cockatiel		4
Campephagidae	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-Shrike		2
Columbidae	*Phaps*	*chalcoptera*	Common Bronzewing		2
Columbidae	*Geophaps*	*plumifera*	Spinifex Pigeon		100
Columbidae	*Geopelia*	*cuneata*	Diamond Dove		4
Columbidae	*Ocyphaps*	*lophotes*	Crested Pigeon		12
Corvidae	*Corvus*	*orru*	Torresian Crow		6
Estrildidae	*Emblema*	*pictum*	Painted Finch		18
Estrildidae	*Taeniopygia*	*guttata*	Zebra Finch		38
Eurostopodidae	*Eurostopodus*	*argus*	Spotted Nightjar		1
Falconidae	*Falco*	*cenchroides*	Nankeen Kestrel		1
Falconidae	*Falco*	*berigora*	Brown Falcon		1
Halcyonidae	*Dacelo*	*leachii*	Blue-winged Kookaburra		1
Halcyonidae	*Todiramphus*	*pyrrhopygius*	Red-backed Kingfisher		1
Megaluridae	*Cincloramphus*	*mathewsi*	Rufous Songlark		1
Megaluridae	*Eremiornis*	*carteri*	Spinifexbird		2
Meliphagidae	*Lichenostomus*	*keartlandi*	Grey-headed Honeyeater		26
Meliphagidae	*Lichenostomus*	*penicillatus*	White-plumed Honeyeater		6
Meliphagidae	*Lichenostomus*	*virescens*	Singing Honeyeater		2
Meliphagidae	*Lichmera*	*indistincta*	Brown Honeyeater		12
Meliphagidae	*Manorina*	*flavigula*	Yellow-throated Miner		12
Meropidae	*Merops*	*ornatus*	Rainbow Bee-eater		20
Monarchidae	*Grallina*	*cyanoleuca*	Magpie-lark		6

Otididae	*Ardeotis*	*australis*	Australian Bustard		prints
Pachycephalidae	*Colluricincla*	*harmonica*	Grey Shrike-thrush		3
Pachycephalidae	*Pachycephala*	*rufiventris*	Rufous Whistler		1
Pomatostomidae	*Pomatostomus*	*temporalis*	Grey-crowned Babbler		4
Psittacidae	*Barnardius*	*zonarius zonarius*	Port Lincoln Parrot		2
Psittacidae	*Melopsittacus*	*undulatus*	Budgerigar		5
Ptilonorhynchidae	*Ptilonorhynchus*	*guttatus*	Western Bowerbird		2
Rhipiduridae	*Rhipidura*	*leucophrys*	Willie Wagtail		2
Strigidae	Ninox	novaeseelandiae	Boobook Owl		1
Tunicidae	*Turnix*	*velox*	Little Button-quail		3
Reptiles					
Agamidae	*Amphibolurus*	*longirostris*	Long-snouted Water Dragon		1
Agamidae	*Ctenophorus*	*caudocinctus caudocinctus*	Ringtail Dragon		4
Agamidae	*Ctenophorus*	*isolepis isolepis*	Central Military Dragon		14
Diplodactylidae	*Lucasium*	*stenodactylum*	Sand-plain Gecko		1
Diplodactylidae	*Diplodactylus*	*conspiculatus*	Fat-tailed Gecko		1
Gekkonidae	*Gehyra*	*punctata*	Spotted Dtella		scats
Gekkonidae	*Gehyra*	*variegata*	Tree Dtella		4
Gekkonidae	*Heteronotia*	*binoei*	Bynoe's Gecko		1
Pygopodidae	*Lialis*	*burtoni*	Burton's Legless Lizard		1
Scincidae	*Cryptoblephurus*	*ustulatus*	Russet Snake-eyed Skink		1
Scincidae	*Ctenotus*	*pantherinus ocellifer*	Panther's Skink		1
Scincidae	*Ctenotus*	*saxatalis*	Rock Ctenotus		3
Scincidae	*Menetia*	*greyii*	Common Dwarf Skink		1
Scincidae	*Morethia*	*ruficauda exquisita*	Fire-tailed Skink		1
Varanidae	*Vananus*	*accanthurus*	Ridge-tailed Monitor		1
Varanidae	*Vananus*	*panopties rubidus*	Yellow spotted Monitor		tracks, digs
Mammals					
Bovidae	*Bos*	*taurus*	Cow	intro	many
Camelidae	*Camelus*	*dromedarius*	Camel	intro	prints, scats
Canidae	*Canus*	*lupis domesticus*	Dog	intro	prints
Emballonuridae	*Saccolaimus*	*flaviventris*	Yellow-bellied Sheathtail Bat		calls
Emballonuridae	*Austromomus*	*australis*	White-striped Freetail Bat		calls
Emballonuridae	*Taphozous*	*georgianus*	Common Sheathtail-bat		calls
Felidae	*Felis*	*catus*	Cat	intro	prints
Macropodidae	*Macropus*	*robustus*	Euro		2

Macropodidae	*Petrogale*	*rothchildi*	Rothchilds Rock Wallaby		1
Muridae	*Pseudomys*	*chapmani*	Pilbara Pebble-mound Mouse	P4	mounds
Tachyglossidae	*Tachyglossus*	*aculeatus*	Echidna		prints, digs
Vespertilionidae	*Chalinolobus*	gouldii	Gould's Wattled Bat		calls

Legend:

X or number = recorded during current survey or numbers recorded (observed or heard)

Shed skin, scats, tracks, prints or digs = Evidence of observation

calls = bat detector (SM2) record

OS = outside survey area

R = roadkill record

intro= introduced species

Conservation codes – Appendix B

Parameters of fauna Likelihood of Occurrence assessment

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within the survey area.
Likely	Species are likely to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as unlikely include: those species previously recorded within the study area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area OR • Those species that have a known distribution overlapping with the survey area however: there is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area the suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered highly unlikely to occur in the survey area include those species: • That have no suitable habitat within the survey area • That have become locally extinct, or are not known to have ever been present in the region of the survey area.

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following MM = migratory marine species, MW = migratory wetland species, MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered

WC Act - Species listed as CR = critically endangered, En = endangered, Vu = Vulnerable, CD = conservation dependent, IA = international migratory agreement migratory birds, OS = other specially protected fauna

DPaW – Species listed as Priority (P) 1, 2, 3 or 4

Source information - desktop searches

PMST = DotE PMST to identify fauna listed under the EPBC Act potentially occurring within the study area accessed May 2016

NM = DPaW NatureMap (2016) records of threatened fauna, database search within the study area (accessed May 2016),

DPaW = WA Government, Department of Parks and Wildlife Threatened and Priority fauna rankings (current as of 20 November 2015) - *Wildlife Conservation Act 1950* for the DPaW Pilbara region http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals

Definitions

study area = a 20 km buffer around the survey area

locality = the area within an approximate 50 km radius of the survey area

Fauna Likelihood of Occurrence assessment

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Night Parrot *Pezoporus occidentalis*	E	S1, CR			X	The Night Parrot inhabits arid and semi-arid areas that are characterised by having dense, low vegetation. Based on accepted records, the habitat of the Night Parrot consists of *Triodia* grasslands in stony or sandy environments and of samphire and chenopod shrublands, including genera such as *Atriplex*, *Bassia* and *Maireana*, on floodplains and claypans, and on the margins of saltlakes, creeks or other sources of water (Parker, 1980). It has also been observed to enter dense *Muehlenbeckia* growth when flushed from a more typical habitat (Boles et al. 1994).	**Unlikely –** This species is only known to occur in long unburnt areas of *Triodia* hummock grasslands. Some habitat is present in the survey area however no specimens have been recorded in WA since the mid 1990's. **Habitat** Some areas of unburnt habitat is present particularly at each end of the proposed side access road. **Records** The closest known record is from approximately 195 km south west of the survey area.
Fork-tailed Swift *Apus pacificus*	Mi, Ma	S5/ IA			X	In Pilbara WA there are scattered records along the coast, ranging along the west coast and inland. They are widespread in coastal and sub-coastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. This species is almost exclusively aerial, flying less than 1 m to at least 300 m above ground. This species is considered rare in the south-west region (DSEWPaC 2013).	**Unlikely** – This species is an opportunistic visitor to Australia only encounter when large storms or cyclones are present. **Habitat** This species is strictly aerial. **Records** The species has been recorded within 60 km of the survey area, however these observations are restricted to aerial habits (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Oriental Plover, Oriental Dotterel *Charadrius veredus*	Mi, Ma	S5/ IA			X	Immediately after arriving in non-breeding grounds in northern Australia, Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. Thereafter they usually inhabit flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns and cattle camps or open areas that have been recently burnt (Storr 1980).	**Unlikely** – The species is not known to persist in the region, however may occur opportunistically during migration. **Habitat** Habitat for this species only occurs along the water course and associated flood plains in the in the southern portion and just outside of the survey area. **Records** The species is known from very few records in the region with the closest record 55 km south of the survey area.
Grey Falcon *Falco hypoleucos*		S3, Vu		X		The Grey Falcon inhabits lightly timbered country, especially stony plains and lightly timbered acacia scrub. This species is considered scarce to rare and is usually found singularly or sometimes in pairs (Morcombe 2004). In Pilbara WA, the grey falcon is very rare. The distribution of the Grey Falcon is centred on inland drainage systems, where it frequents timbered lowland plains, particularly acacia shrublands cross by tree-lined watercourses. It also hunts in treeless areas and frequents tussock grassland and open woodland, especially in winter, but it generally avoids deserts	**Likely** – This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. **Habitat** Habitat for this species only occurs along the water courses and plains in the survey area. **Records** The species is known from the area with one record approximately 20 km south at Coongan Gorge.
Peregrine Falcon		S7		X		The Peregrine Falcon is seen occasionally anywhere in the Pilbara of WA. It is found	**Likely** – The Peregrine Falcon has been recorded in the region on three

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Falco peregrinus						everywhere from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions (Morcombe 2004).	occasions and habitat is present for the species. **Habitat** No breeding habitat is present in the survey area, however all the habitats types in the survey area provide suitable foraging habitat for the species. **Records** The species is known from the region and populations persist in the Pilbara. Three records surround the survey area - 50 km south, 40 km east and 60 km north east (DPaW 2016).
Oriental Pratincole *Glareola maldivarum*	Mi, Ma	S5/ IA			X	In non-breeding grounds in Australia, the Oriental Pratincole usually inhabits open plains, floodplains or short grassland (including farmland or airstrips), often with extensive bare areas. They often occur near terrestrial wetlands, such as billabongs, lakes or creeks, and artificial wetlands such as reservoirs, salt works and sewage farms, especially around the margins. The species also occurs along the coast, inhabiting beaches, mudflats and islands, or around coastal lagoons (Lloyd and Lloyd 1991).	**Unlikely** – The species is not known to persist in the region, however may occur opportunistically during migration. **Habitat** Habitat for this species only occurs along the water courses and associated plains in the southern portion of the survey area. **Records** The species is not known from the area only occurring with 100 km of the coast in the Pilbara (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Barn Swallow *Hirundo rustica*	Mi, Ma	S5/ IA			X	In Australia, the Barn Swallow is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires, and also in or over freshwater wetlands, paperbark *Melaleuca* woodland, mesophyll shrub thickets and tussock grassland.	**Unlikely** – The species is not known to persist in the region, however may occur opportunistically during migration. **Habitat** Habitat for this species only occurs along the water courses and associated plains in the southern portion of the survey area. **Records** The species is not known from the area, only occurring with 80 km of the coast in the Pilbara (DPaW 2016).
Grey Wagtail *Motacilla cinerea*	Mi, Ma	S5, IA			X	Like the Yellow Wagtail the Grey is a migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	**Unlikely –** non-breeding seasonal visitor, may occasionally have opportunistic use. **Habitat:** Limited habitat is available due no water bodies, plains or wetlands present in the area. **Records** No records from the region.

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Yellow Wagtail *Motacilla flava*	Mi, Ma	S5, IA			X	A migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	**Unlikely –** non-breeding seasonal visitor, may occasionally have opportunistic use. **Habitat:** Limited habitat is available due no water bodies, plains or wetlands present in the area. **Records** No records from the region.
Letter-winged Kite *Elanus scriptus*		P4		X		The letter-winged kite is a conspicuous raptor with a core range in central Australia. The adult is a small and graceful, predominantly pale grey and white, bird with black shoulders and red eyes. Breeding is eruptive in response to population booms of the Long-haired Rat during good times. The letter-winged Kite is able to achieve a sudden population increase and during this time disburses in search of resources. The species is rarely recorded in WA but has been seen in the Pilbara at Learmonth, Abydos, Hedley, Coolawanyah, Roebourne and Onslow (Johnstone et al 2013). The species is also known to occur in the northern Deserts and Kimberley region during population explosions (Morcombe 2004).	**Unlikely** – may occasionally have opportunistic use. **Habitat**: Habitat is available for this species in the water course and plains. **Records** Very few records in WA, however one individual was recorded approximately 185 km south west of the survey area (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Australian Painted Snipe *Rostratula australis*	E, Ma	S1/ En			X	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. The species rarely occurs in Pilbara of WA, where it was once more common (Marchant and Higgins 1993; Garnett and Crowley 2000).	**Unlikely** – may occasionally have opportunistic use. **Habitat**: Habitat is available for this species in the water course and plains. **Records** Very few records in WA, however one individual was recorded approximately 145 km north east of the survey area (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Brush-tailed Mulgara *Dasycercus blythi*		P4		X		*Dasycercus blythi* was originally described as distinct from *D. cristicauda*, but for more than thirty years it was assumed to be synonymous with that species (e.g., Groves 1993, 2005; Maxwell et al. 1996). Adams et al. (2000) conducted a limited molecular study of the genus *Dasycercus* and determined that there were two species to which the names *D. cristicauda* and *D. hillieri* were assigned. It has since been established that the correct names for the two species are *D. blythi* and *D. cristicauda* (Woolley 2005). The Brush-tailed Mulgara is primarily nocturnal, shelters in burrows and feeds on insects, other arthropods and small vertebrates. This species inhabits spinifex grasslands and, in central Australia, lives in burrows that it digs on the flats between low sand dunes (Van Dyck and Strahan 2008). The Mulgara is a solitary species exhibiting high site fidelity and a low propensity for dispersal once a home range has been established (Masters and Crowther 2003). Males and females maintain home ranges of 1.4 to 14 hectares (Masters and Crowther 2003) which on average, overlap by less than 20% (Masters and Crowther 2003).	**Likely** – This species has been recorded in the region previously and habitat is present for the species. **Habitat** Habitat for this species only occurs on the sandy plain portion of the survey area. **Records** The species is not known from the survey area, however one record is present within 20 km of the survey area (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Northern Quoll *Dasyurus hallucatus*	E	S2, En			X	The Northern Quoll once occurred across the majority of northern Australia but its range has significantly contracted. It occurs in the Pilbara region but in disjunct populations. The Northern Quoll inhabits a range of habitats but is especially abundant on dissected rocky escarpment and eucalypt woodland within 200 km of the coast. It is known to den in rock crevices and rock piles and favours rocky areas. They are nocturnal but are occasionally active during the day, particularly during the mating season and are known to have a large home range (Van Dyck and Strahan 2008).	**Likely** – The species is known from the region and core habitat is available for the species. **Habitat** The Complex and steep rocky slopes habitat would provide core habitat for the Quoll (ie denning) and the other habitat types in the survey area would support foraging and dispersal. **Records** There are over 4 records of the Quoll within 40 km of the survey area (DPaW 2016) and GHD recorded numerous records of the species approximately 20 km south at Coongan Gorge.
Spectacled Hare-wallaby *Lagorchestes conspicillatus subsp. leichardti*		P3	X			The Spectacled Hare-wallaby was once widely distributed across the lower latitudes of northern Australia from Queensland, through Northern territory to the Pilbara and Kimberley in WA, with a subspecies on Barrow Island. In the Pilbara region this species has declined drastically, possibly due to fox predation and because frequent burning of spinifex grasslands has prevented the development of the large hummocks required for shelter (Van Dyck and Strahan 2008). They live in open woodlands, shrublands and hummock grasslands, sheltering under vegetation or in burrows	**Unlikely** – This species hasn't been recorded in the region previously, however some habitat is present for the species. **Habitat** Habitat for this species only occurs on the sandy plain portion of the survey area. **Records** The species is not known from the region with one record 95 km south of the survey area (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
						during the day and searching for herbs, grass and fruits at night.	
Ghost Bat *Macroderma gigas*	V	S3, Vu			X	The Ghost Bat occurs in a wide range of habitats, and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost. It is patchily distributed across Australia, and is sensitive to disturbance (Van Dyck and Strahan 2008).	**Unlikely** – The species has not been recorded in the survey area and no caves are present in the survey area to support the species. Opportunistic foraging may occur over the survey area. **Habitat** No caves are present in the survey area to support the species. The survey area does provide foraging habitat however the use of this would be opportunistic. **Records** Several records surround the survey area around 40 km away with one record from Coongan Gorge (GHD 2016) approximately 30 km south of the survey area (DPaW 2016).
Bilby *Macrotis lagotis*	V	S3, Vu			X	The Greater Bilby distribution in WA is restricted to the north, including the Pilbara, Sandy and Gibson Deserts. The Greater Bilby usually spends the daytime in burrows, often built against termite mounds, spinifex hummock or shrubs (Van Dyck and Strahan 2008). Extant population of the Greater Bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils. It occupies three	**Unlikely** – The species has not been recorded in the survey area and no records are present within 50 Km. **Habitat** Habitat for this species only occurs on the sandy plain portion of the survey area. **Records**

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
						major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas. Laterite and rock feature substrates are an important part of Greater Bilby habitat. These habitat support shrub species, such as *Acacia kempeana*, *A. hilliana* and *A. rhodophloia*, which have root-dwelling larvae that provide a constant food source for the Greater Bilby. After dark they leave their burrows to feed and populations are known to move long distances when current habitat ranges become unsuitable. Bilbies are largely solitary, widely dispersed and found in low numbers. The current occurrence of the Greater Bilby is strongly associated with higher rainfall and temperatures, which promote areas of higher plant and food production. The Greater Bilby may also prefer these conditions as higher rainfall and temperatures are not well tolerated by foxes (Pavey 2006; Southgate et al. 2007).	The species is known from the region with one record approximately 50 km south of the survey area (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Western Pebble-mound Mouse *Pseudomys chapmani*		P4	X			The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the Western Pebble-mound Mouse can be found on stony hillsides with hummocky grasslands and little or no soil. It constructs large mounds of pebbles on stony slopes which cover an area of 0.5-9.0 square metres. 'Active' mounds are characterized by volcano-like cones capped by 'craters' that mark occluded entrances to subterranean burrow systems in which the mice live, often gregariously (Van Dyck and Strahan 2008).	**Present** – The Western Pebble-mound Mouse was recorded via the presence of both active mounds and inactive mounds recorded in the survey area. **Habitat** The rocky hills and undulating stony plains are preferred habitat for the mouse. **Records** The species is well known in the region with over 50 records of the species within 40 km of the survey area (DPaW 2016).
Lakeland Downs Mouse Leggadina lakedownensis		P4	X			The Lakeland Downs Mouse occupies a diverse range of habitats from the monsoon tropical coast to semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical *Eucalyptus* and *Melaleuca* woodlands and stony ranges. Most habitats, however, are seasonally inundated on red or white sandy-clay soils. They are nocturnal, largely solitary, and individuals spend the day in simple, single-chambered burrows (Van Dyck and Strahan 2008).	**Likely** – This species has been recorded in the region previously and habitat is present for the species. **Habitat** Habitat for this species only occurs along the water courses and sandy plains in the survey area. **Records** The species is known from the region with one record approximately 2 km east of the survey area.

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Long-tailed Dunnart *Sminthopsis longicaudata*		P4		X		The Long-tailed Dunnart occurs throughout the Gibson Desert, Murchison, southern Carnarvon Basin and the Pilbara in WA. Its habitat includes rugged, rocky areas with hummock grasses, shrubs and tall open shrublands and woodlands. In the Young Range in the Gibson Desert, the Long-tailed Dunnart has been found to be associated with plateaus, composed of boulders and stones, with some fine red soils, and sparsely vegetated Mulga (*Acacia aneura*) and Miniritchie (*A. grasbyi*) shrubs over spinifex (Van Dyck and Strahan 2008).	**Unlikely** – The species has not been recorded in the survey area and no records are present within 40 km. **Habitat** Habitat for this species only occurs on the rock ridgeline to which there is very little in the survey area. **Records** The survey area appears outside of the northern limits of the species distribution with the closest records approximately 40 km south of the survey area (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia (Pilbara form)*	V	S3, Vu			X	The Pilbara Leaf-nosed Bat roosts in deep caves or mines in the wet season and forages nearby. This species occurs in the Pilbara region where its populations are scattered and localised. There are a few known populations of this species in the western Pilbara, roosting in caves formed in gorges that dissect massive siliceous sedimentary geology. It is most often observed in flight over waterholes in gorges (Van Dyck and Strahan 2008). Optimal roosts are thought to occur in caves that form between ascending rock layers, where humidity is maintained from seeping groundwater (Van Dyck and Strahan 2008). Roosts are commonly located over pools of water, or areas deep within the mine or cave structure which provides elevated temperature and humidity. Foraging habitat includes: *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with *Eucalyptus camaldulensis* along the creeks; over small watercourses throughout granite boulder terrain; over pools and low shrubs in ironstone gorges; and in and around gravelly watercourses with *Melaleuca leucadendron*.	**Unlikely** – This species has been recorded in the region previously and no caves suitable for the species are present in the survey area. A broader area was traversed with no caves found. **Habitat** Only foraging habitat is available for this species across the survey area, however the riparian and water bodies along the Coongan and Talga Rivers would be significant to the species which is mostly outside of the survey area. **Records** The species is known from the region with several records within 60 km and the closest record 40 km south west of the survey area (DPaW 2016).

Species	Status		Source Information			Habitat and ecology	Likelihood of Occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Olive Python (Pilbara subspecies) *Liasis olivaceus barroni*	V	S3, Vu			X	The Olive Python (Pilbara subspecies) is a dull olive-brown to pale fawn or rich-brown python with a white underside and pale finely dotted lips. This species reaches an average size of 2.5 m but can grow up to 4 m long. The Olive Python's range is restricted to the Pilbara region, north WA, and the Dampier Archipelago. Habitat consists of rocky escarpments, gorges and waterholes within the Pilbara region. The preferred microhabitats for this species are under rock piles, on top of rocks, and under spinifex as well as in man-made features such as overburden heaps, railway embankments and sewerage treatment ponds. The species' breeding season occurs from June to August, with males moving long distances in search of breeding females (Wilson and Swan 2010).	**Unlikely** – The species is known to persist in the Pilbara, however no waterbody's and very little rocky breakaway/ridgeline habitat is present within the survey area. **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. No waterbody's are present along the water course to be utilised by this species. **Records** The species is known from the region with several records within 80 km of the survey area (DPaW 2016).

References:

Adams, M, Cooper, N, and Armstrong, J 2000, *Revision of Dasycercus systematics*, Report to the South Australian Department for Environment and Heritage.

Boles, W.E., N.W. Longmore & M.C. Thompson (1994). A recent specimen of the Night Parrot, Geopsittacus occidentalis. Emu. 94:37-40

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Species Profile and Threats Database (SPRAT)*, Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Government.

DPaW 2016, *NatureMap:* Mapping Western Australia's Biodiversity, retrieved April 2016, from http://naturemap.dpaw.wa.gov.au/.

Garnett, ST and Crowley, GM 2000, The Action Plan for Australian Birds 2000, Canberra, Environment Australia.

Groves, CP 1993, *Order Dasyuromorphia*, In: Wilson, DE and Reeder, DM (eds), Mammal Species of the World, pp. 23-37, Smithsonian Institution Press, Washington, DC, USA.

Groves 2005 Order Dasyuromorphia, In Wilson, D.E. & Reeder, D.M. (eds.) Mammal Species of the World, Third Edition. The Johns Hopkins University Press, Baltimore.: 111-184.

Johnstone, RE, Burbidge, AH, and Darnell, JC. 2013, Birds of the Pilbara region, including seas and offshore islands, Western Australia: distribution, status and historical changes. Records of the Western Australian Museum, Supplement 78: 343–441 (2013).

Lloyd, RL and Lloyd, HJ 1991, *An Oriental Pratincole at the Dry Creek Saltfields*, South Australian Ornithologist, vol. 31, pp 74.

Marchant, S. and Higgins, P.J. (1990). *Handbook of Australian, New Zealand and Antarctic Birds. Volume 1 - Ratites to Ducks*. Melbourne, Victoria: Oxford University Press.

Marchant, S and Higgins, PJ (eds.) 1993, *Handbook of Australian, New Zealand and Antarctic Birds, Volume 2 – Raptors to Lapwings*, Melbourne, Victoria, Oxford University Press.

Masters, P, Dickman, CR and Crowther, M 2003, *Effects of cover reduction on mulgara Dasycercus cristicauda (Marsupialia: Dasyuridae), rodent and invertebrate populations in central Australia: Implications for land management*, Austral Ecology, vol. 28, Issue 6, pp 658–665.

Maxwell, S, Burbidge, AA and Morris, KD 1996, *The 1996 action plan for Australian marsupials and monotremes*, Wildlife Australia.

Morcombe, M 2004, *Field Guide to Australian Birds*, Queensland, Australia, Steve Parish Publishing Archer Field.

Parker, S.A. (1980). Birds and conservation parks in the north-east of South Australia. South Australian Parks and Conservation. 3:11-18.

Pavey, C 2006, National Recovery Plan for the Greater Bilby Macrotis lagotis. Northern Territory Department of Natural Resources, Environment and the Arts.

Southgate, R., R. Paltridge, P. Masters & S. Carthew (2007). Bilby distribution and fire: A test of alternative models of habitat suitability in the Tanami Desert, Australia. Ecography. 30:759-776.

Storr, GM 1980, *Birds of the Kimberley Division, Western Australia*, Special Publications of the Western Australian Museum, No. 11, pp 1-117, Perth, Western Australia, Western Australian Museum.

Wilson, S and Swan, G 2010, *A Complete Guide to Reptiles of Australia*, 2nd Edition, Sydney Australia, New Holland Press

Woolley, P.A. (2005). The species Dasycercus Peters, 1875 (Marsupialia: Dasyuridae). Memoirs of Museum Victoria 62, 213-221.

Van Dyck, S and Strahan, R 2008, *The Mammals of Australia*, New Holland, Sydney, NSW.

Call analysis method

Ultrasonic detection surveys

The primary method of recording ultrasonic bat calls was the SM2BAT+ SongMeter recorder (Wildlife Acoustics Inc., USA). Bat calls were recorded between sunset and sunrise across consecutive nights with audio settings designed to optimise detection and recording of the target species (*Rhinonicteris aurantia*). Recorded call data were saved as 45 minute to 1 hour blocks in Wildlife Acoustics' patented WAC compressed audio format.

Craig Grabham from GHD completed the analysis of all data collected during the survey using ultrasonic bat detectors. Data from SM2 units was downloaded and viewed using Kaleidoscope Viewer (version 3.1.6, Wildlife Acoustics Inc 2016) as full-spectrum audio files. WAC files were also converted to Anabat sequence files (zero-crossing format) suitable for analysis in AnalookW version 4.1s (Corben 2015).

Call analysis

WAC files were viewed and bat calls were identified using Kaleidoscope Viewer (version 3.1.6, Wildlife Acoustics Inc. 2016) by visually comparing the Kaleidoscope Viewer spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material (McKenzie and Bullen 2009; 2012, Armstrong and Cole 2007). The spectrogram displayed each call sequence (see below for call definition) with information on the number and timing of calls.

The call identification was also assisted by consulting distribution information for possible species (Atlas of Living Australia and DPAW NatureMap records) and previous GHD surveys within the region of the survey area. No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area.

The exception to this call definition is the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*). The Pilbara Leaf-nosed Bat has a distinct call from all other microchripteran bat species in the Pilbara region. Unlike other species, the pulse structure is constant frequency (CF) with a characteristic frequency (Fc) of 118–128 kHz (DEWHA 2010). Their echolocation calls are readily identifiable from the characteristic (or more accurately the maximum or peak) frequency, pulse shape, enabling even short call sequences with few pulses to be successfully recognised (Hourigan 2011).

Identification for the PLNB was confirmed from a minimum of two or more consecutive pulses, each being > 4 ms in duration and < 500 ms (0.5 second) between the next consecutive pulse in a sequence within the characteristic range of the species.

Due to variability in the quality of calls, the lack of published information regarding non-search phase calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in the table below. Due to the absence of reference calls from the study area and the poor quality of some the recordings and known overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows Armstrong (2011), then van Dyck et al. (2013).

Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt. Call sequence contains three or more consecutive pulses of similar frequency and shape. Call characteristics match those in referenced material or species reference calls.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail (e.g. number of pulses).
SG - Species Group	X = Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species

Summary of results and survey effort

Microchiropteran bat detector surveys were completed for 1 night during May 2016 in the survey area.

Four species were positively (Definite) identified of the 16 species that are known to occur from this part of the Pilbara region (Armstrong 2011; DPaW 2016). As many as four other species may also have been recorded using bat detectors, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

The tables below provide site location details and a summary of the results for each site for each night.

Summary of bat call analysis May 2016

Species / Group	**Site/Date**
	MO30
	24-25/5/16
Austronomus australis	D
Chalinolobus gouldii	D
Taphozous georgianus	D
S.falviventris/C.jobensis	X

Notes:

Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one Nyctophilus species where recorded.

See Table 1 for confidence rating e.g. D or Pr, - = not recorded. X = species group present.

CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, P1- 4 (priority species) species under the *Wildlife Conservation Act 1950*

Qualifications

Craig Grabham has completed microchiropteran bat surveys and assessments in WA, NSW, QLD, Vic, Tasmania and the NT employing a variety of methods including harp trapping, light tagging, habitat surveys (e.g. cave assessments), roost surveillance (using infrared and thermal video cameras), and echolocation survey (Wildlife Acoustic's SongMeter and Eco Meter devices and Titley Electronic Anabat devices) and analysis (Wildlife Acoustic's SongScope and Chris Corben's Analook). He has completed bat surveys for infrastructure, residential, and mining projects. Craig has also completed bat inventory surveys for National Parks, Nature Reserves, catchment management areas and private land conservation projects. His honours project investigated the use of remnant and revegetated habitats by microchiropteran bats across a fragmented rural landscape in the Eastern Billabong Catchment (south-west slopes) in NSW.

Craig has completed the following training courses with regard to ultrasonic call recording and analysis:

- Anabat system training course – Titley Scientific (December 2012)
- Wildlife Acoustic's Song Meter and SongScope training – Faunatech/Austbat (July 2015).

To date Craig has completed echolocation analysis and reporting for more than 102 projects from WA, NSW, NT, QLD and Victoria since joining GHD in 2006 from calls collected during field surveys from Anabat detectors and/or Song Meter units and identified using Analook or SongScope software.

References

Armstrong, K. N. (2011). The current status of bats in Western Australia. **In:** 'The biology and conservation of Australasian bats.' (Eds B. Law, P. Eby, D. Lunney and L. Lumsden.) pp. 257–269. (Royal Zoological Society of New South Wales: Mosman.)

Armstrong, K. N., and Coles, R. B. (2007). Echolocation call frequency differences between geographic isolates of *Rhinonicteris aurantia* (Chiroptera: Hipposideridae): implications of nasal chamber size. *Journal of Mammalogy* **88**, 94-104.

Bullen, R. D. and McKenzie, N. L. (2011). Recent developments in studies of the community structure, foraging ecology and conservation of Western Australian bats. In 'The biology and conservation of Australasian bats.' (Eds B. Law, P. Eby, D. Lunney and L. Lumsden.) pp. 31-43. (Royal Zoological Society of New South Wales: Mosman.)

Churchill, S 2008. Australian Bats, Allen and Unwin, Australia.

Department of the Environment, Water, Heritage and the Arts, (2010). Survey guidelines for Australia's threatened bats Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

DPaW 2016, *NatureMap*: Mapping Western Australia's Biodiversity, retrieved April 2016, from http://naturemap.dpaw.wa.gov.au/.

Duffy, AM, Lumsden, LF, Caddle, CR, Chick, RR & Newell, GR (2000). The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in southeastern Australia, Acta Chiropterologica 2: 127-144.

Hourigan, C. 2011. Orange leaf-nosed bat, *Rhinonicteris aurantia*. Targeted species survey guidelines.Queensland Herbarium, Department of Science, Information Technology and Innovation, Brisbane.

Law, B, Anderson, J & Chidel, M (1998). A bat survey in State Forests on the south-west slopes of New South Wales with suggestions of improvements for future surveys, Australian Zoologist 30(4): 467-479.

Law, BS, Anderson, J Chidel, M (1999). Bat communities in a fragmented forest landscape on the south-west slopes of New South Wales, Australia, Biological Conservation 88(3): 333-345.

Mills, DJ, Norton, TW, Parnaby, HE, Cunningham, RB & Nix, HA (1996), Designing surveys for microchiropteran bats in complex forest landscapes – a pilot study from south-east Australia. Forest Ecology and management 85(1-3):149-161.

McKenzie, N. L., and Bullen, R. D. (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. *Records of the Western Australian Museum* Supplement **78**: 123–155.

McKenzie, N. L., and Bullen, R. D. (2012). An acoustic survey of zoophagic bats on islands in the Kimberley, Western Australia, including data on the echolocation ecology, organisation and habitat relationships of regional communities. Records of the Western Australian Museum Supplement **81**: 67–108.

Threatened Species Scientific Committee (TSSC) (2016), Conservation Advice *Rhinonicteris aurantia* (Pilbara form) (Pilbara Leaf-nosed Bat). Approved 10/03/2016.

Van Dyke. S, Gynther. I, and Baker. A. (2013). Field Companion To The Mammals of Australia. New Holland Publishers.

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Main Roads Western Australia

Coongan Gorge Road Realignment

Biological Assessment

August 2016

Executive summary

Introduction

The Coongan Gorge Realignment project is located on the Marble Bar Road from SLK 323 to 328 in the Shire of East Pilbara. The 4 km section of road through Coongan Gorge is a narrow winding section of road with steep descents and restricted sight distances that are safety hazards.

The proposed project will include:

- The realignment and reconstruction of approximately five km of Marble Bar Road between SLK 318 and 323
- The upgraded road shall have an 8.0 m wide seal on a 10.0 m wide formation
- Associated drainage works include minor floodways, culverts and off-road drainage
- Possibility of a side track to divert traffic during stages of construction.

Clearing extents of the project are currently unknown and will depend on the requirement of the side track.

GHD Pty Ltd was commissioned by Main Roads to undertake a biological assessment of the survey area.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions and qualifications contained throughout the report.

Key results

- Nine vegetation associations were identified and described from the survey area. Aerial photography shows this vegetation is continuous outside the survey area. The vegetation is also consistent with vegetation associations identified in the vegetation mapping for the area (Beard 1979; Payne and Schoknecht 2011).
- The survey area is largely in a disturbed condition with signs of obvious disturbance, including fire, flood, grazing and road maintenance activities.
- No EPBC Act, WC Act or Priority listed flora taxa were recorded within the survey area during the survey. The Likelihood of Occurrence assessment post-field survey concluded that two conservation significant flora taxa are considered likely and four conservation significant flora taxa may possibly occur within the survey area.
- Ten introduced flora taxa were recorded within the survey area during the field survey, none of which is a Declared Pest under Section 22 of the BAM Act or a WoNS (DotE 2016).
- The EPBC Act listed Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigus*), Greater Bilby (*Macrotis lagotis*), and Priority 4 listed Western Pebble-mound Mouse (*Pseudomys chapmani*) were recorded during the survey
- The Likelihood of Occurrence assessment post-field survey concluded that nine additional conservation significant fauna taxa may likely occur within the survey area.

Potential project constraints – biological aspects

Preliminary environmental approvals and referrals advice based on the biological constraints identified within the survey area. As the project is in concept design there may be opportunities

to avoid and minimise the impacts on these biological constraints through design refinement. Furthermore, if the biological constraints can be avoided or impacts to these minimised it may negate the need for referral to Federal/State environmental agencies.

Key biological constraints within survey area

Biological aspect	Survey area
Flora of conservation significance	No flora taxa of conservation significance were recorded during the field assessment. The likelihood of occurrence assessment indicates that six flora taxa are considered likely to be present within the survey area.
Fauna of conservation significance	Presence of six fauna species: • Northern Quoll (*Dasyurus hallucatus*) – One specimen recorded active, at least two specimens on camera trap, four latrine sites and prints obsertved. The range with rocky habitats, riverine and woodlands are all important habitat for the species. The remainder is potential foraging habitat and supportive only • Ghost Bat (*Macroderma gigas*) – One specimen recorded active at night in the survey area. No caves present in the survey area. The survey area is foraging habitat for the species • Greater Bilby (*Macrotis lagotis*) – three sets of print identified as potential Bilby and one old burrow system. Habitat is present, the species is known from the region • Western Pebble-mound Mouse (*Psudomys chapmani*) – recent evidence of seven active mounds was recorded within the survey area including 12 inactive mounds Potential presence of nine species and their habitats within the survey area are: • Grey Falcon (*Falco hypoleucos*) – Records within the survey area and the species is a potential resident with breeding and hunting habitat present • Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – Records in the region and foraging habitat present in riverine, woodland and ranges. Foraging habitat available for the species throughout the survey area • Pilbara Olive Python *(Liasis olivaceus barroni*) - Records in the region and habitat present in riverine (water body), woodland and ranges, all considered core habitat • Peregrine Falcon (*Falco peregrinus*) – Records in the region and habitat present in riverine, woodland, and ranges, hunting (foraging) habitat available for the species throughout the survey area • Long-tailed Dunnart (*Sminthopsis longicaudata*) – Records in the region and habitat available for the species. • Glossy Ibis *(Plegadis falcinellus)* – Records in the region and habitat available for the species • Wood Sandpiper *(Tringa glareola)* – Records in the region and habitat available for the species • Sharp-tailed Sandpiper *(Calidris acuminata)* – Records in the region and habitat available for the species • Common Sandpiper *(Actitis hypoleucos)* - Records in the region and habitat available for the species.

Matters of National Environmental Significance

It was considered that the Northern Quoll, Greater Bilby and Pilbara Olive Python would require referral based on the presence of these species, records in the region and habitat critical to the survival of a population these species present within the survey area.

It was considered that the Ghost Bat, Pilbara Leaf-nosed Bat, Glossy Ibis, Wood Sandpiper, Sharp-tailed Sandpiper and Common Sandpiper are unlikely to rely on the habitats present within the survey area and clearing of habitat for the project is unlikely to significantly impact a population of these species. It is considered unlikely that the project would require referral to the DotE for impacts on these species.

Environmental Protection Authority

The potential impacts from the loss of native vegetation and loss of fauna habitat can be effectively assessed through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, with consideration of the biological values discussed in this report, it is considered unlikely that the project would require referral to the EPA under Section 38 of the *Environmental Protection Act 1986*.

Department of Environment and Regulation

No EPBC Act, WC Act or Priority listed flora taxa were recorded within the survey area during the survey. The Likelihood of Occurrence assessment post-field survey concluded that two conservation significant flora taxa are considered likely and four conservation significant flora taxa may possibly occur within the survey area.

Fifteen fauna of conservation significance are considered to occur or likely to occur in survey area. As such, any clearing permit application should assess the significance of any potential impacts of the proposed clearing area on these species.

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Appendices

1. Introduction

1.1 Background

The Coongan Gorge Realignment project is located on the Marble Bar Road from Straight Line Kilometre (SLK) 323-328 in the Shire of East Pilbara. The four kilometre (km) section of road through Coongan Gorge is a narrow winding section of road with steep descents and restricted sight distances that are safety hazards.

The proposed project will include:

- The realignment and reconstruction of approximately five km of Marble Bar Road between SLK 318 and 323
- The upgraded road shall have an 8.0 metre (m) wide seal on a 10.0 m wide formation
- Associated drainage works include minor floodways, culverts and off-road drainage
- Possibility of a side track to divert traffic during stages of construction.

Clearing extents of the project are currently unknown and will depend on the requirement of the side track to be established. Material pits will be determined when funding for the project is confirmed and will be assessed in due course.

1.2 Purpose of this report

GHD Pty Ltd (GHD) was commissioned by Main Roads Western Australia (Main Roads) to undertake a biological assessment of the survey area. The purpose of the assessment was to delineate key flora, vegetation, fauna, soil, groundwater and surface water values within the survey area and the potential impact to areas of sensitivity. The outcomes of the assessment will be used in the environmental assessment and approvals process.

1.3 Location

1.3.1 Study area

A study area[1] was defined for the desktop based searches of the biological assessment and includes a 40 km buffer of the survey area.

1.3.2 Biological survey area

The survey area is located on the Marble Bar Road from SLK 323-328, approximately 40 km north of Marble Bar in the Pilbara Region of Western Australia (WA).

The survey area is 146.39 hectares (ha) in size and is located in the Shire of East Pilbara. The location of the survey area is mapped in Figure 1, Appendix A.

1.4 Scope of works

The scope of works, as detailed in the Main Roads Consultants' Brief was to undertake a desktop assessment and biological survey for the Coongan Gorge Realignment project located on Marble Bar Road SLK 323-328. Upon completion of the biological survey the consultant was required to supply to Main Roads with a constraints assessment highlighting areas of significance (e.g. locations of Priority Flora, Threatened Fauna, etc.).

[1] The 40 km radius boundary of the study area has been updated from that indicated by the Main Roads brief for the project due to the fact that 40 km is the maximum *NatureMap* buffer size applicable to any one search.

The following actions were completed to fulfil the scope:

- A desktop assessment of the study area prior to the field survey work to identify all biological features and constraints, which may be in, or nearby the survey area
- Identify and review any existing and relevant environmental reports
- Identify significant flora, vegetation/ecological communities, fauna, soil, groundwater and surface water values and potential sensitivity to impact
- Identify pre-European vegetation type(s) using Beard mapping
- Conduct a field survey (to be done by an environmental specialist in accordance with regulatory expectation for years of experience in the relevant bioregion) to verify / ground truth the desktop assessment findings
- Undertake vegetation condition mapping using Environmental Protection Authority (EPA) and Department of Parks and Wildlife (DPaW) (2015)
- Undertake ecological community mapping and describe according to National Vegetation Information System (NVIS) structural and floristics
- Undertake relevant environmental constraints mapping using GIS mapping software (e.g. ArcMap)
- Assess the survey areas plant species diversity, density, composition, structure and weed cover, recording the percentage of each in nominated quadrats
- Undertake a targeted flora and fauna survey, to a level deemed necessary according to results of *NatureMap* (DPaW, 2016) database searches
- Assess all biological aspects likely to require referral of the project to the EPA
- Assess Matters of National Environmental Significance (MNES) and indicate whether potential impacts on MNES as protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are likely to require referral of the project to the Australian Government Department of the Environment (DotE). Provide justification of decision as to whether referral to the DotE is likely to be required. Ensure to reference relevant Australian Government significant impact guidelines
- Determine the legislative context of environmental aspects required for the assessment
- Provide a concise report on the findings of the biological survey
- Provide raw survey data at project completion in electronic form including but not limited to flora/fauna records, ecological community and condition mapping. The data is to be provided in a format that satisfies Main Roads data standards
- Submit a WA Herbarium and a DPaW Threatened/Priority Flora Report Form for any conservation significant flora recorded during the survey.

