



# LandCorp

Broome Motorplex Environmental Site Investigation

June 2016

## Executive summary

LandCorp is the lead agency progressing the multi-staged Broome Motorplex Project. GHD Pty Ltd (GHD) was commissioned by LandCorp to undertake to undertake desktop and field environmental investigations for the Project. The purpose of the investigations was to determine key site physical, flora, vegetation and fauna constraints, and recent and present land use for two Sites, Site 1 – Lot 351 McGuigan Road (29.56 ha) and Site 2 – Lot 591 Broome Road (128.08 ha). The outcomes of the investigations will inform the future direction of the Project.

This report is subject to, and must be read in conjunction with the limitations set out in Section 1.5 and the assumptions and qualifications contained throughout the report.

## Potential project constraints-biological aspects

Constraint	Site 1	Site 2
Land use and physical characteristics	No constraints identified.	Fly tipping of house hold waste, including large, flat panel fragments of surficial potential asbestos containing materials present.
Vegetation and flora	29.56 ha of native vegetation is present.	<ul> <li>127.89 ha of native vegetation is present.</li> <li>Approximately 9,940 individuals of <i>Jacquemontia</i> sp. Broome (P1) are present.</li> <li>Approximately six individuals of <i>Pterocaulon ?intermedium</i> (P3) are present.</li> <li>One individual of <i>Terminalia Kumpaja</i> (P3) is present.</li> </ul>
Fauna	<ul> <li>Potential breeding and foraging habitat for three species:</li> <li>J Rainbow Bee-eater (<i>Merops</i> ornatus) –Migratory Terrestrial species (EPBC Act)</li> <li>J Little North-western Mastiff Bat (<i>Ozimops cobourgianus</i>) – Priority 1 (DPaW)</li> <li>J Greater Bilby (<i>Macrotis lagotis</i>) – Vulnerable (EPBC Act and WC Act)</li> <li>Potential foraging habitat for three species:</li> <li>J Grey Falcon (<i>Falco</i> hypoleucos) – Vulnerable (WC Act)</li> <li>J Peregrine Falcon (<i>Falco</i> peregrinus) – Schedule 7 (WC Act)</li> <li>J Dampierland Burrowing Snake (<i>Simoselaps minimus</i>) – Priority 2 (DPaW)</li> </ul>	<ul> <li>Potential breeding and foraging habitat for three species:</li> <li>Rainbow Bee-eater (<i>Merops</i> ornatus) –Migratory Terrestrial species (EPBC Act)</li> <li>Little North-western Mastiff Bat (<i>Ozimops cobourgianus</i>) – Priority 1 (DPaW)</li> <li>Greater Bilby (<i>Macrotis</i> lagotis) – Vulnerable (EPBC Act and WC Act)</li> <li>Potential foraging habitat for three species:</li> <li>Grey Falcon (<i>Falco</i> hypoleucos) – Vulnerable (WC Act)</li> <li>Peregrine Falcon (<i>Falco</i> peregrinus) – Schedule 7 (WC Act)</li> <li>Dampierland Burrowing Snake (<i>Simoselaps minimus</i>) – Priority 2 (DPaW)</li> </ul>

The key constraints identified for the Site during the environmental investigations are summarised below.

#### Environmental approvals and referrals

The following environmental approvals and referrals advice is based on the environmental constraints identified within the Sites during the preliminary site investigation and biological assessment. As the Project is in concept design, it is assumed there will be opportunities to avoid and minimise the impacts on these constraints through design. If the constraints can be avoided or impacts to these minimised, it may negate the need for environmental approvals or referral to Commonwealth/State environmental agencies.

#### **Department of the Environment**

Referral to Department of the Environment under the Environment Protection and Biodiversity Conservation Act 1999 is triggered if a proposed action has or potentially has a significant impact on any Matters of National Environmental Significance. A preliminary assessment has determined that referral is recommended for the Project as there may be a risk (albeit probably low) of a significant impact to an important population of the Greater Bilby.

#### **Environmental Protection Authority**

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 maybe 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 Environmental Protection Authority under Section 38 of the *Environment Protection Act 1986* (EP Act).

#### **Department of Environment Regulation**

Any clearing of native vegetation is regulated by the Department of Environment Regulation and requires a clearing permit under Part V of the EP Act, except when a project is assessed under Schedule 6 of the Act or is prescribed by regulation in the Environmental Protection (Clearing Native Vegetation) Regulations 2004 and not in an Environmentally Sensitive Area.

If the EPA does not assess the Project, a clearing permit will be required for the Project.

# Table of contents

1.	Intro	duction	1
	1.1	Background	1
	1.2	Purpose of the report	1
	1.3	Project Area	1
	1.4	Scope of works	1
	1.5	Limitation and assumptions	2
2.	Meth	odology	3
	2.1	Desktop assessment	3
	2.2	Site inspection	3
	2.3	Field survey	4
	2.4	Limitations	12
3.	Desk	top assessment	16
	3.1	Site information	16
	3.2	Review of previous investigations	16
	3.3	Land use	16
	3.4	Physical characteristics	18
	3.5	Biological characteristics	20
4.	Site i	inspection	26
	4.1	Site description	26
	4.2	Surrounding land use	27
5.	Cond	ceptual site model	28
	5.1	Potential contaminants of concern	28
	5.2	Preferential pathways	28
	5.3	Exposure routes	28
	5.4	Sensitive receptors	28
	5.5	Potential pollutant linkages	28
6.	Flora	a and fauna field results	29
	6.1	Vegetation and flora	29
	6.2	Fauna	33
7.	Proje	ect constraints and referrals	41
	7.1	Key constraints	41
	7.2	Environmental approvals and referrals	43
8.	Cond	clusions and recommendations	45
	8.1	Key findings	45
	8.2	Recommendations	46
9.	Refe	rences	47

## Table index

Table 1	Site details	1
Table 2	Information sources	3
Table 3	Data collection during the flora and vegetation field survey	4
Table 4	Vegetation condition scale	5
Table 5	Fauna references	7
Table 6	Camera trap effort and locations	9
Table 7	Fauna quadrat locations and effort	11
Table 8	Survey limitations	13
Table 9	Summary of historical aerial photographs	16
Table 10	Conservation areas within 20 km of the Sites	18
Table 11	Department of Water geographic atlas queries for the Sites	19
Table 12	WIR bore information	20
Table 13	Land systems mapped within the Sites	21
Table 14	Vegetation associations mapped within the Sites	22
Table 15	Conservation significant ecological communities recorded within 20 km of the Sites	24
Table 16	Location of observed contamination within Site 2	26
Table 17	Conceptual site model summary	28
Table 18	Extent of vegetation condition ratings mapped within the Sites	30
Table 19	Estimated counts of Jacquemontia sp. Broome (A.A. Mitchell 3028)	31
Table 20	Habitat type in the Sites	33
Table 21	Vertebrate fauna results summary	35
Table 22	Mammal families recorded during the field surveys	35
Table 23	Bird families recorded during the field surveys	35
Table 24	Reptile families recorded during the field surveys	36
Table 25	Summary of likelihood of occurrence for conservation significant fauna	38
Table 26	Key constraints identified within the Sites	42
Table 27	Assessment of key biological Matters of National Environmental Significance for the Sites	44

## Appendices

- Appendix A Figures
- Appendix B Relevant legislation, conservation codes and background information
- Appendix C Land use
- Appendix D Biological desktop searches
- Appendix E Site walkover data
- Appendix F Vegetation and flora data
- Appendix G Fauna data

## 1. Introduction

## 1.1 Background

LandCorp is the lead agency progressing the multi-staged Broome Motorplex Project. The existing Broome Speedway and Motorcross facilities are located at the corner of Wattle Drive and Broome Road, and are immediately east of the Broome North District Development Plan area. The noise emissions from the speedway create a significant constraint for the area. In 2013, the Shire of Broome Council resolved to undertake a feasibility study to investigate the location and construction of a new motorsports complex. Following the preliminary feasibility study, a preferred site was identified based on a multi-criteria analysis.

In 2015, the Shire of Broome Council resolved to endorse the progression of further site-specific technical studies. Stage one of the Project involves site selection for the future Broome Motorplex, with a number of investigations forming a key part of this Stage.

## 1.2 Purpose of the report

GHD Pty Ltd (GHD) was commissioned by LandCorp to undertake desktop and field environmental investigations for the Project. The purpose of the investigations was to determine key site physical, flora, vegetation and fauna constraints and recent and present land use. This report documents the environmental investigation method, results and conclusions. The outcomes of the investigations will inform the future direction of the Project.

## 1.3 Project Area

The Project Area is located approximately 10 km north of Broome, in the Kimberley Region of Western Australia and comprises two Sites (Table 1 and Figure 1, Appendix A).

Site ID	Address	Area (ha)
Site 1	Lot 351 McGuigan Road Located near the corner of Cape Leveque and McGuigan Roads	29.56
Site 2	Lot 591 Broome Road Located at the corner of Cape Leveque and Broome Roads	128.08

## Table 1Site details

## 1.4 Scope of works

The scope of works, as detailed in the LandCorp brief and GHD proposal was to:

- Undertake a desktop assessment of physical characteristics, and recent and present land use of the Sites
- Undertake a site inspection to verify the findings from the desktop assessment and assess site conditions including presence of construction material and observable potential contamination
- Undertake a flora and fauna assessment of the Sites to provide:
  - Description and mapping of vegetation units, vegetation condition and fauna habitats
  - Preliminary identification of any Threatened or Priority Ecological Communities
  - Locations and extents of any Threatened or Priority flora
  - Inventory of flora and fauna species

- Locations and/or evidence of any Threatened or Priority fauna
- Prepare a report that documents the results of the desktop assessment, site inspection and biological survey, and assesses (and where applicable recommends) the requirement for referral to statutory authorities or other clearances for the Project.

## 1.5 Limitation and assumptions

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

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

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

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

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

GHD has prepared this report on the basis of information provided by LandCorp 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, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) 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 Site 1 and 2 (Figure 1, Appendix A). Should Site 1 or 2 change or be refined, further assessment may be required.

## Methodology

## 2.1 Desktop assessment

A desktop assessment of the Project was undertaken to identify potential environmental constraints. The desktop assessment involved a review of government agency managed databases and relevant spatial datasets (Table 2).

## Table 2 Information sources

Aspect	Information Source
Geology	Geological Survey of Western Australia (GSWA 1982)
Acid Sulfate Soils (ASS)	Australian Soil Resource information System (ASRIS 2016)
Hydrology and hydrogeology	DoW Geographic Data Atlas (DoW 2016) Laws (1991)
Contaminated sites	DER Contaminated Sites Database (DER 2016a)
Land use and reserves	Department of Parks and Wildlife (DPaW) Estate spatial dataset Shire of Broome Local Planning Scheme (LPS) No. 6, 2015
Environmentally Sensitive Areas	DER Clearing Permit System Map (DER 2016b)
Regional biogeography	Graham (2001)
Vegetation	Beard vegetation mapping (1977)
	State wide Vegetation Statistics (Government of Western Australia (GoWA) 2015)
Threatened and Priority Ecological Communities	DPaW Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) spatial datasets Environmental Protection and Biodiversity Conservation Act 1999
	(EPBC Act) Protected Matters Search Tool (PMST) (DotE 2016a)
Conservation Significant Flora and Fauna	DPaW NatureMap database (DPaW 2007–) DPaW Threatened and Priority Fauna datasets (TPFL) Western Australian Herbarium database (WAHERB)
Matters of National Environmental Significance	EPBC Act PMST (DotE 2016a)

## 2.1.1 Relevant legislation, conservation codes and background information

In Western Australia 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 Project is provided in Appendix B.

## 2.2 Site inspection

An assessment of each Site was undertaken by GHD Ecologists during a site walkover on 18-24<sup>th</sup> March 2016. The site conditions were assessed and any visible areas of potential

environmental and/or human health concerns were recorded. The site walkover also confirmed features documented in the desktop assessment.

## 2.3 Field survey

#### 2.3.1 Vegetation and flora

GHD botanist (Jordan Tindiglia, SL011310) conducted a single season Level 2 vegetation and flora assessment of the Sites from 18-24<sup>th</sup> March 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 by GHD was undertaken with reference to the Environmental Protection Authority (EPA) Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004a) and *Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No.* 3 (EPA 2002).

#### Data collection

Field survey methods involved a combination of sampling quadrats located in identified vegetation units, grid based transect searches and opportunistic recording. Eleven non-permanent quadrats were described throughout the two Sites (Figure 2, Appendix A).

Quadrats (measuring 50 m x 50 m – area of 2,500 m<sup>2</sup>) were located within each identified vegetation unit. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 3.

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 GDA94 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 adapted by 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 cover (using a modified Braun-Blanquet scale)

#### Table 3Data collection during the flora and vegetation field survey

A grid based search was completed across the Sites; this involved one botanist walking transect lines approximately 100 m apart and searching for conservation significant species. A flora inventory was compiled from taxa listed in described quadrats and from opportunistic floristic records throughout the Sites.

#### 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 National Vegetation Information System (NVIS) and are consistent with NVIS Level V (Association). At Level V three taxa per stratum are used to describe the association (ESCAVI 2003).

