

## Browse Bilby Review

CONSOLIDATED INFORMATION RELATING TO THE  
OCCURRENCE OF THE BILBY (MACROTIS  
LAGOTIS) IN THE VICINITY OF THE BROWSE LNG  
PRECINCT AND MORE BROADLY ON THE  
DAMPIER PENINSULA

- Rev 2
- 19 January 2012



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## Limitation Statement

The sole purpose of this report and the associated services performed by Sinclair Knight Merz (“SKM”) as part of the Consolidated Environmental Services (“CES”) contract was to undertake a review and prepare a consolidated report of existing relevant environmental studies for determining the likely status of the Bilby (*Macrotis lagotis*) within and surrounding the Browse Liquefied Natural Gas (BLNG) Downstream Development in an area identified in conjunction with the client in accordance with the scope of services set out in the contract between CES and the Client, Woodside Energy Limited (Woodside). That scope of services, as described in this report, was developed with the Client. This review is to provide information in relation to the likelihood of presence of Bilby in the area of the Downstream Development, the likely preferred habitats and to provide a status and summary of the current knowledge in relation to the species in the study area.

In preparing this report, the CES has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, the CES has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Data in this report have been derived from a number of sources, including surveys undertaken by other consultants for the Client, SKM for the Client, other relevant studies undertaken by third parties for other clients and datasets compiled from other sources (such as records from the Department of Environment and Conservation). The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. CES has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by CES for use of any part of this report in any other context.

This report has been generated based on information provided to CES by the Client and from other publicly available literature. Components of this report were developed with the acknowledged assistance of Environmental Resources Management (ERM).

This report has been prepared on behalf of, and for the exclusive use of, CES’s Client, and is subject to, and issued in accordance with, the provisions of the agreement between the CES and its Client. The CES accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

## Executive Summary

Woodside Energy Limited (Woodside) is the operator of the Browse Liquefied Natural Gas (BLNG) Development on behalf of the Browse Joint Venture. The BLNG Development will recover natural gas and condensate resources from the Browse Basin gas fields (Torosa, Brecknock and Calliance) that are located offshore, approximately 450 km north-north-west of Broome, in the Kimberley region of Western Australia. Subject to government approvals, onshore site investigations and other technical studies, Woodside (as a foundation proponent with Joint Venture partners) proposes to develop the fields through an onshore gas processing facility (the Downstream Development) within a State Government approved gas processing LNG Precinct near James Price Point, 60 km north of Broome on the Dampier Peninsula. The proposed BLNG Precinct is designed to be a multiple-user Kimberley gas hub and has been defined in a Strategic Assessment Report (SAR) released by the Department of State Development (DSD) in 2010. Woodside is the foundation proponent at the Precinct.

In November 2011, Woodside engaged Sinclair Knight Merz (SKM) to prepare a report to assess the current knowledge of distribution, abundance, and regional significance of Bilby, a conservation listed species, in relation to the Browse LNG Downstream Development. The scope of this report includes a literature review, compilation of data, presentation of combined survey effort/results and an assessment of the potential status of the species in relation to the Browse LNG Downstream Development and Precinct.

In preparing this report, specialist input for examining Bilby evidence has been sought and provided for by several respected experts in their fields including:

- Dr Ric How - Senior Curator of Terrestrial Zoology at the Western Australian Museum and a member of the Downstream Environment Expert Panel (DEEP) formed by Woodside;
- Dr Richard Southgate – widely regarded expert in the field of Bilby research and is Director of Envisage Environmental Services. He has published extensive literature in relation to the species; and
- Mr Tim Willing – highly respected in the Kimberley region, with expertise in natural sciences developed over 30 years of work in this field.

### Bilby Description and Status

The Bilby (*Macrotis lagotis*) is a small to medium marsupial mammal species that has historically become restricted in the southern part of its range between the 1800s and 1935, and has apparently had a steady decline since that time. Since around 1980, the Bilby has

experienced significant decline attributed primarily to predation by introduced foxes and feral cats, unsuitable fire regimes and habitat degradation and competition from introduced herbivores such as cattle and rabbits. The species range has decreased by around 70% from what is believed to have been the distribution on mainland Australia prior to European settlement. The species has now vanished from much of the southern part of the range and exists in desert areas and sub-tropical latitudes.