Method as per GHD Section 2 response

The biological assessment will be undertaken in accordance with Part B of the Scope of Works provided by Main Roads. The biological assessment includes a Level 1 vegetation and flora assessment and targeted single seasonal flora of conservation significance survey. The Level 1 flora and vegetation survey will be undertaken with regard to the EPA Guidance Statement No. 51 (EPA 2004b) and the subsequent Flora and Vegetation Technical Guide (EPA and DPaW 2015). In addition to this, the biological assessment includes a Level 1 fauna assessment including a targeted habitat assessment for fauna species of conservation significance and camera trap surveys. The Level 1 fauna assessment will be undertaken with regard to the EPA

Guidance Statement No. 56 (EPA 2004a) and the subsequent Technical Guide (EPA and DEC 2010).

1.5 Relevant legislation, conservation codes and background information

In Western Australia (WA) some ecological communities, flora and fauna are protected under both Australian Government and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.6 Report limitations and assumptions

This report has been prepared by GHD for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Main Roads 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 (including species listings). 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 Main Roads and others who provided information to GHD (including 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 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 access tracks, operational works, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions 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.

This report has assessed the flora and fauna within the survey area (Figure 1, Appendix A). Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identity relevant environmental information pertaining to the area and to assist in survey design. The search parameters used were a 40 km radius from a point on the Marble Bar Road 119° 48' 23" East, 20° 54' 58" South. This included a review of:

- The DotE Protected Matters Search Tool (PMST) to identify communities and species listed under the EPBC Act potentially occurring within the study area (DotE 2016a) (Appendix C)
- The DPaW Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) database to determine the potential for TECs or PECs to be present within the study area
- The *NatureMap* database for flora and fauna species previously recorded within the study area (DPaW 2016) (Appendix C)
- The DPaW Threatened (Declared Rare) and Priority Flora (TPFL) database, the DPaW Threatened and Priority Fauna database, and the WA Herbarium database for flora taxa listed under the *Wildlife Conservation Act 1950* (WC Act) and listed as Priority by the DPaW, previously recorded within the study area (Figure 2, Appendix A)
- Existing datasets including previous vegetation mapping of the survey area (Beard 1975), aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora and fauna species.

2.2 Field survey

2.2.1 Vegetation and flora

As part of the biological survey a Level 1 single season vegetation and flora assessment of the survey area was conducted by botanist Joshua Foster (SL011812) from the 26 May to 30 May 2016. The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant ecological communities and flora taxa were also undertaken.

The survey methodology employed for the survey was undertaken with reference to the EPA and the DPaW *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and DPaW 2015) and EPA (2004b).

Data collection

Field survey methods involved a combination of sampling quadrats located in identified vegetation units and traversing the survey area by foot. Twenty-three non-permanent quadrats were described throughout the survey area. To sample all the apparent vegetation units across the survey area, the location of quadrats was made primarily on the basis of aerial photographic maps. Additional sites were selected *in situ*, based on observations of vegetation units during the field assessment.

Non-permanent quadrats (measuring 50 m x 50 m) were located within each identified vegetation unit, where possible. In situations where vegetation community size or shape (e.g.

drainage channels) precluded establishing sites of the standard dimension, an area of equivalent size (i.e. 2,500 m^2) was assessed, where possible. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Quadrat data are provided to Main Roads in Excel format and presented in Appendix D.

Table 1 Data collected during the flora and vegetation field survey

Aspect	Measurement
Collection attributes	Personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in WGS84 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale as adopted by the EPA and the DPaW (2015).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including average height and cover (using a modified Braun-Blanquet scale).

A flora inventory was compiled from taxa listed in described quadrats and from opportunistic floristic records throughout the survey area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow the NVIS and are consistent with NVIS Level V (Association). At Level V, three (or occasionally more) taxa per stratum are used to describe the association (ESCAVI 2003).

Vegetation mapping has been undertaken at a scale suitable for this project.

Vegetation condition

The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (EPA and DPaW 2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined in Appendix B.

Flora identification and nomenclature

Species well known to the survey botanist were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All plant specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Plant species were identified by the use of taxonomic literature, electronic keys and online electronic databases. Where necessary, plant taxonomists considered to be authorities on particular plant groups were consulted.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 2016) and the EPBC Act List of Threatened Flora (DotE 2016b).

Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 2016).

Surveys for conservation significant flora

Prior to the field survey, information from the desktop assessments (e.g. aerial photography, geology, soils and topography data, EPBC Act PMST, TPFL and *NatureMap*) was reviewed to determine conservation significant flora taxa potentially present within the survey area. Additionally, ecological information (e.g. habitat, associated flora taxa and phenology) was sourced from *FloraBase* (WA Herbarium 2016) and other relevant publications where available, to provide further details.

Potential habitats were searched for the presence of conservation significant flora. Locations within the survey area with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

When any known or potential Threatened, Priority or significant flora was located, the following data was collected: GPS location, height, number of plants and corresponding area of population, reproductive state and plant condition.

2.2.2 Fauna

As part of the biological survey, zoologist (Glen Gaikhorst) undertook a single season Level 1 fauna survey (reconnaissance survey) of the survey area from the 26 May to 30 May 2016. The fauna survey was undertaken concurrently with the vegetation and flora assessment and with reference to the EPA Guidance Statement No. 56 Terrestrial Fauna Survey for Environmental Impact Assessment in Western Australia (EPA 2004a). The purpose of the reconnaissance survey was to verify the accuracy of the desktop study, and delineate and characterise the fauna assemblages present in the survey area.

The majority of the survey area was traversed on foot and by vehicle over the course of five days to identify and describe the dominant fauna habitat types and their condition, assess habitat connectivity, identify and record fauna species within the survey area. A Likelihood of Occurrence assessment for conservation significant fauna and their habitats occurring within the survey area was also undertaken.

Habitat assessment

A field data checklist was used to document the type, condition and extent of fauna habitats within the survey area. The following information was collected for six (20 m x 20 m) fauna habitat assessment quadrats located within the survey area:

- Habitat structure (e.g. vegetation type, presence/absence of structural layers such as ground cover and mid storey)
- Presence/absence of refuge including: density of ground covers, fallen timber, hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways including type, extent and habitat quality within waterways
- Location of the habitat within the survey area in comparison to the habitat within the surrounding landscape
- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey area
- Current land use and disturbance history
- Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance

- Evaluation of the Likelihood of Occurrence of conservation significant fauna within the habitat (based on presence of suitable habitat and observations)
- A representative photograph of each habitat type.

In addition to the habitat assessments, rapid habitat assessments were undertaken at six locations within the survey area to assist with documenting the extent and quality of the different habitat types. Fauna habitat assessment locations are displayed in Figure 5, Appendix A.

Opportunistic fauna searches

Opportunistic fauna searches were also conducted across the survey area. The majority of opportunistic searches were undertaken at habitat assessment locations and focussed on the following:

- Searching the survey area for tracks, scats, bones, diggings and feeding areas for both native and feral fauna (Triggs, 2004). For each scat found, the location, date, brief habitat description and GPS coordinate was recorded
- Searching through microhabitats including turning over rocks and ground debris (e.g. leaf litter) and examining tree hollows and hollow logs for reptile and other small vertebrate fauna
- Visual and aural surveys. This accounted for many bird species potentially utilising the survey area
- A visual assessment of the water bodies to identify any fish species observed
- Recording GPS locations of any conservation significant fauna species.

Camera trap survey

Motion sensor cameras (Reconyx-Hyperfire) were deployed for a period of at least 33 nights each at eight locations within or bordering the survey area. Cameras were positioned in areas where Northern Quoll (*Dasyurus hallucatus*) habitat or other potential significant species might be recorded. Cameras were baited with sardines to attract fauna species, particularly carnivorous marsupials (e.g. Dasyuridae) within the survey area. For each camera location the time and date deployed and recovered, a GPS coordinate, and brief habitat description were recorded (as seen below in Table 2). Camera locations are displayed in Figure 5, Appendix A.

Data from the cameras were downloaded to a computer and analysed for the presence of animals following the field survey.

Table 2 Camera trap locations and effort during the survey

Sites	Easting	Northing	Deployed	Collected	Total Nights	Comments
Cam 11	792921	7683820	24-May	27-Jun	34	On rocky scree slope
Cam 20	792461	7684020	24-May	27-Jun	34	At a low cave entrance on rocky ridgeline
Cam 15	791691	7684234	24-May	27-Jun	34	Rocky ridge line on Snappy Gum
Cam 27	791130	7684652	24-May	27-Jun	34	Rocky ridge line on Snappy Gum
Cam 21	790519	7685986	24-May	27-Jun	34	Amongst large *Triodia* hummocks on plain
Cam 24	792213	7685765	24-May	27-Jun	34	Amongst large *Triodia* hummocks on plain
Cam 18	793620	7684911	25-May	27-Jun	33	Above water body on rocky ridge line
Cam ghd	793705	7685001	25-May	27-Jun	33	On water body on *Melaleuca* at waters edge

Bat survey

A Songmeter SM2BAT+ recorder (Wildlife Acoustics Inc., USA) was deployed at one location for one night to record ultrasonic echolocation calls emitted by microchiropteran bats. The detector location for the survey area is displayed in Figure 5, Appendix A.

Data from the detector was downloaded to a computer and analysed for the presence of bat calls by Craig Grabham of GHD following the field survey (see Appendix E).

Fauna Species Identification

Fauna species were identified in the field using available field and electronic guides (e.g. Morcombe 2014). Where identification was not possible, photographs of specimens were collected to be later identified.

Nomenclature follows that used by the WA Museum (as shown on *NatureMap*), as it is deemed to contain the most up-to-date species information for WA, with the exception of birds, where Christidis and Boles (2008) was used.

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DPaW searches of Threatened flora and fauna provide more accurate information for the general area. However, some collection, sighting or trapping records cannot be dated and often misrepresent the current range of threatened species.

Updated Wildlife Conservation (Rare Flora) and Wildlife Conservation (Specially Protected Fauna) Notices were gazetted on 3 November 2015. The format of these Notices has been changed to align with the EPBC Act threatened species lists. To date information contained in publically available databases such as *NatureMap* does not reflect the most recent gazetted Notices. This report has been updated to reflect the conservation status of flora and fauna listed in these Notices. However, the outputs of database searches contained in this report

such as *NatureMap*, may not reflect the conservation status of flora and fauna listed in these Notices.

2.3.2 Field survey limitations

The EPA and the DPaW (2015) Technical Guide and Guidance Statement No. 51 and 56 (EPA 2004b, a) states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 3.

Table 3 Survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area, this includes: • Broad scale (1:1,000,000) vegetation mapping by Beard (1975) and digitised by Shepherd *et al*. (2002) • Regional biogeography (Kendrick and McKenzie 2001) • Regional vegetation (1:3,000,000) mapping by Beard *et al.* (2013) • Land system mapping (van Vreeswyk *et al.* 2004).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not assessed as part of this survey, although opportunistic records were taken of invertebrate and aquatic fauna.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Moderate	The vegetation and flora survey was a single season survey only and was undertaken in late May 2016. The optimal time to undertake flora and vegetation surveys in the Pilbara region is 6-8 weeks post-wet season from March to June (EPA and DPaW 2015). Most of the conservation significant flora identified in the desktop assessment flower from April to June. The flora recorded from the field survey is detailed in Section 4.4 and a full flora species list is provided in Appendix D. The portion of flora collected and identified was considered low to moderate; with few annual flora present due very low rainfall received in the survey area prior to the field assessment, and that half of the Coongan Gorge had been very recently burnt. The fauna survey was undertaken in late May 2016 and was a reconnaissance survey only. The fauna assessment sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Camera traps were deployed for approximately 1 month in key habitat areas that may support conservation significant species. Many cryptic (e.g. invertebrate species) and nocturnal species would not have been identified during a reconnaissance 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 survey area. No sampling for invertebrates or aquatic species occurred (except for visual inspection and identification of observed fish species). Where terrestrial invertebrate fauna were recorded opportunistically, these findings were mentioned in this report. However, this report is limited to an assessment of terrestrial vertebrate fauna, as the information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.

Aspect	Constraint	Comment
Flora determination	Moderate	Flora determination was undertaken by Joshua Foster in the field and utilising specimens confirmed at the WA Herbarium. Four flora taxa could only be identified to genus due to lack of flowering and fruiting material required for identification. These taxa showed no resemblance to any conservation significant flora identified in the desktop assessment. Additionally, some species, particularly grasses and sedges, may have been overlooked due to lack of material. This may have affected the results of the survey as there are conservation significant flora known from the desktop assessment that are annual taxa and/or sedges. The taxonomy and conservation status of WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time of report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation of Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The survey area follows an existing road alignment corridor and was easily accessed by vehicle and on foot over the course of the field survey. Information gained from the survey was extrapolated across those sections of the survey area not accessed on foot during the field survey to assist with determining the vegetation and habitat types for the entire survey area.
Mapping reliability	Nil	High resolution Environmental Systems Research Institute aerial imagery was available. Data was recorded in the field using hand-held GPS tools (e.g. Nomad Juno and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ±5 m on average. Therefore, the data points consisting of coordinates recorded from the GPS may contain inaccuracies.
Timing/weather/ season/cycle	Major	The field survey was conducted in late May. In the four months prior to the survey (January to April), Marble Bar weather station (No. 004106, Bureau of Meteorology (BoM) 2016) recorded a total of 2.4 millimetres (mm) of rainfall. This rainfall is well below the long-term average (LTA) for the same period (January to April; 272.2 mm) (BoM 2016). An assessment of the flowering times of conservation significant flora taxa shows that April to June is the optimum time to capture a majority of the conservation significant flora in flower Appendix D.
Disturbances (e.g. fire, flood, accidental human intervention)	Major	The majority of the survey area has been impacted to some degree by past disturbances including minor roads, communication line establishment, historical rail corridor, weed infestation, cattle grazing, flood and fire. Minor tracks used for access to pastoralism, fence lines, tourism, and access to material pits occur at various locations along the length of the survey area. Cattle grazing is evident throughout the survey area, in particular along drainage lines and creeks. Cattle (and native fauna) have been responsible for the majority of weed spread along watercourses and to shelter sites higher in the landscape. Flood events have scoured drainage lines and shifted debris in the larger creeks and rivers. Fire has significantly altered the vegetation of the survey area with repeat fires noted. The entirety of the southern side of the Coongan Gorge has been burnt within the last 12 months and was mostly devoid of vegetation.
Intensity (in retrospect, was the intensity adequate)	Nil	The vascular flora of the survey area was sampled with reference to the EPA and the DPaW (2015) Technical Guide and terrestrial fauna sampled in accordance to EPA (2004a) as required by the scope of works. The survey area was sufficiently covered by two ecologists during the survey.

Aspect	Constraint	Comment
Resources	Nil	Adequate resources were employed during the field survey. Twelve person days were spent undertaking the survey using one dedicated botanist and one zoologist.
Access restrictions	Minor	No access problems were encountered during the survey. The survey area was easily accessed by vehicle and on foot. Due to safety concerns some of the steeper slopes within the Coongan Gorge were not climbed.
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields. Glen Gaikhorst (zoologist) is a Senior Ecologist with over 20 years' experience in undertaking ecological surveys, most of which is undertaking surveys in WA, including projects in the Pilbara and Kimberley. Joshua Foster is an Ecologist (botanist and zoologist) with over 18 years' experience in undertaking ecological surveys in WA, including over 12 years in the Pilbara and Kimberley.

3. Desktop assessment

3.1 Climate

The survey area is located in the Pilbara Region of WA and experiences an arid tropical climate with summer rain, with an annual precipitation of 250-300 mm (Beard, 1990). Beard (1990) noted the local influence of topography on the rainfall recordings with higher rainfall averages occurring on the more elevated areas. The other major climatic influence on the flora and vegetation in the Pilbara Region is the heavy rains that occur during and immediately following cyclonic events. Cyclones develop off the northwest coast and often cross the coastline between Karratha and Port Hedland, resulting in cyclonic rainfall events inland.

The BoM Marble Bar station (site number: 004106) is the nearest, active weather station to the study area with continuous long-term data (approximately 40 km south from the study area). Climatic data from this site indicates the mean maximum temperature of the area ranges from 26.8 degrees Celsius (°C) in July to 41.8 °C in December, and the mean minimum temperature of the area ranges from 12.0 °C in July to 26.6 °C in January. The mean annual rainfall is 362.4 millimetres (mm), with an average of 27.4 rain days per year (BoM 2016a).

Rainfall and temperature data for Marble Bar in the 12 months preceding the survey are summarised in Plate 1 (BoM, 2016). In the four months prior to the survey (January to April), Marble Bar weather station recorded a total of 2.4 mm of rainfall. This rainfall total is well below the LTA for the same period (January to April; 272.2 mm) (BoM, 2016a).

The weather conditions recorded during the field survey included (BoM, 2016a):

- Maximum temperature range: 31.4 °C – 34.4 °C
- Minimum temperature range: 17.5 °C – 21.0 °C
- Rainfall 0.0 mm.

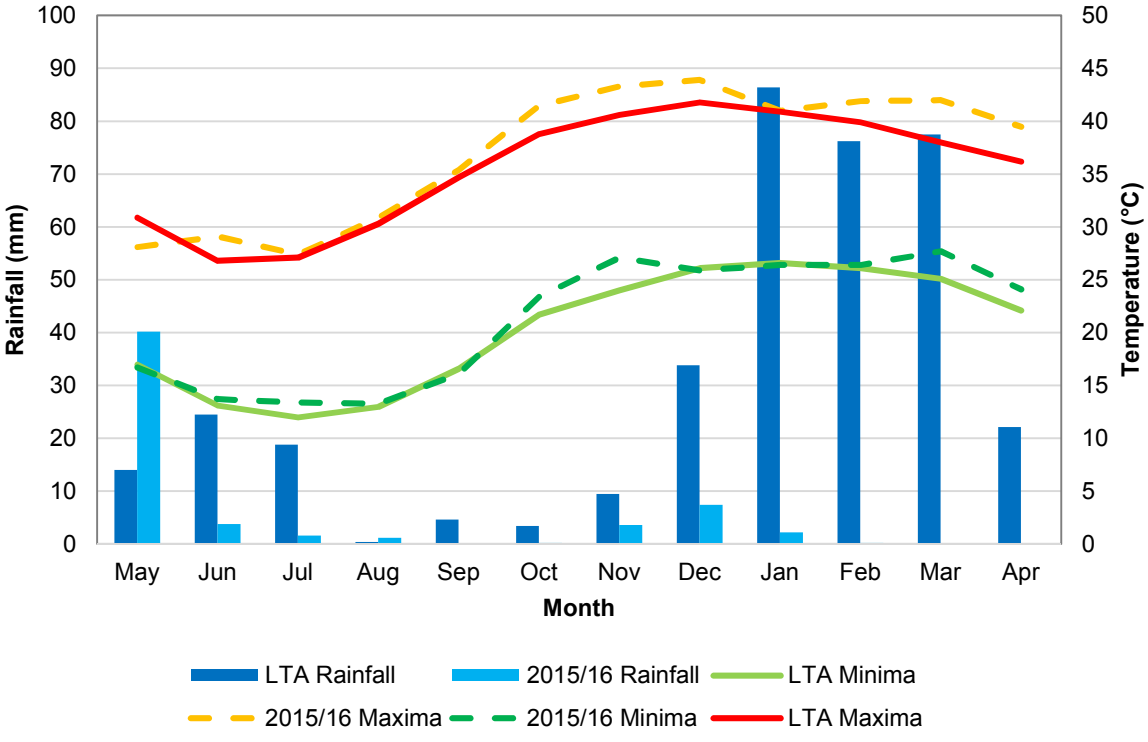


Plate 1 Rainfall and temperature data for Marble Bar (BoM 2016a)

3.2 Landforms and soils

The survey area is located within the Chichester Ranges Zone of the Fortescue Soil-landscape Province. This zone is characterised by hills and dissected plateaux (with some stony plains) on basalt and sedimentary rocks of the Hamersley Basin. Stony soils with some red shallow loams and hard cracking clays, supporting spinifex grasslands with kanji and snappy gum (and some tussock grasslands) (Tille 2006).

3.3 Land systems

Land system mapping of the Pilbara was prepared by the Department of Agriculture and Food Western Australia (DAFWA) (van Vreeswyk *et al.,* 2004). The purpose of the rangelands survey was to provide a comprehensive description and map of the biophysical resources of the region, together with an evaluation of the condition of the soils and vegetation throughout. Lands within the Pilbara area have been described and mapped into 20 broad land types comprised of 102 land systems according to a combination of landforms, soils, vegetation and drainage patterns (van Vreeswyk *et al.,* 2004).

The mapping by van Vreeswyk *et al.* (2004) indicates that two land systems are present within the survey area:

- River Land System – Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands
- Talga Land System – Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.

3.4 Hydrology

A summary of the Department of Water (DoW) Geographic Data Atlas (DoW 2016) queries for the survey area is provided in Table 4. The survey area is located within the Pilbara Groundwater Area and the Pilbara Surface Water Area as listed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

3.4.1 Wetlands

No wetlands occur within the survey area.

3.4.2 Watercourses

Two major river systems and associated tributaries intersect the survey area (Figure 2; Appendix A). Talga River intersects the eastern portion of the survey area and Coongan River intersects the western portion of the survey area.

3.4.3 Groundwater Dependent Ecosystems

There are two groundwater dependent ecosystems occur within the survey area: the Talga River and the Coongan River (BoM 2016b).

Table 4 Department of Water geographic atlas queries for the survey area

Aspect	Details	Result
Groundwater areas	Groundwater areas proclaimed under the RIWI Act.	Pilbara
Surface water areas	Surface water areas proclaimed under the RIWI Act.	Pilbara
Irrigation district	Irrigation Districts proclaimed under the RIWI Act.	None present
Rivers	Rivers proclaimed under the RIWI Act.	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947*.	None present
Waterway Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*.	None present

3.5 Land use

The survey area occurs within Eginbah Pastoral Station.

3.5.1 Conservation reserves and estate

No DPaW managed conservation areas are located within the study area. The closest DPaW managed conservation area is located approximately 40 km to the east of the survey area, associated with Meentheena Pastoral Station excised for conservation.

3.5.2 Environmentally Sensitive Areas

One Environmentally Sensitive Area (ESA) is located within the study area. The nationally important wetland is associated with the Fortescue Marsh located approximately 170 km south of the survey area. No ESAs are located within the survey area.

3.6 Regional biogeography

The survey area is situated in the Eremaean Botanical Province (Beard 1990), within the Pilbara Bioregion and Chichester Sub-region as described by the Interim Biogeographic Regionalisation of Australia (IBRA) (DotE, 2016c).

The Pilbara Bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses (Kendrick and McKenzie, 2001).

The Chichester Sub-region comprises the northern section of the Yilgarn Craton. It is characterised by undulating Archaean granite and basalt plains that include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule, Sherlock) (Kendrick and McKenzie, 2001).

3.7 Conservation significant ecological communities

A search of the EPBC Act PMST database did not identify any TECs within the study area. Similarly, a search of the DPaW TEC database did not identify any State-listed TECs within the study area.

No DPaW-listed PECs were identified within the study area. The nearest PEC is located over 85 km to the south of the survey area.

3.8 Vegetation

3.8.1 Pre-European vegetation associations and extent

Broad scale (1:1,000,000) pre-European vegetation mapping of the Pilbara area was completed by Beard (1975) at an association level. The mapping indicates that three vegetation associations are present within the survey area:

- Association 93: Hummock grasslands, shrub steppe; kanji over soft spinifex
- Association 171: Hummock grasslands, low tree steppe; snappy gum over soft spinifex & *Triodia brizioides*
- Association 619: Medium woodland; river gum (*Eucalyptus camaldulensis*).

The pre-European mapping has been adapted and digitised by Shepherd *et al.* (2002). The extents of the vegetation association have been determined by the State-wide vegetation remaining extent calculations maintained by the DPaW (Current as of June 2015 – Government of Western Australia (GoWA) 2015). The current extents of vegetation associations remaining are greater than 99 per cent of the pre-European extent at all scales (e.g. State, IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA), and are therefore above the 30 per cent threshold level[2] (Table 5).

Table 5 Pre-European vegetation extents (Beard 1975, GoWA 2015)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
93	State: Western Australia	3,044,309.54	3,040,641.00	99.88	1.96
	IBRA Bioregion: Pilbara	3,042,114.29	3,038,471.70	99.88	1.96
	IBRA Sub-region: Chichester	2,940,348.06	2,936,731.56	99.88	2.03
	LGA: Shire of East Pilbara	1,709,522.26	1,706,780.59	99.84	2.70
171	State: Western Australia	331,951.73	330,643.10	99.61	10.92
	IBRA Bioregion: Pilbara	331,307.42	330,026.24	99.61	10.94
	IBRA Sub-region: Chichester	331,307.42	330,026.24	99.61	10.94
	LGA: Shire of East Pilbara	331,951.73	330,643.10	99.61	10.92
619	State: Western Australia	119,373.78	118,205.02	99.02	0.20
	IBRA Bioregion: Pilbara	118,920.31	118,116.79	99.32	0.20

[2] The 30 per cent threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (EPA 2000).

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
	IBRA Sub-region: Chichester	85,543.15	85,520.95	99.97	0.28
	LGA: Shire of East Pilbara	52,765.30	52,763.69	100.00	0.0

3.9 Flora

3.9.1 Flora diversity

A search of the *NatureMap* database identified 416 plant taxa, representing 56 families, which have previously been recorded within the study area. This total comprises 399 native flora taxa and 17 naturalised (non-native) flora taxa. Dominant families include:

- Fabaceae (88 taxa)
- Poaceae (70 taxa)
- Amaranthaceae (28 taxa)
- Malvaceae (28 taxa).

The *NatureMap* database search is provided in Appendix C.

3.9.2 Conservation significant flora

Desktop searches of the EPBC Act PMST database, *NatureMap* database, and the DPaW TPFL and WAHERB databases identified the presence/potential presence of nine conservation significant flora taxa within the study area.

The desktop searches recorded:

- No taxa listed under the EPBC Act
- No taxa listed as Threatened Flora under the WC Act
- Two Priority 1 taxa
- Two Priority 2 taxa
- Four Priority 3 taxa
- Two Priority 4 taxa.

The locations of conservation significant flora registered on the DPaW databases are provided in Figure 2, Appendix A. A Likelihood of Occurrence assessment for the conservation significant flora is provided in Appendix D.

3.9.3 Introduced flora

A search of the *NatureMap* database identified 17 introduced flora taxa previously recorded within the study area. One is listed as a Declared Pest (s22) under the *Biosecurity and Management Act 2007* (BAM Act) (**Datura leichhardtii*) but does not require any management in the Shire of East Pilbara. No plants identified as a Weed of National Significance (WoNS) have been recorded in the study area (DotE 2016c).

3.10 Fauna

3.10.1 Fauna diversity

A search of *NatureMap* identified 209 vertebrate native fauna taxa previously recorded within 40 km of the survey area. This total included 26 mammals (two introduced species), three amphibians, 122 birds and 58 reptiles. The EPBC Act PMST indicated the potential presence of nine additional fauna taxa within 50 km of the survey area.

3.10.2 Conservation significant fauna

Searches of the EPBC Act PMST, DPaW Threatened and Priority Fauna database and *NatureMap* database identified the presence/potential presence of 23 conservation significant fauna species (Appendix E). Species identified by the PMST as marine and migratory marine were excluded from this assessment as no marine habitats were present within or nearby the survey area however species identified by the PMST as migratory terrestrial/wetland were considered as part of this assessment.

In addition to the 23 species identified by the database searches, four additional species were also considered for this assessment as a result of a review of the species listed under Schedules 1-3 and 5-7 of the WC Act (revised 20 November 2015) to occur within the DPaW Pilbara region (DPaW 2015).

4. Field results

4.1 Soils

The soils within the survey area are considered to be similar to that as identified in the desktop assessment. The majority are rocky soils, with sandier soils associated with areas of water flow (sheetwash, rivers and creeks).

4.2 Hydrology

4.2.1 Wetlands

There are no wetlands within the survey area. Semi-permanent pools occur on the Talga River and Coongan River, immediately abutting the survey area.

4.2.2 Watercourses

The watercourses identified as part of the desktop assessment occur within the survey area: the Talga River to the east and the Coongan River to the west.

4.3 Vegetation

4.3.1 Vegetation types

Nine vegetation types (VT) were identified and described from the survey area (Table 6 and Figure 3, Appendix A). These include vegetation associations as described by the NVIS and a cleared/degraded vegetation type (VT1). The survey area is dominated by VT04 and VT05, with VT09 occupying the smallest area. Soil types are primarily stony sandy loams with sandier soils associated with areas of water flow. The vegetation types are closely allied with the landform feature in which they occur.

The vegetation types identified within the survey area are considered to be well represented outside the survey area. A review of the aerial photography indicates that there is representation of the defined vegetation types outside the survey area. The vegetation is also consistent with vegetation associations identified in the vegetation mapping for the area (Beard, 1979; Payne and Schoknecht, 2011).

4.3.2 Conservation significant ecological communities

No Australian Government or State-listed TECs or DPaW-listed PECs were identified within the survey area during the field survey.

4.3.3 Other significant vegetation

No areas considered to support ‘other significant vegetation’ (EPA, 2004b) were identified.

Table 6 Vegetation types recorded during the field survey

Vegetation types	Description	Landform and substrate	Extent (ha) Survey Locations	Representative photograph
VT01 Cleared/Degraded	Areas mostly devoid of native vegetation – covering roads, access tracks and material pits. Flora taxa present include representation from adjacent vegetation types and also include disturbance response taxa.	Various – roads, tracks etc.	4.79 R1	
VT02 Riparian Woodland	Woodland to Low Woodland of *Eucalyptus camaldulensis, Melaleuca argentea* with *Sesbania formosa, E. victrix, Atalaya hemiglauca* over Tall Shrubland to Open Shrubland of *Acacia ampliceps, *Calotropis procera, A. trachycarpa* with **Vachellia farnesiana*, *Petalostylis labicheoides* over Low Open Shrubland of *Corchorus parviflorus*, *Pluchea tetranthera*, over Very Open Sedgeland of *Cyperus vaginatus* with Open Tussock Grassland of **Cenchrus ciliaris* with mixed Herbs.	Major creeklines and rivers, often with sandy soils.	6.79 Q10, Q18, Q19, R2	

Vegetation types	Description	Landform and substrate	Extent (ha) Survey Locations	Representative photograph
VT03 Floodplain Low Open Woodland	Low Open Woodland of *Corymbia hamersleyana* over Tall Open Shrubland to Scattered Shrub of *Acacia inaequilatera* with *A. trachycarpa* over Tussock Grassland of **Cenchrus ciliaris* with Hummock Grassland of *Triodia longiceps, T. epactia.*	Floodplains adjacent to major rivers. With red-orange (brown) loamy sands.	10.54 Q9, Q16	
VT04 Spinifex Steppe on Calcareous Stony Lower Slopes	Hummock Grassland of *Triodia epactia* with *T. schinzii, T. longiceps* with emergent Scattered Trees of *Corymbia hamersleyana*, Scattered Shrubs to Tall Shrubland of *Acacia inaequilatera, Grevillea wickhamii, A. tumida* var. *Pilbarensis* Scattered Low Shrubs to Low Shrubland of *Corchorus parviflorus, A. spondylophylla, A. ptychophylla*, with Scattered Herbs	Lower Slopes with stony calcareous soils.	31.96 Q5, Q6, Q7, Q11, Q17, R3, R4	
VT05 Spinifex Steppe with Emergent Scrub on Sandy Lower Slopes	Hummock Grassland of *Triodia epactia* with *T. schinzii, T. longiceps* with **Cenchrus ciliaris*, with emergent Scattered Trees of *Corymbia hamersleyana*, Open Shrubland to Tall Shrubland of *Acacia tumida*, *Grevillea wickhamii, G. pyramidalis, A. inaequilatera, Petalostylis labicheoides,* Scattered Low Shrubs to Low Shrubland of *Corchorus parviflorus, A. spondylophylla, A. ptychophylla*, with Mixed Herbs of *Cleome* spp., *Heliotropium* spp.	Lower Slopes to broad drainage lines or areas of sheetwash with stony sandy soils.	32.89 Q8, Q15, Q20	

Vegetation types	Description	Landform and substrate	Extent (ha) Survey Locations	Representative photograph
VT06 Spinifex Steppe on Stony Mid Slopes	Hummock Grassland of *Triodia epactia* with emergent Scattered Trees of *Corymbia hamersleyana*, Scattered Shrubs to Tall Shrubland of *Acacia inaequilatera, Grevillea wickhamii, Hakea lorea* with Scattered Low Shrubs to Low Shrubland of *Corchorus parviflorus, A. spondylophylla, A. ptychophylla*, with Scattered Herbs	Mid Slopes with stony soils.	18.03 Q3, Q13, Q14, Q23, R8	
VT7 Spinifex Steppe on Stony Upper Slopes with Emergents	Hummock Grassland of *Triodia epactia* with Very Open Tussock Grassland of *Eriachne mucronata, Cymbopogon ambiguus, *Cenchrus ciliaris* with emergent Scattered Trees of *Corymbia hamersleyana*, *Atalaya hemiglauca* with Scattered Shrubs to Tall Shrubland of *Acacia inaequilatera, Grevillea wickhamii, Hakea lorea* with Scattered Low Shrubs to Low Shrubland of *Corchorus parviflorus, A. spondylophylla, A. ptychophylla*, *Indigofera monophylla, Triumfetta chaetocarpa* with Scattered Herbs	Upper Slopes in Coongan Gorge with Outcropping rock and steep slopes.	38.49 Q2, Q4, Q22, R5, R7	
VT8 *Terminalia – Atalaya* Low Woodland on Steep Slopes	Low Open Forest to Low Open Woodland of *Terminalia circumalata, Atalaya hemiglauca* over Tall Shrubland to Shrubland of *Ehretia saligna, Acacia inaequilatera*, *Flueggea virosa*, over Low Shrubland of *Corchorus parviflorus, A. spondylophylla, A. ptychophylla*, *Indigofera monophylla, Triumfetta chaetocarpa* over Hummock Grassland of *Triodia epactia* with Open Tussock Grassland of *Eriachne mucronata, E. lindleyanus, Cymbopogon ambiguus, *Cenchrus ciliaris* with Scattered Herbs	Upper (south facing) Slopes in Coongan Gorge on sheltered stony gullies and very steep slopes.	0.96 R6	

Vegetation types	Description	Landform and substrate	Extent (ha) Survey Locations	Representative photograph
VT9 *Atalaya-Flueggea* Shrublands on Large Stony Scree	Open Shrubland to Tall Open Shrubland of *Atalaya hemiglauca*, *Flueggea virosa*, *Clerodendrum floribundum* with *Ehretia saligna* over Shrubland to Low Open Shrubland of *Gossypium australe, Senna glutinosa* subsp. *glutinosa, Corchorus parviflorus* over Very Open Hummock Grassland of *Triodia epactia, T. wiseana* with Very Open Tussock Grassland of **Cenchrus ciliaris, Eriachne mucronata, Cymbopogon ambiguus* with Scattered Herbs of *Cucumis variabilis* and *Boerhavia coccinea*	Upper slopes in Coongan Gorge on massive boulder field / large stony scree.	1.92 Q1, Q21	

4.3.4 Vegetation condition

The vegetation within the survey area was rated as between condition 3 and 7. The majority of vegetation throughout the survey area was rated as condition 6; in these areas the vegetation had been recently burnt. Rivers within the survey area were also rated as condition 6 due to the high weed infestation and disturbance by grazing cattle. A similarly large area of condition 5 was recorded indicating a recovery from extensive moderate to recent fires.

The areas mapped as condition 7 are due to the presence of historical material extraction and the Marble Bar Road. The better condition vegetation (condition 3) is associated with unburnt areas along the south facing slopes and gullies of the Coongan Gorge.

The extents of the vegetation condition ratings mapped within the survey area are provided in Table 7 with the vegetation condition of the survey area mapped in Figure 4, Appendix A.

Table 7 Extent of vegetation condition ratings within the survey area

Condition rating	Extent (ha)
3	4.94
4	14.46
5	53.70
6	67.12
7	6.17
Total	**146.39**

4.4 Flora

4.4.1 Flora diversity

The survey recorded 120 flora taxa (including subspecies and varieties) representing 39 families. This total comprised 110 native species and ten introduced (exotic) species. Due to the absence of adequate flowering parts and/or fruiting bodies required for identification, four taxa could only identified to genera, however none of these taxa are considered to be introduced or conservation significant taxa.

Dominant families recorded from the survey area are:

- Fabaceae (26 taxa)
- Poaceae (19 taxa)
- Malvaceae (6 taxa)
- Asteraceae (5 taxa)
- Boraginaceae (5 taxa)
- Amaranthaceae (5 taxa).

The average species richness for the 23 quadrats was 14.26 ± 4.72 (standard deviation of the mean), with a range of eight to 27 species per quadrat.

A flora taxa list for the survey area is provided in Appendix D.

4.4.2 Conservation significant flora

No EPBC Act, WC Act or DPaW Priority listed flora taxa were recorded within the survey area during the 2016 survey.

Likelihood of Occurrence

A Likelihood of Occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species.

The Likelihood of Occurrence assessment concluded that two taxa are considered likely to occur, based on known location and preferred habitat, four taxa may possibly occur and the remaining four taxa are unlikely to occur within the survey area. The recent burn over almost half of the survey area cannot preclude the presence of the six taxa being present. Four of the taxa considered are annual species and may not have been present due to the low rainfall. One taxon (*Nicotiana umbratica*) that may possibly occur has been recorded within 10 km of the survey area and some suitable habitat occurs within the survey area. A summary of the outcomes of species considered as known, likely or possible to occur is provided below (Table 8).

Table 8 Summary of Likelihood of Occurrence Assessment

Species	DPaW listing	Likelihood of Occurrence
Acacia cyperophylla var. *omearana*	P1	Possible
Euphorbia clementii	P2	Likely
Gomphrena leptophylla	P3	Possible
Nicotiana umbratica	P3	Likely
Bulbostylis burbidgeae	P4	Possible
Ptilotus mollis	P4	Possible

4.4.1 Other significant flora

No other significant flora as defined by the EPA and DPaW (2015) was identified within the survey area during the field survey.

4.4.2 Introduced flora

The survey area has had extensive disturbance from flood, fire, fauna grazing, weed infestation and road maintenance with weed species widespread across the survey area. Most weed species were associated with drainage lines or the main riverine channels, however, **Cenchrus ciliaris* (Buffel Grass) was often recorded high in the landscape due to transportation by fauna. Ten introduced taxa were recorded within the survey area during the field survey (Appendix D). The most commonly recorded weed species were **Cenchrus ciliaris, *Aerva javanica* and **Calotropis procera*.

Weeds of National Significance and Declared Pests

No introduced species listed as a Declared Pest under Section 22 of the BAM Act or a WoNS (DotE 2016d), was recorded within the survey area.

4.5 Fauna

4.5.1 Fauna habitat

Five main fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation associations described in section 4.3 and mapped in Figure 3, Appendix A and include:

- *Triodia* hummock grassland on plain or undulating plain
- Minor drainage lines with small dense patches of trees/shrubs and scattered trees
- *Eucalyptus camaldulensis and Melaleuca argentia* along Talga and Coongan Rivers
- Rocky ridgelines /rocky ranges (with scree) with hummock grasslands and scattered trees and shrubs
- Water bodies and riverine habitats along the Talga River.

Disturbed areas also formed portions of the survey area and although not alsways considered as fauna habitat the minor roads in the survey area in areas comprise wheel ruts which still have the ability to be utilise by fauna. Disturbed areas have been included in Table 9.

The topography of survey area varied from riverine and flat plain to undulating plain with rocky ranges including Coongan Gorge. There are two major rivers (Talga and Coongan River) within the survey area, both low points in the environment with water bodies present. Minor drainage lines drain from the hills/ranges surrounding the survey area into these rivers. Soils were predominantly red or red-brown stony-sandy loams with surface gravels on the plain, some exfoliating rock was present in subtle rises. The rocky hills and ranges comprise mostly of rocky substrates with breakaways or exposed conglomerate rock. Most peaks or high points on the range had exposed rocky areas with scree slopes and breakaways in areas.

The habitat types for the survey area are described in Table 9.

Habitat connectivity

The fauna habitats of the survey area are part of a contiguous largely intact area of remnant vegetation within leased land primarily used for cattle grazing.

The fauna habitats of the survey area are part of a much larger area of similar habitats within the local area and greater study area. The positionof the Marble Bar Road is mostly on a plain with large flat to undulating expanses of hummock grassland with open woodland. The Marble Bar Road (at the survey area) winds within the Coongan Gorge and its associated ranges (and drainage lines) which consists mostly rocky hills/ranges.

The ephemeral drainage lines within the survey area drain into both the Coongan and Talga Rivers which are major watercourses in the region, ultimately draining into the much larger system of the De Grey River in the north.

The Marble Bar Road provides the only artificial barrier to fauna moving north-south through the landscape including the survey area. A natural barrier to movement of fauna is the large expanse of open sandy river bed of the Coongan and Talga river where at some point were one kilometre across with little cover. Apart from the Marble Bar Road (and other minor access tracks) fauna movement is largely unrestricted. Overall, the habitats within the survey area are largely contiguous through the local area and mostly well connected with habitats through the greater study area.

Disturbance

Some of the habitats within the survey area have been impacted to some degree by past disturbances including roads and minor roads, communication line establishment, historical rail and infrastructure, parking areas and cattle grazing. Roads make up a very small area of impact and are either maintained by pastoralism, tourism (access to rivers) or access to old rail areas. Portions of the survey area had been historically impacted by the establishment of underground services (telecommunications) lines. This corridor in some areas was approximately six m wide and ripped. Rehabilitation appeared to have naturally occurred in these areas. Cattle's grazing/use was evident throughout the survey area with heavy use age along drainage lines and river habitats. However, use by cattle was evident in all areas.