Vegetation mapping has been undertaken at a scale of 1:5,000, which is considered a suitable scale for this Project.

#### **Vegetation condition**

The vegetation condition of the Sites was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (adapted by EPA and DPaW (2015)). The scale recognises the intactness of vegetation and consists of six rating levels as outlined in Table 4.

#### Table 4 Vegetation condition 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 relatively non-aggressive species, 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 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.

#### 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. Flora identification was undertaken by Jordan Tindiglia. Plant species were identified by the use of local and regional flora keys and by comparison with the named species held at the Western Australian Herbarium (WA Herbarium).

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–) and the EPBC Act List of Threatened Flora (DotE 2016b).

Nomenclature used in this report follows that used by the Western Australian Herbarium as reported on *FloraBase* (WA Herbarium 1998–).

#### Targeted survey for conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. aerial photography, geology, soils and topography data, TPFL, EPBC Act PMST, *NatureMap* and the WAHERB database search results) was reviewed to determine potential conservation significant flora taxa and locations. Additionally, ecological information (e.g. habitat, associated flora taxa

and phenology) was sourced from *FloraBase* (WA Herbarium 1998–) and other relevant publications where available, to provide further details.

A targeted survey for conservation significant flora species was completed concurrently with the flora and vegetation survey. The aim of the survey was to identify and record the locations of conservation significant flora species, particularly targeting *Polymeria* sp. Broome, within the Sites. The targeted survey involved one botanist walking transects approximately 100 m apart, in a north-south direction across Site 1 and in an east-west direction across Site 2.

#### 2.3.2 Fauna

GHD zoologists undertook a two phased fauna investigation of the Sites from 2015 to 2016. A brief site visit was undertaken by Glen Gaikhorst on 20<sup>th</sup> November 2015 to deploy camera traps around the Sites. Phase 1 was undertaken by Glen Gaikhorst and Laura Zimmermann from the 14-15<sup>th</sup> December 2015 and included identification and evaluation of fauna habitats and targeted searching for conservation significant fauna species. This phase assisted in finalising the methods to be employed during the phase 2 survey. Phase 2 was undertaken by Glen Gaikhorst and Bradford Maryan from the 15-24<sup>th</sup> March 2016, in conjunction with the vegetation and flora survey. This phase included a trapping program and targeted searching for conservation significant fauna surveys were undertaken to collect baseline data on the species present and identify any conservation significant species present/likely to occur within the Sites.

The survey methodology employed by GHD was based on recent discussions with DPaW Broome and undertaken with reference to the Environmental Protection Authority (EPA) Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b) and *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010).

#### **Permits**

A Regulation 17 Licence to Take Fauna for Scientific Purposes was obtained from DPaW prior to undertaking the fauna surveys (Licence Number: SF010731).

The fauna surveys (specifically trapping and animal handling) were undertaken in accordance with Standard Operating Procedures (SOPs) which were required to be followed under the conditions of GHD's fauna trapping permit. At the time of survey, compliance with these SOPs was accepted by DPaW as evidence of ethical treatment of animals:

- SOP No. 9.1 Elliott traps for live capture of terrestrial vertebrates (DEC 2009a)
- SOP No. 9.3 Dry pitfall trapping for vertebrates and invertebrates (DEC 2009b)
- SOP No. 9.2 Cage traps for live capture of terrestrial vertebrates (DEC 2009c)
- SOP No. 9.6 Hand capture of wildlife (DEC 2009d)
- SOP No. 10.1 Animal handling/restraint using soft containment (DEC 2009e)
- SOP No. 10.2 Hand restraint of wildlife (DEC 2009f)
- SOP No. 14.2 First Aid for animals (DEC 2009g)

#### Fauna identification and nomenclature

Nomenclature used in this report follows the WA Museum as reported on *NatureMap* (DPaW 2007–). This nomenclature is deemed the most up-to-date species information for Western Australia groups: reptiles, amphibians, invertebrates and mammals (including bats). All bird nomenclature follows Christidis and Boles (2008). Other reference materials used are presented in Table 5.

#### Table 5 Fauna references

Fauna Group	Field Guide
Mammals	Menkhorst and Knight (2004; 2010), Van Dyck and Strahan (2008; 2013)
Birds	Morcombe (2004)
Geckos	Wilson and Swan (2013)
Skinks	Storr et al. (1999), Wilson and Swan (2013)
Dragons	Wilson and Swan (2013)
Varanids	Wilson and Swan (2013)
Legless Lizards	Wilson and Swan (2013)
Snakes	Storr et al. (2002), Wilson and Swan (2013)
Amphibians	Tyler and Doughty (2009)

#### Systematic searches

Trapping for terrestrial fauna was undertaken using a series of standardised systematic trapping quadrats comprising of one or more of the following trap methods: pit-fall traps, funnel traps, Elliot box traps and cage traps. Details of each trap type used are provided below. Seven quadrats were used throughout the two Sites, with each quadrat systematically surveyed (trapped) for six to eight nights during the March survey. Quadrats consisted of either cage lines, Funnel lines or a complete trapping event of pits, funnels, Elliott's and cages. Quadrat type and effort is described in greater detail below. Traps were checked twice daily, early in the morning before the heat of the day and late afternoon.

Fauna systematic search locations are shown in Figure 2, Appendix A.

#### Pit-trap with drift fence

Five pit-traps were established at two quadrats within the Sites. Pit-traps comprised of 20 litre (L) plastic buckets (30 cm diameter, 40 cm deep). A 30 metre (m) long flywire drift fence (30 cm high) bisected the pits; directing fauna into them. Pits were spaced at 5 m intervals along the fence. Soil and other refuge (e.g. an egg carton) was placed within each pit to provide shade and protection for captured animals.

#### **Funnel traps**

Ten funnel traps were used along each drift fence (at all seven quadrats). Traps were placed such that animals were directed into them from the drift fence in between the pit traps. Funnel traps were covered with insulating materials to minimise heat or cold exposure to animals. An additional three quadrats of only funnels (10) and drift fence was used around termite mounds or areas of hard soils.

#### Elliot box traps

Ten Elliott box traps were used at three quadrats. Traps were placed approximately 10 m apart and baited with universal bait (a mixture of peanut butter, rolled oats and sardines) or dried cat food (depending on ant invasion in the area). Elliott traps were located within shady areas or covered with vegetation to minimise exposure to captured animals. A line of 10 Elliott traps were used per pit location. Each 100 m line was positioned 10 m from the end of the pit trapping drift fence.

#### Cage traps

Two cage traps were located at each quadrat. These traps were placed within 10 m of the end of drift fence. Cage traps were baited with universal bait and covered with hessian sacks and

insulated materials. An additional two quadrats of cage traps only were established in the Sites. Nine cages were positioned at 50 m intervals in a row within the Sites (approximately 450 m long).

#### **Bat sampling**

Assessment of bats was undertaken using an SM2+ Bat SongMeter recorder at two locations. A minimum of one night assessment was undertaken at each Site.

Craig Grabham (GHD) completed the analysis of all data collected during the survey using ultrasonic bat detectors. Data from SongMeter recorders was downloaded using Kaleidoscope version 3.1.6 (Wildlife Acoustics 2016). Calls were first viewed and analysed using Kaleidoscop Viewer version 3.1.6 and then converted to files suitable for analysis in AnalookW version 4.1s (Corben 2015). Calls were identified using zero-crossing analysis and AnalookW by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency (Fc) and call shape) with species call descriptions from available reference material (McKenzie and Bullen 2009; 2012, Armstrong and Cole 2007).

The call identification was also assisted by consulting distribution information for possible species (Atlas of Living Australia and *NatureMap* records). No reference calls were collected during the survey.

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 (e.g. there is known overlap in call characteristics between some species) a conservative approach was taken when analysing calls.

#### Avifauna (bird)

Avifauna surveys were undertaken using a 20 minute census of birds within an unbounded 2 ha area, which is the standard method used by Birds Australia for the Bird Atlas Project. Birds detected visually (using binoculars) and/or aurally over a 20 minute period were recorded. Numbers of each species observed were also recorded.

All systematic bird surveys were undertaken within four hours of dawn or two hours of dusk, as these are the times of day when birds are most active. In addition to systematic surveys, observations of birds were also made opportunistically.

#### **Camera Traps**

Seven remote cameras were positioned around the Sites from 20<sup>th</sup> November 2015 with data extracted in December and March (Table 6). Remote cameras that are triggered by motion were positioned in areas that contain optimal habitat for threatened fauna. These cameras were set to target the Bilby and Northern Brushtail Possum, but also collected information on all species that are active in the range of the camera. Cameras were set with a lure (such as sardines, peanut butter and universal bait) to increase the rate of encounter. Cameras were set up to spatially complement other survey efforts.

Camera	Easting	Northing	Deployed	Collected	Nights Deployed
Cam 2	423,171	8,025,091	20th Nov 15	14th Dec 15	24
Cam 30	423,171	8,024,862	20th Nov 15	14th Dec 15	24
Cam GHD	422,401	8,022,735	14th Dec 15	11th Mar 16	87
Cam 2a	423,042	8,025,977	14th Dec 15	11th Mar 16	87
Cam 7	422,983	8,024,197	14th Dec 15	11th Mar 16	87
Cam 23	422,899	8,024,045	14th Dec 15	11th Mar 16	87
Cam GHD1	423,115	8,025,978	14th Dec 15	11th Mar 16	87

#### Table 6 Camera trap effort and locations

#### **Targeted bilby surveys**

Bilby are recognised as a species that requires targeted surveys in the Broome area in which GHD has undertaken several. In undertaking these surveys guidance has been provided by DotE as to the methodology to be utilised. The sampling technique involves a plot based assessment. Each plot is 2 hectares in size and sufficiently spaced to capture activity over an area. The plots were sampled in line with similar work undertaken by GHD on the Cape Leveque Road utilising Southgate's methods of Bilby Plot Assessments (Southgate *et al.* 2005).

Eight Bilby plots were established and assessed during the December 2015 survey. An additional two Bilby plots were established during the March 2016 survey to collect additional regional data. All ten plots were assessed during the March 2016 survey. Each plot is approximately 70 x 300 m in size and were ground truthed at 30 m intervals with all Bilby observations/evidence recorded including:

- Burrows, active and inactive
- Diggings, fresh or old and conical, shrub or plate
- Scats, fresh and old
- Prints, fresh and old

The evidence based assessment relies on more than one pieces of evidence or where the evidence is conclusive to that species (i.e. digs can be made from a range of species, but Bilby burrows are typical and identifiable).

#### Non-systematic sampling

To provide the best opportunity to determine the presence and relative prevalence of fauna species of conservation significance, this assessment employed a variety of sampling methods. The systematic sampling was applied through the trapping program with additional sampling methods also applied at these quadrats. Furthermore, other areas that were not assessed through the systematic trapping effort were also surveyed using non-systematic techniques. Non-systematic sampling methods comprised of the following:

- Diurnal searching Each site was searched for amphibians, reptiles, and mammals. Surveys comprised of searching ground layer (overturning logs, rocks and leaf litter) and low vegetation (under bark and in tree stumps) and recording all individuals observed. Species presence was also determined via secondary evidence, in the form of scats, tracks, feathers, burrows and remains. A minimum of 1 hour was spent at each location and within the general area.
- Nocturnal searching Nocturnal surveys were conducted using hand held spotlights during the survey. Spot lighting was undertaken to locate nocturnal species that may not

be sampled by other techniques. A minimum of 1 hour was spent at each location and within the general area.

Opportunistic observations – While conducting any activities in the Sites, opportunistic observations were made of any other vertebrates (or signs of their presence). Fauna taxa observed or heard were noted, and indirect evidence (such as scats, tracks, diggings, nests, feathers, bones, pellets (Triggs 1996)) indicating the current or recent presence of a species also noted. Wherever possible, numbers of individuals, microhabitat use and other relevant information was recorded.

#### Quadrat locations and trapping effort

The single phase of trapping was completed for the Sites in the wet season of 2016. Trapping effort is described as the duration and number of survey types undertaken during an assessment. Table 7 provides detail on the type and amount of time undertaken during the survey.

Quadrat	Location		Nights open	Elliot	traps	Pit trap	S	Cage Traps Funnel Traps		Cage Traps Funnel Traps		Cage Traps		Funnel Traps		Bat survey (nights)	Birds search	Active search	Night search
	Easting	Northing		No.	Total	No.	Total	No.	Total	No.	Total		(minutes)	(minutes)	(minutes)				
Q01	422,512	8,022,828	8	0	0	0	0	2	16	10	80	1	100 min	120 min	60 min				
Q02	423,046	8,022,886	8	0	0	0	0	2	16	10	80		80 min	60 min	60 min				
Q03	422,940	8,024,129	8	0	0	0	0	2	16	10	80		0	70 min	0				
Q04	423,060	8,023,383	8	10	80	0	0	9	72	10	80	1	80 min	60 min	0				
Q05	422,611	8,025,609	8	10	80	5	40	2	16	10	80		80 min	60 min	60 min				
Q06	423,049	8,024,427	7	0	0	0	0	9	63	10	70		0	60 min	0				
Q07	423,142	8,025,260	6	10	60	5	40	2	12	10	60		60 min	60 min	120 min				
TOTAL				30	220	10	80	28	211	70	530	2	400 min	490 min	300 min				

## Table 7 Fauna quadrat locations and effort

## 2.4 Limitations

#### 2.4.1 Desktop limitations

The information presented in this report was obtained from a variety of sources including government agencies and various reference documents. The information provided by these sources has a varying degree of accuracy and therefore GHD has sought to consult several sources, wherever possible, to confirm the accuracy of the information.