The entire southern side of Marble Bar Road had recently been impacted by fire (including Coongan Gorge and associated plain) with the majority of the survey area being unburnt (< 5 years).

Habitat value

The survey area primarily consisting of Coongan Gorge and associated ranges and the riverine environments provides a high level of habitat diversity and significance for many native fauna species including species of conservation significance.

The hummock grassland plain would be moderate to high significance because of it connectivity and use by fauna moving between environments (ranges to water bodies and riverine) within the survey area. If these areas are further impacted or fragmented fauna movement maybe restricted and populations affected.

The habitats within the survey area are mostly intact, variable in composition and well connected with habitats within the local area and greater study area, with the exception of the Marble Bar Road.

A natural barrier to fauna exists via large expanses of open river bed which does provide existing barriers to the movement of some fauna. This is a natural barrier and species may have adapted to the environment.

The overall value of the habitat was considered to be high, because of the diversity and quality of habitat types (e.g. good to excellent structural diversity within each habitat type), good connectivity and for supporting known and potential habitat values for conservation significant ffauna species (see Table 9). In particular, the Marble Bar Road winds between and bisects Coongan Range that have large amounts rocky habitat available. These habitat areas a known to support conservation species and likely to move over the landscape to utilise other areas and resources.

Following a review of aerial photography and corresponding native vegetation associations, and review of habitat types whilst driving along the Marble Bar Road the habitats of the survey area are considered to be well represented within the local area and are probably well represented within the greater study area. However, it is difficult to determine the value (e.g. habitat quality) of the habitats for conservation significant fauna in the greater study area (e.g. does the surrounding vegetation contain the necessary structure and microhabitats for breeding?). It is considered unlikely that the habitat within the survey area provides the habitat requirements for all fauna species of conservation significance discussed in section 4.5.3.

Table 9 Fauna habitat types within survey area

Description	Indicative photograph
***Triodia* hummock grassland on plain or undulating plain** Vegetation association: VA03, VA04 This habitat type occurs across the majority of the survey area on the plain or with slight undulation where there is association to low hills. This habitat type is mostly dominated by a *Triodia* hummock grassland (10-60 % cover depending on fire scaring) with heavy loam stony soils. The native grassland area appeared a mosaic of burn scars from 1 year to long unburnt (> 5 years) given the density and size of the grass hummocks recorded. However, some areas were open due to over grazing rather than burn scar. The grassland provides good foraging and breeding opportunities for small native ground mammals and reptiles. Small skinks and dragons were observed active during the survey. Animal tracks, digs and occasional small burrows were recorded in this habitat type, most of which were varanid digs/burrows. The undulating areas (closest to the ranges) had presence of Western Pebble-mound mouse (*Pseudomys chapmani*). The overstorey consist of open woodland of scattered trees and small clumps of trees including *Corymbia* and *Eucalyptus* species (<10%). These trees were often small (to 6-8 meters) and provided few hollows. The shrub/midstorey layer was sparse but sometimes moderate to dense in small patches and consisted of *Acacia, Hakea and Grevillea* species (<10 %). Fallen branches were sparse in this habitat type-which is probably an artefact of the fire history and the open scattered over storey. Leaf-litter and other forms of non-vascular (ground cover of dead plant material) was localised beneath small clumps of trees but was uncommon. *Habitat value for fauna species of conservation significance* Moderate to high value Part of a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat provides for the Western Pebble-mound mouse and potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). One Northern Quoll (*Dasyurus hallucatus*) was observed leaving the ranges onto the plain towards the Talga River during a night survey. It appears that the plain is used as a crossing for Quoll to water and resources. The Pilbara Leaf-nose Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*) would utilise the aerial environment for foraging.	 

Description	Indicative photograph
Minor drainage lines with small dense patches of trees/shrubs and scattered trees Vegetation association: VA05, VA08 This habitat type occurs across the survey area in the flatter areas with minor catchments and primarily consists of a small corridor of denser vegetation over a rocky substrate. Some of these drainage lines appeared artefacts of the road construction or run off provided by the road. Most of the drainage lines flowed into larger systems in the area eventually getting to either the Talga or Coogan Rivers. This habitat type is mostly dominated by a dense coverage of Acacia to 30 % which thins as you move away from the bed. Incursion by *Triodia* hummock grassland also occurs at some drainage lines up to 30 %, with Buffel Grass (*Cenchrus spp*.) also invaded into some lines forming up to 10 % coverage. These areas appeared a mosaic of burn scars from 1 year to long unburnt (> 5 years) given the density and size of the grass hummocks recorded. However some areas were open due to over grazing rather than burn scar. The drainage lines provide good foraging opportunities for small native ground mammals and reptiles as well as small birds such as honey eaters, wrens and whistlers. Some small skinks (*Carlia munda, Menetia greyi, Morethia ruficauda* and *Ctenotus saxatalis*) and dragons (*Amphibolurus logirostris*) were often observed moving amongst the dense grassland during the survey. Several Spinifex Pigeon (*Geophaps plumifera*) were flushed in this habitat. Few animal signs were recorded in this habitat type, due to the mostly stony substrates. Cattle and Kangaroo browsing and resting evidence was recorded. The overstorey consists of an open woodland (<10 %) of scattered trees including *Corymbia* and *Eucalyptus* species to 8 meters and provided few hollows, however the composition of trees varied if the drainage line was within the range or on the plain. Fallen timber, hollow bearing logs were very occasionally recorded in this habitat type-which is probably an artefact of the fire and the scattered overstorey. Leaf-litter and other forms of non-vascular (ground cover of dead plant material) were scarce. *Habitat value for fauna species of conservation significance* Moderate to high value Patchy in the landscape but part of a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). Northern Quoll (*Dasyurus hallucatus*) has also been historically recorded in drainage lines. The Pilbara Leaf-nose Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*) would utilise the aerial environment for foraging. The Pilbara Olive Python (*Liasis olivaceus barroni*) may utilise this habitat to move between the range and the Riverine environments.	 

Description	Indicative photograph

Description	Indicative photograph
***Eucalyptus camaldulensis and Melaleuca argentea* Woodland within Rivers** Vegetation association: VA02 This habitat type occurs in the Talga and Coongan River in (and close to) the survey area that comprise large Eucalyptus species primarily *Eucalyptus camaldulensis and Melaleuca argentea* in low points in the environment. This habitat type occurs in only small portions of the survey area and is associated to low lying areas where water bodies are present. This habitat type is mostly dominated by a moderate to sometimes dense coverage of *Melaleuca argentea* only with scattered *Eucalyptus camaldulensis* and scattered other tall shrubs and trees (60 %) to 15 meters tall, with the occasional very tall ~20 m present. The shrub/midstorey layer was sparse but sometimes moderate to dense in small patches and consisted of a mixed shrub species or young Eucalyptus and Melaleuca species (10 to 30 %). Portions of the river beds were open with occasional logs and debris present. This habitat appeared long unburnt given the size and lack of fire evidence present. Cattle use was evident throughout this habitat area. The tree and tall shrub coverage provided in the environment are excellent for a range of bush birds including an array of Honey eaters, Rufous Whistlers (*Pachycephala rufiventris*), Grey Shrike Thrush (*Colluricincla harmonica*) and Yellow Throated Miner (*Manorina flavigula*). Additionally, numerous water birds were utilising this habitat for roosting including Straw-necked Ibis (*Threskiornis spinicollis*), Australasian Darter (*Anhinga novaehollandiae*), Little Pied Cormorant (*Microcarbo melanoleucos*) and Little Black Cormorant (*Phalacrocorax sulcirostris*). Diameter at breast height (DBH) ranges from of 30-80 cm with the majority of trees probably between 40-60 cm. Small and medium (5–15 cm diameter) aerial hollows including some dead spouts are common within most larger trees, whereas large hollows (> 15 cm) were present but less common (but were in approximately 1 in 30 trees). Aerial hollows provide potential roosting and breeding habitat for native fauna (i.e. many nocturnal and diurnal birds, reptiles and microchiropteran bats). Animal tracks were prominent and easily identified in the soft sands in this habitat type, most of which were dog, cattle, cat, potential Bilby (*Macrotis lagotis*) and Northern Quoll (*Dasyurus hallucatus*). However large monitors, bustard and stone curlew were also recorded. Fallen timber, hollow bearing logs were very occasionally recorded in this habitat type-however where present were often a part of or tangled within root buttress of large trees forming dense entangled areas of woody debris. Leaf-litter and other forms of non-vascular (ground cover of dead plant material) was present but not built up due to water flow. *Habitat value for fauna species of conservation significance* High value A small area of habitat (in the survey area) that joins to or is a part of a larger area of continuous remnant vegetation extending beyond the survey area. This habitat provides potential hunting and foraging	 

Description	Indicative photograph
opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). Northern Quoll and Bilby prints were recorded in the soft sands. A single Ghost Bat (*Macroderma gigas*) was recorded flying around (foraging) and likely that the Pilbara Leaf-nose Bat (*Rhinonicteris aurantia*) would utilise the aerial environment for the same purpose. The dense buttress areas of debris would also provide excellent hide areas for Quoll and Pilbara Olive Python (*Liasis olivaceus barroni*). Roosting by migratory species Glossy Ibis (*Plegadis falcinellus*), Wood Sandpiper (*Tringa glareola*), Sharp-tailed Sandpiper (*Calidris acuminata*) and Common Sandpiper (*Actitis hypoleucos*) could also occur in tall trees.	

Description	Indicative photograph
Rocky Ridgelines / hills with hummock grasslands and scattered trees and shrubs (breakaway and scree were present in some areas) Vegetation association: VA06, VA07, VA09 This habitat type occurs across the survey area, where the road intersects (and portions of the loop road) the ranges and association to low hills. This habitat type is mostly dominated by *Triodia* hummock grassland (0 to 80% cover), depending on burn scars and scree presence. Substrate composition was rocky ranging from pebble rocks amongst *Triodia*, to breakaways and scree slope areas. Large areas of conglomerate rock were also present. The majority of the native grassland area appeared both long unburnt (> 5 years) and recently burnt in some areas (<1 year) given the density and size of the grass hummocks recorded. However some areas were a mosaic of burn ages. The grassland provides good foraging and breeding opportunities for small native ground mammals and reptiles. Small skinks and dragons were observed active during the survey. Animal tracks were recorded in this habitat type, most of which were kangaroo and wallaby. The rocky habitats on the ranges and hills also provide habitat to a different array of species (*Dasyurus*, dunnart, *Pseudoantechinus* and reptiles) as well as provide cave structures to bats. No large caves were recorded in the survey area to support Ghost Bat (*Macroderma gigas*) or Pilbara Leaf-nose Bat (*Rhinonicteris aurantia*). No overstorey or mid storey was present or very scattered and the understorey shrub layer was sparse but sometimes moderate to <10 % and primarily consisted of a low *Acacia*, *Grevillea* or *Hakea* species. Fallen branches were very sparse in this habitat type-which is probably an artefact of the fire history and the open scattered over and mid storey. Leaf-litter and other forms of non-vascular (ground cover of dead plant material) was localised and uncommon. *Habitat value for fauna species of conservation significance* High value A large area of habitat that joins to or is apart of a contiguous remnant environment extending beyond the survey area. This habitat provides resources for the Western Pebble-mound mouse (*Pseudomys chapmani*) and Long-tailed Dunnart (*Sminthopsis longicaudata*) and potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) Grey Falcon (*Falco hypoleucos*). No large cliffs were present in the survey area for Peregrine Falcon to utilise for breeding however looked to be present in the greater study area. Northern Quoll (*Dasyurus hallucatus*) scats and feeding evidence was recorded in this environment and one individual was recorded traversing from the range onto the plain towards the river. This habitat is regarded as important habitat for this species. Ghost Bat (Macroderma gigas) and Pilbara Leaf-nose Bat (*Rhinonicteris aurantia*) would utilise the aerial environment for foraging purposes. They would also utilise large caves for roosting and breeding however none were recorded in the survey area but maybe present within the greater study area. This environment is also important habitat for the Pilbara Olive Python (*Liasis olivaceus* subsp. *barroni*) which would utilise the rocky habitat areas as reuge	 

Description	Indicative photograph
moving to water bodies as required.	
Riverine and water bodies along the Coongan and Talga River Vegetation association: VA02 This habitat type occurs in a very small portion of the survey area where the survey area intersects the riverine environment. This environment is associated to and merges with Eucalyptus camaldulensis and Melaleuca argentea Woodland in the river beds. This habitat is mostly dominated by water bodies surrounded by either woodland or mud flats. The water body has water plants, fish and potentially the Plate-shelled Turtle (*Chelodina steindachneri*) present suggesting permanent (or semi permanent) in nature. Due to the presence of water and shade from the woodland high use was recorded by introduced grazers such as cattle, horse and camel and had severely impacted the area with extensive bank trampling and over grazing. Additionally, high use was also recorded by native species includeing water birds, bush birds, kangaroos and NortherN Quoll (*Dasyurus hallucatus*). The bat detector was placed over the water body on a rocky ridge and eight species of microchripteran bat were recotrded suggesting high use of the water resource to bat species. Fallen timber, hollow bearing logs were very occasionally recorded in this habitat type-however where present were often a part of or tangled within root buttress of large trees forming dense entangled areas of woody debris. Leaf-litter and other forms of non-vascular (ground cover of dead plant material) was present but not built up due to water flow. Habitat value for fauna species of conservation significance High value A small area of habitat (in the survey area) that joins to or is a part of scattered and isolated water bodies in the greater study area. This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*). Northern Quoll prints were recorded near by and likely utilise the water source. A single Ghost Bat (*Macroderma gigas*) was recorded flying around (foraging) nearby and likely that the Pilbara Leaf-nose Bat (*Rhinonicteris aurantia*) would utilise the aerial environment for the same purpose. The dense buttress areas of debris would also provide excellent hide areas for Quoll and Pilbara Olive Python (*Liasis olivaceus* subsp. *barroni*). Additionally, the python would utilise the water body as an ambush hunting location and is considered important habitat for the species. Foraging habitat on the banks and mud flat would be utilised by migratory species Glossy Ibis (*Plegadis falcinellus*), Wood Sandpiper (*Tringa glareola*), Sharp-tailed Sandpiper (*Calidris acuminata*) and Common Sandpiper (*Actitis hypoleucos*) could also occur in tall trees.	 

Description	Indicative photograph
Disturbed area Vegetation association: VA01 This environment occurs across small cleared areas or comprise of corridors within the survey area. These include minor and major roads, old railway line corridor and supportive infrastructure. Most of the disturbed area have very little fauna significance except the old railwat corridor and infrastructure which is comprised of a formed raised corridor of placed rocks. These areas now breaking down is some areas provided crevices and ruge locations for geckos, snakes and liards. Animal tracks were recorded in this habitat type, most of which were cattle and Kangaroo moving between the ranges to the water bodies. Vegetation in these areas varied depending on the location of the disturbance. Habitat value for fauna species of conservation significance Low to Moderate value Disurbed areas are mostly formed corridors in the landscape extending beyond the survey area. This habitat provides limited opportunites to conservation significant fauna. However, a Northern Quoll latrine site was found along side the old Railway corridor (near to the water body) amongst boulders. Additionally where these corridors are positioned within the environment (to wind around the range) would force animals to cross from the ranges to the water bodies.	 

4.5.2 Fauna diversity

One hundred and sixteen fauna species were recorded within or in close proximity to the survey area during the survey, these included:

- 67 native birds
- 19 native mammals and six introduced mammals
- 20 native reptiles
- Four native fish.

The camera traps recorded a number of common species known from the area however the Northern Quoll and Rothchild's RockWallaby were identified and confirmed in the survey area.

NatureMap records indicate 209 vertebrate fauna taxa within the study area, many of which occur in the same and similar habitats that occur within and adjoining the survey area. The species diversity recorded during the current survey is considered to be moderate and it is likely with additional survey effort a higher number of native vertebrate fauna would be recorded within the survey area.

Of the 116 species recorded during this survey all have been previously recorded within the locality of the east Pilbara area (Atlas of Living Australia (ALA) 2016; DPaW 2007–).

A full list of fauna recorded during the field survey is presented in Appendix E.

Introduced fauna

During the survey, evidence for six introduced fauna species were recorded in the survey area and adjoining areas:

- Cat (*Felis catus*) – cat tracks were recorded at one location along a drainage line
- Dingo/dog (*Canis lupus dingo*) – scats and tracks were recorded
- Cow (*Bos taurus*) – scats and tracks everywhere
- Camel (*Camelus dromedarius*) - scats and tracks were recorded
- Horse (*Equus caballus*) - scats and tracks were recorded
- Rabbit (*Oryctolagus cuniculus*) - potential tracks (could also be Greater Bilby) but no other evidence recorded.

4.5.3 Conservation significant fauna

Three fauna species of conservation significance were recorded during the field surveys within the survey area. The Greater Bilby may also be present. Possible prints were recorded in the sand beds of the Talga River, however no other evidence was recorded. This species is also discussed below.

Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll (*Dasyurus hallucatus*) is listed as Endangered under the EPBC Act and under the WC Act.

The Northern Quoll once occurred across the majority of northern Australia but its range has significantly contracted. It occurs in the Pilbara region but in disjunct populations. The Northern Quoll inhabits a range of vegetation associations but is especially abundant on dissected rocky escarpment and eucalypt woodland within 200 km of the coast. It is known to den in rock crevices and rock piles and favours rocky areas. They are predominantly nocturnal but are

occasionally active during the day, particularly during the mating season and are known to have a large home range (Van Dyck and Strahan 2008).

The Northern Quoll was recorded active in the survey area during nocturnal searchs. One individual (a female – due to visible neck fat rolls) was observed moving from the ranges onto the plain moving directly towards the Talga River. It is likely that this species is routinely moving between the range and rivers (water bodies) for resources. The species was also captured 10 times on camera trap from five localities (Plate 2 and Plate 3) (at least three males and seven females). Further evidence of this was the presence of numerous sets of prints located in the soft sands of the river beds. Three latrine sites were identified on the range and near to the water body (but still on rocky habitat) all of which were fresh sites. Plate 4 and Plate 5 show these observations. Data records are mapped in Figure 5.

Plate 2 Male Northern Quoll from within the survey area

Plate 3 Female Northern Quoll from the survey area

Plate 4 Northern Quoll Scats under a large boulder

Plate 5 Northern Quoll prints in the Talka River bed.

Ghost Bat *(Macroderma gigas)*

The Ghost Bat (*Macroderma gigas*) is listed as Vulnerable under the EPBC Act and under the WC Act.

The Ghost Bat occurs in a wide range of habitats (foraging), and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost (roosting and breeding). It is patchily distributed across Australia with an isolated population persisting in the Pilbara region, and is sensitive to disturbance (Van Dyck and Strahan 2008).

The Ghost Bat was recorded on the edge of the survey area during spot lighting surveys. One individual was visually recorded flying within the *Melaleuca* Woodland presumably hunting. This location is mapped in Figure 5.

No caves suitable for Ghost Bat were recorded in the survey area and broader searches in the study area failed to yield any large caves. However this search was not exhaustive and additional surveys may identify cave systems. The complex and steep rocky slopes of habitat in the study area may contain caves that are suitable roosting and feeding habitat and may include maternity caves. The species has been recorded on numerous occations within 40 km of the survey area east and south (DPaW 2007–).

Greater Bilby (*Macrotis lagotis*)

The Greater Bilby (*Macrotis lagotis*) is listed as Vulnerable under the EPBC Act and under the WC Act.

The Greater Bilby distribution in Western Australia is restricted to the north, including the Pilbara, Sandy and Gibson Deserts. Extant population of the Greater Bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils. It occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas. Populations are known to move long distances when current habitat ranges become unsuitable and resources depleated. Bilbies are largely solitary, widely dispersed and found in low numbers.

During the survey three sets of potential Bilby tracks were recorded in the bed of the Talga River (see Plate 6 and Plate 7). Unfortunately Bilby and Rabbit tracks are very similar in look and difficult to tell apart. Broader searches were undertaken within the study area (but only up to 1km from the survey area boundary) to locate any additional information from either the Bilby or Rabbit's presence. A old burrow system was located on the far side of the Talga River but due to the age and eroded nature of the system, no conclusive decision could be determined if it was Bilby or Rabbit. No other evidence was found from either species to make an informed disicion on which species (if not both) are present in the survey and study area. The survey area is within the northern most limit of the Rabbits distribution with only one record in the study area. However Bilby are known from the area with a recent population of bilby identified approximately 20 km north of the survey area (Martin Dziminski pers comm, DPaW 19/06/2016) and an additional population recorded 20 km south (DPaW 2007–).

Plate 6 A set of Bilby or Rabbit prints in the Talga River.

Plate 7 Second set of Bilby or Rabbit prints in the Talga River.

Western Pebble-mound Mouse *(Pseudomys chapmani)*

The Western Pebble-mound Mouse is listed Priority 4 under DPaW Priority fauna listing.

The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the species can be found on stony hillsides with hummock grasslands. It constructs large mounds of pebbles on stony slopes which cover an area of 0.5-9.0 square metres. 'Active' mounds are characterized by volcano-like cones capped by 'craters' that mark occluded entrances to subterranean burrow systems in which the mice live, often gregariously (Van Dyck and Strahan, 2008).

Evidence of the species was recorded in 19 locations within the survey area (as shown in Figure 5, Appendix A). In total seven active and 12 inactive mounds were recorded on the range, low stony hills or undulating plains. Plate 8 shows one of the active mounds recorded. *NatureMap*

records (DPaW, 2007–) indicate that this species is widespread in the eastern Pilbara region. However this species is known to be sensitive to external impacts and populations are known to decline in areas where disturbance has occurred.

Plate 8 An active mound amongst Triodia.

Likelihood of Occurrence

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 27 conservation significant fauna species. An assessment on the Likelihood of Occurrence for conservation significant fauna species in the survey area was conducted (Appendix E). This assessment was based on species biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the survey area and the surrounding area (e.g. DPaW 2007–).

The assessment identified the likely presence of an additional nine other species of conservation significance (see Table 10). The Likelihood of Occurrence assessment revealed that other fauna species of conservation significance could occasionally occur within the habitats of the survey area (those species deemed 'unlikely' to occur). However, it is considered unlikely that the survey area provides important habitat (e.g. breeding habitat or key foraging habitat) for any of these species deemed 'unlikely' to occur and that these other species may occasionally use the habitats of the survey area for temporary refuge and dispersal between other areas of habitat.

Table 10 Summary of fauna species of conservation significance recorded during survey and determined likely to occur within the survey area

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Pilbara form) Vu, S3, Vu	**Likely – species is known from the study area and habitat present** No Caves were recorded in the survey area nor any identified during regional walks in study area. However the survey area is likely foraging habitat only used as required. There are no historical records within survey area with numerous records within 40 km of the survey area.
Pilbara Olive Python *Liasis olivaceus barroni* Vu, S3, Vu	**Likely – resident/regular visitor, opportunistic use in/to the survey area** The survey area provides suitable habitat for the species. The rocky ranges, rivers and associated habitats including the water bodies would be regarded as important habitat for the species. The remainder of the habitat in the survey area is supportive only. There are no historical records within survey area, numerous records within 80 km (one within 40 km).
Peregrine Falcon *Falco peregrinus* OS, S7	**Likely – regular visitor or resident to survey area** The survey area provides suitable hunting and roosting habitat. The survey area is probably part of the species broader home range, limited breeding habitat occurs within the survey area (breeding potential could occur in the large *E. camaldulensis* and *Melaleuca argentea* Woodland in the river). Important breeding habitat (e.g. steep cliffs) may be found in nearby ranges outside the survey area but within the study area. There are no historical records within survey area and three records within the study area.
Grey Falcon *Falco hypoleucos* Vu, S3	**Likely – regular visitor or resident to survey area** The survey area provides suitable hunting, roosting and breeding habitat for the species. The survey area is probably part of the species broader home range, limited breeding habitat occurs within the survey area (breeding potentially could occur in *E. camaldulensis* and *Melaleuca argentea* Woodland in the rivers). There are records within survey area and numerous records within the study area.
Long-tailed dunnart *Sminthopsis longicaudata* P4	**Likely –resident to survey area, restricted to the rocky ranges** The survey area provides suitable habitat for the species particularly in rocky ranges and associated rocky habitats. The species has been recorded within the study area and the species likely present. There is no historical records within survey area and numerous records are within 20 km.
Glossy Ibis *Plegadis falcinellus* Miw, S5, IA	**Likely – resident/regular visitor, opportunistic use in/to the survey area** This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. This species is knowbn tro persist in the Pilbara. The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area).

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence
Wood Sandpiper *Tringa glareola* Miw, S5, IA	**Likely –seasonal visitor, opportunistic use in/to the survey area** This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. This species is knowbn tro persist in the Pilbara. The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area).
Sharp-tailed Sandpiper *Calidris acuminata* Miw, S5, IA	**Likely –seasonal visitor, opportunistic use in/to the survey area** This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. This species is knowbn tro persist in the Pilbara. The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area).
Common Sandpiper *Actitis hypoleucos* Miw, S5, IA	**Likely –seasonal visitor, opportunistic use in/to the survey area** This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. This species is knowbn tro persist in the Pilbara. The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area).

Table note:

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following: MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered

WC Act - Species listed as CR = critically endangered, En = endangered, Vu = Vulnerable, IA = international migratory agreement migratory birds, OS = other specially protected fauna

DPaW – Species listed as Priority (P) 1, 2, 3 or 4

5. Project constraints and approvals

This section provides preliminary environmental approvals and referrals advice based on the biological constraints identified within the survey area. As the project is in concept design there may be opportunities to avoid and minimise the impacts on these biological constraints through design refinement. If the biological constraints can be avoided or impacts to them minimised it may negate the need for environmental approvals or referral to Australian Government / State environmental agencies.

5.1 Key biological constraints

The key biological constraints identified within the survey area during the biological assessment are summarised below in Table 11.

5.2 Environmental approvals and referrals

5.2.1 Australian Government approvals

Referral to the DotE under the EPBC Act is triggered if a proposed action has or potentially has a significant impact on any MNES. Table 12 shows an assessment of the survey area against key biological MNES.

Table 11 Key biological constraints within the survey area

	Survey area
Flora of conservation significance	No flora taxa of conservation significance were recorded during the field assessment. The likelihood of occurrence assessment indicates that six flora taxa of conservation significance taxa are considered likely to be present within the survey area.
Fauna of conservation significance	Presence of four fauna species: • Northern Quoll (*Dasyurus hallucatus*) – One specimen recorded active, at least two specimens on camera trap, four latrine sites and prints obsertved. The range with rocky habitats, riverine and woodlands are all important habitat for the species. The remainder is potential foraging habitat and supportive only • Ghost Bat (*Macroderma gigas*) – One specimen recorded active at night in the survey area. No caves present in the survey area. The survey area is foraging habitat for the species • Greater Bilby (*Macrotis lagotis*) – three sets of print identified as potential Bilby and one old burrow system. Habitat is present, the species is known from the region • Western Pebble-mound Mouse (*Psudomys chapmani*) – recent evidence of seven active mounds was recorded within the survey area including 12 inactive mounds Potential presence of nine species and their habitats within the survey area: • Grey Falcon (*Falco hypoleucos*) – Records within the survey area and the species is a potential resident with breeding and hunting habitat present • Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – Records in the region and foraging habitat present in riverine, woodland and ranges. Foraging habitat available for the species throughout the survey area • Pilbara Olive Python *(Liasis olivaceus barroni*) - Records in the region and habitat present in riverine (water body), woodland and ranges, all considered important habitat • Peregrine Falcon (*Falco peregrinus*) – Records in the region and habitat present in riverine, woodland, and ranges, hunting (foraging) habitat available for the species throughout the survey area • Long-tailed Dunnart (*Sminthopsis longicaudata*) – Records in the region and habitat available for the species • Glossy Ibis *(Plegadis falcinellus)* – Records in the region and habitat available for the species • Wood Sandpiper *(Tringa glareola)* – Records in the region and habitat available for the species • Sharp-tailed Sandpiper *(Calidris acuminata)* – Records in the region and habitat available for the species • Common Sandpiper *(Actitis hypoleucos)* - Records in the region and habitat available for the species.

Table 12 Assessment of the key biological Matters of National Environmental Significance for the survey area

Key biological MNES	Present	Need for referral to DotE under EPBC Act (likely significant impact)
Listed Threatened Species and Ecological Communities	No EPBC listed flora species, or ecological communities were identified during the current survey or are considered likely to occur. The assessment identified the presence or likely presence of one EPBC listed fauna species: Northern Quoll (*Dasyurus hallucatus*). Greater Bilby (*Macrotis lagotis*) Pilbara Olive Python *(Liasis olivaceus barroni*) Ghost Bat (*Macroderma gigas*) Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	**Northern Quoll** **Referral Recommended** A review of the Significant Impact Guidelines (DotE 2013) and the species specific Northern Quoll referral guidelines (Commonwealth of Australia (CoA) 2016 – see Table 12) was undertaken to consider the need for referral to the DotE for the Northern Quoll. Referral is recommended for the Northern Quoll because: • The species was recorded during current surveys at numerous locations within the survey area via several methods including sighting, camera traps, latrine/scat sites and prints. Visual observations of specimens recorded both male and females. • There is significant habitat present for the species and a portion may be impacted by the project. The habitat within the survey area is considered habitat critical to the survival for a population of the Northern Quoll The Northern Quoll was recorded moving in-between the range to the riverine environment in search of resources. The project proposes to put a loop road through these areas potentially bisecting habitat which may cause additional barrier effects. **Greater Bilby** **Referral Recommended** A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotE for the Greater Bilby. Referral is recommended for the Greater Bilby because: • Observations of potential use were identified via possible prints in sand at 3 locations and a potential old burrow was located • There is a known population both north and south of the survey area within 20 km • Although no direct conclusive evidence was collected for this species, due to their presence in the region a precautionary principle is advised • With additional survey effort this conclusion could be refined and potential eliminate the need for referral for this species.

Key biological MNES	Present	Need for referral to DotE under EPBC Act (likely significant impact)
		Pilbara Olive Python **Referral Recommended** A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotE for the Pilbara Olive Python. Referral is recommended for the Pilbara Olive Python because: • Habitat recorded in the survey area is considered important to the species including the rocky ranges, drainage lines, riverine and water bodies • There is a known population within the region and numerous specimens recorded within 80 km of the survey area • Although no direct conclusive evidence was collected for this species, due to their presences in the region the precautionary principle is triggered and taken • The species is likely to move in-between the range and riverine environment in search of resources. The proposed project is to put a road through these areas bisecting habitat causing additional barrier effects. The impact of this need to be mitigated • With additional survey effort this conclusion could be refined and potential eliminate the need for referral for this species. **Ghost Bat** **Referral unlikely** A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotE for the Ghost Bat. Referral is unlikely for the Ghost Bat because: • No core habitat for the species was recorded during the current survey, foraging habitat is present only • There is a low risk of a substantial impact to critical habitat for a population of the Ghost Bat, no cave habitats were recorded in the survey area. Only foraging habitat is present in the environment. **Pilbara Leaf-nosed Bat**

Key biological MNES	Present	Need for referral to DotE under EPBC Act (likely significant impact)
		Referral unlikely A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotE for the Pilbara Leaf-nosed Bat. Referral is unlikely for the Pilbara Leaf-nosed Bat because: • No core habitat for the species was recorded during the current survey, foraging habitat is present only • There is a low risk of a substantial impact to critical habitat for a population of the Pilbara Leaf-nosed Bat, no cave habitats were recorded in the survey area. Only foraging habitat is present in the environment.
Migratory Species	The assessment identified the likely presence of four EPBC listed migratory wetland fauna species: Glossy Ibis (*Plegadis falcinellus*) Wood Sandpiper (*Tringa glareola*) Sharp-tailed Sandpiper (*Calidris acuminata*) Common Sandpiper (*Actitis hypoleucos*)	**Migratory Birds** **Referral unlikely** A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotE for the Migratory birds. These species are are nomadic utilising habitats as required. Much of the habitat available to the wading species is restricted to the riverine environment and unlikely to be impacted by the proposed works. Glossy Ibis are widespread throughout Australia and occurs in a wide range of habitat types, it is unlikely to rely on the habitats present within the survey area and clearing of habitat for the Project is unlikely to significantly impact a population of this species.

Table 13 Review of the Referral Guidelines for the Northern quoll

Aspect	Information	Outcome and risk assessment
Modelled distribution of northern quoll	Map 1 and Map 3 of the guideline (CoA 2016) DPaW (2016)	Modelling indicates (CoA 2016) the species is known/likely to occur within the survey area. The survey area occurs within the Pilbara mainland region distribution of the species and is part of the area of the Pilbara regional population as described in the guideline. Prior to this survey there were no records of the species in the survey area. Numerous records are present within 30 km of the survey area.
Habitat critical to the survival of the Northern Quoll	Habitat critical to the survival of the species is listed on page 16 of the guidelines (CoA 2016). The species was identified via scat searches (4 latrine locations) and camera trapping (10 records consisting of three males and seven females) and an additional animal was recorded during night surveys (a female). Prints were also recorded in the riverine environment. The Northern Quoll was confirmed to occur within the survey area during the field investigation from multiple locations and individuals. The fauna assessment determined that habitat within the survey area (ranges, rocky habitat, drainage lines, woodlands and riverine) are considered significant habitat for the species and the plain supportive habitat. The survey area provides suitable hunting, refuge and denning habitat, (ranges, rocky habitat, drainage lines, woodlands and riverine). The habitas as a whole form key resources for the species and provide connectivity with habitats adjacent the survey area. The survey area may be part of the home range of more than two individuals.	Given the results of the survey (one active animal, 10 camera records, four scat latrine locations and prints in the Talga River), it is likley that the survey area is a component of habitat critical to the survival of the regional population. The habitat within the survey area is part of a broader area of habitat for multiple individuals (from camera 10 records indicates at least three males and seven females. The active animal was female). It is considered that there is a risk of a substantial impact to critical habitat for a population of the Northern Quoll.
Populations important for the long-term survival of the Northern Quoll	High density populations are described by the guideline (pp16). The survey did record evidence of at least 11 Northern Quoll consisting of both males (3) and females (eight, including the active animal) over numerous locations throughout the survey area. Additionally the females recorded had the beginnings of fatty collars developing. These fatty collars on the necks of females develop as a point of male biting (holding) while mating and is an indication the population (at least females) are entering or in reproductive cycle, indicating a breeding event and population.	Considering the level of survey effort, and the evidence of the species presense in the survey area and greater study area, it is likely that the survey area is considered to be part of a high density quoll population, and therefore the habitat identified is significant to a population of Northern Quoll.

5.2.2 State approvals

Environmental Protection Authority

Significant proposals must be referred to the EPA under Section 38 of the EP Act. In deciding whether a proposal will be subject to the formal environmental impact assessment process, the EPA takes into account the environmental significance of any potential impacts that may result from the implementation of the scheme or proposal.

In the absence of a broader environmental assessment, the majority of the likely biological impacts associated with the project are linked to native vegetation clearing and loss of fauna habitat to conservation significant species recorded. The potential impacts from the loss of native vegetation and loss of fauna habitat can be effectively assessed through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, with consideration of the biological values discussed in this report, it is considered unlikely that the project would require referral to the EPA under Section 38 of the EP Act.

Department of Environment and Regulation

The clearing of native vegetation in Western Australia requires a permit under Part V of the EP Act, unless an exemption applies. Main Roads has been granted a Statewide Purpose Clearing Permit (CPS 818) which allows Main Roads to clear native vegetation for road projects and associated activities.

The Australian and Western Australia governments have entered into a bilateral agreement under the EPBC Act relating to environmental assessment (assessment bilateral agreement). Specifically, this agreement now includes the clearing permit assessment process under Part V Division 2 of the EP Act. Under the assessment bilateral agreement, if a native vegetation clearing permit is required and the clearing will have or is likely to have an impact on a MNES, the assessment of the clearing application including the potential impacts to the MNES can be conducted by the Department of Environment Regulation (DER) or the Department of Mines and Petroleum (DMP) under delegation.

Six DPaW Priority-listed flora species considered to likely occur in the survey area. Fifteen fauna of conservation significance are considered to occur or likely to occur in survey area. As such, any clearing permit application should assess the significance of any potential impacts of the proposed clearing area on these species.

6. Conclusions

6.1 Key findings

6.1.1 Vegetation and flora

Nine vegetation associations were identified and described from the survey area. A review of the aerial photography illustrates there is representation of this vegetation outside the survey area. The vegetation is also consistent with vegetation associations identified in the vegetation mapping for the area (Beard 1979; Payne and Schoknecht 2011).

The survey area is in a largely disturbed condition with signs of obvious disturbance, including fire, flood, grazing and road maintenance activities.

No EPBC Act, WC Act or Priority listed flora taxa were recorded within the survey area during the survey. The Likelihood of Occurrence assessment post-field survey concluded that two conservation significant flora taxa are considered likely and four conservation significant flora taxa may possibly occur within the survey area.

Ten introduced taxa were recorded within the survey area during the field survey. No introduced species listed as a Declared Pest under Section 22 of the BAM Act or a WoNS (DotE 2016) were recorded.

6.1.2 Fauna

The EPBC Act listed Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigas*), (potentially the) Greater Bilby (*Macrotis lagotis*) and Priority 4 listed Western Pebble-mound Mouse (*Pseudomys chapmani*) were recorded during the current survey.

Nine additional species are likely to occur in the survey area and include Grey Falcon (*Falco hypoleucos*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), Pilbara Olive Python (*Liasis olivaceus barroni*), Peregrine Falcon (*Falco peregrinus*), Long-tailed Dunnart (*Sminthopsis longicaudata*), Glossy Ibis (*Plegadis falcinellus*), Wood Sandpiper (*Tringa glareola*), Sharp-tailed Sandpiper (*Calidris acuminata*) and Common Sandpiper (*Actitis hypoleucos*).

A review of the Significant Impact Guidelines (DotE 2013) was undertaken to consider the need for referral to the DotE listed species and it was considered that the Northern Quoll, Greater Bilby and Pilbara Olive Python would require referral based on the presence of the species, knowledge of species in the region and habitats present within the survey area. The Northern Quoll and the Pilbara Olive Python move between the range and the riverine environment in search of resources. The proposed project is to put a road through these areas bisecting habitat causing additional barrier effects. The impact of this needs to be explored and mitigated.

The Ghost Bat was recorded once in the survey area (at night foraging) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) is considered likely to utilise the survey area as foraging. No caves of a suitable nature were recorded for in the survey area nor within additional search areas in the study area. Both species are likely to only utilise the survey area opportunistically for foraging and unlikely trigger referral.

The Western Pebble-mound Mouse is endemic to the Pilbara region and regarded as common in most of its range. Seventeen mounds of the species were recorded during the survey with evidence of seven active mounds present and the remaining 12 mounds inactive. Typically this species is sedentary and restricted to stony habitats on hill slope or on undulating plain. The species is known to be susceptible to disturbance and will disappear from areas once this occurs. The habitat within the survey area is probably well represented in the local area and within the larger study area. It is also most likely that the larger study area contains additional

resources for this species. It is considered unlikely that the habitats within the survey area form a substantial portion or an important component of habitat for the species.

The Peregrine Falcon, Grey Falcon, Long-tailed Dunnart are known from the region and habitat is present for the species however, the habitat available is not critical to the survival of the species and generally restricted to only small portions of the survey area having little impact on the species.

The Glossy Ibis, Wood Sandpiper, Sharp-tailed Sandpiper and Common Sandpiper have previously been recorded within 2 km of the survey area and habitats present in the survey area. All of these species may utilise the habitats present in the riverine environments but impacts likely minimal to the species.

7. References

Atlast of Living Australia 2016, Atlas of Living Australia, retrieved May 2016, from http://lists.ala.org.au/iconic-species?fq=kvp+group%3ABirds.

Beard, JS 1975, *Pilbara, 1:1 000,000 vegetation series: explanatory notes to sheet 5 – the vegetation of the Pilbara area*, Nedlands, WA, University of Western Australia Press.

Beard, JS 1990, *Plant Life of Western Australia*, Perth, Kangaroo Press.

Beard, JS, Breeston, GR, Harvey, JM, Hopkins, AJM, and Shepherd, DP 2013, *The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir.* Conservation Science Western Australia 9 (1): 1-152.

BoM 2016a, *Climatic statistics for Australian locations*, retrieved April 2016, from http://www.bom.gov.au/climate/averages/tables.

BoM 2016b, Atlas of Groundwater Dependent Ecosystems. Retrieved April 2016, from http://www.bom.gov.au/water/groundwater/gde/map.shtml

Christidis, L and Boles, WE 2008, *Systematics and Taxonomy of Australian Birds*, Melbourne, CSIRO Publishing.

CoA 2016, Referral guideline for the Northern Quoll (*Dasyurus hallucatus*) under the EPBC Act. Commonwealth of Australia.

DPaW 2007–2016, *NatureMap: Mapping Western Australia's Biodiversity*, retrieved April 2016, from http://naturemap.dpaw.wa.gov.au/.

DPaW 2015, *Threatened and Priority Fauna Rankings*, retrieved April 2016, from http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals?view=categories&id=109.

DotE 2013, *Matters of National Environmental Significance Significant Impact Guidelines 1.1: Environment Protection and Biodiversity Act 1999* Commonwealth of Australia.

DotE 2016a *Environment Protection and Biodiversity Act 1999 Protected Matters Report*, retrieved April 2016, from http://www.environment.gov.au/epbc/pmst/

DotE 2016b, *Environment Protection and Biodiversity Act 1999 List of Threatened Flor*a, retrieved April 2016, from http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora

DotE 2016c, *Interim Biogeographic Regionalisation of Australia*, Version 7, retrieved April 2016, from http://www.environment.gov.au/topics/land/nrs/science-maps-and-data/australiasbioregions- ibra.

DotE 2016d, *Weeds of National Significance*, retrieved April 2016, from http://www.environment.gov.au/node/14156

DoW 2016, *Geographic Data Atlas*, retrieved April 2016 from, http://www.water.wa.gov.au/idelve/dowdataext/index.jsp.

EPA 2000, *Environmental Protection of Native Vegetation in Western Australia, Clearing of native vegetation, with particular reference to the agricultural area*, Position Statement No. 2, Perth, EPA

EPA 2004a, *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, Perth, EPA.

EPA 2004b, *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*, Perth, EPA.

EPA and DEC 2010, *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (eds BM Hyder, J Dell and MA Cowan), Perth, WA.EPA and DPaW 2015, *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (eds. K Freeman, G Stack, S Thomas and N Woolfrey), Perth, WA.

ESCAVI 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*, Canberra, Department of the Environment and Heritage.

GoWA 2015, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report),* Current as of June 2015, Perth Western Australia, Department of Environment and Conservation, retrieved June 2016, from https://www2.landgate.wa.gov.au/web/guest/downloader.

Kendrick, P and McKenzie, N 2001, *Pilbara 1 (PIL1 – Chichester subreigon) A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002,* Western Australian Government Department of Environment and Conservation, Perth, Western Australia.

Morcombe, M 2004, *Field Guide to Australian Birds*, Steve Parish Publishing Archer Field Queensland Australia.

Morcombe, M 2014, *Morcombe eGuide to Australian Birds V1.4. PDA Solutions.*

Shepherd, DP, Beeston, GR and Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status*, Resource Management Technical Report 249, Perth, Department of Agriculture, WA.

Tille, P 2006, *Soil-landscapes of Western Australia's Rangelands and Arid Interior*, Resource Management Technical Report 313, Perth, DAFWA.

van Vreeswyk, AM, Leighton, KA, Payne, AL and Hennig, P 2004, *An inventory and condition survey of the Pilbara region, Western Australia*, Technical Bulletin No. 92, Department of Agriculture and Food, Western Australia.

WA Herbarium 1998–2016, *FloraBase—the Western Australian Flora*, Department of Parks and Wildlife, retrieved April 2016, from http://florabase.dpaw.wa.gov.au/.

Appendices

Appendix A – Figures

BIDYADANGA COMMUNITY

GREAT NORTHERN HIGHWAY

PORT HEDLAND

POINT SAMSON

DAMPIER

WICKHAM

ROEBOURNE

KARRATHA

MARBLE BAR

ONSLOW

NORTHWEST COASTAL HIGHWAY

PANNAWONICA

PANNAWONICA ROAD

ROEBOURNE WITTENOOM ROAD

ONSLOW ROAD

MARBLE BAR ROAD

MUNJINA ROY HILL ROAD

KARIJINI DRIVE

TOM PRICE

BURKETT ROAD

NANUTARRA WITTENOOM ROAD

PARABURDOO

NEWMAN

Paper Size A3

0 20 40 60 80 100

Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

LEGEND

Town

Survey area

Major Road

Minor Road

GHD

mainroads WESTERN AUSTRALIA

SLIP ENABLER

Main Roads Western Australia
Coongan Gorge Realignment and Side-track Biological Survey

Job Number	61-34579
Revision	0
Date	25 Jul 2016

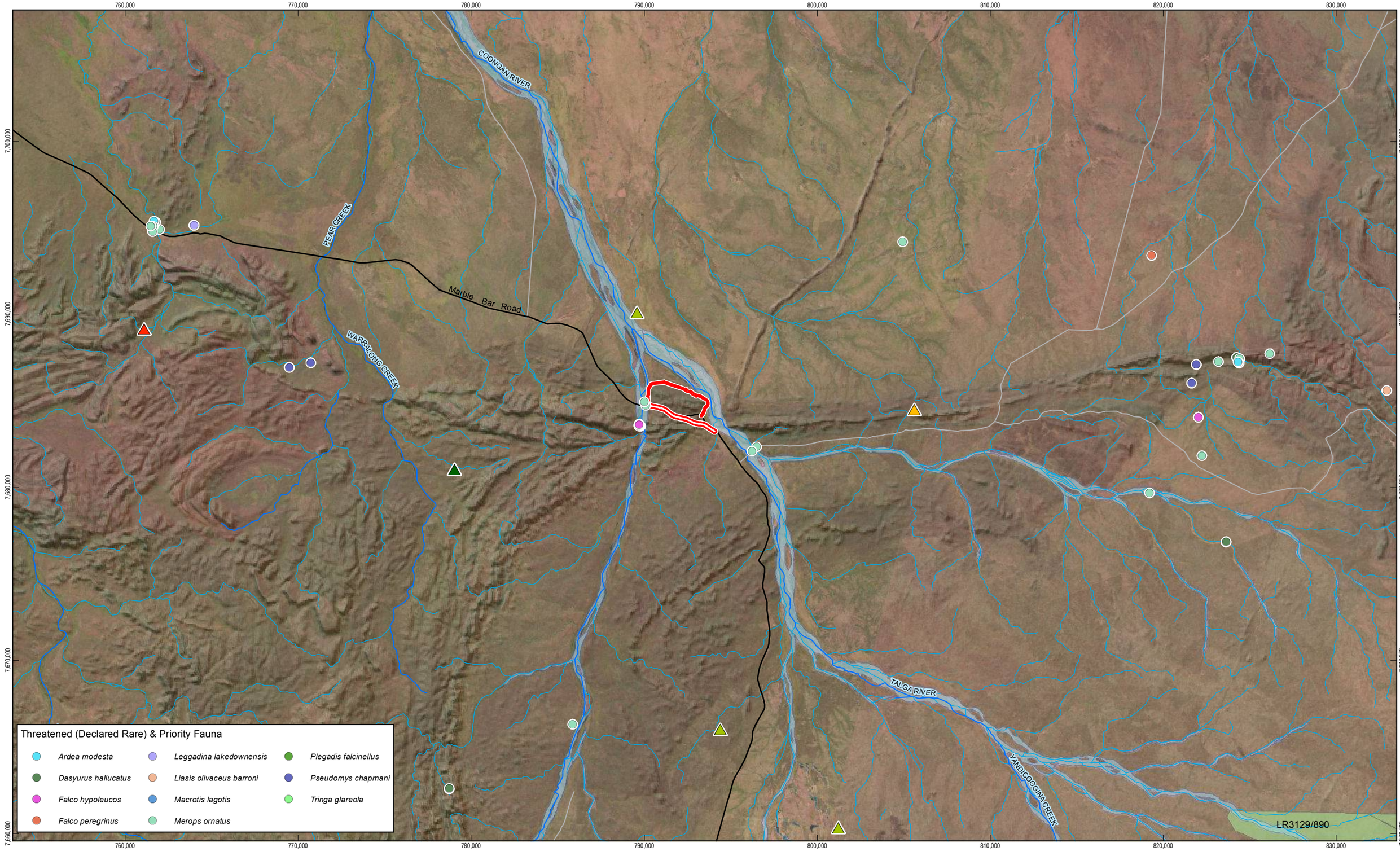
Project Location

Figure 1

G:\61\34579\GIS\Maps\MXD\6134579_001_Rev0_Fig1Locality.mxd

Data source: Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Survey Area 20160530; Landgate: Aerial Imagery - Site Inset (Virtual Mosaic). Created by:afeeney

999 Hay Street Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



Paper Size A3

0 2 4 6 8 10

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

Threatened (Declared Rare) & Priority Flora

- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa
- Major Road
- Minor Road
- Major Watercourse
- Minor Watercourse
- Waterbody
- DPaW Managed Lands
- Survey area

Main Roads Western Australia
Coongan Gorge Realignment and Side-track Biological Survey

Job Number	61-34579
Revision	0
Date	25 Jul 2016

Biological Constraints

Figure 2

G:\61\34579\GIS\Maps\MXD\6134579_002_Rev0_Fig2EnviroConstraints.mxd

Data source: Geoscience Australia: Landsat Imagery, Topo 250k Series III; MRWA: Survey Area 20160530, Roads - 20140723; Landgate: ; DPaW: Rare and Priority Flora - 2060523, Rare and Priority Fauna - 20160516. Created by:afeeney

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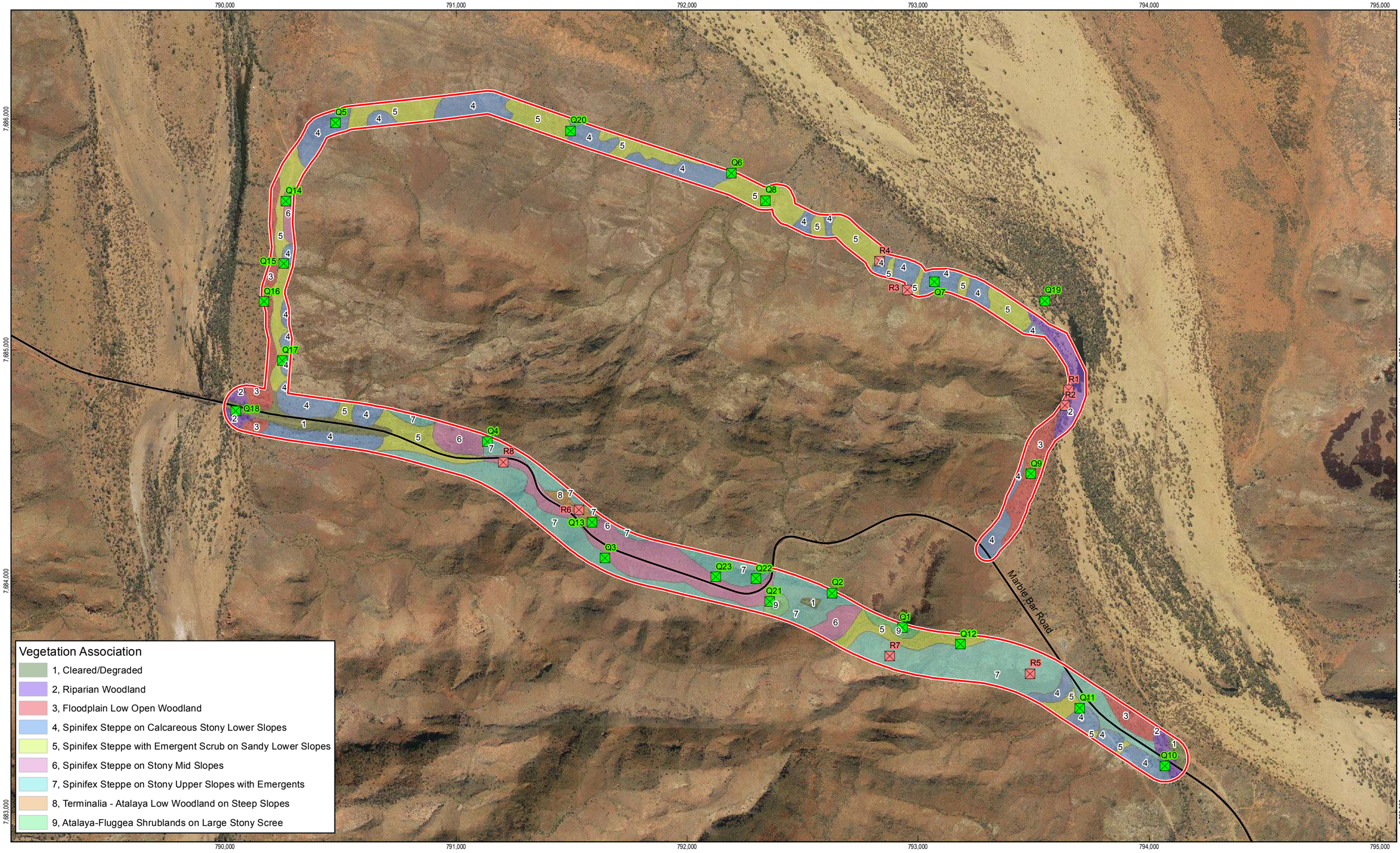

Paper Size A3

0 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

Quadrat — Road

Relevé — Survey area

Main Roads Western Australia
Coongan Gorge Realignment and Side-track Biological Survey

Job Number	61-34579
Revision	0
Date	25 Jul 2016

Vegetation Associations

Figure 3

G:\61\34579\GIS\Maps\MXD\6134579_003_Rev0_Fig3VegAssoc.mxd

999 Hay Street 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: MRWA: Survey Area 20160530, Roads - 20140723; Landgate: Imagery (Virtual Mosaic); GHD: Quadrat and Relevé Locations, Vegetation Associations - 20160615. Created by:afeeney

790,000 791,000 792,000 793,000 794,000 795,000

7,686,000 7,685,000 7,684,000 7,683,000

Mangle Bar Road

Paper Size A3

0 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

Road

Survey Area

Vegetation Condition (EPA and DPaW, 2015)

3
4
5
6
7

GHD

mainroads WESTERN AUSTRALIA

SLIP ENABLER

Main Roads Western Australia
Coongan Gorge Realignment and Side-track Biological Survey

Job Number	61-34579
Revision	0
Date	25 Jul 2016

Vegetation Condition

Figure 4

G:\61\34579\GIS\Maps\MXD\6134579_004_Rev0_Fig4VegCondition.mxd

Data source: MRWA: Survey Area 20160530, Roads - 20140723; Landgate: Aerial Imagery - Warrie Aug. 2013; GHD: Vegetation Condition - 20160615. Created by:afeeney

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790,000 791,000 792,000 793,000 794,000 795,000

7,686,000 7,685,000 7,684,000 7,683,000

cam 21
habitat 6
habitat 8
habitat 7
cam 24
habitat 3
cam ghdb
cam 18
habitat 2
cam 27
habitat 9
habitat 9
habitat 9
habitat 10
habitat 11
cam 15
cam 20
cam 11
habitat 1
habitat 4
Marble Bar Road

Fauna Results

- Ghost Bat
- Northern Quoll (Prints)
- Northern Quoll (Scats)
- Northern Quoll (Sightings)
- Northern Quoll (Camera Capture)
- Pebble Mound (Active Mound)
- Pebble Mound (Inactive Mound)
- Potential Bilby Burrow
- Possible Bilby Prints

Paper Size A3

0 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

Fauna Method

- Bat Detector
- Camera
- Habitat Assessment Location
- Road
- Survey area

Main Roads Western Australia
Coongan Gorge Realignment and Side-track Biological Survey

Job Number	61-34579
Revision	0
Date	27 Jul 2016

Fauna Methods and Results

Figure 5

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Data source: MRWA: Survey Area 20160530, Roads - 20140723; Landgate: Imagery (Virtual Mosaic); GHD: Fauna Survey Effort, Fauna Survey Results - 20160727. Created by:mmikkonen

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Appendix B – Relevant legislation, conservation codes and background information

Legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not take an action that has, will have, or is likely to have a significant impact MNES, without approval from the Federal Minister for the Environment.

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Australian Government Minister for the Environment.

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. It provides for an Environmental Protection Authority (EPA), for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the above.

Clearing of native vegetation in Western Australia requires a permit from the Department of Environment Regulation (DER) (formerly the Department of Environment and Conservation – DEC), unless exemptions apply. Native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native, but not vegetation planted in a plantation or planted with commercial intent.

In the EP Act Section 51A, clearing is defined as the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage of some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above.

When making a decision to grant or refuse a permit to clear native vegetation the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.

c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

g) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

There are a number of Environmentally Sensitive Areas (ESAs) within Western Australia where exemptions in regulations do not apply. ESAs include locations of threatened communities and species.

State *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

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

Aspects of Environmentally Sensitive Areas

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the *Environment Protection and Biodiversity Conservation Act 1999* (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*.

State *Wildlife Conservation Act 1950*

The *Wildlife Conservation Act 1950* (WC Act) provides for the conservation and protection of wildlife. It is administered by the Department of Parks and Wildlife (DPaW) (formerly the DEC) and applies to both flora and fauna. Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

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 Areas, 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, districts, individual properties or even paddocks. Categories of control are defined below. 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* (ARRP Act).

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.

Background information and conservation codes

Reserves and conservation areas

Department of Parks and Wildlife managed lands and waters

DPaW manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DPaW managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DPaW managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DPaW managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DPaW managed lands will generally be referred to DPaW throughout the assessment process.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance” (DotE 2016a). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DotE 2016a).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DotE 2016b):

- 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 one percent 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

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 Environmental Protection Authority (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 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.
- From a biodiversity perspective, stream reserves should generally be in the order of at least 200 metres (m) wide.

Vegetation condition

The vegetation condition in the Victoria Bonaparte IBRA bioregion can be assessed in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (devised by Trudgen (1988) and adapted by EPA and DPaW (2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale

Class	Eremaean and Northern Botanical Provinces description
2	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
3	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
4	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
5	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
6	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
7	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act administered by the Department of the Environment (DotE) (formerly Department of Sustainability, Environment, Water, Population and Communities – DSEWPaC). The DPaW also maintains a list of TECs for Western Australia; some of which are also protected under the EPBC Act. 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.

Possible TEC that do not meet survey criteria are added to the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These 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. PECs are not listed under any formal Federal or State legislation.

Conservation codes and definitions for Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment and listed under the *Environment Protection and Biodiversity Conservation Act 1999*

Western Australia conservation categories		Federal Government Conservation Categories (EPBC Act)	
Presumed Totally Destroyed (PD)	The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.	Critically Endangered (CR)	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated	Endangered (EN)	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.	Vulnerable (VU)	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.		

Conservation categories and definitions for Priority Ecological Communities as listed by the Department of Parks and Wildlife

Category	Description
Priority 1	**Poorly known ecological communities.** Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	**Poorly known ecological communities.** Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	**Poorly known ecological communities.** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	**Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.** (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Category	Description
Priority 5	**Conservation Dependent ecological communities.** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Other significant vegetation

Vegetation may be significant for a range of reasons, other than a statutory listing as TEC or because the extent is below a threshold level. The EPA (2004) states that significant vegetation may include vegetation that includes the following:

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

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DotE and/or the EPA.

The Federal conservation level of flora and 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).

Threatened species have been published as Specially Protected under the WC Act 1950, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora. The schedules align with the categories of the EPBC Act. Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant.

Conservation categories and definitions for *Environment Protection and Biodiversity Conservation Act 1999* listed flora & 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

Conservation codes and descriptions for Western Australian flora and fauna

Code	Conservation category	Description
Wildlife Conservation Act 1950		
T	Threatened species	Published as Specially Protected under the *Wildlife Conservation Act 1950,* and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). ***Threatened fauna*** is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. ***Threatened flora*** is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	Critically endangered species	Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	Endangered species	Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	Vulnerable species	Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	Presumed extinct species	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	Migratory birds protected under an international agreement	Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	Conservation dependent fauna	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.
OS	Other specially protected fauna	Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Code	Conservation category	Description
DPaW Priority Listed		
1	Priority One: Poorly-known taxa	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	Priority Two: Poorly-known taxa	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	Priority Three: Poorly-known taxa	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Migratory species listed under the EPBC Act

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)

- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

Other significant flora and fauna

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than as Threatened (Declared Rare) Flora or Priority Flora. The EPA (2004) states that significant flora may include taxa that have:

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

The application of the degree of significance may apply at a range of scales.

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007.*

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 2014).

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Australian Government 2014, *Weeds in Australia*, retrieved 2016, from http://www.environment.gov.au/biodiversity/invasive/weeds/index.html.

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

DotE 2016a, *The Ramsar Convention on Wetlands*, retrieved 2015, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/ramsar-convention-wetlands.

DotE 2016b, *Criteria for determining nationally important wetlands*, retrieved 2015, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important.

English, V and Blyth, J 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, Perth, Department of Conservation and Land Management.

EPA 2000, *Environmental Protection of Native Vegetation in Western Australia. Clearing of native vegetation, with particular reference to the agricultural area. Position Statement No. 2*, Perth, Environmental Protection Authority.

EPA 2004, *Guidance Statement No. 51, Guidance for the Assessment of Environmental Factors: Vegetation and Flora Surveys for Environmental Impact Assessment in Western Australia*, Perth, Environmental Protection Authority.

EPA and DPaW 2015, *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment*, (ed. K Freeman, G Stack, S Thomas and N Woolfrey), Perth, WA.

Keighery, BJ 1994, Bushland Plant Survey: a Guide to Plant Community Survey for the Community, Nedlands, Wildflower Society of WA (Inc.).

Western Australian Herbarium 1998–, *FloraBase—the Western Australian Flora*. Department of Parks and Wildlife, retrieved 2015, from http://florabase.dpaw.wa.gov.au/.

Appendix C – Desktop searches

EPBC Act PMST Report (40 km buffer)

NatureMap Flora Report (40 km buffer)

NatureMap Fauna Report (40 km buffer)

Australian Government

Department of the Environment

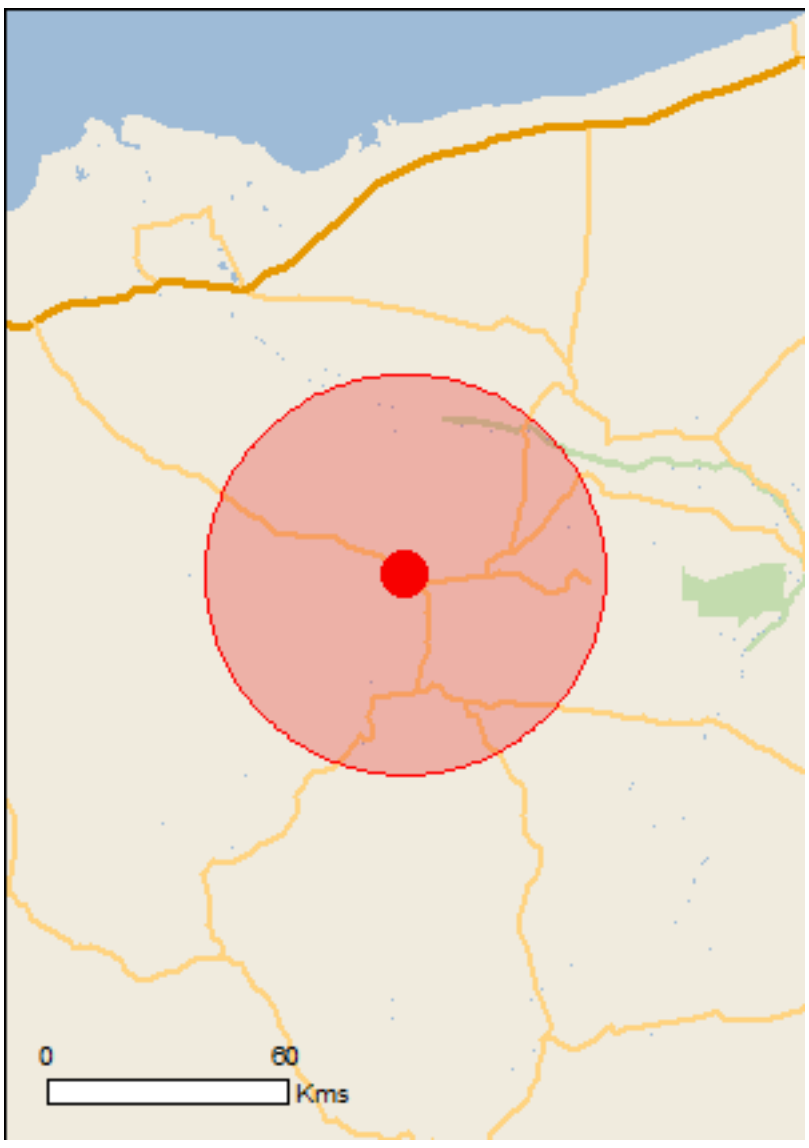
EPBC Act Protected Matters Report

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

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

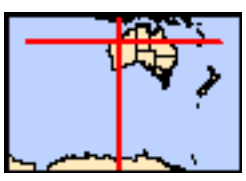
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 11/05/16 16:55:58



Coordinates

Buffer: 50.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	8
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Breeding known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Roosting known to occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Pristis pristis Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Marine Species		
Pristis pristis Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area
Migratory Terrestrial Species		

Name	Threatened	Type of Presence
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Meenthena Station	WA

Invasive Species	[Resource Information]

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

Name	Status	Type of Presence
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
De Grey River	WA

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-20.9177 119.80427

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Joshua Foster on 16/05/2016

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 119° 48' 23" E,20° 54' 58" S
Buffer 40km
Group By Family

Family	Species	Records
Acanthizidae	2	4
Acariformes	5	5
Acarosporaceae	1	1
Accipitridae	10	71
Actinopodidae	1	1
Aegothelidae	1	1
Aeolosomatidae	2	5
Aeshnidae	1	1
Agamidae	7	51
Aizoaceae	4	9
Alaudidae	2	6
Amaranthaceae	28	80
Ameiridae	2	5
Anatidae	6	67
Anhingidae	1	34
Anthelidae	1	1
Apocynaceae	3	5
Araliaceae	2	2
Araneidae	2	5
Arctiidae	3	3
Ardeidae	7	120
Arrenuridae	3	3
Artamidae	8	55
Asphodelaceae	1	2
Asteraceae	18	36
Aturidae	2	2
Baetidae	2	4
Bdelloidea	2	7
Belonolaimidae	1	1
Belostomatidae	2	3
Bignoniaceae	1	1
Blattidae	1	1
Bogidiellidae	1	3
Boidae	4	6
Boraginaceae	11	40
Bostrichidae	1	2
Bothriuridae	1	1
Brachionidae	5	5
Brassicaceae	1	1
Bryaceae	1	1
Bufonidae	1	3
Buprestidae	1	1
Burhinidae	1	15
Byblidaceae	1	2
Cacatuidae	1	55
Caenidae	3	8
Campephagidae	4	59
Candonidae	10	20
Canthocamptidae	1	7
Caprimulgidae	1	1
Carphodactylidae	1	1
Caryophyllaceae	1	2
Centropodidae	2	5
Cephalobidae	1	1
Ceratopogonidae	10	17
Charadriidae	6	79
Cheluidae	1	2
Chenopodiaceae	9	15
Chironomidae	34	62
Chrysomelidae	1	2
Chydoridae	4	5
Cicadidae	1	5
Ciconiidae	1	15
Cleomaceae	4	15
Climacteridae	4	8
Clupeidae	1	1
Coenagrionidae	3	4
Columbidae	8	143
Combretaceae	1	7
Commelinaceae	1	2
Convolvulaceae	11	27
Copepoda	3	4
Corixidae	6	9
Corvidae	4	49
Cracticidae	5	97
Crambidae	1	1
Cuculidae	3	28

Cucurbitaceae	2	2
Culicidae	2	2
Cyclopidae	7	15
Cyperaceae	17	32
Cyprididae	10	19
Cypridopsidae	2	2
Daphniidae	1	1
Darwinulidae	3	5
Dasyuridae	7	43
Diatom Family	20	20
Dicaeidae	1	1
Dicruridae	3	144
Diplodactylidae	4	29
Dolichopodidae	1	2
Droseraceae	1	2
Dytiscidae	15	21
Ecnomidae	1	4
Ectinosomatidae	1	2
Elapidae	10	31
Elatinaceae	2	2
Elmidae	1	1
Emballonuridae	2	10
Enchytraeidae	1	3
Ephydridae	1	1
Estrilidae	5	112
Euchlanidae	2	3
Euglyphiidae	1	1
Euphorbiaceae	11	15
Eylaidae	1	1
Fabaceae	88	250
Falconidae	8	41
Felidae	1	1
Floscullariidae	1	1
Funariaceae	1	1
Gekkonidae	5	59
Gerridae	1	2
Gomphidae	1	1
Goodeniaceae	11	22
Hadziidae	1	2
Halcyonidae	6	89
Haliplidae	1	1
Haloragaceae	2	9
Hebridae	1	2
Hexarthridae	1	1
Hipposideridae	1	1
Hirundinidae	3	7
Hoplolaimidae	2	2
Hydraenidae	5	6
Hydrocharitaceae	2	3
Hydrochidae	5	9
Hydrodromidae	1	2
Hydrophilidae	14	19
Hydropsychidae	2	2
Hydroptilidae	2	2
Hygrobatidae	2	3
Hylidae	2	16
Ilyocryptidae	1	1
Ilyocyprididae	2	2
Isostictidae	1	1
Lamiaceae	2	2
Lecanidae	6	8
Lepadellidae	2	4
Lepidoptera	1	1
Leptoceridae	3	4
Lesquereusidae	1	1
Libellulidae	3	5
Limnesiidae	4	8
Limnichidae	1	1
Limnocytheridae	5	11
Loranthaceae	1	2
Lycaenidae	1	2
Lycosidae	3	4
Lymnaeidae	2	5
Lythraceae	2	7
Macropodidae	4	6
Maluridae	7	23
Malvaceae	28	60
Marsileaceae	2	2
Megadermatidae	1	26
Melanotaeniidae	2	5
Meliphagidae	16	157
Melitidae	2	7
Meropidae	2	66
Microcerberidae	1	6
Molluginaceae	2	4
Molossidae	1	7
Mononchidae	1	2
Moraceae	2	6
Motacillidae	1	2
Muridae	7	29
Muscidae	1	1
Myrmeleontidae	2	2
Myrtaceae	14	38
Mytilinidae	1	1
NO FAMILY	1	5
Naididae	9	20
Nematoda	4	4
Nepidae	1	1
Noctuidae	12	18
Nolidae	1	1
Nyctaginaceae	4	7
Ochteridae	1	1
Oligochaeta	1	1
Onagraceae	1	1
Orobanchaceae	1	1

Ostracoda	1	6
Otididae	1	1
Pachycephalidae	7	32
Papaveraceae	2	6
Paramelitidae	4	15
Parastenocarididae	1	1
Pardalotidae	4	48
Passifloraceae	1	1
Pedaliaceae	2	3
Pelecanidae	1	31
Phalacrocoracidae	2	60
Phasianidae	1	6
Phasmatidae	1	1
Philosciidae	1	2
Phreodrilidae	4	17
Phyllanthaceae	4	5
Planorbidae	4	7
Plantaginaceae	2	2
Pleidae	1	2
Plotosidae	1	2
Poaceae	70	194
Podargidae	1	1
Podicipedidae	2	13
Polycentropodidae	1	1
Polygalaceae	1	1
Pomatostomidae	2	27
Portulacaceae	6	9
Potamogetonaceae	1	3
Proteaceae	6	10
Psittacidae	9	81
Pygopodidae	5	19
Pyralidae	3	3
Rallidae	4	12
Recurvirostridae	1	9
Ricciaceae	2	2
Rotifera	1	1
Rubiaceae	4	8
Santalaceae	1	1
Sapindaceae	1	3
Scarabaeidae	1	1
Scincidae	22	121
Sciomyzidae	1	1
Scirtidae	1	1
Scolopacidae	4	16
Scrophulariaceae	1	1
Sididae	1	1
Simuliidae	2	5
Solanaceae	10	31
Sparassidae	2	8
Staphylinidae	1	1
Stratiomyidae	1	3
Strigidae	7	20
Sylviidae	4	39
Tabanidae	1	1
Tachyglossidae	1	1
Teloschistaceae	1	1
Terapontidae	1	5
Testudinellidae	1	2
Tettigoniidae	1	1
Theridiidae	1	1
Threskiornithidae	4	21
Thylacomyidae	1	3
Thymelaeaceae	1	2
Trichocercidae	2	3
Trichotriidae	1	2
Turbellaria	2	5
Turnicidae	2	9
Unionicolidae	4	7
Urodacidae	1	1
Varanidae	3	4
Verrucariaceae	1	1
Vespertilionidae	3	111
Violaceae	1	3
Zosteropidae	2	2
Zygophyllaceae	6	8
TOTAL	**1052**	**4176**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthizidae					
1.	30948	*Smicrornis brevirostris (Weebill)*			
2.		*Smicrornis brevirostris subsp. ochrogaster*			
Acariformes					
3.		*Acariformes sp.*			
4.		*Oribatida group 1 (PSS)*			
5.		*Oribatida group 5 (PSS)*			
6.		*Oribatida sp. 4 (PSW)*			
7.		*Trombidioidea sp.*			
Acarosporaceae					
8.		*Acarospora sp.*			
Accipitridae					
9.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
10.	25536	*Accipiter fasciatus (Brown Goshawk)*			
11.	24285	*Aquila audax (Wedge-tailed Eagle)*			
12.	24288	*Circus approximans (Swamp Harrier)*			
13.	24289	*Circus assimilis (Spotted Harrier)*			
14.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*		IA	
15.	24295	*Haliastur sphenurus (Whistling Kite)*			
16.		*Hieraaetus (Hieraaetus) morphnoides subsp. morphnoides*			
17.	25542	*Milvus migrans (Black Kite)*			
18.		*Pandion cristatus*			
Actinopodidae					
19.		*Missulena rutraspina*			
Aegothelidae					
20.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
Aeolosomatidae					
21.		*Aeolosoma sp. 1 (PSS)*			
22.		*Aeolosoma sp. 3 (PSS)*			
Aeshnidae					
23.		*Aeshnidae sp.*			
Agamidae					
24.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
25.	24865	*Ctenophorus caudicinctus subsp. caudicinctus (Ring-tailed Dragon)*			
26.	24876	*Ctenophorus isolepis subsp. isolepis (Crested Dragon, Military Dragon)*			
27.	24882	*Ctenophorus nuchalis (Central Netted Dragon)*			
28.		*Diporiphora bilineata*			
29.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
30.		*Pogona sp.*			
Aizoaceae					
31.	44240	*Trianthema cusackianum*			
32.	44261	*Trianthema oxycalyptrum var. oxycalyptrum*			
33.	44305	*Trianthema pilosum*			
34.	29095	*Zaleya galericulata subsp. galericulata*			
Alaudidae					
35.		*Mirafra (Mirafra) javanica subsp. woodwardi*			
36.	25545	*Mirafra javanica (Horsfield's Bushlark, Singing Bushlark)*			
Amaranthaceae					
37.	2645	*Achyranthes aspera (Chaff Flower)*			
38.	2646	*Aerva javanica (Kapok Bush)*	Y		
39.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
40.	2651	*Alternanthera nana (Hairy Joyweed)*			
41.	2652	*Alternanthera nodiflora (Common Joyweed)*			
42.	11035	*Amaranthus induratus*			
43.	2663	*Amaranthus interruptus (Native Amaranth)*			
44.	2666	*Amaranthus mitchellii (Boggabri Weed)*			
45.	20018	*Amaranthus undulatus*			
46.	18361	*Gomphrena affinis subsp. pilbarensis*			
47.	2680	*Gomphrena cunninghamii*			
48.	17894	*Gomphrena leptophylla*		P3	
49.	11131	*Gomphrena sordida*			
50.	2690	*Ptilotus aervoides*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
51.	2696	*Ptilotus astrolasius*			
52.	2698	*Ptilotus auriculifolius*			
53.	2699	*Ptilotus axillaris (Mat Mulla Mulla)*			
54.	2704	*Ptilotus calostachyus (Weeping Mulla Mulla)*			
55.	2711	*Ptilotus clementii (Tassel Top)*			
56.	2725	*Ptilotus fusiformis*			
57.	11236	*Ptilotus gomphrenoides var. gomphrenoides*			
58.	2731	*Ptilotus helipteroides (Hairy Mulla Mulla)*			
59.	2734	*Ptilotus incanus*			
60.	2741	*Ptilotus macrocephalus (Featherheads)*			
61.	2744	*Ptilotus mollis*		P4	
62.	41001	*Ptilotus nobilis subsp. nobilis (Yellow Tails)*			
63.	2749	*Ptilotus petiolatus*			
64.		*Ptilotus sp.*			
Ameiridae					
65.		*Stygonitocrella bispinosa*			
66.		*Stygonitocrella trispinosa*			
Anatidae					
67.	24312	*Anas gracilis (Grey Teal)*			
68.	24316	*Anas superciliosa (Pacific Black Duck)*			
69.	24318	*Aythya australis (Hardhead)*			
70.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
71.	24322	*Cygnus atratus (Black Swan)*			
72.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
Anhingidae					
73.		*Anhinga novaehollandiae*			
Anthelidae					
74.		*Anthela callixantha*			
Apocynaceae					
75.	6567	*Carissa lanceolata (Conkerberry, Marnuwiji)*			
76.	6584	*Cynanchum floribundum (Dumara Bush, Tjipa)*			
77.	16537	*Marsdenia angustata*			
Araliaceae					
78.	6278	*Trachymene oleracea*			
79.	19043	*Trachymene oleracea subsp. oleracea*			
Araneidae					
80.		*Araneus sp.*			
81.		*Cyrtobill darwini*			
Arctiidae					
82.		*Amata sp.*			
83.		*Utetheisa lotrix*			
84.		*Utetheisa sp.*			
Ardeidae					
85.	25559	*Ardea intermedia (Intermediate Egret)*			
86.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
87.	24341	*Ardea pacifica (White-necked Heron)*			
88.	24346	*Butorides striatus subsp. stagnatilis (Striated Heron, Mangrove Heron)*			
89.		*Egretta garzetta*			
90.		*Egretta novaehollandiae*			
91.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
Arrenuridae					
92.		*Arrenurus ensifer*			
93.		*Arrenurus tripartitus*			
94.		*Arrenurus vanderpalae*			
Artamidae					
95.		*Artamus (Angroyan) cinereus subsp. melanops*			
96.		*Artamus (Angroyan) minor subsp. derbyi*			
97.		*Artamus (Angroyan) minor subsp. minor*			
98.		*Artamus (Artamus) leucorynchus*			
99.		*Artamus (Campbellornis) personatus*			
100.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
101.	25567	*Artamus leucorynchus (White-breasted Woodswallow)*			
102.	24355	*Artamus minor (Little Woodswallow)*			
Asphodelaceae					

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
103.	36277	*Aloe vera var. officinalis*	Y		
Asteraceae					
104.	7891	*Calocephalus francisii (Fine-leaf Beauty-heads)*			
105.	7893	*Calocephalus knappii*			
106.	7905	*Calotis multicaulis (Many-stemmed Burr-daisy)*			
107.	7919	*Centipeda minima (Spreading Sneezewood, Kanjirralaa)*			
108.	19762	*Centipeda minima subsp. macrocephala*			
109.	12614	*Chrysocephalum pterochaetum*			
110.	35558	*Flaveria trinervia (Speedy Weed)*	Y		
111.	29594	*Helichrysum luteoalbum (Jersey Cudweed)*			
112.	13494	*Pentalepis trichodesmoides*			
113.	17816	*Pluchea ferdinandi-muelleri*			
114.	8168	*Pluchea rubelliflora*			
115.		*Pluchea sp.*			
116.	8170	*Pluchea tetranthera*			
117.	8192	*Pterocaulon sphacelatum (Apple Bush)*			
118.	13310	*Rhodanthe margarethae*			
119.	8235	*Streptoglossa bubakii*			
120.	8237	*Streptoglossa decurrens*			
121.	8240	*Streptoglossa odora*			
Aturidae					
122.		*Albia rectifrons*			
123.		*Axonopsella sp.*			
Baetidae					
124.		*Baetidae sp.*			
125.		*Cloeon sp.*			
Bdelloidea					
126.		*Bdelloidea sp.*			
127.		*Bdelloidea sp. 2:2*			
Belonolaimidae					
128.		*Morulaimus soldus*			Y
Belostomatidae					
129.		*Diplonychus eques*			
130.		*Lethocerus (Lethocerus) distinctifemur*			
Bignoniaceae					
131.	7115	*Dolichandrone heterophylla (Lemonwood)*			
Blattidae					
132.		*Desmozosteria flava*			Y
Bogidiellidae					
133.		*Bogidiellidae sp.*			
Boidae					
134.	25318	*Antaresia perthensis (Pygmy Python)*			
135.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
136.	25238	*Liasis olivaceus subsp. barroni (Pilbara Olive Python)*		T	
137.		*Liasis sp.*			
Boraginaceae					
138.	6705	*Heliotropium crispatum*			
139.	6706	*Heliotropium cunninghamii*			
140.	6712	*Heliotropium heteranthum*			
141.	17393	*Heliotropium murinum*		P3	
142.	17309	*Heliotropium pachyphyllum*			
143.	17313	*Heliotropium skeleton*			
144.	29535	*Heliotropium sp. Ord River (W. Fitzgerald 1611)*			
145.	17315	*Heliotropium tanythrix*			
146.	6718	*Heliotropium tenuifolium (Mamukata)*			
147.	6727	*Trichodesma zeylanicum (Camel Bush, Kumbalin)*			
148.	11750	*Trichodesma zeylanicum var. zeylanicum*			
Bostrichidae					
149.		*Bostrychopsis jesuita*			
Bothriuridae					
150.		*Cercophonius granulosus*			
Brachionidae					
151.		*Brachionus budapestinensis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
152.		*Brachionus calyciflorus amphiceros*			Y
153.		*Brachionus plicatilis s.l.*			
154.		*Keratella procurva*			
155.		*Platyias quadricornis*			
Brassicaceae					
156.	3038	*Lepidium pholidogynum*			
Bryaceae					
157.		*Bryum pachytheca*			
Bufonidae					
158.	42306	*Platyplectrum spenceri (Centralian Burrowing Frog)*			
Buprestidae					
159.		*Chalcophorotaenia australasiae*			
Burhinidae					
160.	24359	*Burhinus grallarius (Bush Stone-curlew)*			
Byblidaceae					
161.	18073	*Byblis filifolia*			
Cacatuidae					
162.		*Eolophus roseicapillus*			
Caenidae					
163.		*Tasmanocoenis arcuata*			
164.		*Tasmanocoenis sp. M (PSW)*			
165.		*Tasmanocoenis sp. P (PSW)*			
Campephagidae					
166.		*Coracina (Coracina) papuensis*			
167.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
168.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
169.	24367	*Lalage tricolor (White-winged Triller)*			
Candonidae					
170.		*'Amphitritecandona' 'seconda' (PSS)*			Y
171.		*'Kencandona' 'harleyi' (PSS)*			
172.		*'Leicacandona' 'halsei' (PSS)*			Y
173.		*'Leicacandona' 'jimi' (PSS)*			Y
174.		*'Leicacandona' 'makra' (PSS)*			Y
175.		*Areacandona cf. sp. 1 (PSS)*			
176.		*Candonid Genus 6 sp. 1 (PSS)*			Y
177.		*Candonopsis tenuis*			
178.		*Humphreyscandona 'capillus' (PSS)*			
179.		*Humphreyscandona cf. 'capillus' (PSS)*			
Canthocamptidae					
180.		*Elaphoidella humphreysi*			
Caprimulgidae					
181.	24368	*Eurostopodus argus (Spotted Nightjar)*			
Carphodactylidae					
182.	24969	*Nephrurus levis subsp. pilbarensis*			
Caryophyllaceae					
183.	2903	*Polycarpaea longiflora*			
Centropodidae					
184.	25600	*Centropus phasianinus (Pheasant Coucal)*			
185.	24430	*Centropus phasianinus subsp. highami (Pheasant Coucal)*			
Cephalobidae					
186.		*Acrobeles sp.*			Y
Ceratopogonidae					
187.		*Atrichopogon sp. P1 (PSW)*			
188.		*Bezzia sp. P1 (PSW)*			
189.		*Bezzia sp. P2 (PSW)*			
190.		*Culicoides sp.*			
191.		*Culicoides sp. P1 (PSW)*			
192.		*Dasyheleinae sp. P1 (PSW)*			
193.		*Dasyheleinae sp. P2 (PSW)*			
194.		*Monohelea sp. P1 (PSW)*			
195.		*Monohelea sp. P2 (PSW)*			
196.		*Nilobezzia sp. P1 (PSW)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Charadriidae					
197.	24373	*Charadrius melanops (Black-fronted Dotterel)*			
198.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
199.	24378	*Charadrius veredus (Oriental Plover)*		IA	
200.		*Elseyornis melanops*			
201.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
202.	25577	*Vanellus miles (Masked Lapwing)*			
Cheluidae					
203.	25339	*Chelodina steindachneri (Flat-shelled Turtle)*			
Chenopodiaceae					
204.	33596	*Dysphania melanocarpa forma leucocarpa*			
205.	2504	*Dysphania plantaginella*			
206.	11653	*Dysphania rhadinostachya subsp. inflata*			
207.	11890	*Dysphania rhadinostachya subsp. rhadinostachya*			
208.	12064	*Enchylaena tomentosa var. tomentosa (Barrier Saltbush)*			
209.	2582	*Rhagodia eremaea (Thorny Saltbush)*			
210.		*Salsola sp.*			
211.	2604	*Sclerolaena costata*			
212.	2617	*Sclerolaena hostilis*			
Chironomidae					
213.		*Ablabesmyia hilli*			
214.		*Chironomus aff. alternans (V24) (CB)*			
215.		*Cladotanytarsus aff K4 (PSW)*			
216.		*Coelopynia pruinosa*			
217.		*Cricotopus albitarsus*			
218.		*Cryptochironomus griseidorsum*			
219.		*Dicrotendipes 'CA1' Pilbara type 3 (= 'K4', P3)) (PSW)*			
220.		*Dicrotendipes P5 (=balciunasi?) (PSW)*			
221.		*Dicrotendipes jobetus*			
222.		*Harnischia K1 (PSW)*			
223.		*Larsia albiceps*			
224.		*Microchironomus 'K1' (PSW)*			
225.		*Nanocladius sp. 1 (VCD7)*			
226.		*Parachironomus 'K2' (PSW)*			
227.		*Parakiefferiella sp P1 (PSW)*			
228.		*Paramerina sp C (PSW)*			
229.		*Paramerina sp.A (parva?) (SAP)*			
230.		*Paratanytarsus sp.*			
231.		*Paratanytarsus sp. P1 (PSW)*			
232.		*Pentaneurini sp. P1 (PSW)*			
233.		*Polypedilum leei*			
234.		*Polypedilum sp. K1 (PSW)*			
235.		*Polypedilum watsoni*			
236.		*Procladius Pilbara sp. 1 (PSW)*			
237.		*Procladius paludicola*			
238.		*Rheocricotopus sp. P1 (PSW)*			
239.		*Rheotanytarsus trivittatus*			
240.		*Tanytarsus sp. D (SAP)*			
241.		*Tanytarsus sp. H (SAP)*			
242.		*Tanytarsus sp. P1 (PSW)*			
243.		*Tanytarsus sp. P10 (PSW)*			
244.		*Tanytarsus sp. P7 (PSW)*			
245.		*Tanytarsus sp. P9 (PSW)*			
246.		*Thienemanniella sp. P1 (PSW)*			
Chrysomelidae					
247.		*Arsipoda sp.*			Y
Chydoridae					
248.		*Alona rigidicaudis*			
249.		*Dunhevedia crassa*			
250.		*Ephemeroporus barroisi s.l.*			
251.		*Leberis cf. diaphanus (striate) (PSW)*			
Cicadidae					
252.		*Tryella stalkeri*			
Ciconiidae					
253.	25578	*Ephippiorhynchus asiaticus (Black-necked Stork)*			