The information provided by government agencies or obtained from government databases is generally accurate and is sourced from reputable reference documents. Therefore this data has been used as a primary line of evidence wherever available.

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 records of collections, sightings or trappings can 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 these newly 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*, does not reflect the conservation status of flora and fauna listed in these Notices.

Aerial photographs are considered to be an accurate and reliable source of information about the Sites as the information provided is independent of memory of bias. Aerial photographs were available for the Sites although none were available for the time period prior to 1996. Photographs are also open to interpretation and so have been considered in conjunction with other information sources.

## 2.4.2 Field survey limitations

Guidance Statement No. 51 and No. 56 (EPA 2004a, 2004b) states that flora and fauna survey reports for environmental impact assessment in Western Australia 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 8.

## Table 8Survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Minor	<ul> <li>Adequate information is available for the Sites, this includes:</li> <li>Broad scale pre-European vegetation mapping by Beard (1977), digitised by Shepherd <i>et al.</i> (2002)</li> <li>Regional biogeography (Graham 2001)</li> <li>Background information (Kenneally <i>et al.</i> 1996)</li> </ul>
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 the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Minor	The vegetation and flora survey was a single season survey and was undertaken in March 2016. This is generally considered the most optimal time to undertake flora and vegetation surveys in the Kimberley Region. The flora recorded from the field survey is detailed in Section 6.1.5 and a full flora species list is provided in Appendix F. The portion of flora collected and identified was considered high; however it is likely that the survey under-recorded herb species due to the dry conditions at the time of survey. See <i>Timing/weather/season/cycle</i> .
		The fauna survey was undertaken in November 2015 and March 2016. Multiple trapping and survey methods were employed to sample a wide range of fauna groups (including nocturnal species). All trapping and survey methods were implemented with no constraints.
		Fauna assessments that capture the full spectrum of species in an area often include numerous surveys over different seasons over a number of years. This survey was limited to two surveys in two seasons (November 2015 – dry and March 2016 - wet) and although meets the guideline requirements for terrestrial surveys may not identify all species present or that utilise the Sites.
		Additionally this assessment was restricted to vertebrate fauna and did not include invertebrates.
Flora determination	Minor	Flora determination was undertaken by a GHD botanist in the field and at the WA Herbarium. Potential Priority flora taxa were submitted to the WA Herbarium for identification and/or verification (Accession 6794 and 6821 – <i>Jacquemontia</i> sp. Broome, <i>Pterocaulon ?intermedium</i> and <i>Terminalia kumpaja</i> ). Similarly, 'other significant flora' taxa were also verified by the WA Herbarium (Accession 6794 and 6821 – <i>Glycine</i> aff. <i>pindanica</i> and <i>Sehima nervosum</i> ).
		All fauna was identified by zoologists and released on site.
		The taxonomy and conservation status of the Western Australian flora and fauna 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 IUCN criteria.

Aspect	Constraint	Comment
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The Sites were accessed on foot and fully traversed during the vegetation, flora and fauna assessment. Given the level of diversity and condition of the vegetation this was considered adequate to sample the Sites.
Mapping reliability	Minor	The vegetation was mapped at a scale of 1:5,000 using high resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard 1977) and field data. The distribution of quadrats was considered adequate for the definition of vegetation within the Sites. 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 Juno and GPS units used for this survey are accurate to within ±10 m on average. Therefore the data points consisting of coordinates recorded from the Juno and GPS may contain inaccuracies.
Timing/weather/ season/cycle	Minor	The field survey was conducted in March 2016. In the three months prior to the survey (December-February), Broome Airport weather recording station recorded 221.8 mm of rainfall (No. 003003, BoM 2016). This total is approximately half of the long-term average for the same period (December-February; 415.6 mm) (BoM 2016). The weather conditions recorded during the field survey included: ) Daily maximum temperature ranging from 33.2 to 36.5 °C ) Daily minimum temperature ranging from 24.2 to 29.9 °C ) Daily rainfall 0 to 7.2 mm The weather conditions recorded during the survey were considered unlikely to have affected the field surveys.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	There were no disturbances observed that affected the survey.
Intensity (in retrospect, was the intensity adequate)	Nil	The vascular flora of the Sites was sampled in accordance with EPA (2004a) and terrestrial fauna sampled in accordance to EPA (2004b) for Level 2 surveys.
Resources	Nil	Adequate resources were employed during the field survey. Seven person days were spent undertaking the vegetation and flora survey and 20 person days were spent undertaking the fauna survey.
Access restrictions	Nil	No access restrictions were encountered.

Aspect	Constraint	Comment
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields. The vegetation and flora team comprised one botanist (Jordan Tindiglia) who has over 9 years' experience in undertaking field surveys in Western Australia, including a number of projects in the Broome region since 2012. The fauna team comprised three zoologists, Glen Gaikhorst and Brad Maryan individually have over 20 years' of experience undertaking field surveys in Western Australia, including numerous projects in the Broome region. Glen has also undertaken numerous targeted assessments for Bilby's in the broader Broome region since 2010. Laura Zimmermann has over 3 years' experience in undertaking field surveys in Western Australia. Laura has accompanied Glen on a number of targeted assessments for Bilby's in the broader Broome Broome region.

## 3.1 Site information

The Sites are located approximately 10 km north of Broome in the suburb of Waterbank. Site 1 and Site 2 are approximately 30 ha, and 130 ha in size, respectively. The Sites are shown in Figure 1, Appendix A.

## 3.2 Review of previous investigations

#### Draft Broome Motorsport Complex Site Assessment (Cardno 2015)

This document is a draft of a general assessment of four Sites in Broome, including the two currently proposed, with relation to their suitably for the proposed Project. The information provided in the assessment is generally consistent with information described in this report, with the following exceptions that were not included in the scope of works of this report:

- The native title of each Site has been extinguished and the areas are currently part of the Water Corporation's reserve (both Sites)
- It was recommended that a comprehensive heritage survey be conducted should Site 2 become a focus, in the case that the area may contain Aboriginal sites or objects

## 3.3 Land use

#### 3.3.1 Zoning

The Shire of Broome Town Planning Scheme No. 6 indicates that the Sites are zoned as 'Public Purpose: Water Supply', with Site 2 also within the 'Future Broome international airport environs' boundary (Figure 3, Appendix A). The current Local Planning Strategy for Broome indicates that the Sites are zoned as 'Public Purpose', with Site 1 also zoned as a 'Development investigation area'.

#### 3.3.2 Aerial photographs and historic layout

Aerial photographs of the Sites were obtained from Landgate in order to ascertain the development history and land use practices that may have led to contamination. The earliest available aerial photographs are from 1996. Copies of the aerial photographs are summarised in Table 9 and provided in Appendix C.

Year of photograph	Observations
1996	Site observations
Scale: 1:53,119	The sites appear to be undeveloped with scattered vegetation in areas visible in aerial photography. It is noted however that only partial aerial photography coverage of the Sites is available. <b>Site surrounds observations</b>
	All areas surrounding Site 1 appear undeveloped. A large portion of land south of Site 2 is cleared of vegetation, and a smaller portion of land west of Site 2 is also cleared of vegetation. Unsealed roads exist parallel to the eastern boundary of Site 2 (Cape Leveque Road) and the southern boundary of Site 1 (McGuigan Rd).

#### Table 9 Summary of historical aerial photographs

Year of photograph	Observations
2000 Scale: 1:53,119	Site observations No significant changes observed. Site surrounds observations No significant changes observed.
2007 Scale: 1:53,119	Site observations No significant changes observed. Site surrounds observations No significant changes observed.
2011 Scale: 1:53,119	Site observations No significant changes observed. Site surrounds observations No significant changes observed.
2013 Scale: 1:53,119	Site observations No significant changes observed. Site surrounds observations No significant changes observed.
2015 Scale: 1:53,119	Site observations No significant changes observed. Site surrounds observations No significant changes observed.

## 3.3.3 Dangerous goods licences

GHD lodged a request with the Department of Mines and Petroleum (DMP) under the *Freedom of Information Act 1992* to undertake a search of the Dangerous Goods Storage (DGS) licence documents to determine whether any potentially hazardous materials have been licensed for use or storage at the Site.

The search did not produce any documentation containing information relating to DGS at the Sites.

GHD notes that although no documentation could be provided by DMP for the Sites, there is the potential for current and historic storage of dangerous goods at the Sites. Documentation provided by DMP is presented in Appendix C.

#### 3.3.4 Review of DER Contaminated Sites Database

The DER *Contaminated Sites Database* presents information on known or suspected contaminated sites that have been classified by the DER within the following categories:

- Contaminated remediation required
- Contaminated restricted use
- Remediated for restricted use

The DER *Contaminated Sites Database* does not provide details of sites that are listed as 'Possibly contaminated – investigation required'.

A search of the DER *Contaminated Sites Database* shows that the Sites and immediate surrounds have not been reported as known contaminated sites at the time of the search (March 2016) (Appendix C).

## 3.3.5 Conservation reserves and areas

There are eight DPaW-managed conservation areas within 20 km of the Sites (Table 10). No DPaW-managed conservation areas intersect the Sites.

Name	Class	Area (ha)	Location
Unnamed (R 51162)	А	2510	Approximately 5.8 km west of the Sites
Broome Wildlife Centre (R 47964)		5	Approximately 4 km south-west of the Sites
Unnamed (R 51497)	С	716	Approximately 2.3 km south of the Sites
Unnamed (R 51380)	С	65	Approximately 1.2 km south of the Sites
Unnamed (R 51105)	-	333	Approximately 9.5 km south of the Sites
Unnamed (R 51046)	А	37,973	Approximately 10 km south of the Sites
Unnamed (R 1644)	С	1	Approximately 9 km south of the Sites
Unnamed (R 51617)	С	5	Approximately 9.5 km south of the Sites

## Table 10 Conservation areas within 20 km of the Sites

## 3.3.6 Environmentally Sensitive Areas

One Environmentally Sensitive Area (ESA) intersects the southern portion of Site 2 (Figure 3, Appendix A). This ESA is likely aligned with the Roebuck Bay mudflats TEC buffer, which covers the Broome town site and surrounds.

## 3.4 Physical characteristics

## 3.4.1 Geology

The geology of the Sites is reported to comprise Quaternary soils consisting of red, fine to medium grained Aeolian sand and minor silt of the Bossut Formation (GSWA 1982). This is consistent with the observed surficial soil on the Sites of red and gravel and sandy loam. The information is also consistent with bore log information from a DoW Water Information Reporting search of bore OBS5 (Site reference 80119002), which reported clayey sand to 26.5 m, and fine to coarse quartz sand to 32.0 m. Regional geological mapping is provided in Figure 4, Appendix A.

#### 3.4.2 Topography

The Department of Water (DoW) *Geographic Data Atlas* indicates the topography of both Sites is generally flat. The elevation across the majority of the Sites is approximately 22 m Australian Height Datum (AHD) (DoW 2016).

During the site walkover the topography of the Site was observed to be generally flat with no discernible changes in elevation.

## 3.4.3 Acid sulfate soil assessment

Shallow acid sulfate soils (ASS) may occur in low lying landscapes of the North West region of Western Australia. Urban and infrastructure development in these areas may disturb ASS. The Australian Soil Resource Information System (ASRIS) has compiled maps of ASS risk areas; these provide a broad-scale indication of the areas where ASS is most likely to exist. The Sites are classified as an area of 'Extremely low probability/Very low confidence' (ASRIS 2016) (Appendix C).

## 3.4.4 Hydrogeology and hydrology

Based on elevation contours provided in the *Geographic Data Atlas*, surface water is likely to flow in a south-westerly direction (DoW 2016). The nearest surface water bodies are the Indian Ocean, which is located approximately 6 km to the west of the Sites and Dampier Creek, located approximately 3 km south of the Sites. It is expected that surface water infiltrates through sand across both Sites.

The Geographic Data Atlas indicates the Sites are within the DoW North West region (DoW 2016). A summary of the Geographic Data Atlas queries for the Sites is provided in Table 11. The Sites occurs within the Broome groundwater area as proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act) and are adjacent to the Broome Water Reserve, which is a Priority 1 PDWSA (Figure 5, Appendix A).

Aspect	Details	Result
Groundwater areas	Groundwater areas proclaimed under the RIWI Act.	Broome
Surface water areas	Surface water areas proclaimed under the RIWI Act.	None present
Irrigation district	Irrigation Districts proclaimed under the RIWI Act.	None present
River	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 <i>Metropolitan Water Supply, Sewage and Drainage Act 1909</i> or the <i>Country Area Water Supply Act 1947</i> .	None present
Waterway Management Areas	Areas proclaimed under the Waterway Conservation Act 1976.	None present

#### Table 11 Department of Water geographic atlas queries for the Sites

#### Department of Water WIR bore search

A DoW WIR bore search was undertaken to assess registered bores within the vicinity of the Site. The DoW WIR bore search identified there are eight registered bores located within 1 km of each Site boundary. Details of the DoW WIR bore search are provided in Appendix C. The registered locations are presented in Figure 5, Appendix A. Two additional bores were found on the DoW *Geographic Data Atlas* (2016), including a Broome Town Water Supply bore (ID: 11891664). The ID, reference number, and name of each bore are documented in Table 12.

Laws (1991) indicates the existence of a bore within Site 2, adjacent to Cape Leveque Road that is capable of extracting  $50 - 500 \text{ m}^3$ /day of water, which is likely the Broome Town Water Supply bore (ID: 11891664). This bore was not observed during the site-walkover.

GHD notes that it is possible that unregistered bores may exist in the area. However, the limited anthropogenic influence of the Sites and their surrounds suggest it is unlikely that any unregistered domestic bores exist in the area.

Groundwater level data was only available at Site OBS5, which reported historic groundwater levels ranging between approximately 3 to 6.5 m AHD since the mid 1960s.

#### Table 12 WIR bore information

Bore ID	Site reference	Site name	Operation
20078980	80110130	GOVT WELL NO 1	Unknown
23061881	80110320	BR2B	03/02/2011 - unknown
23061882	80110321	BR3B	03/02/2011 - unknown
23061883	80110322	BR4B	03/02/2011 - unknown
23061884	80110323	BR5B	03/02/2011 - unknown
8005	80119002	OBS 5	30/06/1960 - unknown
11891709	80119876	GOODJARA BEAGLE BAY	01/09/1984 - 30/ 4/1997
11891664	80119863	Broome Town Water Res- R25716 McGuigan	unknown
23005133	003092	-	unknown

#### Groundwater

According to Laws (1991), both sites are underlain by the Broome Sandstone Sedimentary Aquifer, which consists of sand, sandstone, gravel, conglomerate, minor clay, and siltstone. This major aquifer has high yields of up to 2000 m<sup>3</sup>/day. Furthermore, Site 2 lies within a small portion of a well field area from which the town supplies its water.

Laws (1991) also indicates that groundwater is flowing in a south-westerly direction at both Sites, towards the Indian Ocean.

## 3.5 Biological characteristics

#### 3.5.1 Regional biogeography

The Sites are situated in the Northern Botanical Province (Beard 1990), within the Dampierland bioregion and Pindanland sub-region as described by the Interim Biogeographic Regionalisation of Australia.

The Pindanland sub-region is located in the western part of the Dampierland bioregion and is the coastal, north-western margin of the Canning Basin. The sub-region comprises the sandplains of the Dampier Peninsula and the western part of Dampier land including the hinterland of Eighty Mile Beach. The sub-region supports vegetation primarily described as Pindan (Graham 2001).

Graham (2001) describes four basic components to the Pindanland sub-region:

- Quaternary sandplain overlying Jurassic and Mesozoic sandstones with Pindan, hummock grasslands on hills
- Quaternary marine deposits on coastal plains, with mangal, samphire *Sporobolus* spp. grasslands, *Melaleuca alsophila* low forests, and Spinifex spp. *Crotalaria* spp. strand communities
- Quaternary alluvia plains associated with the Permian and Mesozoic sediments of Fitzroy Trough support tree savannahs of ribbon grass (*Chrysopogon* spp.) – bluegrass (*Dichanthium* spp.) grasses with scattered coolibah (*Eucalyptus microtheca*) – Bauhinia cunninghamii
- Riparian forests of river red gum (*Eucalyptus camaldulensis*) and Cadjeput (*Melaleuca* spp.) fringe drainages

#### 3.5.2 Land systems

The Kimberley region has been surveyed by the Department of Agriculture and Food, Western Australia (DAFWA) and others for the purposes of land classification, mapping and resource evaluation. One hundred and eleven land systems have been described for the region, which are distinguished on the basis of topography, geology, soils and vegetation (Payne and Schoknecht 2011). The Sites intersect two land systems; details of these land systems are presented in Table 13.

Land system	Description	Geology	Geomorphology
Wanganut	Low-lying sandplain and dunefields with through-going drainage, pindan	Quaternary aeolian soils	Sandplain and dunefields with through-going drainage: sandplain, mainly in the upper parts, with stable dunefields, low lying sandplain, and scattered pans and depressions; sparse to moderately dense branching drainage pattern; relief up to 9 m.
Yeeda	Sandplain, deep red and yellow sands, pindan and tall woodlands	Quaternary aeolian sands	Sandplain and dunefields with little organised drainage; sandplain up to 16 km in extent, with shallow valleys, plains with thin sand cover, and scattered pans; limited surface drainage in zones of sheet-flow up to 3.2 km wide and extending up to 8 km downslope from adjacent uplands.

#### Table 13 Land systems mapped within the Sites

#### 3.5.3 Vegetation and flora

#### Broad vegetation mapping

Broad scale (1:1,000,000) pre-European vegetation mapping of the area was completed by Beard (1977) at an association level. The mapping indicates there is one vegetation association present within the Sites:

• Shrublands, pindan; *Acacia tumida* shrubland with grey box [*Eucalyptus tectifica*] and cabbage gum [*Corymbia flavescens*] medium woodland over ribbon grass [*Chrysopogon* spp.] and curly spinifex (association 750)

The vegetation of the Dampier Peninsula has also been described by Kenneally *et al.* (1996) who recognised 11 (ten terrestrial and one marine) plant communities on or around the Dampier Peninsula. Kenneally *et al.* (1996) noted that 'overwhelming vegetation is pindan, a grassland wooded by scattered trees, generally eucalypts, with a variably dense middle layer of wattles'. Kenneally *et al.* (1996) described the Pindan in the southern half of the peninsula comprising scattered trees, predominantly bloodwoods such as *Corymbia polycarpa, C. zygophylla, C. greeniana* and *Eucalyptus tectifica*, over a wide range of other tree species, understorey shrubs and wattles. Common pindan grass species include *Triodia schinzii, Chrysopogon pallidus* (ribbon grass) and *Sorghum stipoideum* (annual sorghum) and whilst vine species are not common include *Tinospora smilacina* (snake vine) and *Marsdenia viridiflora*. Fire is the controlling agent of the Pindan with the variety in the vegetation, particularly wattles, relating directly to a fire-regeneration cycle (Kenneally *et al.* 1996).

#### Broad vegetation extents

The pre-European mapping has been adapted and digitised by Shepherd *et al.* (2002). The extent of the vegetation associations have been determined by the state-wide vegetation

remaining extent calculations maintained by the DPaW (Government of Western Australia (GoWA) 2015). As shown in Table 14, the current extent remaining of the vegetation association is greater than 99 per cent of the pre-European extent at all scales (e.g. State, IBRA bioregion, IBRA sub-region and LGA). The current extents remaining of the vegetation association at all scales are above the 30 per cent threshold level<sup>1</sup>

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
Dampierland IBRA bioregion		8,343,938.97	8,319,872.22	99.71	1.43
Pindanland IBRA sub-region		4,921,102.73	4,904,095.93	99.65	1.24
750	State: Western Australia	1,231,155.50	1,225,687.52	99.56	2.33
	IBRA bioregion: Dampierland	1,229,182.16	1,225,280.52	99.68	2.33
	IBRA sub-region: Pindanland	1,221,734.45	1,217,843.72	99.68	2.34
	LGA: Shire of Broome	1,115,559.36	1,110,131.18	99.51	2.57

#### Table 14 Vegetation associations mapped within the Sites

#### Conservation significant ecological communities

A search of the EPBC Act PMST database identified the potential presence of one Commonwealth listed TEC, Monsoon vine thickets on the coastal sand dunes of the Dampier Peninsula, within 20 km of the Sites (Table 15 and Appendix D).

A search of the DPaW TEC and PEC databases identified the potential presence of one TEC and five PECs within 20 km of the Sites (Table 15 and Figure 6, Appendix A).

It should be noted DPaW provides locations for TECs and PECs that have a buffer placed typically between 500 m and 5,000 m radius around the community. As such, the TEC/PEC may not be present within the entire extent of the buffer area.

#### Flora diversity

The flora of the Dampierland bioregion is diverse, with 1,542 recorded native species (WA Herbarium 1998–). It is difficult to determine the level of endemism present within this bioregion as collectively Kimberley flora is considered poorly known and collected (Waples 2007).

A search of the *Naturemap* database identified 698 flora taxa representing 101 families and 337 genera previously recorded within 20 km of the Sites. This total comprised 591 native taxa and 107 naturalised (introduced) flora taxa. Dominant families recorded included Fabaceae (109 species), Poaceae (87 species) and Malvaceae (44 species) (Appendix D).

#### **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 21 conservation significant flora taxa within 20 km of the Sites (Appendix D). The desktop searches recorded:

<sup>&</sup>lt;sup>1</sup> The 30% threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (EPA 2000).

- Two taxa listed as Threatened under the EPBC Act and/or as Declared Rare Flora under the WC Act
- Five Priority 1 taxa
- One Priority 2 taxon
- 13 Priority 3 taxa

The locations of conservation significant flora registered on the DPaW databases are provided in Figure 6, Appendix A.

#### 3.5.4 Fauna

#### Fauna diversity

A search of the *NatureMap* database identified 412 vertebrate native fauna taxa previously recorded within 20 km of the Sites. This total included 270 birds, 99 reptiles, 33 mammals and 10 amphibians. This search also included a large number of marine species due to the search (20 km buffer) incorporating marine environments (Appendix D).

#### Conservation significant fauna

Desktop searches of the EPBC Act PMST and *NatureMap* databases identified the presence/ potential presence of 34 conservation significant fauna species within 20 km of the Sites; this included 24 birds, seven mammals and three reptiles (Appendix D).

In addition to the 34 conservation significant species identified by the above mentioned database searches, a review of species listed under Schedules 1-4 of the WC Act that occur within the DPaW Kimberley Region (DPaW 2015b) was undertaken. This review concluded that no additional species may potentially occur in the Sites.

Species identified by the PMST as marine, migratory marine or migratory wetland were excluded from this assessment as no marine or wetland habitat was present within or nearby to the Sites. Species identified by the PMST as migratory terrestrial were considered as part of this assessment.

## Table 15 Conservation significant ecological communities recorded within 20 km of the Sites

Community ID and name	EPBC Act	WC Act/ DPaW	Description (DPaW 2015a)	Location in relation to the Sites
Mangarr (Minyjuru) Relict dune system dominated by extensive stands of Minyjuru Mangarr ( <i>Sersalisia sericea</i> ) PEC		Priority 1	Contains frequent mature (100 years+) <i>Sersalisia sericea</i> or otherwise known as Minyjuru. Minyjuru is a culturally important and renowned local bushtucker species and does not occur in such frequency and longevity in other locations. The community is recorded as a <i>Eucalyptus, Sersalisia</i> low woodland unit that occurs on parallel dunes in the area south-east of Gantheaume Point. The community also contains numerous woodland species such as: <i>Erythrophleum chlorostachys, Corymbia zygophylla, Hakea</i> <i>macrocarpa</i> and <i>Corynotheca micrantha</i> . Some species are more reminiscent of desert and aridlands country including: <i>Solanum cunninghamii, Scaevola parvifolia, Goodenia</i> <i>sepalosa, Senna costata, Gyrostemon tepperi</i> and <i>Triodia</i> sp. The extensive stands of Minyjuru occur in association with species more often found within the nearby TEC – Monsoon vine thicket.	Intersects Site 1 and the north-west corner of Site 2. A further 16 occurrences of the PEC within 20 km of the Sites.
Roebuck Bay mudflats Species-rich faunal community of the intertidal mudflats of Roebuck Bay TEC		V	Roebuck Bay was designated a "Wetland of International Importance" under the Ramsar Convention in June 1990. The Bay is a tropical marine embayment with extensive, biologically diverse, intertidal mudflats. Roebuck Bay supports internationally significant numbers of migratory shorebirds as well as bats, marine and benthic fauna. The Bay also supports various vegetation communities including seagrass beds, mangroves, samphire flats, saline grasslands and Pindan (Bennelongia 2009).	Intersects the southern part of Site 2.
Vegetation Association 73 Kimberley Vegetation Association 73 PEC		Priority 3	Vegetation Association 73 as defined by John Beard's vegetation mapping for the Kimberley (Beard 1979). Grasslands, short bunch grass savanna, grass; salt water grassland ( <i>Sporobolus virginicus</i> ). Threats: extensive threatening processes acting at landscape scales, namely altered fire regimes, overgrazing, and weed invasion	Approximately 2.7 km west of the Sites. A further 3 occurrences of the PEC within 20 km of the Sites.
Dwarf pindan heath community of Broome coast PEC		Priority 1	Occurs between the racecourse and Gantheame Point lighthouse. Insufficient survey outside of Broome townsite area to determine full extent. Threats: clearing, trampling, weed invasion, inappropriate fire regimes	Approximately 13.5 km south-west of the Sites. An additional occurrence of the PEC within 20 km of the Sites.
Vine thickets Monsoon vine thickets on the coastal sand dunes of the Dampier Peninsula TEC	E	V	The Vine thickets ecological community is predominantly restricted to the coastlines of the Dampier Peninsula from Broome in the south to One Arm Point in the north and on the north eastern coast of the Peninsula from One Arm Point to Goodenough Bay. The ecological community represents the most southern occurrences of rainforest type vegetation in Western Australia. The Dampier Monsoon Vine Thickets occurs as discontinuous patches of dense vegetation and contains deciduous, semi-deciduous and evergreen perennial flora species.	Approximately 6 km south-west of the Sites. A further 4 occurrences of the TEC within 20 km of the Sites.