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Cleomaceae					
254.	2985	*Cleome oxalidea*			
255.	2987	*Cleome uncifera*			
256.	29101	*Cleome uncifera subsp. uncifera*			
257.	2988	*Cleome viscosa (Tickweed, Tjinduwadhu)*			
Climacteridae					
258.		*Climacteris (Climacteris) melanura subsp. melanura*			
259.		*Climacteris (Climacteris) melanura subsp. wellsi*			
260.	25582	*Climacteris melanura (Black-tailed Treecreeper)*			
261.	24395	*Climacteris melanura subsp. wellsi (Black-tailed Treecreeper)*			
Clupeidae					
262.		*Nematalosa erebi*			
Coenagrionidae					
263.		*Argiocnemis rubescens*			
264.		*Ischnura aurora aurora*			
265.		*Pseudagrion microcephalum*			
Columbidae					
266.	24401	*Geopelia cuneata (Diamond Dove)*			
267.		*Geopelia humeralis subsp. headlandi*			
268.	25585	*Geopelia striata (Zebra Dove)*			
269.	24403	*Geopelia striata subsp. placida (Peaceful Dove)*			
270.		*Geophaps (Lophophaps) plumifera subsp. ferruginea*			
271.	24404	*Geophaps plumifera (Spinifex Pigeon)*			
272.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
273.	24409	*Phaps chalcoptera (Common Bronzewing)*			
Combretaceae					
274.	45698	*Terminalia circumalata*			
Commelinaceae					
275.	1165	*Commelina ensifolia (Wandering Jew, Buargu)*			
Convolvulaceae					
276.	11167	*Bonamia erecta*			
277.	6606	*Bonamia media*			
278.	6608	*Bonamia pannosa*			
279.	6609	*Bonamia rosea (Felty Bellflower)*			
280.	11200	*Evolvulus alsinoides var. villosicalyx*			
281.	6623	*Ipomoea coptica*			
282.	6637	*Ipomoea polymorpha*			
283.	13553	*Jacquemontia pannosa*			
284.	6653	*Polymeria ambigua (Morning Glory)*			
285.	17513	*Polymeria lanata*			
286.		*Polymeria sp.*			
Copepoda					
287.		*Calanoida sp.*			
288.		*Cyclopoida sp.*			
289.		*Harpacticoida sp*			
Corixidae					
290.		*Agraptocorixa eurynome*			
291.		*Micronecta adelaidae*			
292.		*Micronecta adelaidae (ex P4)*			
293.		*Micronecta annae illiesi*			
294.		*Micronecta micra*			
295.		*Micronecta nsp. P1 (PSW)*			
Corvidae					
296.	24416	*Corvus bennetti (Little Crow)*			
297.	25593	*Corvus orru (Torresian Crow)*			
298.	24418	*Corvus orru subsp. cecilae (Western Crow)*			
299.		*Corvus sp.*			
Cracticidae					
300.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
301.		*Cracticus nigrogularis subsp. picatus*			
302.	25595	*Cracticus tibicen (Australian Magpie)*			
303.		*Cracticus tibicen subsp. longirostris*			
304.	25596	*Cracticus torquatus (Grey Butcherbird)*			
Crambidae					

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305.		*Eclipsiodes homora*			Y
Cuculidae					
306.		*Cacomantis (Vidgenia) pallidus*			
307.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
308.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
Cucurbitaceae					
309.	33030	*Austrobryonia pilbarensis*			
310.	41721	*Cucumis variabilis*			
Culicidae					
311.		*Anopheles annulipes s.l.*			
312.		*Culex sp.*			
Cyclopidae					
313.		*Australoeucyclops karaytugi*			
314.		*Eucyclops australiensis*			
315.		*Mesocyclops darwini*			
316.		*Mesocyclops notius*			
317.		*Metacyclops sp.*			
318.		*Microcyclops varicans*			
319.		*Paracyclops sp. 8 (PSW)*			
Cyperaceae					
320.	751	*Bulbostylis burbidgeae*		P4	
321.	789	*Cyperus difformis (Rice Sedge)*			
322.	12808	*Cyperus hesperius*			
323.	798	*Cyperus iria*			
324.	799	*Cyperus ixiocarpus*			
325.		*Cyperus sp.*			
326.	814	*Cyperus squarrosus*			
327.	818	*Cyperus vaginatus (Stiffleaf Sedge)*			
328.	823	*Eleocharis atropurpurea*			
329.	858	*Fimbristylis leucocolea*			
330.	862	*Fimbristylis microcarya*			
331.	865	*Fimbristylis neilsonii*			
332.	878	*Fimbristylis rara*			
333.	12159	*Fimbristylis simulans*			
334.	952	*Lipocarpha microcephala*			
335.	963	*Schoenoplectus laevis*			
336.	16257	*Schoenoplectus subulatus*			
Cyprididae					
337.		*Bennelongia sp.*			
338.		*Bennelongia sp.2 (PSS)*			
339.		*Cypretta baylyi*			
340.		*Cypretta seurati*			
341.		*Cypretta sp PSW074*			
342.		*Cypricercus salinus*			
343.		*Cyprididae sp.*			
344.		*Heterocypris sp.*			
345.		*Ilyodromus sp BOS25*			
346.		*Stenocypris major*			
Cypridopsidae					
347.		*Cypridopsis sp.*			
348.		*Cypridopsis vidua*			
Daphniidae					
349.		*Simocephalus heilongjiangensis*			
Darwinulidae					
350.		*Penthesilenula brasiliensis*			
351.		*Vestalenula marmonieri*			
352.		*Vestalenula matildae*			
Dasyuridae					
353.	24091	*Dasykaluta rosamondae (Little Red Kaluta)*			
354.	24093	*Dasyurus hallucatus (Northern Quoll)*		T	
355.	24095	*Ningaui timealeyi (Pilbara Ningaui)*			
356.	24105	*Pseudantechinus roryi (Rory's Pseudantechinus)*			
357.	24115	*Sminthopsis longicaudata (Long-tailed Dunnart)*		P4	
358.	24116	*Sminthopsis macroura (Stripe-faced Dunnart)*			
359.	24120	*Sminthopsis youngsoni (Lesser Hairy-footed Dunnart)*			

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Diatom Family					
360.		*Caloneis pulchra Messikommer*			
361.		*Craticula cuspidata (Grun. ex. Van Heurck) Mann*			
362.		*Cymbella cymbiformis Ag.*			
363.		*Epithemia argus (Ehr.) Kütz.*			
364.		*Epithemia smithii Carruthers*			
365.		*Epithemia turgida var. granulata*			Y
366.		*Fragilaria ulna (Nitz.) Lange Bertalot*			
367.		*Gyrosigma attenuatum (Kütz.) Rabh.*			
368.		*Mastogloia elliptica (Ag.) Cl.*			
369.		*Mastogloia elliptica var. danseii (thwaites) grun.*			
370.		*Mastogloia smithii Thwaites*			
371.		*Navicula spicula (Hickie) Cl.*			
372.		*Navicula subrhynchocephala Hust.*			
373.		*Nitzschia amphibia Grun.*			
374.		*Nitzschia compressa var. elongata (grun.) lange-bertalot*			
375.		*Nitzschia constricta (Greg.) Grun.*			
376.		*Nitzschia desertorum Hust.*			
377.		*Pleurosigma delicatulum W. Sm.*			
378.		*Pleurosigma elongatum W. Sm.*			
379.		*Rhopalodia gibba (Ehr.) O. Mull.)*			
Dicaeidae					
380.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
Dicruridae					
381.	24443	*Grallina cyanoleuca (Magpie-lark)*			
382.		*Rhipidura (Sauloprocta) leucophrys subsp. picata*			
383.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
Diplodactylidae					
384.	24926	*Diplodactylus conspicillatus (Fat-tailed Gecko)*			
385.	24944	*Diplodactylus savagei (Southern Pilbara Beak-faced Gecko)*			
386.	30933	*Lucasium stenodactylum*			
387.	30934	*Lucasium wombeyi*			
Dolichopodidae					
388.		*Dolichopodidae sp.*			
Droseraceae					
389.	43544	*Drosera finlaysoniana*			
Dytiscidae					
390.		*Allodessus bistrigatus*			
391.		*Copelatus nigrolineatus*			
392.		*Cybister tripunctatus*			
393.		*Hydroglyphus grammopterus (=trilineatus)*			
394.		*Hydroglyphus leai*			
395.		*Hydroglyphus orthogrammus*			
396.		*Hydrovatus weiri*			
397.		*Hyphydrus lyratus*			
398.		*Laccophilus sharpi*			
399.		*Limbodessus compactus*			
400.		*Necterosoma regulare*			
401.		*Platynectes sp.*			
402.		*Sternopriscus pilbarensis*			
403.		*Sternopriscus sp.*			
404.		*Tiporus tambreyi*			
Ecnomidae					
405.		*Ecnomus pilbarensis*			
Ectinosomatidae					
406.		*Pseudectinosoma galassiae*			
Elapidae					
407.	25243	*Acanthophis pyrrhus (Desert Death Adder)*			
408.	25332	*Acanthophis wellsi (Pilbara Death Adder)*			
409.	25297	*Demansia rufescens (Rufous Whipsnake)*			
410.	25301	*Furina ornata (Moon Snake)*			
411.	25261	*Pseudechis australis (Mulga Snake)*			
412.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
413.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
414.		*Simoselaps semifasciatus*			

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415.	25269	*Suta fasciata (Rosen's Snake)*			
416.	25311	*Vermicella snelli*			
Elatinaceae					
417.	5183	*Bergia ammannioides*			
418.	11912	*Bergia perennis subsp. perennis*			
Elmidae					
419.		*Austrolimnius WA sp. 2 (= adult sp WA 2) (PSW)*			
Emballonuridae					
420.	24174	*Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)*			
421.	24175	*Taphozous georgianus (Common Sheathtail-bat)*			
Enchytraeidae					
422.		*Enchytraeus Pilbara sp. 1 (PSS)*			
Ephydridae					
423.		*Ephydridae sp.*			
Estrilidae					
424.	24631	*Emblema pictum (Painted Finch)*			
425.		*Neochmia (Neochmia) ruficauda subsp. subclarescens*			
426.	25685	*Neochmia ruficauda (Star Finch)*			
427.	30870	*Taeniopygia guttata (Zebra Finch)*			
428.	30871	*Taeniopygia guttata subsp. castanotis (Zebra Finch)*			
Euchlanidae					
429.		*Euchlanis cf. deflexa (6 primary teeth) (PSW)*			
430.		*Euchlanis dilatata*			
Euglyphiidae					
431.		*Euglypha sp.*			
Euphorbiaceae					
432.	17422	*Adriana tomentosa var. tomentosa*			
433.	35303	*Euphorbia australis var. subtomentosa*			
434.	9048	*Euphorbia careyi*			
435.	4622	*Euphorbia clementii*		P2	
436.	4630	*Euphorbia inappendiculata*			
437.	42860	*Euphorbia inappendiculata var. inappendiculata*		P2	
438.		*Euphorbia sp.*			
439.	12097	*Euphorbia tannensis subsp. eremophila (Desert Spurge)*			
440.	42879	*Euphorbia trigonosperma*			
441.	42876	*Euphorbia vaccaria var. vaccaria*			
442.	4650	*Euphorbia wheeleri*			
Eylaidae					
443.		*Eylais sp.*			
Fabaceae					
444.	3198	*Acacia acradenia*			
445.	3209	*Acacia ampliceps*			
446.	3214	*Acacia ancistrocarpa (Fitzroy Wattle)*			
447.	3241	*Acacia bivenosa*			
448.	17013	*Acacia colei var. colei*			
449.	13502	*Acacia coriacea subsp. pendens*			
450.	14087	*Acacia cyperophylla var. omearana*		P1	
451.	3326	*Acacia eriopoda (Broome Pindan Wattle)*			
452.	44582	*Acacia eriopoda x trachycarpa*			
453.	3377	*Acacia inaequilatera (Baderi)*			
454.	3434	*Acacia maitlandii (Maitland's Wattle)*			
455.	3471	*Acacia orthocarpa (Needleleaf Wattle)*			
456.	3501	*Acacia ptychophylla*			
457.	29015	*Acacia pyrifolia var. pyrifolia*			
458.	15203	*Acacia sabulosa*			
459.	13078	*Acacia sclerosperma subsp. sclerosperma*			
460.	29135	*Acacia sericophylla*			
461.		*Acacia sp.*			
462.	3551	*Acacia sphaerostachya*			
463.	3553	*Acacia spondylophylla*			
464.	19456	*Acacia stellaticeps*			
465.	13070	*Acacia synchronicia*			
466.	3579	*Acacia trachycarpa (Minni Ritchi, Balgali)*			
467.	29992	*Acacia trachycarpa x tumida var. pilbarensis*			
468.	3585	*Acacia tumida (Pindan Wattle, Walgali)*			

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469.	20319	*Acacia tumida var. pilbarensis*			
470.	19641	*Acacia tumida var. tumida*			
471.	3680	*Aeschynomene indica (Budda Pea)*			
472.	17147	*Alysicarpus muelleri*			
473.	12757	*Bauhinia cunninghamii*			
474.		*Bauhinia gilva*			Y
475.	10972	*Cajanus marmoratus*			
476.		*Cassia sp.*			
477.	3774	*Crotalaria cunninghamii (Green Birdflower, Bilbun)*			
478.	20175	*Crotalaria cunninghamii subsp. sturtii*			
479.	20179	*Crotalaria medicaginea var. neglecta*			
480.	11231	*Crotalaria novae-hollandiae subsp. novae-hollandiae*			
481.	19398	*Crotalaria ramosissima*			
482.	17433	*Cullen badocanum*			
483.	17439	*Cullen lachnostachys*			
484.	17118	*Cullen leucanthum*			
485.	17217	*Cullen pallidum*			
486.	17120	*Cullen pogonocarpum*			
487.	15714	*Cullen stipulaceum*			
488.	11117	*Gompholobium simplicifolium*			
489.	3973	*Indigofera colutea (Sticky Indigo)*			
490.	3978	*Indigofera hirsuta (Hairy Indigo)*			
491.	3980	*Indigofera linifolia*			
492.	3982	*Indigofera monophylla*			
493.	3987	*Indigofera trita*			
494.	31035	*Indigofera trita subsp. trita*			
495.	3989	*Isotropis atropurpurea (Poison Sage)*			
496.	3613	*Leucaena leucocephala (Leucaena)*	Y		
497.	3614	*Neptunia dimorphantha (Sensitive Plant)*			
498.	3675	*Petalostylis labicheoides (Slender Petalostylis)*			
499.	4190	*Rhynchosia australis (Rhynchosia)*			
500.	4191	*Rhynchosia minima (Rhynchosia)*			
501.	17720	*Rothia indica subsp. australis*		P1	
502.	17645	*Senna artemisioides*			
503.	12280	*Senna artemisioides subsp. oligophylla*			
504.	18449	*Senna glaucifolia*			
505.	18346	*Senna glutinosa*			
506.	12307	*Senna glutinosa subsp. glutinosa*			
507.	12309	*Senna glutinosa subsp. pruinosa*			
508.	12312	*Senna notabilis*			
509.	18450	*Senna symonii*			
510.	12319	*Senna venusta*			
511.	4196	*Sesbania cannabina (Sesbania Pea)*			
512.	4198	*Sesbania formosa (White Dragon Tree)*			
513.		*Sesbania grandiflora*			
514.	4223	*Swainsona decurrens*			
515.	12356	*Swainsona formosa*			
516.	4231	*Swainsona kingii*			
517.	4244	*Swainsona stenodonta*			
518.	4253	*Templetonia hookeri*			
519.		*Tephrosia brachyodon var. cloncurriensis*			
520.	19531	*Tephrosia rosea var. clementii*			
521.	4281	*Tephrosia simplicifolia*			
522.	15947	*Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)*			
523.	17768	*Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)*			
524.	41811	*Tephrosia sp. Fortescue (A.A. Mitchell 606)*			
525.	42442	*Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)*			
526.	13924	*Tephrosia spechtii*			
527.	4285	*Tephrosia supina*			
528.	4287	*Tephrosia virens*			
529.	30716	*Vachellia farnesiana (Mimosa Bush)*	Y		
530.	4323	*Vigna lanceolata (Maloga Vigna, Wega)*			
531.	31391	*Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)*			

Falconidae

532.		*Falco (Ieracidea) berigora subsp. berigora*			
533.		*Falco (Ieracidea) berigora subsp. occidentalis*			
534.		*Falco (Tinnunculus) cenchroides*			
535.	25621	*Falco berigora (Brown Falcon)*			
536.	25622	*Falco cenchroides (Australian Kestrel)*			
537.	24473	*Falco hypoleucos (Grey Falcon)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
				T	
538.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
539.	24476	*Falco subniger (Black Falcon)*			
Felidae					
540.	24041	*Felis catus (Cat)*	Y		
Flosculariidae					
541.		*Octotrocha speciosa*			Y
Funariaceae					
542.		*Funaria sp.*			
Gekkonidae					
543.	24956	*Gehyra pilbara*			
544.	24958	*Gehyra punctata*			
545.	24959	*Gehyra variegata*			
546.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
547.	24962	*Heteronotia spelea (Desert Cave Gecko)*			
Gerridae					
548.		*Limnogonus fossarum gilguy*			
Gomphidae					
549.		*Austroepigomphus (Xerogomphus) gordoni*			
Goodeniaceae					
550.	7424	*Dampiera candicans*			
551.	7509	*Goodenia forrestii*			
552.	7521	*Goodenia lamprosperma*			
553.	7526	*Goodenia microptera*			
554.	12552	*Goodenia muelleriana*			
555.	12574	*Goodenia prostrata*			
556.		*Goodenia sp.*			
557.	10982	*Goodenia stobbsiana*			
558.	7558	*Goodenia triodiophila*			
559.	7560	*Goodenia vilmoriniae*			
560.	13178	*Scaevola amblyanthera var. centralis*			
Hadziidae					
561.		*Nedsia sp.*			
Halcyonidae					
562.	25547	*Dacelo leachii (Blue-winged Kookaburra)*			
563.	24304	*Dacelo leachii subsp. leachii (Blue-winged Kookaburra)*			
564.		*Todiramphus (Cyanalcyon) pyrrhopygius*			
565.		*Todiramphus (Todiramphus) sanctus subsp. sanctus*			
566.	42351	*Todiramphus pyrrhopygius (Red-backed Kingfisher)*			
567.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
Haliplidae					
568.		*Haliplus pilbarensis*			
Haloragaceae					
569.	23465	*Haloragis gossei var. gossei*			
570.	6201	*Myriophyllum verrucosum (Red Water Milfoil)*			
Hebridae					
571.		*Merragata hackeri*			
Hexarthridae					
572.		*Hexarthra sp P1 3-4/3-4 (PSW)*			Y
Hipposideridae					
573.	43368	*Rhinonicteris aurantia (Orange Leafnosed-bat)*		T	
Hirundinidae					
574.	24489	*Hirundo ariel (Fairy Martin)*			
575.	24491	*Hirundo neoxena (Welcome Swallow)*			
576.		*Petrochelidon (Petrochelidon) ariel*			
Hoplolaimidae					
577.		*Helicotylenchus sp.*			
578.		*Scutellonema sp.*			
Hydraenidae					
579.		*Hydraena brittoni*			
580.		*Hydraena nr. rudallensis (PSW)*			
581.		*Hydraena sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
582.		*Limnebius sp.*			
583.		*Ochthebius sp. P2 (PSW)*			
Hydrocharitaceae					
584.	139	*Najas tenuifolia (Water Nymph)*			
585.	17793	*Vallisneria annua*			
Hydrochidae					
586.		*Hydrochus burdekinensis*			
587.		*Hydrochus eurypleuron*			
588.		*Hydrochus group 3 "black" (PSW)*			
589.		*Hydrochus interioris*			
590.		*Hydrochus sp. P1 (PSW)*			
Hydrodromidae					
591.		*Hydrodroma sp.*			
Hydrophilidae					
592.		*Berosus dallasi*			
593.		*Berosus nr josephenae (was Pilbara sp 3) (PSW)*			
594.		*Berosus pulchellus*			
595.		*Chaetarthria nigerrimus*			
596.		*Enochrus deserticola*			
597.		*Georissus sp.*			
598.		*Helochares tatei*			
599.		*Laccobius matthewsi*			
600.		*Paracymus pygmaeus*			
601.		*Paracymus spenceri*			
602.		*Paranacaena horni*			
603.		*Regimbartia attenuata*			
604.		*Sternolophus australis*			
605.		*Sternolophus marginicollis*			
Hydropsychidae					
606.		*Cheumatopsyche dostinei*			
607.		*Cheumatopsyche wellsae*			
Hydroptilidae					
608.		*Hellyethira sp.*			
609.		*Orthotrichia sp.*			
Hygrobatidae					
610.		*Australiobates sp. P3 (nr crassisetus) (PSW)*			
611.		*Coaustraliobates minor*			
Hylidae					
612.	25375	*Cyclorana maini (Sheep Frog)*			
613.	25392	*Litoria rubella (Little Red Tree Frog)*			
Ilyocryptidae					
614.		*Ilyocryptus raridentatus*			
Ilyocyprididae					
615.		*Ilyocypris 'spiculata' (ms name) (SAP)*			
616.		*Ilyocypris australiensis*			
Isostictidae					
617.		*Eurysticta coolawanyah*			
Lamiaceae					
618.	13694	*Clerodendrum floribundum var. floribundum*			
619.		*Pityrodia sp.*			
Lecanidae					
620.		*Lecane batillifer*			
621.		*Lecane bulla*			
622.		*Lecane closterocerca*			
623.		*Lecane hornemanni*			
624.		*Lecane papuana*			
625.		*Lecane signifera*			
Lepadellidae					
626.		*Colurella sp.*			
627.		*Lepadella ovalis*			
Lepidoptera					
628.		*Lepidoptera (non-pyralid) Pilbara sp. 2 (hairy) (PSW)*			Y

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Leptoceridae					
629.		*Oecetis sp. Pilbara 4 (PSW)*			
630.		*Oecetis sp. Pilbara 8 (PSW)*			
631.		*Triplectides ciuskus seductus*			
Lesquereusidae					
632.		*Lesquereusia spiralis*			
Libellulidae					
633.		*Crocothemis nigrifrons*			
634.		*Diplacodes haematodes*			
635.		*Orthetrum pruinosum migratum*			
Limnesiidae					
636.		*Limnesia maceripalpis*			
637.		*Limnesia parasolida*			
638.		*Limnesia sp. 4 (PSW)*			
639.		*Limnesia sp. 7 (PSW)*			
Limnichidae					
640.		*Limnichidae sp. P1*			
Limnocytheridae					
641.		*Gomphodella 'hirsuta' (PSS)*			
642.		*Gomphodella 'quasihirsuta' (PSS)*			
643.		*Limnocythere dorsosicula*			
644.		*Limnocythere sp.*			
645.		*Limnocythere sp. 1 (PSS)*			
Loranthaceae					
646.	2396	*Lysiana casuarinae*			
Lycaenidae					
647.		*Nacaduba biocellata subsp. biocellata*			
Lycosidae					
648.		*Hogna hickmani*			
649.		*Lycosa sp.*			
650.		*Venatrix arenaris*			
Lymnaeidae					
651.		*Austropeplea sp.*			
652.		*Austropeplea vinosa*			
Lythraceae					
653.	5277	*Ammannia baccifera*			
654.	5278	*Ammannia multiflora*			
Macropodidae					
655.	24135	*Macropus robustus subsp. erubescens (Euro, Biggada)*			
656.		*Macropus robustus subsp. robustus*			
657.	24136	*Macropus rufus (Red Kangaroo, Marlu)*			
658.	24144	*Petrogale rothschildi (Rothschild's Rock-wallaby)*			
Maluridae					
659.	24540	*Amytornis striatus subsp. whitei (Striated Grasswren)*			
660.		*Malurus (Leggeornis) lamberti subsp. assimilis*			
661.		*Malurus (Malurus) splendens subsp. splendens*			
662.		*Malurus (Musciparus) leucopterus subsp. leuconotus*			
663.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
664.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
665.	24549	*Malurus leucopterus subsp. leuconotus (White-winged Fairy-wren)*			
Malvaceae					
666.	4886	*Abutilon amplum*			
667.	4895	*Abutilon lepidum*			
668.	40910	*Androcalva luteiflora (Yellow-flowered Rulingia)*			
669.	18410	*Corchorus carnarvonensis*			
670.	4857	*Corchorus elachocarpus*			
671.	17339	*Corchorus incanus*			
672.	25847	*Corchorus incanus subsp. incanus*			
673.	4862	*Corchorus parviflorus*			
674.	4867	*Corchorus walcottii (Woolly Corchorus)*			
675.	4910	*Gossypium australe (Native Cotton)*			
676.	4918	*Gossypium robinsonii (Wild Cotton)*			
677.	29317	*Hibiscus austrinus var. austrinus*			
678.	4930	*Hibiscus goldsworthii*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
679.	4933	*Hibiscus leptocladus*			
680.	11651	*Hibiscus sturtii var. campylochlamys*			
681.	4962	*Malvastrum americanum (Spiked Malvastrum)*	Y		
682.	5051	*Melhania oblongifolia*			
683.	31758	*Sida arsiniata*			
684.	4972	*Sida clementii*			
685.	18149	*Sida rohlenae subsp. rohlenae*			
686.	33698	*Sida sp. Pilbara (A.A. Mitchell PRP 1543)*			
687.		*Sida sp. Pilbara (A.A.Mitchell PRP1543)*			
688.	4875	*Triumfetta chaetocarpa (Urchins)*			
689.	14942	*Triumfetta maconochieana*			
690.	17317	*Triumfetta propinqua*			
691.		*Triumfetta sp.*			
692.	5106	*Waltheria indica*			
693.	5107	*Waltheria virgata*			
Marsileaceae					
694.	75	*Marsilea exarata*			
695.		*Marsilea sp.*			
Megadermatidae					
696.	24180	*Macroderma gigas (Ghost Bat)*		P4	
Melanotaeniidae					
697.		*Melanotaenia australis*			
698.		*Melanotaenia sp.*			
Meliphagidae					
699.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
700.		*Conopophila (Conopophila) rufogularis*			
701.		*Epthianura (Parepthianura) tricolor*			
702.	42314	*Gavicalis virescens (Singing Honeyeater)*			
703.		*Lichmera (Lichmera) indistincta subsp. indistincta*			
704.	25661	*Lichmera indistincta (Brown Honeyeater)*			
705.		*Manorina (Myzantha) flavigula*			
706.		*Manorina (Myzantha) flavigula subsp. lutea*			
707.		*Manorina (Myzantha) flavigula subsp. wayensis*			
708.	24583	*Manorina flavigula (Yellow-throated Miner)*			
709.		*Melithreptus (Eidopsarus) gularis subsp. laetior*			
710.	25665	*Melithreptus gularis (Black-chinned Honeyeater)*			
711.	42323	*Ptilotula keartlandi (Grey-headed Honeyeater)*			
712.	42341	*Ptilotula penicillatus (White-plumed Honeyeater)*			
713.	42344	*Purnella albifrons (White-fronted Honeyeater)*			
714.	42310	*Sugomel niger (Black Honeyeater)*			
Melitidae					
715.		*Melitidae sp.*			
716.		*Melitidae sp. 1 (PSS)*			
Meropidae					
717.		*Merops (Merops) ornatus*			
718.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
Microcerberidae					
719.		*Microcerberidae sp.*			
Molluginaceae					
720.	2835	*Glinus lotoides (Hairy Carpet Weed)*			
721.	29851	*Mollugo molluginea*			
Molossidae					
722.	24181	*Chaerephon jobensis (Northern Freetail-bat)*			
Mononchidae					
723.		*Mononchus sp.*			
Moraceae					
724.	31578	*Ficus aculeata var. indecora (Ranji)*			
725.	19648	*Ficus brachypoda*			
Motacillidae					
726.		*Anthus (Anthus) novaeseelandiae subsp. novaeseelandiae*			
Muridae					
727.	24217	*Leggadina lakedownensis (Short-tailed Mouse, Karekanga)*		P4	
728.	24223	*Mus musculus (House Mouse)*	Y		
729.	24233	*Pseudomys chapmani (Western Pebble-mound Mouse, Ngadji)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
				P4	
730.	24234	*Pseudomys delicatulus (Delicate Mouse)*			
731.	24235	*Pseudomys desertor (Desert Mouse)*			
732.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
733.	24248	*Zyzomys argurus (Common Rock-rat)*			
Muscidae					
734.		*Muscidae sp.*			
Myrmeleontidae					
735.		*Bandidus handschini*			Y
736.		*Heoclisis ramosa*			
Myrtaceae					
737.	14650	*Corymbia flavescens*			
738.	17093	*Corymbia hamersleyana*			
739.		*Corymbia sp.*			
740.		*Corymbia terminalis*			
741.	17084	*Corymbia zygophylla*			
742.	5580	*Eucalyptus camaldulensis (River Gum, Yabalinyba)*			
743.	35345	*Eucalyptus camaldulensis subsp. obtusa (Blunt-budded River Red Gum)*			
744.	35343	*Eucalyptus camaldulensis subsp. refulgens*			
745.	18088	*Eucalyptus leucophloia subsp. leucophloia*			
746.	14548	*Eucalyptus victrix*			
747.	5875	*Melaleuca argentea (Silver Cadjeput, Bandaran)*			
748.	5915	*Melaleuca glomerata*			
749.	5923	*Melaleuca lasiandra*			
750.	5933	*Melaleuca linophylla*			
Mytilinidae					
751.		*Mytilina ventralis macracantha*			
NO FAMILY					
752.		*No invertebrates*			
Naididae					
753.		*Allonais pectinata*			
754.		*Allonais ranauana*			
755.		*Chaetogaster diastrophus*			
756.		*Dero furcata*			
757.		*Dero nivea*			
758.		*Monopylephorus n. sp. WA29 (ex Pristina WA3) (PSS)*			
759.		*Nais communis*			
760.		*Pristina longiseta*			
761.		*Tubificidae WA28 (SAP))*			
Nematoda					
762.		*Nematoda sp.*			
763.		*Nematoda sp. 14 (PSS)*			
764.		*Nematoda sp. 2 (PSS)*			
765.		*Nematoda sp. P8 (PSW)*			
Nepidae					
766.		*Laccotrephes (Laccotrephes) tristis*			
Noctuidae					
767.		*Acontia clerana*			Y
768.		*Athetis tenuis*			
769.		*Diatenes aglossoides*			
770.		*Heliocheilus canusina*			
771.		*Heliocheilus ionola*			
772.		*Heliocheilus melibaphes*			
773.		*Heliocheilus pallida*			
774.		*Ipanica cornigera*			
775.		*Niguza oculita*			
776.		*Pandesma submurina*			
777.		*Prorocopis melanochorda*			
778.		*Xanthograpta purpurascens*			Y
Nolidae					
779.		*Armactica conchidia*			Y
Nyctaginaceae					
780.	2769	*Boerhavia burbidgeana*			
781.	2770	*Boerhavia coccinea (Tar Vine, Wituka)*			
782.	2772	*Boerhavia gardneri*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
783.		*Boerhavia sp.*			
Ochteridae					
784.		*Ochterus nr eurythorax*			
Oligochaeta					
785.		*Oligochaeta sp.*			
Onagraceae					
786.	6136	*Ludwigia perennis*			
Orobanchaceae					
787.	12492	*Striga squamigera*			
Ostracoda					
788.		*Ostracoda (unident.)*			
Otididae					
789.	24610	*Ardeotis australis (Australian Bustard)*			
Pachycephalidae					
790.		*Colluricincla (Colluricincla) harmonica subsp. rufiventris*			
791.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
792.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
793.	24618	*Oreoica gutturalis (Crested Bellbird)*			
794.		*Pachycephala (Alisterornis) lanioides subsp. carnarvoni*			
795.		*Pachycephala (Alisterornis) rufiventris subsp. rufiventris*			
796.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
Papaveraceae					
797.	2961	*Argemone ochroleuca (Mexican Poppy)*	Y		
798.	17797	*Argemone ochroleuca subsp. ochroleuca*	Y		
Paramelitidae					
799.		*Paramelitidae sp.*			
800.		*Paramelitidae sp. 2 (PSS)*			
801.		*Paramelitidae sp. 6 (PSS)*			
802.		*Paramelitidae sp. 7 (PSS)*			
Parastenocarididae					
803.		*Parastenocaris sp.*			
Pardalotidae					
804.		*Pardalotus (Pardalotinus) rubricatus subsp. rubricatus*			
805.		*Pardalotus (Pardalotinus) striatus subsp. uropygialis*			
806.	24627	*Pardalotus rubricatus (Red-browed Pardalote)*			
807.	25682	*Pardalotus striatus (Striated Pardalote)*			
Passifloraceae					
808.	14096	*Passiflora foetida var. hispida*	Y		
Pedaliaceae					
809.	7118	*Josephinia eugeniae (Josephinia Burr)*			
810.	19261	*Josephinia sp. Mt Edgar Station (N.T. Burbidge 1194)*			
Pelecanidae					
811.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
Phalacrocoracidae					
812.		*Microcarbo melanoleucos*			
813.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
Phasianidae					
814.	25701	*Coturnix ypsilophora (Brown Quail)*			
Phasmatidae					
815.		*Hyrtacus caurus*			
Philosciidae					
816.		*Philosciidae sp.*			
Phreodrilidae					
817.		*Insulodrilus lacustris s.l. Pilbara type 2/3 = WA35 (PSS)*			
818.		*Phreodrilid with dissimilar ventral chaetae*			
819.		*Phreodrilid with similar ventral chaetae*			
820.		*Phreodrilus peniculus*			
Phyllanthaceae					
821.	12013	*Flueggea virosa subsp. melanthesoides (Dogwood, Guwal)*			
822.	38421	*Notoleptopus decaisnei*			