Community ID and name	EPBC Act	WC Act/ DPaW	Description (DPaW 2015a)	Location in relation to the Sites
<i>Corymbia paractia</i> dominated community on dunes PEC		Priority 1	<i>Corymbia paractia</i> behind dunes, Broome township area, Dampier Peninsula. Transition zone where coastal dunes (with vine thickets) merge with Pindan (desert) vegetation. Also, port north of Broome. Threats: clearing, trampling, weed invasion, inappropriate fire regimes	Approximately 4.6 km south-west of the Sites. A further 61 occurrences of the PEC within 20 km of the Sites.
Nimalaica Claypan Community		Priority 4	Nimalaica claypan is a unique, almost permanent, freshwater lake inland from Willie Creek, Broome. Threats: groundwater extraction, causeway construction, feral animals, expansion of township	One occurrence approximately 7.5 km north of the Sites.

## 4. Site inspection

## 4.1 Site description

A site walkover was undertaken by GHD Ecologists on 18-24<sup>th</sup> March 2016. Photographs taken during the site walkover are presented in Appendix E.

The Sites are surrounded by scattered vegetation, consisting predominantly of undisturbed Pindan grassland. The vegetation within and surrounding the Sites is described in detail in Section 6.1. Surficial soil on the Sites consisted of yellow and red gravel and sandy loam.

Fly tipping was observed beyond the western boundary of Site 2, as shown in Figure 7, Appendix A (old materials area). The fly tipping was observed to comprise: numerous household goods, two old vehicles. Potential ACM fragments were observed in this area (Photos A and B, Appendix E).

An area of land of approximately 2 ha showed evidence of disturbance (previous clearing) with subsequent regrowth within Site 2. This area is located near the eastern boundary within the centre of Site 2 (outlined as VC6 in Figure 8, Appendix A). Fragments of spent shotgun cartridges, as well as evidence of fly tipping of potential ACM and household rubbish was observed at several locations within this immediate area, as shown in Photos C to F in Appendix E. The potential ACM observed consisted of several large and flat sheets (~0.5 x 1 m) stacked atop one another, and appeared to be part of wall/floor tiling material. Remnant stockpiles of aggregate which are indicative of road construction material (herein referred to as "old spoil storage") (Photo G, Appendix E) were also identified in this area although no visual or olfactory indications of contamination were observed with the stockpile constituents. The location of observed instances of fly tipping within the Sites is summarised in Table 16 and mapped in Figure 7, Appendix A. The vegetation in this area is less dense and appears to be more easily accessed for fly tipping. A signed Telstra telecoms underground service was observed to span then entire north-south length near the eastern boundary of Site 2 (Photo H, Appendix E). It is noted that ducts within old telecom service pits may contains ACM, however this is unlikely in this case due to the relatively new and good condition of the observed signage. No other evidence of fly tipping was observed within either of the Sites.

An old and rusted metal barbed wire fence line in poor condition was observed within Site 1 (Photo I, Appendix E), spanning along a skewed path adjacent the proposed southern and eastern site boundary, as shown in Figure 7, Appendix A.

A signed Telstra telecoms underground service was observed to span the entire north-south length along the centre-line of Site 2 (Photo H, Appendix E). It is noted that ducts within old telecom service pits may contain ACM, however this is unlikely in this case due to the relatively new and good condition of the observed signage.

Item	Zone	Easting	Northing	Photo
Dumped asbestos	51	422924.7318	8023917.802	С
Shotgun cartridges	51	422913.099	8023886.521	D
Shotgun cartridges	51	422954.477	8023827.851	-
Old spoil storage	51	422969.4204	8023904.338	G
Dumped rubbish	51	422984.9878	8023897.022	E
Dumped rubbish	51	423003.3274	8023857.999	F

#### Table 16 Location of observed contamination within Site 2

## 4.2 Surrounding land use

The two sites are surrounded by the following land uses:

- North:
  - Scattered vegetation exists north of Site 1
  - Site 2 is bound to the north by McGuigan Road, with scattered vegetation beyond
- East:
  - Scattered vegetation exists to the east of Site 1, with Cape Leveque Road several hundred meters away
  - Site 2 is bound to the east by Cape Leveque Road, with scattered vegetation beyond
- South:
  - Site 1 is bound to the south by McGuigan Road, with scattered vegetation beyond
  - The south of Site 2 is occupied by slightly more dense vegetation, followed by an area of cleared vegetation. Broome Road is approximately 800 m south of Site 2
- West:
  - Scattered vegetation exists west of Site 1 and Site 2

Other nearby land uses include a material source area approximately 300 m south of Site 2, as well as semi-rural residential dwellings and small businesses located approximately 2.5 km south-west of Site 2. The closest sensitive receptor, Roebuck Primary School located approximately 7.3 km south west of Site 2. It is anticipated there are no noise, light, dust or odour impacts from the surrounding land use.

# 5. Conceptual site model

A Conceptual Site Model is based on information available to date (as presented in this report), that identifies potential primary sources of contamination, pathways and receptors.

## 5.1 Potential contaminants of concern

Based on desktop information typical contaminants of concern would likely consist of potential asbestos from fly tipping.

## 5.2 Preferential pathways

Preferential pathways for contamination migration at the Sites may include:

• Disturbance and generation of airborne fibres during high wind events or other surface disturbance (e.g. disturbance)

## 5.3 Exposure routes

The means by which identified populations may be exposed to potential contamination at the Sites comprise:

Inhalation of free fibres during high wind events or other surface disturbance (e.g. earthworks)

## 5.4 Sensitive receptors

Based on a review of surrounding land uses and activities at the Sites, potentially sensitive environmental and anthropogenic receptors that may be affected by potential or actual soil and/or ground or surface water contamination at the site include the following:

- Site users (the Site is open to public access)
- Construction and maintenance workers at the Site

## 5.5 Potential pollutant linkages

The potential for source, pathway and receptor linkages are presented in Table 17.

#### Table 17 Conceptual site model summary

Potential contamination source	Contaminants of Potential Concern	Pathways	Receptors	Qualitative Risk Rating
Fly tipping of house hold waste, including large, flat panel fragments of surficial potential asbestos containing materials in sound condition, noted within area near eastern boundary of Site 2 (VC6 in Figure 8, Appendix A).	Asbestos	1, 2	Humans onsite (current and future): workers, site occupants, visitors Humans offsite: future surrounding residents and visitors	Isolated occurrence of flat panel fragments of potential ACM (~ 0.5 x 1 m) was noted within area near eastern boundary of Site 2 (VC6 in Figure 8, Appendix A). Likelihood: Low Consequence: Moderate Risk Rating: Low

## 6. Flora and fauna field results

## 6.1 Vegetation and flora

#### 6.1.1 Vegetation associations

The vegetation of the Sites was largely uniform with one vegetation association identified and described. This vegetation association is described as Pindan grassland and generally comprised isolated trees of *Corymbia* over a mixed shrubland and *Sorghum* and *Triodia* dominated grassland on red loamy sands on flat plains. The Pindan grassland vegetation association is detailed below and mapped in Figure 8, Appendix A.

#### Pindan grassland (Plate 1)

Corymbia flavescens, C. zygophylla isolated trees over Acacia eriopoda, Ficus aculeata var. indecora, Bauhinia cunninghamii tall open shrubland over Bauhinia cunninghamii, A. eriopoda, Ehretia saligna mid- sparse shrubland with Sorghum sp., Triodia schinzii tall tussock grasses over Sida sp. and Gyrostemon tepperi low isolated shrubs with Eriachne obtusa mid- sparse tussock grassland over Murdannia graminea, Glycine tomentella and Galactia tenuiflora isolated herbs and vines.

This vegetation association is represented by quadrats Q01 to Q11 (Appendix F).

This vegetation association is well represented in areas adjacent to the Sites and is consistent with Beard (1977) and descriptions of Pindan reported by Kenneally *et al.* (1996). It is likely to be well represented in the broader area.



## Plate 1 Pindan grassland

Localised variation in the vegetation structure and species composition was observed throughout the Sites. The southern part of Site 2 contained a greater density of *Corymbia* individuals compared with the rest of the Sites. This variation can largely be attributed to fire, with a number of burnt (killed) and/or burnt, reshooting *Corymbia* trees observed throughout the Sites. Fire is considered a controlling process of Pindan vegetation (Kenneally *et al.* 1996). Time since last fire was estimated to be greater than 5 years for the Sites.

#### 6.1.2 Conservation significant vegetation

The vegetation association identified within the Sites during the field does not align with any known Commonwealth or State listed TECs or PECs.

The desktop assessment identified the Mangarr (Minyjuru) PEC buffer occurring within Site 1. This PEC is recorded as a *Eucalyptus*, *Sersalisia* low woodland vegetation unit and often occurs in association with species found within the nearby Monsoon vine thicket TEC. Whilst the Sites contained a number of woodland and aridland species reported to occur in the PEC, the vegetation within Site 1 (and Site 2) did not contain mature Minyjuru (*Sersalisia sericea*) nor was considered to represent *Eucalyptus* woodland. Therefore the vegetation within the Sites is not considered representative of the Mangarr (Minyjuru) PEC.

The Roebuck Bay mudflats TEC buffer intersects the southern part of Site 2. This TEC is aligned with Roebuck Bay, which is a tropical marine embayment with extensive, biologically diverse, intertidal mudflats. The landform of and vegetation contained within the Sites is not representative of the Roebuck Bay TEC.

#### 6.1.3 Other significant vegetation

No other significant vegetation as defined by the EPA (2004a) or vegetation that grows in, or in association with watercourses or wetlands was identified within the Sites during the field survey.

## 6.1.4 Vegetation condition

The vegetation condition within the Sites was rated from condition 2 to 7. The majority of vegetation throughout the Sites was rated as condition 2; in these areas the vegetation structure was intact, with disturbances limited to occasional tracks. One area within Site 2 was rated condition 6; this area had been historically cleared, contained old spoil piles from road maintenance and was largely overrun with \**Cenchrus biflorus* (Gallon's Curse). A number of culverts associated with the Cape Leveque Road intersect the eastern boundary of Site 2; these were rated as condition 7.

The extents of the vegetation condition ratings mapped within the Sites are detailed in Table 18 with vegetation condition mapped in Figure 9, Appendix A.

Condition rating	Site	Extent (ha)
2	1	29.56
	2	127.59
6	2	0.30
7	2	0.19

#### Table 18 Extent of vegetation condition ratings mapped within the Sites

#### 6.1.5 Flora diversity

108 taxa (including subspecies and varieties) representing 41 families and 90 genera were recorded from the Sites during the field survey. This comprised 105 native taxa and three introduced taxa. A flora taxa list for the Sites is provided in Appendix F.

Dominant families recorded from the Sites included:

- Fabaceae (25 taxa)
- Poaceae (12 taxa)
- Malvaceae (10 taxa)

The flora diversity recorded during the March 2016 survey was similar to that recorded in previous surveys in the broader area (e.g. 133 native flora taxa recorded from 297 ha along the Cape Leveque Road (GHD 2012); 217 flora taxa recorded from the James Price Point area (AECOM 2011)).

The Sites are considered to have a moderate level of floristic diversity. Based on described quadrats, species diversity ranged from 22 to 35 taxa per 2,500 m<sup>2</sup>.

## 6.1.6 Conservation significant flora

Three DPaW Priority-listed flora taxa were recorded within the Sites, with an additional taxon recorded adjacent to Site 2 during the field survey. Details on these taxa are provided below with locations mapped in Figure 8, Appendix A.

#### Jacquemontia sp. Broome (A.A. Mitchell 3028) (Priority 1)

*Jacquemontia* sp. Broome (Plate 2) is a creeping/scrambling herb to approximately 0.4 m high. The species is characterised by narrowly linear leaves with a mucronulate apex, and light pink to mauve flowers. *Jacquemontia* sp. Broome is reported to grow in Pindan soils and is currently restricted to the Dampierland IBRA region, specifically the Broome LGA.

Jacquemontia sp. Broome was recorded scattered throughout Site 2 during the field survey. Due to the extent of individuals observed, density calculations were undertaken at quadrat locations and extrapolated across the site (Table 19). It is estimated approximately 9,940 individuals of *J.* sp. Broome occur within Site 2, with the greatest density of individuals occurring in the southern part of the Site. Low to moderate numbers of the taxon were recorded in the central part of the Site with low or no individuals recorded in the northern part of the Site. Where present, the taxon often occurred in clumps.