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823.	4680	*Phyllanthus maderaspatensis*			
824.		*Phyllanthus sp.*			
Planorbidae					
825.		*Ferrissia (Pettancylus) petterdi*			
826.		*Ferrissia sp.*			
827.		*Gyraulus (Gyraulus) hesperus*			
828.		*Gyraulus hesperus*			
Plantaginaceae					
829.	7098	*Stemodia grossa (Marsh Stemodia, Mindjaara)*			
830.	7102	*Stemodia viscosa (Pagurda)*			
Pleidae					
831.		*Paraplea n. sp. (ANIC 6)*			
Plotosidae					
832.		*Neosilurus hyrtlii*			
Poaceae					
833.	204	*Aristida burbidgeae*			
834.	207	*Aristida contorta (Bunched Kerosene Grass)*			
835.	12063	*Aristida holathera var. holathera*			
836.	211	*Aristida hygrometrica (Northern Kerosene Grass)*			
837.	215	*Aristida latifolia (Feathertop Wiregrass)*			
838.	240	*Bothriochloa ewartiana (Desert Bluegrass)*			
839.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
840.	29721	*Cenchrus setiger (Birdwood Grass)*	Y		
841.	270	*Chloris pumilio*			
842.	273	*Chrysopogon fallax (Golden Beard Grass)*			
843.	279	*Cymbopogon ambiguus (Scentgrass)*			
844.	281	*Cymbopogon obtectus (Silkyheads)*			
845.	303	*Dichanthium fecundum (Curly Bluegrass)*			
846.	13741	*Dichanthium sericeum subsp. humilius*			
847.	310	*Digitaria brownii (Cotton Panic Grass)*			
848.	313	*Digitaria ctenantha (Comb Finger Grass)*			
849.	328	*Echinochloa colona (Awnless Barnyard Grass)*	Y		
850.	357	*Enneapogon caerulescens (Limestone Grass)*			
851.	360	*Enneapogon lindleyanus (Wiry Nineawn, Purple-head Nineawn)*			
852.	365	*Enneapogon polyphyllus (Leafy Nineawn)*			
853.	20377	*Enneapogon robustissimus*			
854.	368	*Enteropogon ramosus (Windmill Grass, Curly Windmill Grass)*			
855.	16730	*Eragrostis crateriformis*		P3	
856.	375	*Eragrostis cumingii (Cuming's Love Grass)*			
857.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
858.	380	*Eragrostis eriopoda (Woollybutt Grass, Wangurnu)*			
859.	388	*Eragrostis leptocarpa (Drooping Lovegrass)*			
860.	391	*Eragrostis parviflora (Weeping Lovegrass)*			
861.	395	*Eragrostis speciosa (Handsome Lovegrass)*			
862.	398	*Eragrostis tenellula (Delicate Lovegrass)*			
863.	399	*Eragrostis xerophila (Knotty-butt Neverfail)*			
864.	400	*Eriachne aristidea*			
865.	403	*Eriachne benthamii (Swamp Wanderrie)*			
866.	404	*Eriachne ciliata (Slender Wandarrie Grass)*			
867.	410	*Eriachne glauca (Pan Wandarrie Grass)*			
868.	411	*Eriachne helmsii (Buck Wanderrie Grass)*			
869.	413	*Eriachne mucronata (Mountain Wanderrie Grass)*			
870.	414	*Eriachne obtusa (Northern Wandarrie Grass)*			
871.	415	*Eriachne ovata*			
872.	16485	*Eriachne pulchella subsp. dominii*			
873.	11011	*Eulalia aurea*			
874.	443	*Heteropogon contortus (Bunch Speargrass)*			
875.	458	*Iseilema dolichotrichum*			
876.	471	*Leptochloa digitata (Whorled Cane Grass)*			
877.	19124	*Leptochloa fusca subsp. fusca*			
878.	503	*Panicum decompositum (Native Millet, Kaltu-kaltu)*			
879.	515	*Paraneurachne muelleri (Northern Mulga Grass)*			
880.	10975	*Paspalidium basicladum*			
881.	518	*Paspalidium clementii (Clements Paspalidium)*			
882.	606	*Setaria dielsii (Diels' Pigeon Grass)*			
883.	612	*Setaria surgens (Pigeon Grass)*			
884.	613	*Setaria verticillata (Whorled Pigeon Grass)*	Y		
885.	619	*Sorghum plumosum (Plume Canegrass)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
886.	628	*Sporobolus actinocladus (Ray Grass, Katoora)*			
887.	629	*Sporobolus australasicus (Fairy Grass)*			
888.	673	*Themeda triandra*			
889.	679	*Triodia angusta*			
890.	681	*Triodia brizoides*			
891.	13131	*Triodia epactia*			
892.	689	*Triodia lanigera*			
893.	690	*Triodia longiceps (Giant Grey Spinifex)*			
894.	17873	*Triodia schinzii*			
895.	700	*Triodia secunda*			
896.	704	*Triodia wiseana (Limestone Spinifex)*			
897.	706	*Triraphis mollis (Needle Grass)*			
898.	11321	*Urochloa holosericea subsp. velutina*			
899.	717	*Urochloa piligera*			
900.	728	*Whiteochloa cymbiformis*			
901.	729	*Xerochloa barbata (Rice Grass)*			
902.	732	*Yakirra australiensis*			
Podargidae					
903.	25703	*Podargus strigoides (Tawny Frogmouth)*			
Podicipedidae					
904.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
905.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
Polycentropodidae					
906.		*Paranyctiophylax sp AV5 (KIM-UWA)*			
Polygalaceae					
907.	41363	*Polygala galeocephala*			
Pomatostomidae					
908.		*Pomatostomus (Pomatostomus) temporalis subsp. rubeculus*			
909.	25706	*Pomatostomus temporalis (Grey-crowned Babbler)*			
Portulacaceae					
910.	40825	*Calandrinia pentavalvis*			
911.	2866	*Calandrinia quadrivalvis*			
912.	2870	*Calandrinia stagnensis*			
913.	2878	*Portulaca conspicua*			
914.	2884	*Portulaca oleracea (Purslane, Wakati)*			
915.	2886	*Portulaca pilosa (Djanggara)*	Y		
Potamogetonaceae					
916.	20426	*Potamogeton tepperi*			
Proteaceae					
917.	2079	*Grevillea pyramidalis (Caustic Bush, Tjungu)*			
918.	19570	*Grevillea pyramidalis subsp. leucadendron*			
919.	15975	*Grevillea pyramidalis subsp. pyramidalis*			
920.	13440	*Grevillea wickhamii subsp. aprica*			
921.	19478	*Grevillea wickhamii subsp. hispidula*			
922.	19137	*Hakea lorea subsp. lorea*			
Psittacidae					
923.		*Barnardius zonarius*			
924.		*Barnardius zonarius subsp. zonarius*			
925.	24725	*Cacatua roseicapilla subsp. assimilis (Galah)*			
926.	25716	*Cacatua sanguinea (Little Corella)*			
927.		*Cacatua sp.*			
928.	24736	*Melopsittacus undulatus (Budgerigar)*			
929.		*Neopsephotus bourkii*			
930.	24742	*Nymphicus hollandicus (Cockatiel)*			
931.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
Pygopodidae					
932.	24998	*Delma elegans*			
933.	25001	*Delma nasuta*			
934.	25002	*Delma pax*			
935.	25004	*Delma tincta*			
936.	25005	*Lialis burtonis*			
Pyralidae					
937.		*Pyralidae Pilbara sp 2 (PSW)*			
938.		*Pyralidae sp.*			
939.		*Pyralidae sp. 3 of JHH (PSW) (= Margarosticha ?repetitalis)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rallidae					
940.	25727	*Fulica atra (Eurasian Coot)*			
941.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
942.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
943.	24771	*Porzana tabuensis (Spotless Crake)*			
Recurvirostridae					
944.	25734	*Himantopus himantopus (Black-winged Stilt)*			
Ricciaceae					
945.		*Riccia macrospora*			
946.		*Riccia sp.*			
Rotifera					
947.		*Rotifera sp.*			
Rubiaceae					
948.	7338	*Oldenlandia crouchiana*			
949.	7339	*Oldenlandia galioides*			
950.	7363	*Synaptantha tillaeacea*			
951.	13339	*Synaptantha tillaeacea var. tillaeacea*			
Santalaceae					
952.	10765	*Exocarpos sparteus (Broom Ballart, Djuk)*			
Sapindaceae					
953.	4740	*Atalaya hemiglauca (Whitewood)*			
Scarabaeidae					
954.		*Eupoecila inscripta*			
Scincidae					
955.	25015	*Carlia munda (Shaded-litter Rainbow Skink)*			
956.	25036	*Ctenotus duricola*			
957.	25043	*Ctenotus grandis subsp. titan*			
958.	25045	*Ctenotus helenae*			
959.	25064	*Ctenotus pantherinus subsp. ocellifer (Leopard Ctenotus)*			
960.	25062	*Ctenotus piankai*			
961.	25070	*Ctenotus robustus*			
962.	25072	*Ctenotus rubicundus*			
963.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
964.	25090	*Cyclodomorphus melanops subsp. melanops (Slender Blue-tongue)*			
965.	25092	*Egernia depressa (Southern Pygmy Spiny-tailed Skink)*			
966.	41408	*Egernia epsisolus (Eastern Pilbara Spiny-tailed Skink)*			
967.	25125	*Lerista bipes*			
968.	30929	*Lerista jacksoni*			
969.	42411	*Lerista timida*			
970.	30925	*Lerista verhmens*			
971.	25184	*Menetia greyii*			
972.	25187	*Menetia surda subsp. surda*			
973.	25193	*Morethia ruficauda subsp. exquisita*			
974.	25197	*Notoscincus ornatus subsp. ornatus*			
975.	25199	*Proablepharus reginae*			
976.	25202	*Tiliqua multifasciata (Central Blue-tongue)*			
Sciomyzidae					
977.		*Sciomyzidae sp.*			
Scirtidae					
978.		*Scirtidae sp.*			
Scolopacidae					
979.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
980.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
981.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
982.	24808	*Tringa nebularia (Common Greenshank)*		IA	
Scrophulariaceae					
983.		*Eremophila sp.*			
Sididae					
984.		*Latonopsis australis*			
Simuliidae					
985.		*Cnephia nr aurantiacum*			
986.		*Simulium sp. P1 (cf tonnoiri) (PSW)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Solanaceae					
987.	6962	*Datura leichhardtii (Native Thornapple)*	Y		
988.	6971	*Nicotiana benthamiana (Tjuntiwari)*			
989.	11856	*Nicotiana occidentalis subsp. occidentalis*			
990.	6980	*Nicotiana umbratica*		P3	
991.	6998	*Solanum cleistogamum*			
992.	7001	*Solanum dioicum (Gilu)*			
993.	7002	*Solanum diversiflorum*			
994.	7014	*Solanum horridum*			
995.	7029	*Solanum phlomoides*			
996.		*Solanum sp.*			
Sparassidae					
997.		*Holconia sp.*			
998.		*Typostola pilbara*			Y
Staphylinidae					
999.		*Staphylinidae sp.*			
Stratiomyidae					
1000.		*Stratiomyidae sp.*			
Strigidae					
1001.		*Ninox (Ninox) novaeseelandiae*			
1002.		*Ninox (Ninox) novaeseelandiae subsp. boobook*			
1003.		*Ninox (Ninox) novaeseelandiae subsp. ocellata*			
1004.	25747	*Ninox connivens (Barking Owl)*			
1005.	24819	*Ninox connivens subsp. connivens (Barking Owl (southwest pop P2), Barking Owl)*		P2	
1006.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
1007.		*Ninox novaeseelandiae subsp. carteri*			Y
Sylviidae					
1008.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
1009.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
1010.	24837	*Eremiornis carteri (Spinifex-bird)*			
1011.	25758	*Megalurus gramineus (Little Grassbird)*			
Tabanidae					
1012.		*Tabanidae sp.*			
Tachyglossidae					
1013.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
Teloschistaceae					
1014.	27627	*Caloplaca cupulifera*			
Terapontidae					
1015.		*Leiopotherapon unicolor*			
Testudinellidae					
1016.		*Testudinella patina*			
Tettigoniidae					
1017.		*Antipodectes brevicaudus*			
Theridiidae					
1018.		*Latrodectus hasseltii*			
Threskiornithidae					
1019.	24842	*Platalea regia (Royal Spoonbill)*			
1020.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
1021.	24844	*Threskiornis molucca (Australian White Ibis)*			
1022.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Thylacomyidae					
1023.	24168	*Macrotis lagotis (Bilby, Dalgyte)*		T	
Thymelaeaceae					
1024.	5230	*Pimelea ammocharis*			
Trichocercidae					
1025.		*Trichocerca pusilla*			
1026.		*Trichocerca sp.*			
Trichotriidae					
1027.		*Macrochaetus altamirai*			
Turbellaria					
1028.		*Microturbellaria sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1029.		*Turbellaria sp.*			
Turnicidae					
1030.		*Turnix (Alphaturnia) velox*			
1031.	24851	*Turnix velox (Little Button-quail)*			
Unionicolidae					
1032.		*Koenikea sp. 2/3 (Pilbara) (PSW)*			
1033.		*Neumania sp.*			
1034.		*Recifella sp.*			
1035.		*Recifella tinka*			
Urodacidae					
1036.		*Urodacus yaschenkoi*			
Varanidae					
1037.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
1038.	25216	*Varanus giganteus (Perentie)*			
1039.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
Verrucariaceae					
1040.		*Catapyrenium sp.*			
Vespertilionidae					
1041.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
1042.	24200	*Scotorepens greyii (Little Broad-nosed Bat)*			
1043.	24205	*Vespadelus finlaysoni (Finlayson's Cave Bat)*			
Violaceae					
1044.	5215	*Hybanthus aurantiacus*			
Zosteropidae					
1045.	24857	*Zosterops luteus (Yellow White-eye)*			
1046.		*Zosterops luteus subsp. balstoni*			
Zygophyllaceae					
1047.	4368	*Tribulopis angustifolia*			
1048.	4377	*Tribulus hirsutus*			
1049.	4379	*Tribulus macrocarpus*			
1050.	4380	*Tribulus occidentalis (Perennial Caltrop)*			
1051.	4381	*Tribulus platypterus (Cork Hopbush)*			
1052.	4383	*Tribulus terrestris (Caltrop)*	Y		

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

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

Appendix D – Flora Data

Flora species list

Flora Likelihood of Occurrence assessment guidelines

Flora Likelihood of Occurrence assessment

Quadrat data

Flora taxa recorded from the survey area

Family	Genus	Species	Status	Gorge	Sidetrack
Amaranthaceae	*Aerva*	*javanica*	*	x	x
Amaranthaceae	*Amaranthus*	*undulatus*			x
Amaranthaceae	*Ptilotus*	*calostachyus*			x
Amaranthaceae	*Ptilotus*	*clementii*		x	
Amaranthaceae	*Ptilotus*	*nobilis*			x
Apocynaceae	*Calotropis*	*procera*	*	x	x
Asteraceae	*Chrysocephalum*	*pterochaetum*			x
Asteraceae	*Pluchea*	*dentex*			x
Asteraceae	*Pluchea*	*ferdinandi-muelleri*			x
Asteraceae	*Pluchea*	*tetranthera*		x	x
Asteraceae	*Streptoglossa*	*macrocephala*			x
Boraginaceae	*Ehretia*	*saligna*		x	
Boraginaceae	*Heliotropium*	*cunninghamii*			x
Boraginaceae	*Heliotropium*	*heteranthum*		x	x
Boraginaceae	*Heliotropium*	sp. (insufficient material)			x
Boraginaceae	*Trichodesma*	*zeylanicum*		x	
Caryophyllaceae	*Polycarpaea*	*longiflora*		x	
Chenopodiaceae	*Dysphania*	*plantaginella*			x
Chenopodiaceae	*Salsola*	*australis*			x
Cleomaceae	*Cleome*	*uncifera*			x
Cleomaceae	*Cleome*	*viscosa*		x	x
Combretaceae	*Terminalia*	*circumalata*		x	
Convolvulaceae	*Bonamia*	*erecta*			x
Convolvulaceae	*Operculina*	*aequisepala*		x	
Convolvulaceae	*Polymeria*	*ambigua*			x
Cucurbitaceae	*Citrullus*	*lanatus*	*		x
Cucurbitaceae	*Cucumis*	*variabilis*		x	x
Cyperaceae	*Cyperus*	*castaneus*		x	
Cyperaceae	*Cyperus*	*vaginatus*		x	x
Euphorbiaceae	*Euphorbia*	*coghlanii*			x
Euphorbiaceae	*Euphorbia*	*hirta*	*		x
Euphorbiaceae	*Euphorbia*	*trigonosperma*		x	x
Fabaceae	*Acacia*	*ampliceps*		x	x
Fabaceae	*Acacia*	*bivenosa*		x	
Fabaceae	*Acacia*	*inaequilatera*		x	x
Fabaceae	*Acacia*	*orthocarpa*		x	x
Fabaceae	*Acacia*	*ptychophylla*		x	x
Fabaceae	*Acacia*	*spondylophylla*		x	x
Fabaceae	*Acacia*	*trachycarpa*		x	x
Fabaceae	*Acacia*	*tumida var. Pilbarensis*		x	x
Fabaceae	*Crotalaria*	*cunninghamii*			x
Fabaceae	*Crotalaria*	*medicaginea*		x	
Fabaceae	*Cullen*	*stipulaceum*			x

Family	Genus	Species	Status	Gorge	Sidetrack
Fabaceae	*Erythrina*	*vespertilio*			x
Fabaceae	*Indigofera*	*monophylla*		x	x
Fabaceae	*Petalostylis*	*labicheoides*		x	x
Fabaceae	*Rhynchosia*	*minima*		x	x
Fabaceae	*Senna*	*artemisioides* subsp. *helmsii*			x
Fabaceae	*Senna*	*artemisioides* subsp. *oligophylla*		x	
Fabaceae	*Senna*	*glutinosa* subsp. *glutinosa*		x	x
Fabaceae	*Senna*	*notabilis*		x	x
Fabaceae	*Senna*	*symonii*		x	x
Fabaceae	*Senna*	*venusta*			x
Fabaceae	*Sesbania*	*formosa*			x
Fabaceae	*Tephrosia*	*rosea* var. *clementii*		x	x
Fabaceae	*Tephrosia*	sp. B Kimberley Flora (C.A. Gardner 7300)		x	x
Fabaceae	*Vachellia*	*farnesiana*	*	x	x
Fabaceae	*Vigna*	*lanceolata*			x
Goodeniaceae	*Dampiera*	*incana*			x
Goodeniaceae	*Goodenia*	*lamprosperma*			x
Goodeniaceae	*Goodenia*	*stobbsiana*		x	x
Goodeniaceae	*Scaevola*	*parvifolia*			x
Haloragaceae	*Myriophyllum*	*verrucosum*			x
Hydrocharitaceae	*Vallisneria*	*annua*			x
Lamiaceae	*Clerodendrum*	*floribundum*		x	
Lauraceae	*Cassytha*	sp. (insufficient material)		x	
Lythraceae	*Ammannia*	*baccifera*			x
Malvaceae	*Corchorus*	*parviflorus*		x	x
Malvaceae	*Gossypium*	*australe*		x	x
Malvaceae	*Hibiscus*	*burtonii*		x	
Malvaceae	*Hibiscus*	*coatesii*		x	
Malvaceae	*Melhania*	*oblongifolia*			x
Malvaceae	*Triumfetta*	*chaetocarpa*		x	x
Menispermaceae	*Tinospora*	*smilacina*		x	
Molluginaceae	*Mollugo*	*molluginea*			x
Moraceae	*Ficus*	*aculeata*			x
Moraceae	*Ficus*	*brachypoda*		x	
Myrtaceae	*Corymbia*	*hamersleyana*		x	x
Myrtaceae	*Eucalyptus*	*camaldulensis*		x	x
Myrtaceae	*Eucalyptus*	*victrix*		x	
Myrtaceae	*Melaleuca*	*argentea*		x	x
Nyctaginaceae	*Boerhavia*	*coccinea*		x	x
Onagraceae	*Ludwigia*	*perennis*			x
Papaveraceae	*Argemone*	*ochroleuca*	*		x
Passifloraceae	*Passiflora*	*foetida*	*		x
Phyllanthaceae	*Flueggea*	*virosa*		x	x

Family	Genus	Species	Status	Gorge	Sidetrack
Phyllanthaceae	*Sauropus*	*lissocarpus*		x	
Plantaginaceae	*Stemodia*	*grossa*		x	x
Plantaginaceae	*Stemodia*	*viscosa*			x
Poaceae	*Cenchrus*	*ciliaris*	*	x	x
Poaceae	*Chloris*	*barbata*	*		x
Poaceae	*Chrysopogon*	*fallax*			x
Poaceae	*Cymbopogon*	*ambiguus*		x	x
Poaceae	*Cynodon*	*dactylon*	*		x
Poaceae	*Enneapogon*	*caerulescens*		x	
Poaceae	*Enneapogon*	*lindleyanus*		x	x
Poaceae	*Eragrostis*	*tenellula*		x	x
Poaceae	*Eriachne*	*helmsii*		x	
Poaceae	*Eriachne*	*mucronata*		x	x
Poaceae	*Eriachne*	*obtusa*			x
Poaceae	*Eriachne*	*pulchella* subsp. *dominii*		x	
Poaceae	*Themeda*	*triandra*			x
Poaceae	*Triodia*	*epactia*		x	x
Poaceae	*Triodia*	*longiceps*		x	x
Poaceae	*Triodia*	*pungens*			x
Poaceae	*Triodia*	*schinzii*			x
Poaceae	*Triodia*	sp. (insufficient material)		x	
Poaceae	*Triodia*	*wiseana*		x	
Portulacaceae	*Calandrinia*	*quadrivalvis*			x
Potamogetonaceae	*Potamogeton*	*tricarinatus*			x
Proteaceae	*Grevillea*	*pyramidalis*		x	x
Proteaceae	*Grevillea*	*wickhamii*		x	x
Proteaceae	*Hakea*	*lorea*		x	x
Rubiaceae	*Oldenlandia*	*crouchiana*		x	
Sapindaceae	*Atalaya*	*hemiglauca*		x	x
Solanaceae	*Solanum*	*diversiflorum*			x
Violaceae	*Hybanthus*	*aurantiacus*		x	x
Zygophyllaceae	*Tribulus*	*macrocarpus*			x
Zygophyllaceae	*Tribulus*	*platypterus*		x	
Zygophyllaceae	*Tribulus*	sp. (insufficient material)		x	

Refer to Appendix A for conservation codes; * denotes introduced species

Flora Likelihood of Occurrence assessment guidelines

Likelihood of Occurrence	Guideline
Known	Species recorded within study area from field survey results.
Likely	Species previously recorded within 10 km and large areas of suitable habitat occur in the study area.
Possible	Species previously recorded within 10 km and areas of suitable habitat occur/may occur in the study area.
Unlikely	Species previously recorded within 10 km, but suitable habitat does not occur in the study area.
Highly unlikely	Species not previously recorded within 10 km, suitable habitat does not occur in the study area and/or the study area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Definitions

Study area = a 20 km buffer around the survey area

Source information - desktop searches

PMST – DotE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area
DPaW – DPaW (2007 -) records of threatened flora, database search within the study area (accessed May 2016)
NM – DPaW NatureMap (accessed May 2016)
Survey – recorded within the survey area during the 2016 survey

References

Craven, LA 1996, A Taxonomic Revision of Heliotropium (Boraginaceae) in Australia, Australian Systematic Botany, vol. 9, pp 521-657.

Flora Likelihood of Occurrence assessment

Species Name	Status	Source	Description	Preferred Habitat	Preferred Flowering Time	NatureMap Counts	Nearest Record	Within Known Range	Within Known Habitat	Likelihood
	DPaW	NM								
Acacia cyperophylla var. *omearana*	P1	x	Tree, 4-10 m high, 'minni-ritchi' bark.	Stony and gritty alluvium. Along drainage lines.	Fl. yellow, Mar to Apr.	22	30 km west	Yes	Yes	Possible - not recorded during field survey.
Rothia indica subsp. *australis*	P1	x	Prostrate annual, herb, to 0.3m high, densely covered in spreading hairs.	Sandy soils. Sandhills and sandy flats	Fl. Apr to Aug.	19	37 km northwest	Yes	Marginal	Unlikely - not recorded during field survey
Euphorbia clementii	P2	x	Erect herb, to 0.6 m high	-	Gravelly hillsides, stony grounds	33	14 km east	Yes	Yes	Likely - not recorded during field survey.
Euphorbia inappendiculata var. *inappendiculata*	P2	x	Spreading, procumbent herb, to 0.4 m high.	Fl. Pink, Aug	Clay soils. Among broken rocky screes	5	37 km northwest	Yes	No	Unlikely - not recorded during field survey
Eragrostis crateriformis	P3	x	Annual, grass-like or herb, 0.17-0.42m high.	Fl. Jan to May or Jul.	Clayey loam or clay. Creek banks, depressions	28	37 km northwest	Yes	No	Unlikely - not recorded during field survey
Gomphrena leptophylla	P3	x	Prostrate or erect to spreading annual, hrb, to 0.15 m high	Fl. White, Mar to Sep.	Sand, sandy to clayey loam, granite, quartzite. Open flats, sandy creek beds, edges salt pans and marshes, stony hillsides	11	26 km southeast	Yes	Yes	Possible - not recorded during field survey.
Heliotropium murinum	P3	x	Short-lived perennial, herb, up to 0.4 m high.	Fl. May or Sep	Red sand. Plains	14	20 km south	Yes	No	Unlikely - not recorded during field survey

Species Name	Status	Source	Description	Preferred Habitat	Preferred Flowering Time	NatureMap Counts	Nearest Record	Within Known Range	Within Known Habitat	Likelihood
	DPaW	NM								
Nicotiana umbratica	P3	x	Erect, short-lived annual or perennial, herb, 0.3-0.7m high.	Fl. White, Apr to Jun	Shallow soils. Rocky outcrops	30	6 km north	Yes	Yes	Likely - not recorded during field survey.
Bulbostylis burbidgeae	P4	x	Tufted, erect to spreading annual, grass-like or herb (sedge), 0.03 - 0.25 m high, spikelets in a simple umbel or rarely solitary; stamens 3; involucral bracts long, hairy.	Fl. Brown, Mar or Jun to Aug.	Granitic soils. Granite outcrops	31	12 km west	Yes	Yes	Possible - not recorded during field survey.
Ptilotus mollis	P4	x	Compact, perennial shrub, to 0.5 m high, soft, grey foliage.	Fl. White/pink, May or Sep.	Stony hills and screes	37	37 km northwest	Yes	Yes	Possible - not recorded during field survey.

Site	Q1	project			Coongan Gorge Upgrade			
Date:	2505/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	New Alignment		**Easting:**	792933	**Northing:**	7683800	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3584	**Camera:**	NW	
Site Disturbance:	Weeds, tracks nearby	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	no					
Veg Condition:	4	**Field Vegetation Type:**	Shrubs on large scree					
Drainage:	Good							
Fire Frequency:	Nil	**Fire Intensity:**	no damage					
Surface Component:	10% gravel (20-60mm), 10% cobbles (60-200mm), 20% stones (200-600mm), 60% boulders (>600mm)	**Soil Type:** **Major Component:**	Rock			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange, Brown	**Slope (if present):**	Steep (south)					
Landform:	Outcrop, hill crest							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover				<2	2-10	2-10	10-30	2-10
Ht range (m)				2-4	1-2	0.4-1.0	0.7-1.1	0.4-1
Av ht (m)				4	1.3	0.9	0.9	0.7

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Clerodendrum	*floribundum*		M1	<2T	4
Flueggea	*virosa*		M1	2-10	4
Ehretia	*saligna*		M1	<2T	4
Atalaya	*hemiglauca*		M1	<2T	4
Grevillea	*wickhamii*		M1	<2T	4
Atalaya	*hemiglauca*		M2	<2T	1.4
Flueggea	*virosa*		M2	2-10	1.9
Ehretia	*saligna*		M2	10-30	1.4
Gossypium	*australe*		M2	<2T	1.1
Senna	*glutinosa* subsp. *glutinosa*		M2	<2T	1.4
Atalaya	*hemiglauca*		M3	<2T	0.4
Ehretia	*saligna*		M3	2-10	0.5
Acacia	*inaequilatera*		M3	<2T	0.9
Triodia	*wiseana*		G1	30-70	1.1
Enneapogon	*lindleyanus*		G2	2-10	0.6
Eriachne	*mucronata*		G2	<2N	0.3
Cymbopogon	*ambiguus*		G2	<2N	0.5
Cenchrus	*ciliaris*	*	G2	2-10	0.4

Site	Q2	project			Coongan Gorge Upgrade			
Date:	2505/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	New Alignment		**Easting:**	792628	**Northing:**	7683949	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3593	**Camera:**	NW	
Site Disturbance:	cattle, tracks nearby	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	no					
Veg Condition:	4	**Field Vegetation Type:**	Upper Slope with outcrops					
Drainage:	Good							
Fire Frequency:	Nil, old >5yr	**Fire Intensity:**	no damage					
Surface Component:	20% pebbles (6-20mm) 20% gravel (20-60mm), 20% cobbles (60-200mm), 20% stones (200-600mm), 20% boulders (>600mm),	**Soil Type: Major Component:**	Sandy Loam, Rock			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange, Brown	**Slope (if present):**	Steep (south)					
Landform:	Outcrop, hill crest							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover				<2	<2	10-30	10-30	10-30
Ht range (m)				2-5	1-2	0.2-1.0	0.4-1.1	0.1-1.1
Av ht (m)				4	1.3	0.8	0.9	0.7

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Grevillea	*wickhamii*		M1	<2T	5
Atalaya	*hemiglauca*		M1	<2T	4
Flueggea	*virosa*		M1	<2T	3
Hakea	*lorea*		M1	<2T	5
Gossypium	*australe*		M2	<2T	1.5
Acacia	*inaequilatera*		M2	<2T	1.5
Grevillea	*wickhamii*		M2	<2T	1.4
Senna	*glutinosa* subsp. *glutinosa*		M2	<2T	1.2
Acacia	*ptychophylla*		M2	10-30	1.2
Hakea	*lorea*		M3	<2T	0.9
Grevillea	*pyramidalis*		M3	<2T	0.4
Acacia	*ptychophylla*		M3	<2T	0.9
Gossypium	*australe*		M3	<2N	0.5
Triodia	*wiseana*		G1	10-30	1.1
Enneapogon	*lindleyanus*		G2	10-30	0.7
Cymbopogon	*ambiguus*		G2	<2N	0.5
Eriachne	*mucronata*		G2	2-10	0.3
Cenchrus	*ciliaris*	*	G2	<2N	0.4
Euphorbia	*trigonosperma*		G2a	<2T	0.1
Cucumis	*variabilis*		G2a	<2T	climber

Site	Q3	project			Coongan Gorge Upgrade			
Date:	2505/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	Central		**Easting:**	791645	**Northing:**	7684101	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			nil	**Camera:**	NW	
Site Disturbance:	cattle, tracks nearby	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	?water					
Veg Condition:	6	**Field Vegetation Type:**	Burnt					
Drainage:	Good							
Fire Frequency:	Recent <1yr	**Fire Intensity:**	total damage					
Surface Component:	10% soil, 10% fines (2-6mm), 30% pebbles (6-20mm) 30% gravel (20-60mm), 20% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam, Rock			**Minor:**		
Leaf Litter:	Nil	**Wood Litter:**	Nil					
Soil Colour:	Red Orange, Brown	**Slope (if present):**	Moderate to Steep (north)					
Landform:	Slope – middle/lower							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m		**Shrub <1 m**	M2					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover				<2	<2		2-10	<2
Ht range (m)				4	0.4		0.1-0.4	0.1-0.4
Av ht (m)				4	0.4		0.2	0.1

No Quadrat Photograph - Quadrat location arrowed

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Acacia	*inaequilatera*		M1	<2T	4
Acacia	*inaequilatera*		M2	<2N	0.4
Indigofera	*monophylla*		M2	<2T	0.2
Tephrosia	*rosea* var. *clementii*		M2	<2T	0.1
Acacia	*ptychophylla*		M2	<2N	0.8
Triodia	sp. (insufficient material)		G1	2-10	0.4
Cleome	*viscosa*		G2	<2T	0.1
Tribulus	sp. (insufficient material)		G2	<2T	0.1
Ptilotus	*clementii*		G2	<2T	0.4

Site	Q4	project			Coongan Gorge Upgrade			
Date:	2505/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	Central		**Easting:**	791137	**Northing:**	7684606	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3601	**Camera:**	NW	
Site Disturbance:	old infrastructure, cattle, flood, old road works	**Frequency:**	current (animal), infrastructure >10 yrs					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	5	**Field Vegetation Type:**	Spinifex Steppe on Stony Lower slopes					
Drainage:	Good							
Fire Frequency:	Nil, old >5yr	**Fire Intensity:**	no damage					
Surface Component:	10% soil, 10% fines (2-6mm), 20% pebbles (6-20mm) 20% gravel (20-60mm), 10% cobbles (60-200mm), 10% stones (200-600mm), 20% boulders (>600mm)	**Soil Type:** **Major Component:**	Sandy Loam, Rock			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange, Brown	**Slope (if present):**	Gentle to Moderate (south)					
Landform:	Slope – middle/lower							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	G2
Hummock Grass	G1	**Sedge**	
Vine		**Herbs**	
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			2-10	<2	<2	>70	2-10
Ht range (m)	4-5			2-6	1-2	0.4-1	0.2-1.1	0.1-0.7
Av ht (m)	5			5	1.4	0.8	1.0	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	5
Acacia	*inaequilatera*		M1	2-10	6
Grevillea	*wickhamii*		M1	<2T	6
Hakea	*lorea*		M1	<2T	4.5
Acacia	*spondylophylla*		M2	<2T	1.4
Acacia	*inaequilatera*		M2	<2T	1.3
Grevillea	*wickhamii*		M2	<2T	1.3
Indigofera	*monophylla*		M3	<2T	0.5
Acacia	*spondylophylla*		M3	<2T	0.9
Corchorus	*parviflorus*		M3	<2T	0.8
Grevillea	*wickhamii*		M3	<2T	0.8
Senna	*notabilis*		M3	<2T	0.2
Boerhavia	*coccinea*		G2a	<2N	0.1
Triodia	*epactia*		G1	>70	1.1
Cenchrus	*ciliaris*	*	G2	<2N	0.5
Cymbopogon	*ambiguus*		G2	<2N	0.6
Eriachne	*mucronata*		G2	<2N	0.5
Goodenia	*stobbsiana*		G2a	<2T	0.4
Cassytha	sp. (insufficient material)		G2a	<2T	climber
Heliotropium	*heteranthum*		G2a	<2T	0.05
Acacia	*trachycarpa*		M3	<2T	0.9

Site	Q5	project			Coongan Gorge Upgrade			
Date:	2505/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	Western End		**Easting:**	790476	**Northing:**	7685984	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3607	**Camera:**	NW	
Site Disturbance:	cattle, old ?rail line	**Frequency:**	current (animal), infrastructure >10 yrs					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	?water					
Veg Condition:	4	**Field Vegetation Type:**	Spinifex Steppe on Stony Calcareous Lower Slopes					
Drainage:	Good							
Fire Frequency:	Mod 1-5 yr	**Fire Intensity:**	most trees killed					
Surface Component:	20% soil, 20% fines (2-6mm), 20% pebbles (6-20mm) 30% gravel (20-60mm), 10% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam, Rock			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Gentle (north)					
Landform:	Lower Slope – Plain							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**						
Shrub 1-2 m		**Shrub <1 m**	M1					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						
STRATUM	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
% cover				<2			>70	<2
Ht range (m)				0.8			0.3-1.3	0.4
Av ht (m)				0.8			0.8	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Acacia	*spondylophylla*		M1	<2T	0.8
Acacia	*trachycarpa*		M1	<2T	0.9
Corchorus	*parviflorus*		M1	2-10	0.9
Grevillea	*pyramidalis*		M1	<2T	0.9
Grevillea	*wickhamii*		M1	<2T	0.9
Acacia	*inaequilatera*		M1	<2T	0.9
Bonamia	*erecta*		M1	<2T	0.4
Triodia	*epactia*		G1	>70	1.1
Triodia	*longiceps*		G1	<2N	1.1
Triodia	*epactia*		G1	<2N	1.1
Stemodia	*grossa*		G2	<2T	0.4

Site	Q6	project			Coongan Gorge Upgrade			
Date:	2505/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	north west		**Easting:**	792192	**Northing:**	7685766	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3612	**Camera:**	NW	
Site Disturbance:	cattle, gravel track	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	5	**Field Vegetation Type:**	Spinifex Steppe on Stony Calcareous Lower Slopes					
Drainage:	Good							
Fire Frequency:	Old >5yr	**Fire Intensity:**	Mostly killed					
Surface Component:	20% soil, 20% fines (2-6mm), 20% pebbles (6-20mm) 30% gravel (20-60mm), 10% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam, Rock			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange, Grey	**Slope (if present):**	Gentle (north)					
Landform:	Plain							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m		**Shrub <1 m**	M2
Cycads		**Tussock Grass**	
Hummock Grass	G1	**Sedge**	
Vine		**Herbs**	G2
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			<2	2-10		30-70	<2
Ht range (m)	3-5			3	0.1-1		0.1-1.2	0.1-0.5
Av ht (m)	5			3	0.7		1.0	0.1

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	5
Acacia	*inaequilatera*		M1	<2T	3
Corchorus	*parviflorus*		M2	<2N	0.4
Acacia	*inaequilatera*		M2	<2N	0.4
Hakea	*lorea*		M2	<2T	0.4
Triodia	*epactia*		G1	2-10	1
Triodia	*longiceps*		G1	10-30	1.1
Triodia	*epactia*		G1	2-10	0.8
Cleome	*viscosa*		G2	<2T	0.1
Heliotropium	sp. (insufficient material)		G2	<2N	0.1
Salsola	*australis*		G2	<2T	0.1
Goodenia	*stobbsiana*		G2	<2T	0.5

Site	Q7	project			Coongan Gorge Upgrade			
Date:	26/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	east		**Easting:**	793072	**Northing:**	7685297	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3651	**Camera:**	NW	
Site Disturbance:	cattle, fire, old rail, old fencing	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	5	**Field Vegetation Type:**	Spinifex Steppe on Stony Calcareous Lower Slopes					
Drainage:	Good							
Fire Frequency:	?Recent ?<1yr to Mod 1-5 yr	**Fire Intensity:**	Mostly killed					
Surface Component:	10% soil, 10% fines (2-6mm), 20% pebbles (6-20mm) 20% gravel (20-60mm), 20% cobbles (60-200mm) , 10% stones (200-600mm), 10% boulders/plates (>600mm)	**Soil Type:** **Major Component:**	Loamy Sand, rock			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Gentle (north)					
Landform:	Lower Slope							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	
Hummock Grass	G1	**Sedge**	
Vine		**Herbs**	G2
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover				<2	<2	2-10	30-70	<2
Ht range (m)				2.5-4	1-2	0.4-1	0.1-0.7	0.2-0.5
Av ht (m)				2.5	1.2	0.7	0.5	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Acacia	*inaequilatera*		M1	<2T	4
Acacia	*inaequilatera*		M2	<2T	1.1
Corchorus	*parviflorus*		M3	10-30	0.7
Bonamia	*erecta*		M3	<2T	0.2
Pluchea	*tetranthera*		M3	<2T	0.5
Scaevola	*parvifolia*		M3	<2T	0.4
Acacia	*inaequilatera*		M3	<2T	0.3
Tephrosia	sp. B Kimberley Flora (C.A. Gardner 7300)		M3	<2T	0.2
Triodia	*pungens*		G1	10-30	0.7
Triodia	*epactia*		G1	10-30	0.7
Cleome	*viscosa*		G2	<2T	0.5
Senna	*notabilis*		G2	<2T	0.2

Site	Q8	project			Coongan Gorge Upgrade			
Date:	26/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	north east		**Easting:**	792341	**Northing:**	7685648	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3661	**Camera:**	NW	
Site Disturbance:	cattle, fire, old rail, flood	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water?					
Veg Condition:	5	**Field Vegetation Type:**	gusher / sandy plain					
Drainage:	Good							
Fire Frequency:	Mod 1-5 yr	**Fire Intensity:**	Mostly killed					
Surface Component:	20% soil, 20% fines (2-6mm), 20% pebbles (6-20mm) 20% gravel (20-60mm), 10% cobbles (60-200mm) , 10% stones (200-600mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Gentle (north)					
Landform:	Lower Slope, sheetwash (drainage line)							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			2-10	<2	10-30	30-70	2-10
Ht range (m)	4.5-5.5			2-4	1-2	0.1-1	0.1-1.0	0.2-1.1
Av ht (m)	5			3	1.4	0.7	0.6	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	5
Petalostylis	*labicheoides*		M1	2-10	4
Acacia	*inaequilatera*		M2	<2T	1.7
Grevillea	*wickhamii*		M2	<2T	1.3
Corchorus	*parviflorus*		M2	<2T	1.2
Acacia	*ptychophylla*		M2	<2T	1.1
Corchorus	*parviflorus*		M3	10-30	0.8
Acacia	*spondylophylla*		M3	<2N	0.9
Bonamia	*erecta*		M3	<2N	0.4
Streptoglossa	*macrocephala*		M3	<2T	0.4
Indigofera	*monophylla*		M3	<2T	0.2
Acacia	*ptychophylla*		M3	<2T	0.4
Triodia	*epactia*		G1	10-30	0.7
Triodia	*pungens*		G1	10-30	0.7
Cenchrus	*ciliaris*	*	G2	<2N	0.2
Eriachne	*obtusa*		G2	<2N	0.4
Eriachne	*mucronata*		G2	<2N	0.7
Cymbopogon	*ambiguus*		G2	<2T	1.1
Senna	*notabilis*		G2a	<2T	0.2
Euphorbia	*trigonosperma*		G2a	<2N	0.2
Cleome	*uncifera*		G2a	<2N	0.2
Boerhavia	*coccinea*		G2a	<2N	0.7
Goodenia	*stobbsiana*		G2a	<2T	0.4
Heliotropium	*cunninghamii*		G2a	<2T	0.1
Polymeria	*ambigua*		M3	<2N	0.2
Triumfetta	*chaetocarpa*		M3	<2T	0.6
Acacia	*inaequilatera*		M3	<2T	0.4
Grevillea	*pyramidalis*		M3	<2T	0.9
Ptilotus	*calostachyus*		M3	<2T	0.8
Corymbia	*hamersleyana*		M3	<2T	0.5
Pluchea	*ferdinandi-muelleri*		M3	<2T	0.7
Triodia	*schinzii*		G1	<2T	0.3

Site	Q9	project			Coongan Gorge Upgrade			
Date:	26/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	south east		**Easting:**	793488	**Northing:**	7684465	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3670	**Camera:**	NW	
Site Disturbance:	cattle, fire, old rail, flood, weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	6	**Field Vegetation Type:**	Floodplain with Buffel					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	No damage					
Surface Component:	30% soil, 20% fines (2-6mm), 20% pebbles (6-20mm) 20% gravel (20-60mm), 10% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**	?Clay (bulldust)	
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange, Brown	**Slope (if present):**	Gentle (east)					
Landform:	Plain – floodplain							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**						
Shrub 1-2 m	M1	**Shrub <1 m**	M2					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	10-30			<2	<2		10-30	30-70
Ht range (m)	2-6			1-2	0.5		0.1-1.3	0.1-0.3
Av ht (m)	5.5			1.3	0.5		1.1	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	10-30	6
Acacia	*trachycarpa*		M1	<2T	1.3
Hakea	*lorea*		M1	<2N	1.5
Acacia	*trachycarpa*		M2	<2N	0.5
Pluchea	*tetranthera*		M2	<2T	0.3
Corchorus	*parviflorus*		M2	<2T	0.3
Hakea	*lorea*		M2	<2T	0.8
Pluchea	*ferdinandi-muelleri*		M2	<2N	0.9
Acacia	*inaequilatera*		M2	<2T	0.4
Triodia	*longiceps*		G1	10-30	1.1
Triodia	*longiceps*		G1	<2T	1.1
Triodia	*epactia*		G1	<2T	1.1
Cenchrus	*ciliaris*	*	G2	30-70	0.2
Heliotropium	*heteranthum*		G2a	<2T	0.05

Site	Q10	**project**			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	eastern end		**Easting:**	794070	**Northing:**	7683200	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3687	**Camera:**	NW	
Site Disturbance:	cattle, fire, old rail, flood, weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	6	**Field Vegetation Type:**	Riparian Woodland on narrow channel					
Drainage:	Good							
Fire Frequency:	Nil - south, burnt recent on north side	**Fire Intensity:**	No damage (south), scars north					
Surface Component:	80% soil, 10% pebbles (6-20mm) 10% gravel (20-60mm)	**Soil Type:** **Major Component:**	Loamy Sand			**Minor:**		
Leaf Litter:	Plentiful	**Wood Litter:**	Moderate					
Soil Colour:	Red Orange, Brown	**Slope (if present):**	Gentle (north)					
Landform:	Creekline							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	G1
Hummock Grass	G2a	**Sedge**	G2
Vine		**Herbs**	
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
% cover	30-70			2-10	<2	<2	30-70	2-10
Ht range (m)	4-8			2-5	1-2	0.1-1	0.1-1	0.1-1.1
Av ht (m)	7			3	1.2	0.7	0.5	1.0

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	2-10	5
Eucalyptus	*camaldulensis*		U1	10-30	8
Eucalyptus	*victrix*		U1	10-30	8
Eucalyptus	*camaldulensis*		U2	<2N	1.5
Eucalyptus	*victrix*		U2	<2N	1.5
Acacia	*ampliceps*		M1	<2T	5
Acacia	*trachycarpa*		M1	<2N	2.1
Flueggea	*virosa*		M1	<2T	2.1
Acacia	*trachycarpa*		M2	<2T	1.4
Acacia	*inaequilatera*		M2	<2T	1.1
Acacia	*tumida*		M2	<2T	1.5
Vachellia	*farnesiana*	*	M2	<2T	1.7
Acacia	*trachycarpa*		M3	<2T	0.7
Vachellia	*farnesiana*	*	M3	<2N	0.7
Atalaya	*hemiglauca*		M3	<2T	0.8
Grevillea	*wickhamii*		M3	<2T	0.7
Corchorus	*parviflorus*		M3	<2T	0.8
Pluchea	*tetranthera*		M3	<2T	0.5
Cenchrus	*ciliaris*	*	G1	30-70	0.8
Triodia	*longiceps*		G2a	2-10	1.1
Cyperus	*vaginatus*		G2	10-30	0.9

Site	Q11	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	eastern end		**Easting:**	793700	**Northing:**	7683451	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3688	**Camera:**	NE (due to sun)	
Site Disturbance:	cattle, fire, old rail, weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	6	**Field Vegetation Type:**	Spinifex steppe on stony plains					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	Minor					
Surface Component:	10% soil, 10% fins (2-6mm), 30% pebbles (6-20mm) 20% gravel (20-60mm), 20% cobbles (60-200mm), stones (200-600mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Gentle (north)					
Landform:	Lower Slope / Plain							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	
Hummock Grass	G1	**Sedge**	
Vine		**Herbs**	G2
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			2-10	<2	2-10	30-70	<2
Ht range (m)	6			3	1-2	0.2-1	0.1-1	0.4
Av ht (m)	6			3	1.3	0.8	0.8	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	6
Grevillea	*wickhamii*		M1	<2T	3
Acacia	*inaequilatera*		M1	<2T	3
Acacia	*orthocarpa*		M1	2-10	3
Grevillea	*wickhamii*		M2	<2T	1.5
Acacia	*orthocarpa*		M2	<2T	1.8
Acacia	*tumida*		M2	<2T	1.3
Senna	*symonii*		M2	<2T	1.3
Acacia	*ptychophylla*		M2	<2T	1.1
Acacia	*spondylophylla*		M2	<2T	1.1
Acacia	*ptychophylla*		M3	2-10	0.8
Senna	*symonii*		M3	<2T	0.5
Corchorus	*parviflorus*		M3	<2T	0.2
Acacia	*inaequilatera*		M3	<2T	0.2
Triodia	*epactia*		G1	30-70	1
Eriachne	*mucronata*		G2	<2T	0.2
Goodenia	*stobbsiana*		G2a	<2T	0.4