Current records obtained from *NatureMap* indicate that *J*. sp. Broome is known from three records from the Dampier Peninsula. The frequency of *J*. sp. Broome individuals has been noted on one collection as sparse (WA Herbarium 1998–).

#### Table 19 Estimated counts of Jacquemontia sp. Broome (A.A. Mitchell 3028)

Taxon	Relevant area within Site 2	Average density (No. individuals per ha)	Estimated count (density x area)
Jacquemontia sp. Broome (A.A. Mitchell 3028)	127.5 ha	78	9,942



Plate 2 Jacquemontia sp. Broome (A.A. Mitchell 3028)

#### Pterocaulon ?intermedium (Priority 3)

*Pterocaulon intermedium* is a perennial shrub to approximately 0.6 m high. The species is characterised by stems with narrow wings, and pink/violet flowers with long peduncles. *Pterocaulon intermedium* grows in loamy sand or sands (often Pindan soils) on plains or near coastal locations in swales or on dunes, and is currently known from Central Kimberley, Dampierland, Northern Kimberley and Pilbara IBRA regions.

Six individuals of *Pterocaulon* were recorded from the central and northern parts of Site 2 during the field survey. All individuals occurred as small shrubs and were sterile at the time of survey.

A representative collection was submitted to the WA Herbarium and based on vegetative characters only, was tentatively identified as *P. ?intermedium* (M. Hislop, pers. comm.).

Current records obtained from *NatureMap* indicate that *P. intermedium* is known from 27 records in Western Australia, with the taxon occurring throughout the Pilbara and Kimberley Regions. The frequency of *P. intermedium* individuals at these locations has been recorded (where noted) as sparse and common, with several collections noting 2-5 or 6-20 plants present (WA Herbarium 1998–).

#### Terminalia kumpaja (Priority 3)

*Terminalia kumpaja* is a shrub or small spreading tree to 6 m high that is characterised by deeply fissured bark and small narrow leaves. The taxon has small white to cream flowers and is reported to flower from June to November. *Terminalia kumpaja* grows on red-brown sand dunes or sand flats, and occasionally on clay, in open pindan woodland (Barrett 2015), and is known from the Dampierland and Great Sandy Desert IBRA regions.

One individual of *T. kumpaja* was recorded from the southern part of Site 2 during the field survey. The individual occurred as small tree with old fruit present.

Current records obtained from *NatureMap* indicate that *T. kumpaja* is known from 17 records in Western Australia, with the taxon occurring in the vicinity of Wallal Downs and Mandora Station, and around Broome, north to Coconut Well. The frequency of *T. kumpaja* individuals at these locations has been recorded (where noted) as common, occasional, very sparse and infrequent, with one collection noting 2-5 plants present (WA Herbarium 1998–).

#### Glycine pindanica (Priority 3)

*Glycine pindanica* (Pindan Glycine) is a prostrate or scrambling perennial, herb or climber that is characterised by linear to narrow-lanceolate, 3-foliate leaves and rust-coloured hirsute stems (Kenneally et al. 1996). The taxon has pink, blue or purple flowers and is reported to flower from February to March or June. *Glycine pindanica* grows in reddish brown sand in mixed pindan woodland and is only known from the Dampier Peninsular.

One individual of *G. pindanica* was recorded on the southern side of McGuigan Road, adjacent to, but outside of Site 2. *Glycine pindanica* is a disturbance response taxon and has been previously recorded growing in large continuous clumps along the Cape Leveque Road (on the road verge and in culverts) north of the James Price Point turnoff (GHD 2012).

Current records obtained from *NatureMap* indicate that *G. pindanica* is known from 32 records, including various sites around Broome, along the Cape Leveque Road and further north along the Dampier Peninsula. The frequency of *G. pindanica* individuals at these locations has been recorded as sparse, occasional and common, with two collections noting 2-5 plants present (WA Herbarium 1998–). It is likely that *G. pindanica* is more common than *NatureMap* records indicate, especially in areas of recent or increased disturbance. Additionally, increased disturbance in areas where this taxon is already present is likely to increase its frequency and extent.

#### Likelihood of occurrence assessment

A likelihood of occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix F). 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 three taxa (*Pterocaulon intermedium, Jacquemontia* sp. Broome (A.A. Mitchell 3028) and *Terminalia kumpaja*) are known to occur within the Sites and one taxon (*Glycine pindanica*) is known to

occur adjacent to the Sites 2. Furthermore, the assessment concluded that one taxon may possibly occur and 16 taxa are unlikely to occur within the Sites. The single taxon that may possibly occur (*Aphyllodium glossocarpum*) has been recorded within 20 km of the Sites and suitable habitat occurs. Although the Sites were sufficiently traversed during the field survey, this species can be cryptic.

## 6.1.7 Other significant flora

Two taxa considered 'significant flora' as define by the EPA (2004a) were recorded within Site 2 during the field survey. One taxon was identified as *Glycine* aff. *pindanica* and likely represents a naturally occurring hybrid between *G. pindanica* (P3) and *G. tomentella*. The other taxon was identified as *Sehima nervosum* and represents a range extension; this collection is the most south western record of the species.

#### 6.1.8 Introduced flora

Three introduced flora taxa were recorded within the Sites during the field survey including *\*Stylosanthes scabra, \*Cenchrus biflorus* (Gallon's Curse) and *\*Eleusine indica* (Crowsfoot Grass). All of the taxa are considered environmental weeds and have been previously recorded in the Dampierland IBRA region.

## 6.2 Fauna

## 6.2.1 Fauna habitat

One broad fauna habitat type, Pindan grasslands was identified within both Sites during the field surveys. This habitat is broadly represented in the local and regional areas. The fauna habitat type aligns with the vegetation association described above and mapped in Figure 8, Appendix A. A description of the fauna habitat type is provided in Table 20.

Micro-habitats throughout the Sites include termite mounds, leaf litter, tree hollows and hollow logs (on the ground). These habitats provide micro-habitat features that conservation significant fauna may utilise for refuges, foraging and breeding. In particular, there are some areas throughout the Sites with moderately deep leaf litter which provides particularly good habitat for reptiles. There are no permanent waterbodies located within the Sites, however evidence of seasonal pooling in low areas of the environment particularly along the western boundary of Site 2 was recorded.

#### Table 20 Habitat type in the Sites

#### Description

#### Pindan Grasslands

The Pindan grasslands habitat type consists of scattered *Corymbia* trees over mixed shrubs and grasses. The southern part of Site 2 contains a greater density of *Corymbia* trees compared with the remainder of the Site. In this area, some mature *Corymbia* trees had hollows present. The southern part of Site 2 contains also contains a greater density of termite mounds. The termite mounds provide micro habitat for numerous fauna species including reptiles and small mammals.

Ground cover over much of the Sites was >50%, however some small open areas are present particularly where termitaria are present (termites harvesting the grasses in the immediate area).



Representation photograph

#### Description

Ground cover consists of mixed grasses and low shrubs. Built up litter and dead grasses are present forming clumps around shrubs and *Corymbia* species. Some logs and debris with the occasional hollow log are present on the ground.

The predominant soil type within the Sites is loamy sand, however heavy loams occurred where termite mounds were present. The habitat in the Sites provides resources for conservation significant fauna including:

- Greater Bilby
- Rainbow Bee-eater
- Grey Falcon (Opportunistic use only)
- Peregrine Falcon (Opportunistic use only)

#### Representation photograph



#### Habitat connectivity

The fauna habitat within the Sites is part of a large continuous tract of habitat that extends along the Dampier Peninsula (extending north and east of the Sites). There is also high connectivity to habitats directly south and west of the Sites, however, beyond this lies the town site of Broome to the south and the Indian Ocean to the west.

#### Disturbance

Localised variation in habitat was evident throughout the Sites and this is likely attributable to fire. The fire age of the Sites is estimated to be greater than 5 years. It is likely the southern part of Site 2 is long unburnt compared to the remainder of the Sites based on the increased presence of mature *Corymbia* trees.

In the central-eastern part of Site 2 there was an area approximately (2-3 ha) that has been historically modified and disturbed. This area has been partially cleared and contained old spoil piles from road maintenance; rubbish and weeds were also present in this area.

#### Habitat quality

The fauna habitat is largely in excellent condition with the overall habitat value considered to be moderate. Whilst fauna diversity was limited, particularly to birds and mammals, this is likely due to the drier than normal conditions experienced at the time of survey and lack of creeks or water bodies in the Sites.

The southern part of Site 2 contained a higher density of mature *Corymbia* trees and termite mounds. Both habitat features provide valuable areas such as hollows, nooks and crevices for small mammals and reptiles. The trapping data is reflective of this with large numbers of geckos and numerous moon snakes recorded around termite mounds.

#### 6.2.2 Fauna assemblages

The dual-phase vertebrate fauna survey recorded 108 vertebrate fauna species, including 54 birds, 41 reptiles, one amphibian and 12 mammals. The results the surveys are summarized in Table 21, with more detailed results provided in Appendix G.

Survey	Birds	Reptiles (native/introduced)	Mammals (native/introduced)	Amphibia	Total
Phase 1	35	10	4 (3/1)	0	49
Phase 2	47	38 (37/1)	12 (9/3)	1	98

#### Mammals

The surveys recorded 12 mammal species within the Sites, including three introduced and nine native mammals. The composition of native species includes four bats, two native rodents, one macropod, Dingo and Echidna. The most specious family was the Freetail bats (two species) and native rodents (two species). Forty six individual mammals (excluding bats) were recorded over the trapping program between eight species, with the most abundant being the Agile Wallaby. Nineteen Agile Wallaby's were recorded (41% of total mammal recordings). No other mammal was abundant in the Sites.

Bats were only recorded via echolocation, therefore only presence or absence information could be collected. Of the bats identified, one is listed as DPaW Priority fauna, the Little North-western Mastiff Bat (Priority 1). A breakdown of native mammal families recorded during the surveys is provided in Table 22.

Table 22	Mammal 1	families	recorded	during	the	field	surveys
----------	----------	----------	----------	--------	-----	-------	---------

Mammal Family	No. of species
Bovidae (Cow)	1
Canidae (Dingo)	1
Equidae (Horse)	1
Emballonuridae (Sheathtail Bats)	1
Molossidae (Freetail Bats)	2
Muridae (Native Rodents)	2
Macropodidae (Wallaby)	1
Tachyglossidae	1
Vespertilionidae (Bats)	2
Total	12

#### **Birds**

The bird surveys identified 54 bird species from 31 families. The most specious families were the Accipitridae (6 species), Artamidae (4 species), Meliphagidae (3 species), Columbidae (3 species), Cacatuidae (3 Species) and Psittacidae (3 species). The most abundant species were the Red-collared Lorikeet with 26 records (8.5% of total bird recordings) and Red-backed Fairy-wren with 23 records (7.5% of total bird recordings). A breakdown of bird families recorded during the survey is provided in Table 23.

#### Table 23 Bird families recorded during the field surveys

Bird Family	No. of species
Accanthizidae (Weebill/Gerygone)	2
Accipitridae (Diurnal birds of prey)	6
Artamidae (Magpie group)	4
Cacatuidae (Cockatoo group)	3
Campephagidae (Cuckoo-shrikes)	2
Columbidae (Doves)	3
Coraciidae (Dollarbird)	1

Bird Family	No. of species
Corvidae (Crow)	1
Cuculidae (Cuckoos)	1
Estrildidae (Finchs)	2
Falconidae (Falcons)	2
Halcyonidae (Kingfishers)	2
Maluridae (Wrens)	2
Megaluridae (Songlarks)	1
Meliphagidae (Honeyeaters)	3
Meropidae (Bee eater)	1
Monarchidae (Lark)	2
Nectariniidae (Mistletoebird)	1
Neosittidae (Sittella)	1
Otitidae (Bustard)	1
Pachycephalidae (Whistlers)	1
Pardalotidae (Pardalote)	1
Petroicidae (Robin)	1
Podargidae (Frogmouth)	1
Pomatostomidae (Babblers)	1
Psittacidae (Parrots)	3
Ptilonorhynchidae (Bowerbird)	1
Rhipiduridae (Fantail)	1
Strigidae (Owls)	1
Threskiornithidae (Ibis)	1
Turnicidae (Quail)	1
Total	54

## **Reptiles**

A total of 41 reptile species were recorded during the field surveys from 9 families. The most specious families were the Scincidae (13 species), and Gekkonidae (6 species). Four hundred and seven reptiles were recorded within the Sites over the trapping program. The most abundant species were *Heteronotia binoei* with 98 records (24% of total reptile recordings), *Gehyra pilbara* with 88 records (22% of total reptile recordings) and *Ctentotus inornatus* with 48 records (12% of total reptile recordings). A breakdown of reptile families recorded during the survey is provided in Table 24.