Site	Q12	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	eastern end new alignment		**Easting:**	793185	**Northing:**	7683728	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3700	**Camera:**	SE (due to sun)	
Site Disturbance:	cattle, flood, weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	5	**Field Vegetation Type:**	Spinifex steppe on stony plains with creek and dense shrub layer					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	nil					
Surface Component:	30% soil, 20% fines (2-6mm), 20% pebbles (6-20mm) 20% gravel (20-60mm), 10% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Moderate	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	Gentle (north-east)					
Landform:	Lower Slope / Creekline							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			10-30	2-10	<2	30-70	2-10
Ht range (m)	5.5			2-5	1-2	0.2-1	0.1-1.2	0.1-0.5
Av ht (m)	5.5			4	1.1	0.9	1.0	0.3

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	5.5
Acacia	*tumida*		M1	10-30	4.5
Grevillea	*wickhamii*		M1	2-10	3.5
Acacia	*inaequilatera*		M1	<2N	4
Grevillea	*wickhamii*		M2	2-10	1.9
Acacia	*inaequilatera*		M2	<2T	1.8
Acacia	*ptychophylla*		M2	2-10	1.1
Acacia	*tumida*		M2	<2T	1.2
Senna	*glutinosa* subsp. *glutinosa*		M2	<2T	1.6
Grevillea	*pyramidalis*		M2	<2T	1.5
Acacia	*inaequilatera*		M3	<2T	0.8
Grevillea	*pyramidalis*		M3	<2T	0.5
Gossypium	*australe*		M3	<2T	0.5
Grevillea	*wickhamii*		M3	<2N	0.8
Acacia	*spondylophylla*		M3	<2T	0.9
Triodia	*epactia*		G1	30-70	1.1
Cenchrus	*ciliaris*	*	G2	2-10	0.1
Euphorbia	*trigonosperma*		G2a	<2N	0.3
Boerhavia	*coccinea*		G2a	<2T	0.2
Cyperus	*vaginatus*		G2b	<2T	0.4
Eriachne	*helmsii*		G2	<2N	0.5
Hibiscus	*coatesii*		M2	<2T	1.4
Tephrosia	sp. B Kimberley Flora (C.A. Gardner 7300)		M2	<2T	1.1

Site	Q13	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	east end		**Easting:**	791588	**Northing:**	7684254	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3702	**Camera:**	SE (due to sun)	
Site Disturbance:	?cattle, road nearby	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	3	**Field Vegetation Type:**	Spinifex steppe on upper slopes					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	nil					
Surface Component:	5% soil, 5% fines (2-6mm), 10% pebbles (6-20mm), 20% gravel (20-60mm), 20% cobbles (60-200mm), 20% stones (200-600mm), 20% boulders (>600mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Steep (south)					
Landform:	Middle to Upper slope							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			2-10	<2	<2	>70	2-10
Ht range (m)	4.5			2-4	1-2	0.4-1	0.1-1	0.1-0.3
Av ht (m)	4.5			3.5	1.2	0.9	0.8	0.3

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	4.5
Grevillea	*wickhamii*		M1	<2T	4
Acacia	*inaequilatera*		M1	2-10	4
Hakea	*lorea*		M1	<2T	3
Atalaya	*hemiglauca*		M1	<2T	2.5
Acacia	*spondylophylla*		M2	<2T	1.2
Acacia	*ptychophylla*		M2	<2N	1.3
Acacia	*inaequilatera*		M2	<2T	1.4
Hakea	*lorea*		M2	<2T	1.5
Atalaya	*hemiglauca*		M2	<2T	1.7
Flueggea	*virosa*		M2	<2T	1.6
Acacia	*spondylophylla*		M3	<2T	0.9
Hakea	*lorea*		M3	<2T	0.4
Acacia	*ptychophylla*		M3	<2T	0.9
Indigofera	*monophylla*		M3	2-10	0.7
Corchorus	*parviflorus*		M3	2-10	0.5
Triodia	*epactia*		G1	>70	0.8
Eriachne	*mucronata*		G2	2-10	0.6
Cymbopogon	*ambiguus*		G2	2-10	1.1
Cucumis	*variabilis*		G2a	<2T	climber
Euphorbia	*trigonosperma*		G2a	<2T	0.2

Site	Q14	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	West end		**Easting:**	790263	**Northing:**	7685646	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3725	**Camera:**	NW	
Site Disturbance:	?cattle, road nearby	**Frequency:**	old >10yr					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	4	**Field Vegetation Type:**	chert hills/foothills					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	nil					
Surface Component:	10% soil, 5% fines (2-6mm), 10% pebbles (6-20mm), 20% gravel (20-60mm), 20% cobbles (60-200mm), 20% stones (200-600mm), 50% boulders (>600mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Moderate (west)					
Landform:	Lower Slope							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**						
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			2-10	<2	<2	30-70	<2
Ht range (m)	4			2-4	1-2	0.4-1	0.1-1.3	0.2
Av ht (m)	4			3	1.3	0.7	1.1	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	4
Acacia	*inaequilatera*		M1	2-10	4
Acacia	*inaequilatera*		M2	<2T	1.3
Senna	*symonii*		M2	<2T	1.1
Acacia	*ptychophylla*		M2	<2T	1.3
Senna	*glutinosa* subsp. *glutinosa*		M2	<2T	1.4
Acacia	*inaequilatera*		M3	<2T	0.8
Acacia	*spondylophylla*		M3	<2T	0.7
Acacia	*ptychophylla*		M3	<2T	0.7
Triodia	*epactia*		G1	30-70	1.3
Triodia	*longiceps*		G1	<2N	1.1
Boerhavia	*coccinea*		G2	<2T	0.2

Site	Q15	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	West end		**Easting:**	790254	**Northing:**	7685376	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3726	**Camera:**	NW	
Site Disturbance:	?cattle, road nearby, historical pit?	**Frequency:**	old >10yr					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	5	**Field Vegetation Type:**	Gusher, broad sheet wash? With calcareous next to					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	nil					
Surface Component:	20% soil, 20% fines (2-6mm), 20% pebbles (6-20mm), 20% gravel (20-60mm), 20% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	Gentle (west)					
Landform:	Lower Slope / Plain / Creekline							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	2-10			2-10	2-10	<2	>70	<2
Ht range (m)	3-5			2-4	1-2	0.2-1	0.1-1.2	0.4
Av ht (m)	4.5			2.2	1.7	0.7	1.0	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	2-10	5
Acacia	*inaequilatera*		M1	2-10	2.5
Petalostylis	*labicheoides*		M1	<2T	2.5
Hakea	*lorea*		M1	<2T	2.2
Grevillea	*wickhamii*		M1	<2T	2.5
Corchorus	*parviflorus*		M2	<2T	1.1
Petalostylis	*labicheoides*		M2	2-10	1.7
Acacia	*spondylophylla*		M2	<2T	1.1
Grevillea	*wickhamii*		M2	<2T	1.3
Petalostylis	*labicheoides*		M3	<2T	0.4
Acacia	*spondylophylla*		M3	<2T	0.5
Corchorus	*parviflorus*		M3	<2T	0.2
Grevillea	*wickhamii*		M3	<2T	0.5
Triodia	*epactia*		G1	30-70	1.1
Triodia	*longiceps*		G1	2-10	1.1
Cenchrus	*ciliaris*	*	G2	<2N	0.4
Goodenia	*stobbsiana*		G2a	<2T	0.4

Site	Q16	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	West end		**Easting:**	790169	**Northing:**	7685201	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3727	**Camera:**	NW	
Site Disturbance:	?cattle, road nearby, weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	5	**Field Vegetation Type:**	Floodplain					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	minor scars					
Surface Component:	80% soil, 10% fines (2-6mm), 10% pebbles (6-20mm)	**Soil Type:** **Major Component:**	Loamy Sand			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	Negligible (west)					
Landform:	Plain							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	G2
Hummock Grass	G1	**Sedge**	
Vine		**Herbs**	
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	10-30			10-30	2-10	<2	30-70	10-30
Ht range (m)	3-6			2-5	1-2	0.7-1	0.1-1.2	0.1-0.3
Av ht (m)	6			4	1.6	0.8	0.7	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	10-30	5
Eucalyptus	*camaldulensis*		U1	<2T	5
Acacia	*inaequilatera*		M1	10-30	4.5
Acacia	*trachycarpa*		M1	<2T	2.2
Acacia	*inaequilatera*		M2	2-10	1.8
Acacia	*trachycarpa*		M2	<2N	1.2
Hakea	*lorea*		M2	<2T	1.2
Acacia	*inaequilatera*		M3	2-10	0.8
Corchorus	*parviflorus*		M3	<2T	0.4
Hakea	*lorea*		M3	<2T	0.7
Grevillea	*pyramidalis*		M3	<2T	0.5
Triodia	*epactia*		G1	10-30	1.1
Triodia	*longiceps*		G1	30-70	1.1
Cenchrus	*ciliaris*	*	G2	10-30	0.3
Euphorbia	*trigonosperma*		G2a	<2T	0.2

Site	Q17	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	West end		**Easting:**	790248	**Northing:**	7684956	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3728	**Camera:**	NW	
Site Disturbance:	?cattle, road nearby, weeds	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	4	**Field Vegetation Type:**	calcareous lower slope					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	most killed?					
Surface Component:	10% soil, 10% fines (2-6mm), 30% pebbles (6-20mm), 30% gravel (20-60mm), 10% cobbles (60-200mm), 10% stones (200-600mm)	**Soil Type:** **Major Component:**	?Clayey Loam			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange, ?White	**Slope (if present):**	Gentle (west)					
Landform:	Lower Slope							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m	U2	**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2	<2		<2	<2	<2	>70	<2
Ht range (m)	3	1.2		3	1.3	0.2-1	0.1-1.1	0.3
Av ht (m)	3	1.2		3	1.3	0.7	0.8	0.3

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	3
Corymbia	*hamersleyana*		U2	<2T	1.2
Acacia	*inaequilatera*		M1	<2T	3
Senna	*glutinosa* subsp. *glutinosa*		M1	<2T	2
Corchorus	*parviflorus*		M2	<2T	1.2
Acacia	*inaequilatera*		M2	<2T	1.1
Senna	*glutinosa* subsp. *glutinosa*		M2	<2T	1.2
Acacia	*spondylophylla*		M3	<2T	0.8
Corchorus	*parviflorus*		M3	<2T	0.4
Triodia	*epactia*		G1	>70	1.1
Triodia	*longiceps*		G1	<2N	0.7
Eriachne	*mucronata*		G2	<2N	0.3
Heliotropium	*heteranthum*		G2a	<2T	0.1

Site	Q18	project			Coongan Gorge Upgrade			
Date:	27/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	Coongan River		**Easting:**	790047	**Northing:**	7684737	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3729	**Camera:**	NW	
Site Disturbance:	clearing, cattle, weeds, flood, various infrastructure	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	6	**Field Vegetation Type:**	Riparian Woodland					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	nil					
Surface Component:	50% soil, 20% fines (2-6mm), 10% pebbles (6-20mm), 10% gravel (20-60mm)	**Soil Type:** **Major Component:**	Sand			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange (pale)	**Slope (if present):**	negligible (river flow north)					
Landform:	Riparian bank							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m	U2	**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	G2
Hummock Grass		**Sedge**	G1
Vine		**Herbs**	
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	10-30	10-30		2-10	<2	<2	2-10	2-10
Ht range (m)	10-14	6-10		2-5	1-2	0.8	1.1	0.05-0.3
Av ht (m)	312	9		4	1.3	0.8	1.1	0.1

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Eucalyptus	*camaldulensis*		U1	10-30	12
Eucalyptus	*camaldulensis*		U2	2-10	8
Melaleuca	*argentea*		U2	2-10	9
Atalaya	*hemiglauca*		M1	2-10	6
Calotropis	*procera*	*	M1	2-10	4
Acacia	*inaequilatera*		M1	<2T	5
Petalostylis	*labicheoides*		M2	<2T	1.1
Atalaya	*hemiglauca*		M2	<2N	1.8
Acacia	*trachycarpa*		M2	<2T	1.3
Acacia	*spondylophylla*		M2	<2T	1.5
Acacia	*spondylophylla*		M3	<2T	0.8
Atalaya	*hemiglauca*		M3	<2T	0.8
Acacia	*inaequilatera*		M3	<2T	0.5
Crotalaria	*medicaginea*		M3	<2T	0.3
Corchorus	*parviflorus*		M3	<2T	0.9
Hakea	*lorea*		M3	<2T	0.5
Cyperus	*vaginatus*		G1	2-10	1.1
Eragrostis	*tenellula*		G2	<2T	0.1
Cenchrus	*ciliaris*	*	G2	2-10	0.3
Triodia	*longiceps*		G2a	<2T	1
Cleome	*viscosa*		G2b	<2N	0.3
Boerhavia	*coccinea*		G2b	<2N	0.2
Euphorbia	*trigonosperma*		G2b	<2N	0.2
Cucumis	*variabilis*		G2b	<2T	climber
Operculina	*aequisepala*		G2b	<2T	climber

Site	Q19	project			Coongan Gorge Upgrade			
Date:	28/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	Talga River		**Easting:**	793549	**Northing:**	7685214	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3755	**Camera:**	NW	
Site Disturbance:	clearing, cattle, weeds, flood, various infrastructure	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	6	**Field Vegetation Type:**	Riparian Woodland					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	nil					
Surface Component:	65% fines (2-6mm), 15% pebbles (6-20mm), 20% gravel (20-60mm)	**Soil Type:** **Major Component:**	Sand			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange (pale)	**Slope (if present):**	negligible (river flow north-west)					
Landform:	Riparian bank / Creekline							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**						
Hummock Grass		**Sedge**	G1					
Vine		**Herbs**	G2					
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	30-70			<2	<2	<2	10-30	2-10
Ht range (m)	4-10			3	1-2	0.5	0.8-1.1	0.05-0.5
Av ht (m)	8			3	1.1	0.5	1.0	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Melaleuca	*argentea*		U1	30-70	10
Sesbania	*formosa*		U1	<2T	8
Eucalyptus	*camaldulensis*		U1	<2T	5
Melaleuca	*argentea*		M1	2-10	4
Crotalaria	*cunninghamii*		M1	<2T	2.1
Sesbania	*formosa*		M2	<2T	1.1
Calotropis	*procera*	*	M2	<2T	1.4
Sesbania	*formosa*		M3	<2N	0.3
Calotropis	*procera*	*	M3	<2N	0.2
Petalostylis	*labicheoides*		M3	<2T	0.3
Hybanthus	*aurantiacus*		M3	<2T	0.4
Cyperus	*vaginatus*		G1	10-30	1.1
Cenchrus	*ciliaris*	*	G2	<2N	0.3
Chloris	*barbata*	*	G2	<2N	0.8
Eragrostis	*tenellula*		G2	<2T	0.2
Cynodon	*dactylon*	*	G2	<2N	0.3
Cleome	*viscosa*		G2a	<2N	0.4
Citrullus	*lanatus*	*	G2a	<2T	0.3
Calandrinia	*quadrivalvis*		G2a	<2N	0.15
Stemodia	*viscosa*		G2a	<2N	0.2
Amaranthus	*undulatus*		G2a	<2T	0.15
Ammannia	*baccifera*		G2a	<2N	0.4
Myriophyllum	*verrucosum*		G2a	<2T	-
Euphorbia	*hirta*	*	G2a	<2N	0.3
Vigna	*lanceolata*		G2a	<2T	climber
Stemodia	*grossa*		G2a	<2T	0.5
Cucumis	*variabilis*		G2a	<2T	climber

Site	Q20	project			Coongan Gorge Upgrade			
Date:	28/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Sidetrack	North		**Easting:**	791496	**Northing:**	7685950	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3766	**Camera:**	NE (due to sun)	
Site Disturbance:	clearing, cattle, weeds, flood, various infrastructure	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	5	**Field Vegetation Type:**	Gusher, broad sheet wash					
Drainage:	Good							
Fire Frequency:	Recent <1yr	**Fire Intensity:**	most killed					
Surface Component:	60% soil, 15% fines (2-6mm), 20% pebbles (6-20mm), 5% gravel (20-60mm)	**Soil Type: Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligibe					
Soil Colour:	Red Orange	**Slope (if present):**	negligible (north)					
Landform:	Plain, broad sheetwash							

GROWTH FORM TABLE:			
Tree >10 m		**Tree 2-10 m**	U1
Tree <2 m		**Tree Mallee**	
Palm		**Shrub >2 m**	M1
Shrub 1-2 m	M2	**Shrub <1 m**	M3
Cycads		**Tussock Grass**	G2
Hummock Grass	G1	**Sedge**	
Vine		**Herbs**	
Other		**Mallee Shrub**	
Heath Shrub		**Samphire Shrub**	
Chenopod		**Rush**	
Grass Tree		**Other**	

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			<2	<2	30-70	10-30	2-10
Ht range (m)	6			2-4	1-2	0.2-1	0.1-1.0	0.1-0.3
Av ht (m)	6			3.5	1.3	0.7	0.5	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	5
Grevillea	*pyramidalis*		M1	<2T	4
Acacia	*inaequilatera*		M1	<2T	3.5
Hakea	*lorea*		M1	<2T	3
Grevillea	*pyramidalis*		M2	<2N	1.5
Acacia	*inaequilatera*		M2	<2T	1.3
Acacia	*trachycarpa*		M2	<2T	1.1
Corchorus	*parviflorus*		M3	30-70	0.8
Acacia	*ptychophylla*		M3	<2T	0.4
Grevillea	*pyramidalis*		M3	<2N	0.8
Bonamia	*erecta*		M3	<2N	0.2
Solanum	*diversiflorum*		M3	<2T	0.3
Acacia	*tumida*		M3	<2T	0.4
Triodia	*epactia*		G1	2-10	1
Cenchrus	*ciliaris*	*	G2	2-10	0.2
Cleome	*uncifera*		G2a	<2N	0.4
Mollugo	*molluginea*		G2a	<2N	0.2
Indigofera	*monophylla*		M3	<2T	0.2
Tephrosia	*rosea* var. *clementii*		M3	<2T	0.2

Site	Q21	project			Coongan Gorge Upgrade			
Date:	29/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	west end of new alignment		**Easting:**	792359	**Northing:**	7683912	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3779	**Camera:**	NW	
Site Disturbance:	clearing, cattle, weeds, fire various infrastructure	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	6	**Field Vegetation Type:**	Large Scree slope					
Drainage:	Good							
Fire Frequency:	Recent <1yr	**Fire Intensity:**	most killed					
Surface Component:	10% pebbles (6-20mm), 10% gravel (20-60mm), 20% cobbles (60-200mm), 30% stones (200-600mm, 30% boulders (>600mm)	**Soil Type:** **Major Component:**	Sandy Loam (Rock)			**Minor:**		
Leaf Litter:	Negligible	**Wood Litter:**	Negligibe					
Soil Colour:	Red Orange	**Slope (if present):**	Steep (west)					
Landform:	Outcrop, Upper Slope							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover	<2			<2	<2	<2	2-10	2-10
Ht range (m)	4.5			2-3	1-2	0.1-1	0.1-0.7	0.1-0.8
Av ht (m)	4.5			3	1.1	0.3	0.3	0.2

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Atalaya	*hemiglauca*		U1	<2T	4.5
Atalaya	*hemiglauca*		M1	<2T	3
Flueggea	*virosa*		M1	<2T	3
Atalaya	*hemiglauca*		M2	<2T	1.3
Flueggea	*virosa*		M2	<2T	1
Gossypium	*australe*		M2	<2T	1
Acacia	*ptychophylla*		M2	<2T	1.1
Trichodesma	*zeylanicum*		M2	<2T	1.2
Clerodendrum	*floribundum*		M2	<2T	1.5
Gossypium	*australe*		M3	2-10	0.8
Rhynchosia	*minima*		M3	<2T	0.3
Atalaya	*hemiglauca*		M3	<2T	0.8
Grevillea	*wickhamii*		M3	<2T	0.2
Senna	*artemisioides* subsp. *oligophylla*		M3	<2T	0.5
Corchorus	*parviflorus*		M3	<2T	0.6
Triodia	*epactia*		G1	2-10	0.7
Cenchrus	*ciliaris*	*	G2	<2N	0.7
Eriachne	*mucronata*		G2	<2N	0.3
Cymbopogon	*ambiguus*		G2	<2N	0.8
Cucumis	*variabilis*		G2a	<2T	climber
Tinospora	*smilacina*		G2a	<2T	climber

Site	Q22	project			Coongan Gorge Upgrade			
Date:	29/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	east end		**Easting:**	792298	**Northing:**	7684011	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	50 x 50	**Photo:**			p3783	**Camera:**	SE (due to slope)	
Site Disturbance:	cattle, weeds, road nearby	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	nil					
Veg Condition:	3	**Field Vegetation Type:**	Upper slope – unburnt					
Drainage:	Good							
Fire Frequency:	Old >5 yr	**Fire Intensity:**	?no damage					
Surface Component:	10% soil, 10% fines (2-6mm), 10% pebbles (6-20mm), 20% gravel (20-60mm), 20% cobbles (60-200mm), 20% stones (200-600mm, 10% boulders (>600mm)	**Soil Type: Major Component:**	Sandy Loam (Rock)			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Sparse					
Soil Colour:	Red Orange	**Slope (if present):**	Steep (south)					
Landform:	Upper Slope							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**						
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	U1	U2	U3	M1	M2	M3	G1	G2
% cover				2-10	<2	10-30	>70	2-10
Ht range (m)				2-5	1-2	0.2-1	0.1-1.0	0.1-0.7
Av ht (m)				4	1.5	0.9	0.9	0.4

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Atalaya	*hemiglauca*		M1	2-10	4
Acacia	*inaequilatera*		M1	<2N	4.5
Grevillea	*wickhamii*		M1	<2T	4
Acacia	*ptychophylla*		M2	<2N	1.2
Acacia	*inaequilatera*		M2	<2T	1.2
Atalaya	*hemiglauca*		M2	<2N	1.2
Triumfetta	*chaetocarpa*		M2	<2T	1.1
Hakea	*lorea*		M2	<2T	1.3
Acacia	*ptychophylla*		M3	10-30	0.9
Corchorus	*parviflorus*		M3	2-10	0.6
Indigofera	*monophylla*		M3	<2N	0.7
Acacia	*spondylophylla*		M3	<2T	0.8
Trichodesma	*zeylanicum*		M3	<2T	0.7
Senna	*glutinosa* subsp. *glutinosa*		M3	<2T	0.7
Triodia	*epactia*		G1	>70	1
Eriachne	*mucronata*		G2	<2N	0.6
Cymbopogon	*ambiguus*		G2	<2N	1
Cyperus	*vaginatus*		G2a	<2T	0.7
Cucumis	*variabilis*		G2b	<2T	climber
Cassytha	sp. (insufficient material)		G2b	<2N	climber

Site	Q23	**project**			Coongan Gorge Upgrade			
Date:	29/05/2016	**Described by:**			J Foster, G Gaikhorst			
Location:	Coongan Gorge	central		**Easting:**	792126	**Northing:**	7684019	
MGA Zone:	50, WGS 84	**Site Type:**			Q			
Dimensions:	25 x 100	**Photo:**			p3787	**Camera:**	NE (due to sun)	
Site Disturbance:	cattle, weeds, road nearby	**Frequency:**	current					
Climate:	Dry, plants not stressed	**Water or Wind Erosion Evidence:**	water					
Veg Condition:	5	**Field Vegetation Type:**	Upper slope – unburnt					
Drainage:	Good							
Fire Frequency:	Mod 1-5yr	**Fire Intensity:**	most killed					
Surface Component:	20% soil, 20% fines (2-6mm), 20% pebbles (6-20mm), 20% gravel (20-60mm), 20% cobbles (60-200mm)	**Soil Type:** **Major Component:**	Sandy Loam			**Minor:**		
Leaf Litter:	Sparse	**Wood Litter:**	Negligible					
Soil Colour:	Red Orange	**Slope (if present):**	gentle (west)					
Landform:	Lower Slope / Plain / Creekline							

GROWTH FORM TABLE:								
Tree >10 m		**Tree 2-10 m**	U1					
Tree <2 m		**Tree Mallee**						
Palm		**Shrub >2 m**	M1					
Shrub 1-2 m	M2	**Shrub <1 m**	M3					
Cycads		**Tussock Grass**	G2					
Hummock Grass	G1	**Sedge**						
Vine		**Herbs**						
Other		**Mallee Shrub**						
Heath Shrub		**Samphire Shrub**						
Chenopod		**Rush**						
Grass Tree		**Other**						

STRATUM	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
% cover	<2			2-10	<2	10-30	>70	<2
Ht range (m)	4.5			2-5	1-2	0.2-1	0.1-1.1	0.1-1.1
Av ht (m)	4.5			4	1.2	0.9	0.7	0.3

Genus	Species	Status	Sub-stratum (NVIS)	% Foliage Cover	Height (m)
Corymbia	*hamersleyana*		U1	<2T	4.5
Acacia	*inaequilatera*		M1	2-10	4.5
Acacia	*inaequilatera*		M2	<2N	1.7
Grevillea	*pyramidalis*		M2	<2T	1.5
Acacia	*ptychophylla*		M2	<2T	1.2
Acacia	*trachycarpa*		M2	<2T	1.7
Grevillea	*wickhamii*		M2	<2T	1.9
Acacia	*ptychophylla*		M3	10-30	0.9
Hakea	*lorea*		M3	<2T	0.4
Aerva	*javanica*	*	M3	<2T	0.5
Indigofera	*monophylla*		M3	<2N	0.3
Acacia	*inaequilatera*		M3	<2N	0.3
Corchorus	*parviflorus*		M3	<2N	0.4
Triodia	*epactia*		G1	>70	0.7
Cenchrus	*ciliaris*	*	G2	<2N	0.1
Euphorbia	*trigonosperma*		G2a	<2T	0.3
Boerhavia	*coccinea*		G2a	<2T	0.3
Goodenia	*stobbsiana*		G2	<2T	0.8

Appendix E – Fauna Data

Fauna species list

Fauna Likelihood of Occurrence assessment guidelines

Fauna Likelihood of Occurrence assessment

Fauna recorded during GHD survey

Family	Genus	Species	Common Name	Status	Observed
Birds					
Accipitridae	*Accipiter*	*fasciatus fasciatus*	Brown Goshawk		2
Accipitridae	*Accipiter*	*cirrocephalus*	Collared Sparrowhawk		1
Accipitridae	*Aquila*	*audax*	Wedge-tailed Eagle		1
Accipitridae	*Haliastur*	*sphenurus*	Whistling Kite		11
Accipitridae	*Hieraaetus*	*morphnoides*	Little Eagle		1
Accipitridae	*Milvus*	*migrans*	Black Kite		3
Anatidae	*Anas*	*gracilis*	Grey Teal		12
Anatidae	*Anas*	*superciliosa*	Black Duck		8
Anhingidae	*Anhinga*	*novaehollandiae*	Australasian Darter		2
Aegothelidae	*Aegotheles*	*cristatus*	Australian Owlet-nightjar		1
Ardeidae	*Ardea*	*pacifica*	White-necked Heron		3
Ardeidae	*Ardea*	*modesta*	Greater Egret		1
Ardeidae	*Egretta*	*garzetta*	Little Egret		1
Ardeidae	*Egretta*	*novaehollandiae*	White-faced Heron		2
Artamidae	*Artamus*	*cinereus*	Black-faced Woodswallow		2
Artamidae	*Artamus*	*minor*	Little Woodswallow		6
Artamidae	*Cracticus*	*nigrogularis*	Pied Butcherbird		10
Burhinidae	*Burhinus*	*grallarius*	Bush Stone-curlew		prints
Cacatuidae	*Cacatua*	*sanguinea westralensis*	Little Corella		200
Cacatuidae	*Eolophus*	*roseicapilla*	Galah		39
Cacatuidae	*Nymphicus*	*hollandicus*	Cockatiel		6
Campephagidae	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-Shrike		2
Casuariidae	*Dromaius*	*novaehollandiae*	Emu		prints
Charadriidae	*Elseyornis*	*melanops*	Black-fronted Dotterel		8
Columbidae	*Phaps*	*chalcoptera*	Common Bronzewing		4
Columbidae	*Geophaps*	*plumifera*	Spinifex Pigeon		56
Columbidae	*Geopelia*	*cuneata*	Diamond Dove		2
Columbidae	*Geopelia*	*striata*	Peaceful Dove		6
Columbidae	*Ocyphaps*	*lophotes*	Crested Pigeon		4
Corvidae	*Corvus*	*orru*	Torresian Crow		6
Estrildidae	*Emblema*	*pictum*	Painted Finch		36
Estrildidae	*Taeniopygia*	*guttata*	Zebra Finch		6
Eurostopodidae	*Eurostopodus*	*argus*	Spotted Nightjar		1

Falconidae	*Falco*	*cenchroides*	Nankeen Kestrel		1
Falconidae	*Falco*	*berigora*	Brown Falcon		1
Halcyonidae	*Dacelo*	*leachii*	Blue-winged Kookaburra		2
Halcyonidae	*Todiramphus*	*sanctus*	Sacred Kingfisher		1
Hirundinidae	*Petrochelidon*	*nigricans*	Tree Martin		5
Maluridae	*Amytornis*	*striatus whitei*	Striated Grasswren		4
Maluridae	*Malurus*	*lamberti*	Variegated Fairy-wren		8
Megaluridae	*Eremiornis*	*carteri*	Spinifexbird		1
Meliphagidae	*Lichenostomus*	*keartlandi*	Grey-headed Honeyeater		4
Meliphagidae	*Lichenostomus*	*penicillatus*	White-plumed Honeyeater		10
Meliphagidae	*Lichenostomus*	*virescens*	Singing Honeyeater		2
Meliphagidae	*Lichmera*	*indistincta*	Brown Honeyeater		3
Meliphagidae	*Manorina*	*flavigula*	Yellow-throated Miner		4
Meliphagidae	*Melithreptus*	*gularis*	Black-chinned Honeyeater		4
Meropidae	*Merops*	*ornatus*	Rainbow Bee-eater		17
Monarchidae	*Grallina*	*cyanoleuca*	Magpie-lark		2
Motacillidae	*Anthus*	*novaeseelandiae*	Australasian Pipit		1
Otididae	*Ardeotis*	*australis*	Australian Bustard		prints
Pachycephalidae	*Colluricincla*	*harmonica*	Grey Shrike-thrush		3
Pachycephalidae	*Pachycephala*	*rufiventris*	Rufous Whistler		1
Pardalotidae	*Pardalotus*	*striatus*	Striated Pardalote		1
Pelecanidae	*Pelecanus*	*conspicillatus*	Australian Pelican		8
Phalacrocoracidae	*Microcarbo*	*melanoleucos*	Little Pied Cormorant		2
Phalacrocoracidae	*Phalacrocorax*	*sulcirostris*	Little Black Cormorant		21
Podicipedidae	*Poliocephalus*	*poliocephalus*	Hoary-headed Grebe		1
Podicipedidae	*Tachybaptus*	*novaehollandiae*	Australasian Grebe		1
Pomatostomidae	*Pomatostomus*	*temporalis*	Grey-crowned Babbler		6
Psittacidae	*Barnardius*	*zonarius zonarius*	Port Lincoln Parrot		9
Psittacidae	*Melopsittacus*	*undulatus*	Budgerigar		14
Ptilonorhynchidae	*Ptilonorhynchus*	*guttatus*	Western Bowerbird		1
Rhipiduridae	*Rhipidura*	*leucophrys*	Willie Wagtail		2
Strigidae	*Ninox*	novaeseelandiae	Boobook Owl		1
Threskiornithidae	*Threskiornis*	*spinicollis*	Straw-necked Ibis		3
Tunicidae	*Turnix*	*velox*	Little Button-quail		1
Reptiles					
Agamidae	*Amphibolurus*	*longirostris*	Long-snouted Water Dragon		1

Agamidae	*Ctenophorus*	*caudocinctus caudocinctus*	Ringtail Dragon		4
Agamidae	*Ctenophorus*	*isolepis isolepis*	Central Military Dragon		2
Agamidae	*Ctenophorus*	*nuchalis*	Central Netted Dragon		1
Cheluidae	*Chelodina*	*steindachneri*	Plate-shelled Turtle		possibly
Gekkonidae	*Gehyra*	*pilbara*	Pilbara Dtella		5
Gekkonidae	*Gehyra*	*punctata*	Spotted Dtella		15
Gekkonidae	*Gehyra*	*variegata*	Tree Dtella		10
Gekkonidae	*Heteronotia*	*binoei*	Bynoe's Gecko		4
Scincidae	*Carlia*	*munda*	Striped Rainbow Skink		2
Scincidae	*Cryptoblephurus*	*ustulatus*	Russet Snake-eyed Skink		1
Scincidae	*Ctenotus*	*grandis grandis*	Titan Skink		C
Scincidae	*Ctenotus*	*pantherinus ocellifer*	Panther's Skink		1
Scincidae	*Ctenotus*	*piankii*	Pianki's Ctenotus		1
Scincidae	*Ctenotus*	*saxatalis*	Rock Ctenotus		1
Scincidae	*Egernia*	*epsisolus*	Eastern Pilbara Spiny-tailed Skink		4
Scincidae	*Menetia*	*greyii*	Common Dwarf Skink		1
Scincidae	*Morethia*	*ruficauda exquisita*	Fire-tailed Skink		1
Varanidae	*Vananus*	*accanthurus*	Ridge-tailed Monitor		1
Varanidae	*Vananus*	*panopties rubidus*	Yellow spotted Monitor		tracks / digs
Mammals					
Bovidae	*Bos*	*taurus*	Cow	intro	many
Camelidae	*Camelus*	*dromedarius*	Camel	intro	prints
Canidae	*Canus*	*lupis domesticus*	Dog	intro	prints
Dasyuridae	*Dasykaluta*	*rosamondae*	Kaluta		C
Dasyuridae	*Dasyurus*	*hallucatus*	Northern Quoll	En, S2	1, 2C
Dasyuridae	*Pseudantechinus*	*Woolleyar or roryi*	Psudantechinus		C
Emballonuridae	*Saccolaimus*	*flaviventris*	Yellow-bellied Sheath-tailed Bat		calls
Emballonuridae	*Taphozous*	*georgianus*	Common Sheathtail-bat		calls
Emballonuridae	*Taphozous*	*georgianus/hilli*	Sheath-tailed Bat		SG
Equidae	*Equus*	*caballus*	Horse	intro	prints/scats
Felidae	*Felis*	*catus*	Cat	intro	prints
Leporidae	*Oryctolagus*	*cuniculus*	Rabbit	intro	potential prints
Macropodidae	*Macropus*	*robustus*	Euro		5
Macropodidae	*Macropus*	*rufus*	Red Kangaroo		1
Macropodidae	*Petrogale*	*rothchildi*	Rothchilds Rock Wallaby		C
Megadermatidae	*Macroderma*	*gigas*	Ghost Bat	Vu, S3	1

Molossidae	*Austronomus*	*australis*	White-striped Free-tailed Bat		calls
Muridae	*Pseudomys*	*chapmani*	Pilbara Pebble-mound Mouse	P4	mounds
Muridae	*Zyzomys*	*argurus*	Common Rockrat		1
Peramelidae	*Macrotis*	*lagotis*	Bilby	Vu, S3	potential prints
Tachyglossidae	*Tachyglossus*	*aculeatus*	Echidna		digs
Vespertilionidae	*Chalinolobus*	*gouldii*	Gould's Wattle Bat		calls
Vespertilionidae	*Chalinolobus*	*morio*	Chocolate Wattle Bat		calls
Vespertilionidae	*Nyctophilus*	*sp. group*	Long-eared Bats		calls
Vespertilionidae	*Scotorepens*	*greyii*	Little Broad-nosed Bat		Pr
Vespertilionidae	*Vespadilus*	*finlaysoni*	Inland Cave Bat		calls
		S.falviventris/C.jobensis	Micro Bats		SG
		Taphozous sp/Ozimops lumsdenae	Micro Bats		Pr
		C.gouildii/Ozimops sp.	Micro Bats		SG
Fish					
Clupeidae	Nematalosa	erebi	Bony Bream		4
Melanotaeniidae	Melanotaenia	australis	Western Rainbow Fish		many
Mugilidae	*Mugil*	cephalus	Sea Mullet		8
Terapontidae	*Leiopotherapon*	unicolor	Spangled Perch		many

Legend:

X or number = recorded during current survey or numbers recorded (observed or heard), many = many records

scats, tracks, prints or digs = Evidence of observation

calls = bat detector (SM2) record, SG= Species group, Pr= Probable

Potential prints = prints record and could be the species identified

Possibly= brief glimpse but not confirmed, species known in the region

intro= introduced species

Conservation codes – Appendix B

Parameters of fauna Likelihood of Occurrence assessment

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within the survey area.
Likely	Species are likely to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as unlikely include: those species previously recorded within the study area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR • Those species that have a known distribution overlapping with the survey area however: there is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area the suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered highly unlikely to occur in the survey area include those species: • That have no suitable habitat within the survey area • That have become locally extinct, or are not known to have ever been present in the region of the survey area.

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following MM = migratory marine species, MW = migratory wetland species, MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered

WC Act - Species listed as CR = critically endangered, En = endangered, Vu = Vulnerable, CD = conservation dependent, IA = international migratory agreement migratory birds, OS = other specially protected fauna

DPaW – Species listed as Priority (P) 1, 2, 3 or 4

Source information - desktop searches

PMST = DotE PMST to identify fauna listed under the EPBC Act potentially occurring within the study area accessed May 2016

NM = DPaW NatureMap (2007 -) records of threatened fauna, database search within the study area (accessed May 2016),

DPaW = WA Government, Department of Parks and Wildlife Threatened and Priority fauna rankings (current as of 20 November 2015) - *Wildlife Conservation Act 1950* for the DPaW Pilbara region http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals

Definitions

study area = a 20 km buffer around the survey area

locality = the area within an approximate 50 km radius of the survey area

Fauna Likelihood of Occurrence assessment

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Night Parrot *Pezoporus occidentalis*	E	S1, Cr			X	The Night Parrot inhabits arid and semi-arid areas that are characterised by having dense, low vegetation. Based on accepted records, the habitat of the Night Parrot consists of Triodia grasslands in stony or sandy environments and of samphire and chenopod shrublands, including genera such as Atriplex, Bassia and Maireana, on floodplains and claypans, and on the margins of saltlakes, creeks or other sources of water (Parker, 1980). It has also been observed to enter dense Muehlenbecki growth when flushed from a more typical habitat (Boles et al. 1994).	**Unlikely –** This species is only known to occur in long unburnt areas of triodia hummock grasslands. Some habitat is present in the survey area however no specimens have been recorded in Western Australia since the mid 1990's. **Habitat** Some areas of unburnt habitat is present particularly at each end of the proposed side access road. **Records** The closest known record is from approximately 165 km south west of the survey area.
Fork-tailed Swift *Apus pacificus*	Mi, Ma	S5/ IA			X	In Pilbara WA there are scattered records along the coast, ranging along the west coast and inland. They are widespread in coastal and sub-coastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. This species is almost exclusively aerial, flying less than 1 m to at least 300 m above ground. This species is considered rare in the south-west region (DSEWPaC 2013).	**Unlikely** – This species is an opportunistic visitor to Australia only encounter when large storms or cyclones are present. **Habitat** This species is strictly aerial. **Records** The species has been recorded within 60 km of the survey area, however these observations are restricted to aerial habits (DPaW 2007).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Oriental Plover *Charadrius veredus*	Mi, Ma	S5/ IA	X		X	Immediately after arriving in non-breeding grounds in northern Australia, Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. Thereafter they usually inhabit flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns and cattle camps or open areas that have been recently burnt (Storr 1980).	**Unlikely** – The species is not known to persist in the region, however may occur opportunistically during migration. **Habitat** Habitat for this species only occurs open areas and open flood plains in the region. Along the Coongan River several water bodies are present all suitable for this species. **Records** The species is known from very few records in the region with the closest record 35 km south of the survey area.
Grey Falcon *Falco hypoleucos*		S3, Vu	X			The Grey Falcon inhabits lightly timbered country, especially stony plains and lightly timbered acacia scrub. This species is considered scarce to rare and is usually found singularly or sometimes in pairs (Morcombe 2004). In Pilbara WA, the grey falcon is very rare. The distribution of the Grey Falcon is centered on inland drainage systems, where it frequents timbered lowland plains, particularly acacia shrublands cross by tree-lined watercourses. It also hunts in treeless areas and frequents tussock grassland and open woodland, especially in winter, but it generally avoids deserts	**Likely** – This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. **Habitat** Habitat for this species only occurs along the water courses and plains in the survey area. **Records** The species is known from the area with one record from the Coongan Gorge.

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Peregrine Falcon *Falco peregrinus*		S7	X			The Peregrine Falcon is seen occasionally anywhere in the Pilbara of Western Australia. It is found everywhere from woodlands to open grasslands, gorges and coastal cliffs - though less frequently in desert regions (Morcombe 2004).	**Likely** - The Peregrine Falcon has been recorded within 40 km of the survey area on three occasions and habitat is present for the species. **Habitat** The breakaway and steep rocky slopes habitat are potentially suitable breeding habitat and all of the habitat types in the survey area provide suitable foraging habitat for the species. **Records** The species is known from the region and populations persist in the Pilbara. Three records surround the survey area - 20 km south, 30 km north east and 40 km north east (DPaW 2007–).
Oriental Pratincole *Glareola maldivarum*	Mi, Ma	S5/ IA			X	In non-breeding grounds in Australia, the Oriental Pratincole usually inhabits open plains, floodplains or short grassland (including farmland or airstrips), often with extensive bare areas. They often occur near terrestrial wetlands, such as billabongs, lakes or creeks, and artificial wetlands such as reservoirs, salt works and sewage farms, especially around the margins. The species also occurs along the coast, inhabiting beaches, mudflats and islands, or around coastal lagoons (Lloyd and Lloyd 1991).	**Unlikely** – The species is not known to persist in the region, however may occur opportunistically during migration. **Habitat** Habitat for this species only occurs along the water courses and plains in the region. **Records** The species is not known from the area only occurring with 100 km of the coast in the Pilbara (DPaW 2007–).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Barn Swallow *Hirundo rustica*	Mi, Ma	S5/ IA			X	In Australia, the Barn Swallow is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires, and also in or over freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland.	**Unlikely** – The species is not known to persist in the region, however may occur opportunistically during migration. **Habitat** Habitat for this species only occurs along the water courses and plains in the region. **Records** The species is not known from the area, only occurring with 80 km of the coast in the Pilbara (DPaW 2007–).
Glossy Ibis *Plegadis falcinellus*		S5, IA	X			The Glossy Ibis' preferred habitats for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons. Within Australia, the largest contiguous area of core habitat is inland and northern floodplains assiated with major rivers (Marchant & Higgins 1990).	**Likely** – This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. **Records** The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Wood Sandpiper *Tringa glareola*	Mi, Ma	S5, IA	X			The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially Melaleuca and River Red Gums Eucalyptus camaldulensis and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. They are also found at some small wetlands only when they are drying. They are rarely found using brackish wetlands, or dry stunted saltmarsh. Typically they do not use coastal flats, but are occasionally recorded in stony wetlands. This species uses artificial wetlands, including open sewage ponds, reservoirs, large farm dams, and bore drains (Higgins & Davies 1996). In Western Australia, within wetlands, birds often occur within a few metres of one another and are concentrated at a few sites in a wetland (Higgins & Davies 1996).	**Likely** – This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. **Records** The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Sharp-tailed Sandpiper *Calidris acuminata*	Mi, Ma	S5, IA	X			In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands, and coastal areas with much beachcast seaweed. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996).	**Likely** – This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. **Records** The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Common Sandpiper *Actitis hypoleucos*	Mi, Ma	S5, IA	X			The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering et al. 2007; Higgins & Davies 1996). Generally the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands (Higgins & Davies 1996). Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks (Higgins & Davies 1996).	**Likely** – This species has been recorded in the vicinity of the survey area previously and habitat is present for the species. **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. **Records** The species is known from the area with one record from the Doolena Gorge (within 2 km of the survey area). There are numerous additional records in the surrounding region.

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Common Greenshank *Tringa nebularia*	Mi, Ma	S5, IA	X		X	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees. The species is not generally found in dry grassland (Higgins & Davies 1996).	**Unlikely** – The species is not known to persist in the region, however may occur opportunistically during migration. **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. **Records** The species is not known from the area typically occurring with 100 km of the coast in the Pilbara (DPaW 2007–). However some scattered records are present throughout the Pilbara potentially utilising these areas while on transit during migration.

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Grey Wagtail *Motacilla cinerea*	Mi, Ma	S5, IA			X	Like the Yellow Wagtail the Grey is a migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	**Unlikely**- non-breeding seasonal visitor, may occasionally have opportunistic use **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. **Records** No records from the region (DPaW 2007–).
Yellow Wagtail *Motacilla flava*	Mi, Ma	S5, IA			X	A migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	**Unlikely**- non-breeding seasonal visitor, may occasionally have opportunistic use **Habitat** Habitat for this species only occurs along the water courses and flood plains in and around the survey area. Only a small amount of this habitat is present in the survey area. **Records** No records from the region (DPaW 2007–).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Letter-winged Kite *Elanus scriptus*		P4		X		The letter-winged kite is a conspicuous raptor with a core range in central Australia. The adult is a small and graceful, predominantly pale grey and white, bird with black shoulders and red eyes. Breeding is eruptive in response to population booms of the Long-haired Rat during good times. The letter-winged Kite is able to achieve a sudden population increase and during this time disburses in search of resources. The species is rarely recorded in Western Australia but has been seen in the Carnarvon, northern Deserts and Kimberley region during a population boom.	**Unlikely**- may occasionally have opportunistic use **Habitat**: Habitat is available for this species in the water course and plains. **Records** Very few records in WA, however one individual was recorded approximately 165 km south west of the survey area (DPaW 2007–).
Australian Painted Snipe *Rostratula australis*	E, Ma	S1/ En			X	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. The species rarely occurs in Pilbara of Western Australia, where it was once more common (Marchant and Higgins 1993; Garnett and Crowley 2000).	**Unlikely**- may occasionally have opportunistic use **Habitat**: Habitat is available for this species in the water course and plains. **Records** Very few records in WA, however one individual was recorded approximately 175 km north east of the survey area (DPaW 2007–).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Northern Brushtail Possum *Trichosurus vulpecula arnhemensis*		Vu		X		*Trichosurus vulpecula arnhemensis* is a sub species of the Common Brushtail Possum (*Trichosurus vulpecula vulpecula*), with its most distinguishing feature being its geographic range and in Western Australia and a smaller tail length. In Western Australia the subspecies is known from the Kimberley and Pilbara regions and is also found on Barrow Island (Nowak, 1999). The Northern Brushtail Possum is able to live in a variety of habitats, including residential areas, vine thickets, forests, woodlands and areas without trees that offer caves and burrows for shelter (such as those on Barrow Island). Typically the species is a nocturnal and solitary however the Northern Brushtail Possum has been known to partake in den sharing and to have a certain amount of tolerance for other individuals (Kerle, 1991). Males may occupy a territory of up to 4 hectares and females, up to 2 ha (Ganslosser, 1990).	**Unlikely** – This species has not been recorded in the study area previously however some habitat is present for the species in habitat unlikely to be affected by the project. **Habitat** Habitat for this species only occurs along the water courses in the survey area, particularly that along the Coongan and Talpa River. **Records** The species is not known from the study area with one record approximately 85 km south of the survey area.

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Brush-tailed Mulgara *Dasycercus blythi*		P4		X		*Dasycercus blythi* was originally described as distinct from *D. cristicauda*, but for more than thirty years it was assumed to be synonymous with that species (e.g., Groves 1993, 2005; Maxwell et al. 1996). Adams et al. (2000) conducted a limited molecular study of the genus Dasycercus and determined that there were two species to which the names *D. cristicauda* and *D. hillieri* were assigned. It has since been established that the correct names for the two species are *D. blythi* and *D. cristicauda* (Woolley 2005). The Brush-tailed Mulgara is primarily nocturnal, shelters in burrows and feeds on insects, other arthropods and small vertebrates. This species inhabits spinifex grasslands and, in central Australia, lives in burrows that it digs on the flats between low sand dunes (Van Dyck and Strahan 2008). The Mulgara is a solitary species exhibiting high site fidelity and a low propensity for dispersal once a home range has been established (Masters and Crowther 2003). Males and females maintain home ranges of 1.4 to 14 hectares (Masters and Crowther 2003) which on average, overlap by less than 20% (Masters and Crowther 2003).	**Unlikely** – The species is not known to persist in the immediate area and the habitats present are not suitable for the species. **Habitat** No sandy habitats are present for this species. Plains within the survey area are primarily heavy loams with rock present. **Records** The species is not known from the survey area with several records greater than 50 km away north and south of the survey area (DPaW 2007–).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Northern Quoll *Dasyurus hallucatus*	E	S2, En	X		X	The Northern Quoll once occurred across the majority of northern Australia but its range has significantly contracted. It occurs in the Pilbara region but in disjunct populations. The Northern Quoll inhabits a range of vegetation associations but is especially abundant on dissected rocky escarpment and eucalypt woodland within 200 km of the coast. It is known to den in rock crevices and rock piles and favours rocky areas. They are predominantly nocturnal but are occasionally active during the day, particularly during the mating season and are known to have a large home range (Van Dyck and Strahan 2008).	**Present** - The species was recorded during the survey via head torching and camera traps. Numerous locations of scat were also recorded. **Habitat**: Habitat is available for this species in the rocky ridgelines, hills (with breakaways), water course and rocky plains. **Records** The species has not been recorded at Coongan Gorge previously however is known form the surrounding ranges in the area within 30 km of the survey area (DPaW 2007–).
Spectacled Hare-wallaby *Lagorchestes conspicillatus subsp. leichardti*		P3		X		The Spectacled Hare-wallaby was once widely distributed across the lower latitudes of northern Australia from eastern Queensland, through Northern territory to the Pilbara and Kimberley in Western Australia, with a subspecies on Barrow Island. In the Pilbara region this species has declined drastically, possibly due to fox predation and because frequent burning of spinifex grasslands has prevented the development of the large hummocks required for shelter (Van Dyck and Strahan 2008). They live in open woodlands, shrublands and hummock grasslands, sheltering under vegetation or in	**Unlikely** – The species is not known to persist in the immediate area and most of the survey area habitat is not suitable for the species. **Habitat** Some areas of unburnt habitat is present for this species, particularly at each end of the proposed side access road. However these area a relatively small and fragmented. **Records** The species is not known from the region with one record 65 km south of

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
						burrows during the day and searching for herbs, grass and fruits at night.	the survey area (DPaW 2007–).
Ghost Bat *Macroderma gigas*	V	S3, Vu	X		X	The Ghost Bat occurs in a wide range of habitats, and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost. It is patchily distributed across Australia, and is sensitive to disturbance (Van Dyck and Strahan 2008).	**Present** - The Ghost bat was recorded in the survey area in flight around the water body associated with the side access track. **Habitat** No cave habitat was recorded in the survey area and several searches regionally failed to identify any cave suitable for Ghost Bat, however the entire area was not traversed. The habitats present in the survey area are all likely to be utilised for foraging. **Records** The species is not known from the survey area, however numerous records are known from approximately 40 km east and south (DPaW 2007–).
Bilby *Macrotis lagotis*	V	S3, Vu	X		X	The Greater Bilby distribution in Western Australia is restricted to the north, including the Pilbara, Sandy and Gibson Deserts. The Greater Bilby usually spends the daytime in burrows, often built against termite mounds, spinifex hummock or shrubs (Van Dyck and Strahan 2008). Extant population of the Greater Bilby occur in a variety of habitats, usually on landforms with level to low slope	**Likely** – Prints were recorded in the sand bed of the Coongan River in two localities. However this is also the northern limit of the rabbit which has a similar print. Broader area searches were undertaken in habitat suitable for both species with no recent additional evidence recorded. A very old burrow system was recorded on the northern

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
						topography and light to medium soils. It occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas. Laterite and rock feature substrates are an important part of Greater Bilby habitat. These habitat support shrub species, such as *Acacia kempeana*, *A. hilliana* and *A. rhodophylla*, which have root-dwelling larvae that provide a constant food source for the Greater Bilby. After dark they leave their burrows to feed and populations are known to move long distances when current habitat ranges become unsuitable. Bilbies are largely solitary, widely dispersed and found in low numbers. The current occurrence of the Greater Bilby is strongly associated with higher rainfall and temperatures, which promote areas of higher plant and food production. The Greater Bilby may also prefer these conditions as higher rainfall and temperatures are not well tolerated by foxes (Pavey 2006; Southgate et al. 2007).	side of the Coongan River, however it could not be distinguished as either Bilby or Rabbit due to its age. **Habitat** Some areas of habitat are present along the banks of the Coongan River and within the plain areas. **Records** The species is known from the region with one record approximately 20 km south of the survey area (DPaW 2007–).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Lakeland Downs Mouse *Leggadina lakedownensis*		P4	X			The Lakeland Downs Mouse occupies a diverse range of habitats from the monsoon tropical coast to semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, Acacia shrublands, tropical Eucalyptus and Melaleuca woodlands and stony ranges. Most habitats, however, are seasonally inundated on red or white sandy-clay soils. They are nocturnal, largely solitary, and individuals spend the day in simple, single-chambered burrows (Van Dyck and Strahan 2008).	**Unlikely** – This species has been recorded in the study area previously limited habitat is available for the species. **Habitat** Limited habitat for this species is present within the survey area. Some habitat is present along the water courses and associated plains however this is mostly outside of the survey area. **Records** The species is known from the region with one record approximately 30 km north west of the survey area. This record is from habitat associated to cracking clays habitat.
Western Pebble-mound Mouse *Pseudomys chapmani*		P4	X			The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the Western Pebble-mound Mouse can be found on stony hillsides with hummocky grasslands and little or no soil. It constructs large mounds of pebbles on stony slopes which cover an area of 0.5-9.0 square metres. 'Active' mounds are characterized by volcano-like cones capped by 'craters' that mark occluded entrances to subterranean burrow systems in which the mice live, often gregariously (Van Dyck and Strahan 2008).	**Present** - The Western Pebble-mound Mouse was recorded via the presence of both active mounds and inactive mounds recorded in the survey area. **Habitat** The rocky hills and undulating stony plains are preferred habitat for the mouse. **Records** The species is well known in the region with over 50 records of the species within 40 km of the survey area (DPaW

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
							2007–).
Long-tailed dunnart *Sminthopsis longicaudata*		P4	X			The Long-tailed Dunnart was not recorded during desktop searches however is known to occur in the region (Atlas Iron Limited 2012) and was recorded during the assessment of the Wodgina DSO project. The Long-tailed Dunnart requires rocky areas to survive and is wide spread throughout the Goldfields, Murchison and Gascoyne. The Pilbara is the northern most portion of the species distribution (Van Dyck and Strahan 2008).	**Likely** - The species has previously been observed in the region and habitat is available to the species. **Habitat** The rocky hills and associated undulating stony plains (with small outcrops) are preferred habitat for the dunnart. **Records** The species is well known in the region with records within 20 km of the survey area (DPaW 2007–).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia (Pilbara form)*	V	S3, Vu	X		X	The Pilbara Leaf-nosed Bat roosts in deep caves or mines in the wet season and forages nearby. This species occurs in the Pilbara region where its populations are scattered and localised. There are a few known populations of this species in the western Pilbara, roosting in caves formed in gorges that dissect massive siliceous sedimentary geology. It is most often observed in flight over waterholes in gorges (Van Dyck and Strahan 2008). Optimal roosts are thought to occur in caves that form between ascending rock layers, where humidity is maintained from seeping groundwater (Van Dyck and Strahan 2008). Roosts are commonly located over pools of water, or areas deep within the mine or cave structure which provides elevated temperature and humidity. Foraging habitat includes: Triodia hummock grasslands covering low rolling hills and shallow gullies, with *Eucalyptus camaldulensis* along the creeks; over small watercourses throughout granite boulder terrain; over pools and low shrubs in ironstone gorges; and in and around gravelly watercourses with *Melaleuca leucadendron*.	**Likely** – This species has been recorded in the region previously however no caves suitable for the species are present in the survey area. A broader area was traversed with no caves found. **Habitat** Only foraging habitat is available for this species across the survey area, however the riparian and water bodies along the Coongan and Talga Rivers would be significant to the species which is mostly outside of the survey area. **Records** The species is known from the region with several records within 40 km of the survey area (DPaW 2007–).

Species	Status		Source Information			Habitat and ecology	Likelihood of occurrence assessment
	EPBC listing	WC Act/ DPaW listing	NM	DPaW	PMST		
Olive Python (Pilbara subspecies) *Liasis olivaceus barroni*	V	S3, Vu	X		X	The Olive Python (Pilbara subspecies) is a dull olive-brown to pale fawn or rich-brown python with a white underside and pale finely dotted lips. This species reaches an average size of 2.5 m but can grow up to 4 m long. The Olive Python's range is restricted to the Pilbara region, north Western Australia, and the Dampier Archipelago. Habitat consists of rocky escarpments, gorges and waterholes within the Pilbara region. The preferred microhabitats for this species are under rock piles, on top of rocks, and under spinifex as well as in man-made features such as overburden heaps, railway embankments and sewerage treatment ponds. The species' breeding season occurs from June to August, with males moving long distances in search of breeding females (Wilson and Swan 2010).	**Likely** – This species has been recorded in the region previously and habitat is present for the species. **Habitat** Habitat is available for this species in the Coongan Gorge and associated hills, also riparian and water bodies along the Coongan and Talga Rivers would be significant to the species. **Records** The species is known from the region with several records within 80 km of the survey area (DPaW 2007–).

References:

Adams, M, Cooper, N, and Armstrong, J 2000, *Revision of Dasycercus systematics*, Report to the South Australian Department for Environment and Heritage.

Atlas Iron Limited (2012) Wodgina DSO Project: Significant Species Management Plan. Prepared by Coffey Environments Pty Ltd for Atlas Iron Limited. Perth, Western Australia

Boles, W.E., N.W. Longmore & M.C. Thompson (1994). A recent specimen of the Night Parrot, Geopsittacus occidentalis. Emu. 94:37-40

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Species Profile and Threats Database (SPRAT)*, Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Government.

Garnett, ST and Crowley, GM 2000, The Action Plan for Australian Birds 2000, Canberra, Environment Australia.

Groves, CP 1993, *Order Dasyuromorphia*, In: Wilson, DE and Reeder, DM (eds), Mammal Species of the World, pp. 23-37, Smithsonian Institution Press, Washington, DC, USA.

Groves 2005 Order Dasyuromorphia, In Wilson, D.E. & Reeder, D.M. (eds.) Mammal Species of the World, Third Edition. The Johns Hopkins University Press, Baltimore.: 111-184.

Lloyd, RL and Lloyd, HJ 1991, *An Oriental Pratincole at the Dry Creek Saltfields*, South Australian Ornithologist, vol. 31, pp 74.

Marchant, S and Higgins, PJ (eds.) 1993, *Handbook of Australian, New Zealand and Antarctic Birds, Volume 2 – Raptors to Lapwings*, Melbourne, Victoria, Oxford University Press.

Masters, P, Dickman, CR and Crowther, M 2003, *Effects of cover reduction on mulgara Dasycercus cristicauda (Marsupialia: Dasyuridae), rodent and invertebrate populations in central Australia: Implications for land management*, Austral Ecology, vol. 28, Issue 6, pp 658–665.

Maxwell, S, Burbidge, AA and Morris, KD 1996, *The 1996 action plan for Australian marsupials and monotremes*, Wildlife Australia.

Morcombe, M 2004, *Field Guide to Australian Birds*, Queensland, Australia, Steve Parish Publishing Archer Field.

Parker, S.A. (1980). Birds and conservation parks in the north-east of South Australia. South Australian Parks and Conservation. 3:11-18.

Pavey, C 2006, National Recovery Plan for the Greater Bilby Macrotis lagotis. Northern Territory Department of Natural Resources, Environment and the Arts.

Southgate, R., R. Paltridge, P. Masters & S. Carthew (2007). Bilby distribution and fire: A test of alternative models of habitat suitability in the Tanami Desert, Australia. Ecography. 30:759-776.

Storr, GM 1980, *Birds of the Kimberley Division, Western Australia*, Special Publications of the Western Australian Museum, No. 11, pp 1-117, Perth, Western Australia, Western Australian Museum.

Wilson, S and Swan, G 2008, *A Complete Guide to Reptiles of Australia*, 2nd Edition, Sydney Australia, New Holland Press

Woolley, P.A. (2005). The species Dasycercus Peters, 1875 (Marsupialia: Dasyuridae). Memoirs of Museum Victoria 62, 213-221.Van Dyck, S and Strahan, R 2008, *The Mammals of Australia*, New Holland, Sydney, NSW.

Call analysis method

Ultrasonic detection surveys

The primary method of recording ultrasonic bat calls was the SM2BAT+ SongMeter recorder (Wildlife Acoustics Inc., USA). Bat calls were recorded between sunset and sunrise across consecutive nights with audio settings designed to optimise detection and recording of the target species (*Rhinonicteris aurantia*). Recorded call data were saved as 45 minute to 1 hour blocks in Wildlife Acoustics' patented WAC compressed audio format.

Craig Grabham from GHD completed the analysis of all data collected during the survey using ultrasonic bat detectors. Data from SM2 units was downloaded and viewed using Kaleidoscope Viewer (version 3.1.6, Wildlife Acoustics Inc 2016) as full-spectrum audio files. WAC files were also converted to Anabat sequence files (zero-crossing format) suitable for analysis in AnalookW version 4.1s (Corben 2015).

Call analysis

WAC files were viewed and bat calls were identified using Kaleidoscope Viewer (version 3.1.6, Wildlife Acoustics Inc. 2016) by visually comparing the Kaleidoscope Viewer spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material (McKenzie and Bullen 2009; 2012, Armstrong and Cole 2007). The spectrogram displayed each call sequence (see below for call definition) with information on the number and timing of calls.

The call identification was also assisted by consulting distribution information for possible species (Atlas of Living Australia and DPAW NatureMap records) and previous GHD surveys within the region of the survey area. No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area.

The exception to this call definition is the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*). The Pilbara Leaf-nosed Bat has a distinct call from all other microchripteran bat species in the Pilbara region. Unlike other species, the pulse structure is constant frequency (CF) with a characteristic frequency (Fc) of 118–128 kHz (DEWHA 2010). Their echolocation calls are readily identifiable from the characteristic (or more accurately the maximum or peak) frequency, pulse shape, enabling even short call sequences with few pulses to be successfully recognised (Hourigan 2011).

Identification for the PLNB was confirmed from a minimum of two or more consecutive pulses, each being > 4 ms in duration and < 500 ms (0.5 second) between the next consecutive pulse in a sequence within the characteristic range of the species.

Due to variability in the quality of calls, the lack of published information regarding non-search phase calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in the table below. Due to the absence of reference calls from the study area and the poor quality of some the recordings and known overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows Armstrong (2011), then van Dyck et al. (2013).

Identification	Description
D - Definite	Species identification not in doubt. Call sequence contains three or more consecutive pulses of similar frequency and shape. Call characteristics match those in referenced material or species reference calls.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail (e.g. number of pulses).
SG - Species Group	X = Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species

Summary of results and survey effort

Microchiropteran bat detector surveys were completed for 5 nights at two locations during May 2016 within the survey area.

Seven species were positively (Definite or Probable) identified of the 16 species that are known to occur from this part of the eastern Pilbara region (Armstrong 2011; NatureMap 2007 -). As many as four other species may also have been recorded using bat detectors, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

The tables below provide site location details and a summary of the results for nights surveyed.

Summary of bat call analysis May 2016

Species / Group	**Site/Date**
	Coongan Gorge
	26-30/5/16
Austronomus australis	D
Saccolaimus flaviventris	D
Taphozous georgianus	D
Chalinolobus gouldii	D
Scotorepens greyii	Pr
Chalinolobus morio	D
Vespadelus finlaysoni	D
Nyctophilus sp	Y
S. falviventris/Chaeroephon jobensis	Y
T. georgianus/hilli	Y
Taphozous sp/Ozimops lumsdenae	Y
C.gouldii/S. greyii	Y
C.morio/V.finlaysoni	Y
Definite species recorded	7 x D
Survey effort	5 nights

Notes:
Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one Nyctophilus species where recorded.
See Table 1 for confidence rating e.g. D or Pr, - = not recorded. X = species group present.
CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, P1- 4 (priority species) species under the *Wildlife Conservation Act 1950*

Qualifications

Craig Grabham has completed microchiropteran bat surveys and assessments in WA, NSW, QLD, Vic, Tasmania and the NT employing a variety of methods including harp trapping, light tagging, habitat surveys (e.g. cave assessments), roost surveillance (using infrared and thermal video cameras), and echolocation survey (Wildlife Acoustic's SongMeter and Eco Meter devices and Titley Electronic Anabat devices) and analysis (Wildlife Acoustic's SongScope and Chris

Corben's Analook). He has completed bat surveys for infrastructure, residential, and mining projects. Craig has also completed bat inventory surveys for National Parks, Nature Reserves, catchment management areas and private land conservation projects. His honours project investigated the use of remnant and revegetated habitats by microchiropteran bats across a fragmented rural landscape in the Eastern Billabong Catchment (south-west slopes) in NSW.

Craig has completed the following training courses with regard to ultrasonic call recording and analysis:

- Anabat system training course – Titley Scientific (December 2012)
- Wildlife Acoustic's Song Meter and SongScope training – Faunatech/Austbat (July 2015).

To date Craig has completed echolocation analysis and reporting for more than 102 projects from WA, NSW, NT, QLD and Victoria since joining GHD in 2006 from calls collected during field surveys from Anabat detectors and/or Song Meter units and identified using Analook or SongScope software.

References

Armstrong, K. N. (2011). The current status of bats in Western Australia. **In:** 'The biology and conservation of Australasian bats.' (Eds B. Law, P. Eby, D. Lunney and L. Lumsden.) pp. 257–269. (Royal Zoological Society of New South Wales: Mosman.)

Armstrong, K. N., and Coles, R. B. (2007). Echolocation call frequency differences between geographic isolates of *Rhinonicteris aurantia* (Chiroptera: Hipposideridae): implications of nasal chamber size. *Journal of Mammalogy* **88**, 94-104.

Bullen, R. D. and McKenzie, N. L. (2011). Recent developments in studies of the community structure, foraging ecology and conservation of Western Australian bats. In 'The biology and conservation of Australasian bats.' (Eds B. Law, P. Eby, D. Lunney and L. Lumsden.) pp. 31-43. (Royal Zoological Society of New South Wales: Mosman.)

Churchill, S 2008. Australian Bats, Allen and Unwin, Australia.

Department of the Environment, Water, Heritage and the Arts, (2010). Survey guidelines for Australia's threatened bats Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

Duffy, AM, Lumsden, LF, Caddle, CR, Chick, RR & Newell, GR (2000). The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in southeastern Australia, Acta Chiropterologica 2: 127-144.

Hourigan, C. 2011. Orange leaf-nosed bat, Rhinonicteris aurantia. Targeted species survey guidelines.Queensland Herbarium, Department of Science, Information Technology and Innovation, Brisbane.

Law, B, Anderson, J & Chidel, M (1998). A bat survey in State Forests on the south-west slopes of New South Wales with suggestions of improvements for future surveys, Australian Zoologist 30(4): 467-479.

Law, BS, Anderson, J Chidel, M (1999). Bat communities in a fragmented forest landscape on the south-west slopes of New South Wales, Australia, Biological Conservation 88(3): 333-345.

Mills, DJ, Norton, TW, Parnaby, HE, Cunningham, RB & Nix, HA (1996), Designing surveys for microchiropteran bats in complex forest landscapes – a pilot study from south-east Australia. Forest Ecology and management 85(1-3):149-161.

McKenzie, N. L., and Bullen, R. D. (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. *Records of the Western Australian Museum* Supplement **78**: 123–155.

McKenzie, N. L., and Bullen, R. D. (2012). An acoustic survey of zoophagic bats on islands in the Kimberley, Western Australia, including data on the echolocation ecology, organisation and habitat relationships of regional communities. Records of the Western Australian Museum Supplement **81**: 67–108.

Threatened Species Scientific Committee (TSSC) (2016), Conservation Advice *Rhinonicteris aurantia* (Pilbara form) (Pilbara Leaf-nosed Bat). Approved 10/03/2016.

Van Dyke. S, Gynther. I, and Baker. A. (2013). Field Companion To The Mammals of Australia. New Holland Publishers.

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J. Foster G Gaikhorst	A Napier C Grabham		C Grabham		08/08/2016

www.ghd.com

Appendix C – Desktop searches

EPBC Act PMST

DAA Registered Sites Report

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

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

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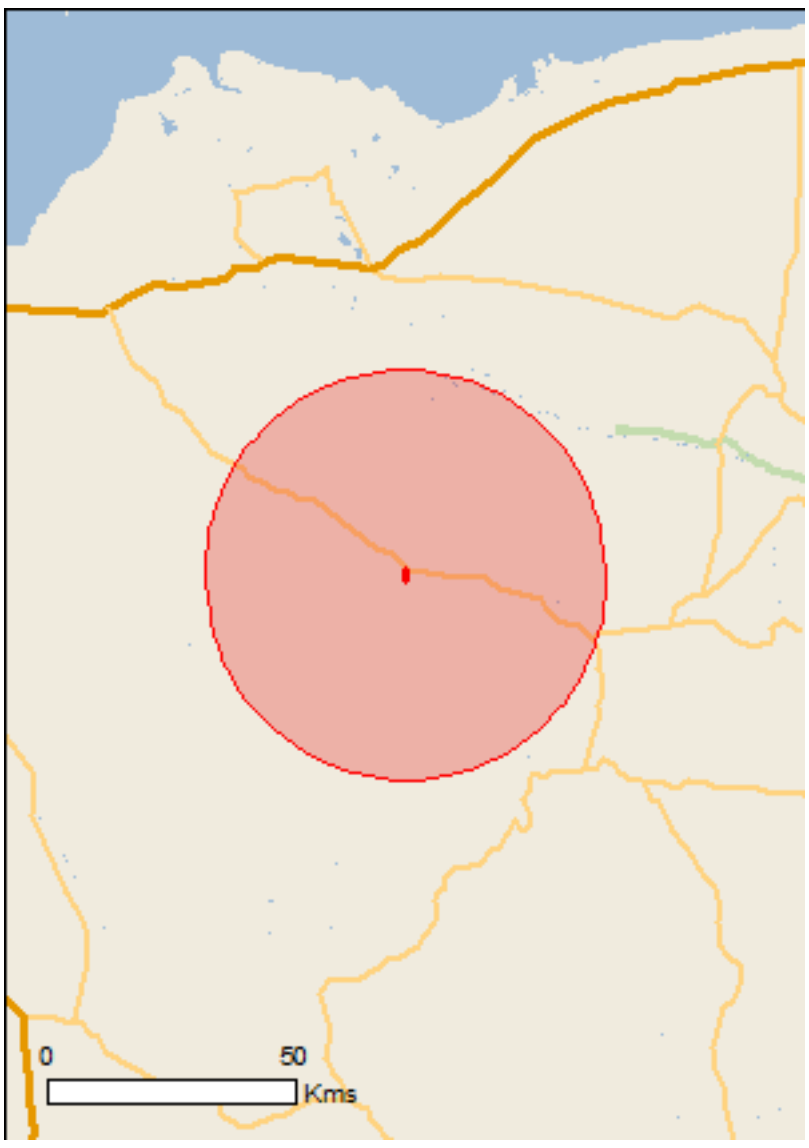

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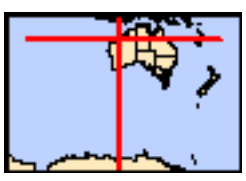

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	10
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [331]	Endangered	Species or species habitat known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Breeding likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Roosting known to occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Pristis pristis Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Pristis pristis		
Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land	[Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species	[Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Foraging, feeding or related behaviour known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

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

Name	Status	Type of Presence

Name	Status	Type of Presence
Birds		
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
De Grey River	WA

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-20.825541 119.503865,-20.845756 119.507255,-20.845756 119.507255

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

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

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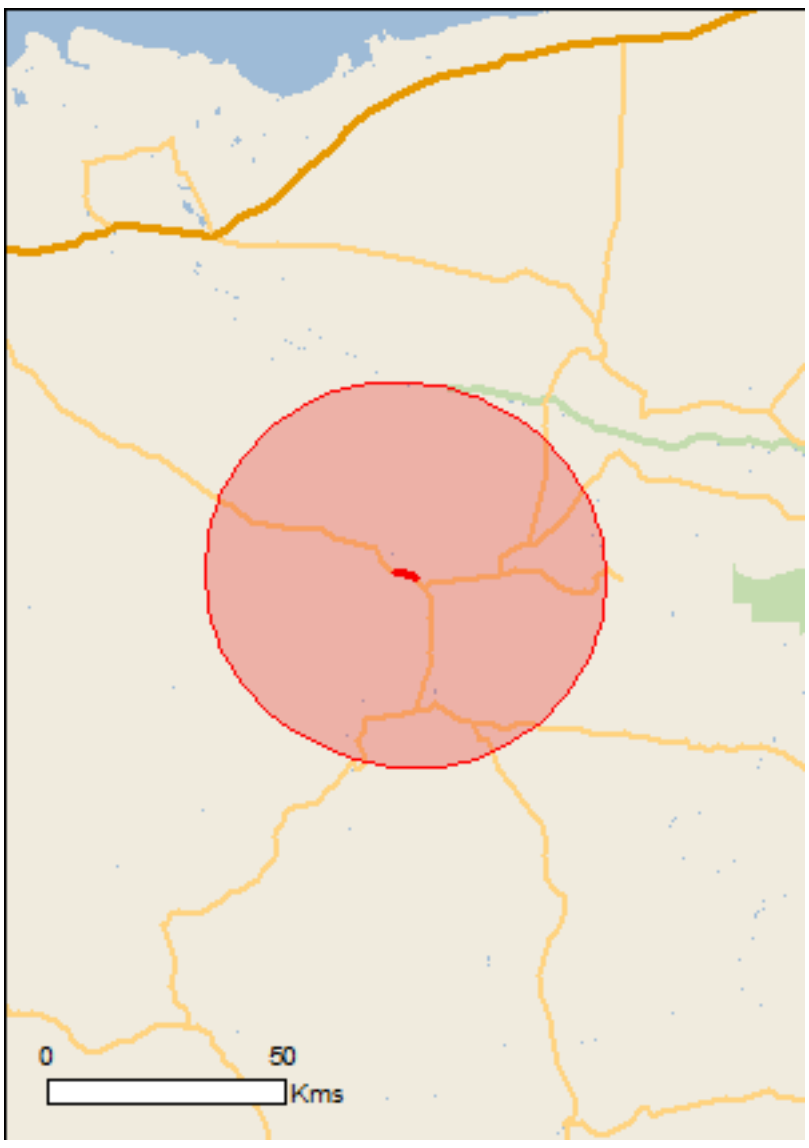

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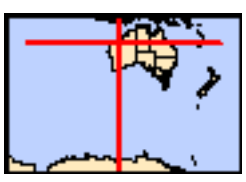

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	10
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [331]	Endangered	Species or species habitat known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Breeding likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Roosting known to occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Pristis pristis Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Migratory Marine Species		
Pristis pristis Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
[Glareola maldivarum](#) Oriental Pratincole [840]		Species or species habitat may occur within area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
[Hirundo rustica](#) Barn Swallow [662]		Species or species habitat may occur within area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat known to occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat known to occur within area
[Rostratula benghalensis (sensu lato)](#) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Meenthena Station	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
De Grey River	WA

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-20.91474 119.78725,-20.916825 119.800382,-20.918749 119.802099,-20.927888 119.827247,-20.927888 119.827247

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix D – Environmental Management Plan

This EMP has been developed for the project area following the completion of the EIA. The aim of this EMP is to minimise the environmental impacts (and potential for occurrence) associated with the proposed works as well as to identify areas of responsibilities required for the implementation of management strategies.

This EMP addresses specific issues that were identified within the EIA. The project management measures identified in this EMP are in addition to the standard environmental management contract specifications. Main Roads' standard environmental contract specifications (Specifications 203, 204, 301, 302 and 304) are to be adhered to where appropriate. It is critical that all clearing works are carried out in accordance with the management measures prescribed in Specifications 301 (Clearing) and 302 (Earthworks).

The areas that require species management will be addressed in terms of the:

- Project component
- Management actions that are necessary to minimise the impact
- Monitoring/maintenance program
- Responsible party for implementing the action
- Timing of the various management actions

Communication plan

Environmental issues specific to the Project will be communicated as follows:

Method	Frequency	Participants	Reference	Record
Project Site				
Induction	Prior to work	All personnel and subcontractors	EMP and Contractor Environmental Policy	Minutes of meeting
Toolbox Meetings	Weekly	Project Personnel	Contractor Safety Plan	Minutes of meeting
Contract Meetings	As required	Main Roads' Project Manager and Contract Project Manager	EMP	Minutes of meeting
Authority Consultation				
DER and DotEE	As required	Main Roads' Project Manager and Contract Project Manager	-	Minutes of meeting

External communication and complaints

A complaints register shall be maintained by the contractor. All complaints received shall be forwarded to the Main Roads' Project Manager for action. Serious complaints shall be investigated within 24 hours of the complaint being received.

Monitoring, auditing and compliance

The clearing area will be monitored prior to clearing by the Environment Officer.

The Environment Officer or appropriate Main Roads representative will audit this EMP within 2 weeks of the start of the project, and upon completion. A record will be kept upon completion of the project to display compliance with this EMP.

Contingency measures

Due to the scale and nature of the project, no contingency measures are identified as the inherent environmental risks are considered to be small.

EMP accountability

Role	Persons Name	Contact Details
Project Manager		
Roadside Management Officer		
Environment Officer		

Environmental Management Plan

Project Component	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
Standard Record Keeping Management				
Record Keeping	• Ensure standard record keeping requirements are completed within 3 months of completion of the project activities.	Post-project record maintenance	Contractor/Project Manager/Environment Officer	3 months after completion of Project
Key Environmental Aspects - Flora and Fauna				
Flora and Vegetation Management	• Demarcate all native vegetation and fauna habitats to be retained or cleared (i.e. pegging), so that "No Go" zones are clearly delineated and noted by project workers, and any accidental loss of vegetation is avoided • Induct all staff and contractors regarding biodiversity constraints, and required actions regarding biodiversity values • No trees or ground vegetation outside of the approved disturbance footprint to be disturbed • A record of native vegetation clearing (coordinates, extent and area) is to be maintained by the Contractor, with these records routinely supplied to the Environment Officer.	Construction maintenance	Contractor/Environment Officer	Duration of project period
Fauna Management	• Incorporate 5-6 box culverts (dry, rectangular culverts with associated rock protection) into road design to facilitate fauna movement (particularly for the Northern Quoll). The box culverts should be situated approximately 500-700 m apart to account for the short dispersal habits of female Northern Quoll and also at locations connecting core Northern Quoll habitat or likely dispersal routes • Incorporate two signs (at the beginning and end of project area) to warn motorists that the area surround the road is habitat for the Northern Quoll • Ensure fauna management commitments are adhered to and records kept	Construction maintenance	Contractor/Environment Officer	Duration of project period

Project Component	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
	• Induct all staff and contractors regarding biodiversity constraints, particularly the presence of conservation significant species, and required actions regarding biodiversity values • Do not permit site personnel to bring firearms, other weapons or pets on site • Where possible schedule clearing operations to avoid peak breeding times of conservation significant fauna particularly the Northern Quoll • If any native fauna is disturbed during clearing it should be allowed to make its own way to adjacent vegetated areas • If clearing is to be undertaken during the breeding season, then targeted pre-clearance fauna relocation surveys for the Northern Quoll and Pilbara Olive Python should be undertaken prior to clearing. • If fauna species are captured during the pre-clearance surveys, then a qualified ecologist to relocate them to outside the clearing area to a pre-determined location in consultation with DPaW. • Any injured wildlife should be taken to a designated veterinary clinic, a DPaW nominated wildlife carer or suitable euthanasia by an appropriately experienced person • Injury to wildlife is to be recorded by the Contractor, with these records routinely supplied to the Environment Officer			
Other Environmental Aspects				
Weed Management	• Machinery will be maintained and cleaned to reduce the spread of weeds throughout the project area • Restrict movement of machines and other vehicles to the limits of the areas cleared.	Machinery checked prior to entering and exiting Project site.	Contractor	Duration of project period
Aboriginal Heritage Site <u>All areas</u>	• Ensure on-site project personnel are aware of the requirement to avoid impacting heritage values	Pre-project/project surveillance	Contractor	Duration of project period

Project Component	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
in the event of unknown sites being unearthed during project process	• Disturbance outside the approved clearing area will not be permitted • In the event that human skeletal material is discovered, work will cease immediately and the Police contacted. If the skeletal remains are determined to be of Aboriginal origin, the DAA will be contacted as soon as practicable • In the event that artefacts or material of Aboriginal origin is discovered, work will cease within 25 metres of the material and a qualified archaeologist will investigate the item(s) and take appropriate actions (i.e. contact DAA).			
Dust	• Clear vegetation only when necessary and treat areas requiring soil stabilisation as soon as practicable • Ensure dust lift is controlled to limit exposure to road users through regular soil watering, road sweeping and treatment of cleared areas • Surface watering, spreading of hydromulch or similar will be used to protect loose surfaces or cleared areas, as required • Minimise or cease project activities when excessive dust is generated	Construction and post-project maintenance	Contractor	Duration of project period
Pollution and Litter	• All waste materials from the project area will be removed from the site upon completion of the project and to the satisfaction of the Roadside Management Officer • Construction waste and other rubbish will be contained in bins with lids (where practicable) and removed regularly.	Construction and post-project maintenance	Contractor/Roadside Management Officer	Duration of project period
Noise and Vibration	• Ensure compliance with all applicable statutory requirements • Adopt project techniques where possible that will minimise noise and vibration impacts to road users	Construction maintenance	Contractor	Duration of project period

Project Component	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
	• Inform stakeholders of activities that may cause excessive noise and respond quickly to complaints.			
Surface Drainage	• Vegetation removal and soil disturbance will be minimised, where practicable • Disturbed areas will be stabilised soon after project activities are completed • Existing natural drainage paths and channels along the road or the vicinity of the project area will not be unnecessarily blocked or restricted during project • Vehicle and equipment wash down areas will be located away from waterways and floodplains • No on-site storage of fuel, oils and other contaminant materials will be permitted within 50 m of a watercourse.	Pre-project/project surveillance	Contractor	Duration of project period
Groundwater	• All spills will be contained immediately to minimise the potential for contaminants to enter groundwater • Spills to be reported as an incident to the Environment Officer for record keeping purposes.	Construction maintenance	Contractor/ Environment Officer	Duration of project period
Hazardous Materials Proximity to Talga River, Coongan River and unnamed ephemeral drainage line. Proximity to Asbestiform mineral location	• Bulk fuel and hazardous material storage areas will be bunded and managed in compliance with applicable Australian Standards • Vehicle servicing will be undertaken at designated areas, at least 100 m away from watercourses • Site personnel shall be trained in the use of emergency Fire suppressant equipment. • Spill trays and spill response equipment will be available near fuel storage or refuelling areas • All hazardous material spills will be reported according to statutory requirements • Site personnel shall be trained on the potential type and presence of fibrous minerals likely to be encountered • If Asbestiform mineral is detected during project works, the Project Manager is to be informed immediately. Dust and fibres should be suppressed	Construction maintenance	Contractor/Project Manager	Duration of project period

Project Component	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
	at source, with the ore mineralogy monitored to ensure fibrous mineral disturbance is minimal • Audits and air monitoring, including measurement (counting) of airborne fibres to be undertaken as required.			
Fire	• No fires shall be lit within the project area • Machinery will be fitted with approved spark arresting exhaust systems • All vehicles, plant and equipment to be fitted with fire extinguishers and restricted to designated cleared areas • Construction personnel will extinguish and report fires occurring within the project area to the Project Manager.	Construction maintenance	Contractor/Project Manager	Duration of project period
Visual Amenity	• Cleared vegetation stockpiles and other materials will be stored in designated areas and kept in a neat and tidy condition at all times • The duration of ground disturbing activities will be limited as far as practicable • The project area is to be kept free of litter and rubbish.	Construction maintenance	Contractor	Duration of project period

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