## Table 24 Reptile families recorded during the field surveys

Reptile Family	No. of species
Agamidae (Dragons)	4
Boidae (Pythons)	2
Diplodactylidae (Geckos)	3
Elapidae (Snakes)	5
Gekkonidae (Geckos)	6
Pygopodidae (Legless Lizards)	2
Scincidae (Skinks)	13
Typhlopidae (Blindsnakes)	2
Varanidae (Monitors)	4
Total	41

#### Amphibians

One amphibian species was recorded in the Sites during the surveys, the Green Tree Frog (*Litoria caerulea*). This species was observed in Site 2.

#### Accumulation curve

The number and type of species trapped each day was recorded and a species accumulation curve generated for the Sites. The species accumulation curve represents the successfulness of the trapping program for its duration. Typically, the longer the trapping program the more compete the representation of species sampled per site or habitat type. Accumulation curves should show "levelling" of the species group counts prior to the completion of the survey. There are many limitations that can influence the results of an accumulation curve, and the curve should be viewed as a guide only. One curve was generated for the project as only one habitat type was recorded within the Sites; the curve is presented in Plate 3. The accumulation curve showed levelling of each species group towards the end of the survey, demonstrating that of the species active at the time of survey, the majority were sampled.



#### Plate 3 Fauna accumulation curve for the Sites

#### 6.2.3 Conservation significant fauna

Two conservation significant fauna species were recorded within the Sites during the field surveys. These include:

- Rainbow Bee-eater (*Merops ornatus*) listed under Schedule 5 (International Agreement) under the WC Act and as Migratory terrestrial under the EPBC Act.
- Little North-western Mastiff Bat (Ozimops cobourgianus) listed as Priority 1 under DPaW Priority Species List.

In addition to the field survey results, an assessment on the likelihood of conservation significant species occurring in the Sites was undertaken. This assessment is based on species biology, habitat requirements, the quality and availability of suitable habitat as determined during the field survey and records of the species in the Sites and locality. Species specific searches of the DPaW *NatureMap* database with a buffer of 20 km were also conducted in order to gather information about the broader regional occurrence of species to further inform the likelihood of occurrence assessment. For example, the Greater Bilby (*Macrotis lagotis*) (listed under

Schedule 3 (Vulnerable) under the WC Act and as Vulnerable under the EPBC Act) was recorded approximately 580 m from Site 1. Although not recorded at Site 1 or 2, these areas fall within the known activity range of the species and have been included in this assessment.

In total, including those recorded at the Sites six species are known or likely to occur. Table 26 summarises the species of conservation significance that are either known, or considered likely, to occur in the Sites. A brief description of these species and their associated habitat types within the Sites are described below Table 26. The parameters of assessment for this likelihood of occurrence assessment and the full likelihood of occurrence assessment are provided in Appendix G.

Species	EPBC Act	WC Act/ DPaW	Assessment outcome	
Birds				
Rainbow Bee-eater ( <i>Merops ornatus</i> )	Mi	S5	Known – The Rainbow Bee-eater was recorded in the Sites. In this region the species may be resident or migratory. Breeding and foraging habitat is present for this species in the Sites.	
Grey Falcon ( <i>Falco hypoleucos</i> )		Vu	Likely – The species has been observed in the region and foraging habitat is available for this species. This species is likely to opportunistically use the sites for foraging only. No known breed events have been recorded in the area. This species is typically rare and may visit the area irregularly.	
Peregrine Falcon ( <i>Falco peregrinus</i> )		S7 (SP)	Likely – The species has been observed a lot in the region and foraging habitat is available for this species. However this species is widespread, not typically abundant and may visit the area irregularly.	
Mammals				
Greater Bilby ( <i>Microtis lagotis</i> )	Vu	S3, Vu	Likely – The species in known from the region and active burrows were recorded 580 m from Site 1. Habitat is available for the species in the Sites and would be considered part of the overall area used by the species.	
Little North-western Mastiff Bat (Ozimops cobourgianus)		P1	Known – The Little North-western Mastiff Bat calls were recorded in the Sites. This species is known to primarily breed in mangrove communities. It is likely the species utilises the Sites for foraging purposes only.	
Reptiles				
Dampierland Burrowing Snake ( <i>Simoselaps</i> <i>minimus</i> )		P2	Likely – The species has previously been recorded in the region and is a likely resident in the area. However the species is not considered common throughout their range, with few animals likely present. Most records are from coastal dunes where this species appears most common.	

# Table 25Summary of likelihood of occurrence for conservation significantfauna

Key - (SP) = Special Protection under WC Act.

#### Fauna species recorded in the Sites

#### Rainbow Bee-eater (Merops ornatus)

The Rainbow Bee-eater (*Merops ornatus*) occurs in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It also inhabits sand dune systems in coastal areas and at inland sites that are in close proximity to water (Morcombe 2004).

The Rainbow Bee-eater was recorded on several occasions across in the Sites. It is also likely the species would breed in the Sites where opportunity presents. The Rainbow Bee-eater is a common and wide spread species in most parts of Australia and has been recorded regularly within 20 km of the Sites (DPaW 2007–). The locations where the Rainbow Bee-eater was recorded is shown on Figure 10, Appendix A.

#### Little North-western Mastiff Bat (Ozimops cobourgianus)

The Little North-western Mastiff Bat is known from 12 locations in Western Australia (DPaW 2007–) and four in the Northern Territory, and within this distribution it is restricted to a few localised habitats, and can appear to be locally common because it aggregates. In Western Australia, this species inhabits mangrove stands, and has been recorded roosting in hollows and or crevices in mangroves (van Dyck et al. 2013). There are records of the Little North-western Mastiff Bat from mangroves near Cape Leveque and on the Dampier Peninsula.

The Little North-western Mastiff Bat is listed as Priority 1 by the DPaW, and was recorded during the Phase 2 survey of the Sites. Echolocation calls were recorded for this species at the eastern side of the Sites. Given the lack of mangrove within the Sites, it is likely this species forages in the area and roosts in the mangroves of Roebuck Bay.

#### Fauna species considered likely to occur within the Sites

#### Greater Bilby (Macrotis lagotis)

The Greater Bilby (Macrotis lagotis) distribution in Western Australia is restricted to the north, including the Pilbara, Dampier Peninsular, southern Kimberley, Sandy and Gibson Deserts. The Greater Bilby usually spends the daytime in burrows, which are in the open or sometimes 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 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 habitats 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).

The Greater Bilby was not recorded in the Sites, however the species is known from the area and is considered likely to occur opportunistically in the Sites. The Pindan habitat is suitable habitat for the Bilby, however the current grass cover across the Sites (on average approximately 50-60%) would restrict the current use by Bilby. Several areas of scratchings

were recorded in the shrublands consistent with Bilby activity, however these could not be verified with additional information such as burrows, scats or prints.

A known active burrow system is approximately 4.8 km from the Cape Leveque Road and Broome Road intersection, which is 1.1 km to the closest point of Site 1. A walk back from the burrows towards the Sites identifying Bilby evidence decreased this distance to 580 meters to Site 1 and approximately 1 km from Site 2. This data is presented in Figure 10, Appendix A. No confirmed Bilby evidence was recorded in any of the plots assessed during surveys despite some minor scratching evidence. A copy of the plot data is present in Appendix G.

#### Grey Falcon (Falco hypoleucos)

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 Northern Pilbara\Southern Kimberley WA, the grey falcon is very rare. The distribution of the Grey Falcon is typically centred on inland drainage systems, where it frequents timbered lowland plains, particularly acacia shrublands cross by tree-lined watercourses to forage. It also hunts in treeless areas and frequents tussock grassland and open woodland, especially in winter, but it generally avoids deserts.

Grey Falcons are known from the region all be it in low numbers. The last recorded in dividual was in 2002. The habitat type in the Sites provide suitable foraging habitat for this species.

#### Peregrine Falcon (Falco peregrinus)

The Peregrine Falcon is uncommon but wide-ranging across Australia. Habitat is extremely diverse, from rainforest to arid scrub, from coastal heath to alpine. The Peregrine Falcon nests primarily on ledges of cliffs, shallow tree hollows, and ledges of building in cities (Morcombe 2004).

The Peregrine Falcon is likely to occur in the Sites and has been recorded within 20 km of the Sites as recently as 2014 (DPaW 2007–) and was recorded in Broome the week prior to this survey (pers. comm. Glen Gaikhorst 2016). The Sites consists of potentially suitable foraging habitat, but lack suitable breeding habitat for the species.

#### Dampierland Burrowing Snake (Simoselaps minimus)

Dampierland Burrowing Snake is known from sandy areas of south-western Kimberley coast, on the Dampierlands Peninsular (Wilson and Swan 2010). Dampierland Burrowing Snake is known from the Broome area primarily from the coastal dunes and adjoining environment. One specimen has previously been recorded in the vicinity of the Sites and the species is likely present on both sites.

#### 6.2.4 Introduced fauna

Three introduced mammal species and one introduced reptile species were recorded in the Sites during the field surveys. These species include the Cat, Cow, Horse and Asian House Gecko. All four specie are known from the area/region with the Cow and Horse likely from the closest active station. However discussion with local resident suggested that some cows and horses were feral in the area.

The Asian House Gecko was recorded only during the Phase 2 surveys of the Sites and in low numbers. Typically this species is more common around town site and developed areas. It is likely that the odd specimen is present in the Sites but no significant population was recorded.

# 7. Project constraints and referrals

This section provides advice on the environmental constraints identified within the Sites during the preliminary site investigation and biological assessment, and potential environmental approvals and referrals that may be required. As the Project is in concept design, it is assumed there will be opportunities to avoid and minimise the impacts on these constraints through design. If the constraints can be avoided or impacts to these minimised, it may negate the need for environmental approvals or referral to Commonwealth/State environmental agencies.

## 7.1 Key constraints

The key constraints identified for the Site during the environmental investigations are summarised below in Table 26.

## Table 26 Key constraints identified within the Sites

Constraint	Site 1	Site 2
Land use and physical characteristics	No constraints identified.	Fly tipping of house hold waste, including large, flat panel fragments of surficial potential asbestos containing materials present.
Vegetation and flora	29.56 ha of native vegetation is present.	<ul> <li>127.89 ha of native vegetation is present.</li> <li>Approximately 9,940 individuals of <i>Jacquemontia</i> sp. Broome (P1) are present.</li> <li>Approximately six individuals of <i>Pterocaulon ?intermedium</i> (P3) are present.</li> <li>One individual of <i>Terminalia Kumpaja</i> (P3) is present.</li> </ul>
Fauna	<ul> <li>Potential breeding and foraging habitat for three species:</li> <li>Rainbow Bee-eater (<i>Merops ornatus</i>) –Migratory Terrestrial species (EPBC Act)</li> <li>Little North-western Mastiff Bat (<i>Ozimops cobourgianus</i>) – Priority 1 (DPaW)</li> <li>Greater Bilby (<i>Macrotis lagotis</i>) – Vulnerable (EPBC Act and WC Act)</li> <li>Potential foraging habitat for three species:</li> <li>Grey Falcon (<i>Falco hypoleucos</i>) – Vulnerable (WC Act)</li> <li>Peregrine Falcon (<i>Falco peregrinus</i>) – Schedule 7 (WC Act)</li> <li>Dampierland Burrowing Snake (<i>Simoselaps minimus</i>) – Priority 2 (DPaW)</li> </ul>	<ul> <li>Potential breeding and foraging habitat for three species:</li> <li>Rainbow Bee-eater (<i>Merops ornatus</i>) –Migratory Terrestrial species (EPBC Act)</li> <li>Little North-western Mastiff Bat (<i>Ozimops cobourgianus</i>) – Priority 1 (DPaW)</li> <li>Greater Bilby (<i>Macrotis lagotis</i>) – Vulnerable (EPBC Act and WC Act)</li> <li>Potential foraging habitat for three species:</li> <li>Grey Falcon (<i>Falco hypoleucos</i>) – Vulnerable (WC Act)</li> <li>Peregrine Falcon (<i>Falco peregrinus</i>) – Schedule 7 (WC Act)</li> <li>Dampierland Burrowing Snake (<i>Simoselaps minimus</i>) – Priority 2 (DPaW)</li> </ul>

## 7.2 Environmental approvals and referrals

## 7.2.1 Commonwealth approvals

Referral to DotE under the EPBC Act is triggered if a proposed action has or potentially has a significant impact on any MNES. Table 27 provides an assessment of the Sites against key biological MNES. The outcome of the assessment was that referral is recommended for the Project as there may be a risk (albeit probably low) of a significant impact to an important population of the Greater Bilby.

#### 7.2.2 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 environmental 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 maybe 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 the Project would require referral to the EPA under Section 38 of the EP Act.

## Department of Environment Regulation

Any clearing of native vegetation is regulated by the DER and requires a clearing permit under Part V of the EP Act, except when a project is assessed under Schedule 6 of the Act or is prescribed by regulation in the Environmental Protection (Clearing Native Vegetation) Regulations 2004 and not in an ESA.

When preparing a native vegetation clearing application an assessment of the impact areas against the "Ten Clearing Principles" should be undertaken to determine whether the Project is likely to be at variance to the Principles. The Ten Clearing Principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

If the EPA does not assess the Project, a clearing permit will be required for the Project.

Matter of National Environmental Significance	Present	Need for referral to DotE under the EPBC Act
Listed Threatened Species and Ecological Communities	No threatened flora species or communities were present or deemed likely to occur within the Sites. The assessment identified the likely presence of one EPBC listed threatened fauna species within the Sites based on known records nearby the Sites and the presence of potential habitat: Greater Bilby ( <i>Macrotis lagotis</i> ) – Vulnerable (EPBC Act and WC Act)	Referral is recommended No confirmed signs of Bilby use were identified on either Site during the surveys, however the Bilby was recorded (via active burrows, digs and scats) approximately 580 m north of Site 1, and have been previously recorded approximately 1 km south of Site 2. Both Sites fall into the known population range of the species. The Greater Bilby is considered highly nomadic and there is suitable habitat present within the Sites. Furthermore, there are nearby recent records of the species within 1 km of the Sites. Therefore GHD recommends referral may be required to DotE given there may be a risk (albeit probably low) of a significant impact to an important population of the species.
Migratory Species	The assessment identified the presence of one EPBC listed Migratory fauna species within the Sites based on the survey and the presence of potential habitat: Rainbow Bee-eater ( <i>Merops</i> <i>ornatus</i> ) –Migratory Terrestrial species (EPBC Act)	Unlikely The Rainbow Bee-eater is widespread throughout Australia and occurs in a wide range of habitat types. The Rainbow Bee-eater is reasonably common bird and there is abundant potentially suitable breeding and foraging habitat nearby. It is most likely that this species would utilise the Sites for foraging and during dispersal, opportunistic breeding may also occur within the Sites. The Rainbow Bee-eater is unlikely to rely on the habitats present within the Sites and any clearing of habitat for the Project is unlikely to significantly impact on individuals or a population of this species.

## Table 27 Assessment of key biological Matters of National Environmental Significance for the Sites

## 8. Conclusions and recommendations

## 8.1 Key findings

#### 8.1.1 Desktop assessment and preliminary site inspection

The Shire of Broome Town Planning Scheme No. 6 indicates that the Sites are zoned as 'Public Purpose: Water Supply', with Site 1 also zoned as a 'Development investigation area'. The historical aerial photography available for the Sites covers a relatively recent and limited time period, however no evidence of prior development within either Site was identified from aerial photography.

The historical aerial photography available for the Sites covers a relatively recent and limited time period, however no evidence of prior development within either Site was identified from aerial photography.

From site inspection, several localised observations of illegal dumping of household waste were observed within Site 2. Of the observed waste, potential ACM was identified as a potential contamination source. The observed ACM was identified as part of tile flooring material. As shown in the Conceptual Site model, the dumped household waste, including potential ACM, is considered to represent a low risk to human health and capable of mitigation by relatively simple management measures.

With respect to ASS, the Sites are classified as an area of 'Extremely low probability/Very low confidence'. No visual indications of ASS (such as any low lying area with indications of surface water ponding or vegetation distress) were observed in site inspection and the site does not display features indicative of a wet/riparian area based on observations made during the Site inspection and a review of the Site topography. Based on review of site conditions, the development area at the Site is not considered to be conducive to the presence of ASS that is likely to require management for the proposed development.

Information sources reviewed in this assessment did not identify other potential contamination sources at the Site or other environmental factors posing a risk to the proposed development and future landowners.

#### 8.1.2 Vegetation and flora

The Sites comprised one vegetation association, which was not considered representative of any Commonwealth or State-listed TECs or PECs, other significant vegetation as defined by the EPA (2004a) nor considered to be growing in association with watercourses or wetlands. The vegetation condition within the Sites was rated from condition 2 to 7. The majority of vegetation throughout the Sites was rated as condition 2. Areas rated as conditions 6 and 7 aligned with historically disturbed or cleared areas.

No EPBC Act or WC Act listed flora taxa were recorded within the Sites, however, three DPaW Priority listed flora taxa, *Jacquemontia* sp. Broome (A.A. Mitchell 3028) (Priority 1), *Pterocaulon ?intermedium* (Priority 3) and *Terminalia kumpaja* (Priority 3) were recorded. An additional Priority listed taxon, *Glycine pindanica* (Priority 3) was recorded adjacent to Site 2. A likelihood of occurrence assessment conducted post-field survey concluded one taxon may possibly occur and the remaining 16 taxa are unlikely to occur within the Sites. The single taxon that may possibly occur (*Aphyllodium glossocarpum*) has been recorded within 20 km of the Sites and suitable habitat occurs. Although the Sites were sufficiently traversed during the field survey, this species can be cryptic. Two taxa considered 'significant flora' as define by the EPA (2004a) were recorded within Site 2 during the field survey. One taxon was identified as *Glycine* aff.

*pindanica* and likely represents a naturally occurring hybrid between *G. pindanica* (P3) and *G. tomentella.* The other taxon was identified as *Sehima nervosum* (Whitegrass) and represents a range extension.

#### 8.1.3 Fauna

One fauna habitat type was recorded in the Sites during the field survey. This habitat is considered to be broadly represented in the local and regional area. The Sites represents a large continuous tract of fauna habitat that retains high connectivity to adjacent lands. Disturbance throughout the Sites includes localised variation in habitat structure likely attributable to fire and partial clearing in a single area of Site 2.

Within the habitat type two habitat features are significant to fauna these are termitaria and large Eucalypts. Both these features are more prevalent in the southern most section of Site 2 and should be retained where possible. The southern portion of Site 2 is also where the most Rainbow Bee-eater (*Merops ornatus*) were recorded and Little North-western Mastiff Bat (*Mormopterus loriae cobourgiana*) calls identified. However both species would likely utilise the entire Sites for foraging.

Additionally the local area and region is known to support Greater Bilby (*Macrotis lagotis*). The habitat within the Sites is Greater Bilby habitat and an active Bilby colony was identified only 580 m from Site 1. Both Site 1 and 2 are within the known foraging range of a Bilby and therefore could potentially utilise the Sites at any time. No evidence of use was identified during the field surveys.

There are six fauna species of conservation significance that are known or considered likely to occur in or adjacent to the Sites:

- Rainbow Bee-eater (known)
- Little North-western Mastiff Bat (known)
- Greater Bilby (known)
- Grey Falcon (likely)
- Peregrine Falcon (likely)
- Dampierlands burrowing Snake (likely)

## 8.2 Recommendations

#### 8.2.1 Potential location to be utilised

One area within Site 2 presents as "more suitable" for development to the rest of the Sites. This area is located adjacent to the Cape Leveque Road and includes the identified disturbed area in the central portion of Site 2. Although this location is associated with fly tipping of house hold waste, including large, flat panel fragments of surficial potential asbestos containing materials, it is likely to have less biological constraints. It should be noted this location is still considered Bilby habitat and would still require referral, however it attempts to distance the Project from the known Bilby activity recorded approximately 580 m north of Site 1, while attempting to limit impacts to *Jacquemontia* sp. Broome (Priority 1) and termite mounds (which provide micro habitat for numerous fauna species including reptiles and small mammals) which were recorded in higher densities in the southern portion of Site 2.

## 9. References

Australian Soil Resource Information System (ASRIS) 2016, *Australian Soil Resource Information Viewer*, retrieved April 2016, from <u>http://www.asris.csiro.au/index\_ie.html</u>.

Beard, JS 1977, Vegetation Survey of Western Australia: Kimberley, 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.

Bennelongia 2009, *Ecological Character Description for Roebuck Bay*, Report to the Department of Environment and Conservation, Bennelongia Pty Ltd, Jolimont.

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

Churchill, S 2008, Australian Bats, Second edition, Allen and Unwin, New South Wales.

Department of Environment and Conservation (DEC) 2009a, Standard Operating Procedure SOP No. 9.1, Elliott traps for live capture of terrestrial vertebrates, Perth, Department of Environment and Conservation.

Department of Environment and Conservation (DEC) 2009b, Standard Operating Procedure SOP No. 9.3 Dry pitfall trapping for vertebrates and invertebrates, Perth, Department of Environment and Conservation.

Department of Environment and Conservation (DEC) 2009c, Standard Operating Procedure SOP No. 9.2 Cage traps for live capture of terrestrial vertebrates, Perth, Department of Environment and Conservation.

Department of Environment and Conservation (DEC) 2009d, Standard Operating Procedure SOP No. 9.6, Hand capture of wildlife, Perth, Department of Environment and Conservation.

Department of Environment and Conservation (DEC) 2009e, Standard Operating Procedure SOP No. 10.1, Animal handling/restraint using soft containment, Perth, Department of Environment and Conservation.

Department of Environment and Conservation (DEC) 2009f, Standard Operating Procedure SOP No. 10.2, Hand restraint of wildlife, Perth, Department of Environment and Conservation.

Department of Environment and Conservation (DEC) 2009g Standard Operating Procedure SOP No. 14.2, First Aid for animals, Perth, Department of Environment and Conservation.

Department of Environment Regulation (DER) 2016a, *Contaminated Sites Database*, retrieved March 2016, from <u>https://secure.dec.wa.gov.au/idelve/css/</u>.

Department of Environment Regulation (DER) 2016b, *Clearing Permit System*, retrieved March 2016, from <u>https://cps.der.wa.gov.au/main.html</u>

Department of Health (2009) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Site in Western Australia.

Department of Parks and Wildlife (DPaW) 2007–, *NatureMap: Mapping Western Australia's Biodiversity*, retrieved March 2016, from <u>http://naturemap.dpaw.wa.gov.au/default.aspx/</u>.

Department of Parks and Wildlife (DPaW) 2015a, *Priority ecological communities for Western Australia*, Version 23, Species and Communities Branch, Department of Parks and Wildlife, 3 December 2015.

Department of Parks and Wildlife (DPaW) 2015b, *Threatened and Priority Fauna Rankings*, retrieved April 2016, from <u>https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals?view=categories&id=109</u>.

Department of the Environment (DotE) 2016a, *Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool Results*, retrieved March 2016, from <u>http://www.environment.gov.au/epbc/pmst/index.html.</u>

Department of the Environment (DotE) 2016b, *Environment Protection and Biodiversity Act* 1999 List of Threatened Flora, retrieved April 2016 from <u>http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora</u>.

Department of Water (DoW) (2016), *Geographic Data Atlas*, retrieved March 2016 from, <u>http://atlases.water.wa.gov.au/idelve/dowdataext/</u>.

Environmental Protection Authority (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.

Environmental Protection Authority (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.

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.

Environmental Protection Authority (EPA) 2010, *Technical Guide – Terrestrial Vertebrate fauna Surveys for Environmental Impact*, Perth, Environmental Protection Authority and the Department of Environment and Conservation.

Environmental Protection Authority and Department of Parks and Wildlife 2015, *Technical Guide* – *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (eds. K Freeman, G Stack, S Thomas and N Woolfrey), Perth, Western Australia.

Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003, Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0, Canberra, Department of the Environment and Heritage.

Geological Survey of Western Australia (GSWA) 1982, *Broome Sheet SE 51-6*, Australia 1:250000 Geological Series.

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

Graham, G 2001, *Dampierland (DL2 – Pindanland subregion)*, A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002, Department of Conservation and Land Management.

Kenneally, KF, Edinger, DC and Willing, T 1996, *Broome and Beyond: Plants and People of the Dampier Peninsula, Kimberley, Western Australia*, WA Naturally Publications.

Laws, AT 1991, Explanatory notes on the Broome 1:250,000 hydrogeological sheet, Perth, WA.

Menkhorst, P and Knight, F 2004, *Field Guide to Mammals of Australia*, 2nd Edition, Victoria Australia, Oxford University Press.

Menkhorst, P and Knight, F 2010, *Field Guide to Mammals of Australia*, 3rd Edition, Victoria Australia, Oxford University Press.

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

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

Payne, A and Schoknecht, N 2011, *Land Systems of the Kimberley Region*, Western Australia, Technical Bulletin No. 98, Perth, DAFWA.

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

Storr, GM, Smith, LA and Johnstone, RE 1999, *Lizards of Western Australia*, Volume 1: Skinks (Revised Edition), Perth, Western Australia, Western Australian Museum.

Storr, GM, Smith, LA and Johnstone, RE, 2002, *Snakes of Western Australia*, Western Australian Museum, Perth, WA.

Trudgen, ME 1998, *A report on the Flora and Vegetation of the Port Kennedy Area*, unpublished report prepared for Bowman Bishaw and Associates, West Perth.

Tyler, M.J. and Doughty, P 2009, *Field Guide to Frogs of Western Australia*, Fourth Edition, Government of Western Australia and Western Australian Museum.

van Dyke, S and Strahan, R 2008, *The Mammals of Australia*, Third Edition, New Holland Publishing, Sydney Australia.

van Dyck, S, Gynther, I and Baker, A 2013, *Field Companion to the Mammals of Australia*, First edition, New Holland Publishing, Sydney Australia

Western Australia (WA) Herbarium 1998–, *FloraBase–the Western Australian Flora*, Department of Parks and Wildlife, retrieved April 2016, from <u>http://florabase.dpaw.wa.gov.au/</u>.

Wilson, S and Swan, G 2013, *A Complete Guide to Reptiles of Australia*, 4th Edition New Holland Press Sydney Australia.