In terms of legislative protection and conservation status, the Bilby is listed as Vulnerable at a National level and Threatened in Western Australia.

Recovery plans have been implemented by conservation agencies with the aim of securing the survival of the species. The species tends to naturally occur at low densities based on current knowledge and can be difficult to capture or to observe. The cryptic nature of the species requires the use of specific assessment methods to effectively and confidently identify evidence of presence or absence of the species and to determine potential abundance and areas of occupancy. Few historical records of Bilby and relatively few published biological studies exist for the Dampier Peninsula region.

Recent evidence indicates that Bilby may be present in the vicinity of the BLNG Downstream Development and Precinct. The purpose of this report is to determine the likely status of Bilby in relation to the BLNG Downstream Development and Precinct with reference to the body of existing evidence and to describe the potential significance of this in a regional context.

An assessment has been made of the available information for the Bilby from existing studies and other evidence to determine the likely significance of local records and whether further regional assessment is considered necessary.

## **Report Findings**

There are 40 historical records of Bilby from the Dampier Peninsula and to the immediate south dating from 1965 to 2001, held in the Threatened Species Database that is managed by the Western Australia Department of Environment and Conservation (DEC). No Bilby records exist prior 1965 or since 2001 for the DEC database. The two nearest localities for DEC Bilby records are from the 1970s in the area of Coulomb Point (approximately 14 km north of the proposed BLNG Downstream Development).

Terrestrial vertebrate fauna field assessment surveys have been conducted between 2008 and 2011. A summary of the survey effort (as detailed in Section 3) conducted for the proposed BLNG Downstream Development and Precinct areas includes, but is not limited to:

- 8 separate survey programs over four years;
- 480 person days;
- 528 hours of motion sensitive camera trapping (diurnal and nocturnal);
- 1957 person hours of daylight searching; and
- 457.5 kilometres of foot traverse transect searching.

Despite the significant amount of survey effort from repeated assessments conducted over extensive areas between 2008 and 2011 (including a 2011 targeted assessment for Bilby in the Quondong Point area and a 2011 targeted assessment for Bilby for a BLNG Precinct Access Road conducted for Main Roads Western Australia), relatively limited evidence of Bilby presence has been identified within the vicinity of the BLNG Downstream Development and Precinct area. The majority of the existing evidence in relation to potential Bilby presence in the broader area became available in the dry season of 2011 and is in the form of burrows and diggings.

Bilby evidence was classified based on likelihood or certainty into one of three categories: 'Likely', 'Possible' and 'Unlikely'.

Thirteen records of Bilby evidence (burrows and diggings) classified as Likely were identified from these assessments and other opportunistic assessments in 2011 based on reviewed advice from Dr Richard Southgate. Only one of the Likely records was considered to be recent or a 'fresh' sign from an active burrow. The Likely records are located outside of the proposed main BLNG Downstream Development but just within a broader buffer zone. The majority of these records occur along the North East Access Track (NEAT) and south of the main Downstream Development and Precinct area on the eastern side of Manari Road. The Possible and Unlikely records have been further detailed in the report.

A separate survey was conducted in August 2011 by members of the Goolarabooloo and Broome No Gas Community in the vicinity of the BLNG Downstream Development and Precinct. A report was prepared by Mr M. Lindsay in October 2011 and has been provided to Woodside.

The Lindsay report provides map and image evidence for up to six Bilbies (plus possibly one or more others), including three young individuals near the North East Access Track (NEAT) outside of the BLNG Downstream Development and Precinct area (but just within a broader buffer zone). Other records are presented on a map of old and recent evidence of burrows south



of the area. Limited comparative value can be taken from the Lindsay report as it does not provide specific details about the methods employed, the survey team, complete results, raw data or coordinates of records and thus is difficult to independently verify.

## Discussion and Conclusion

The current evidence from eight targeted fauna survey programs over four years in the vicinity of the BLNG Downstream Development and Precinct indicates that few Bilbies are present in the surrounding area and these are unlikely to represent a significant isolated colony or population. Therefore, the expected status of Bilby in the area is that Bilbies appear to be present in very low numbers and probably occupy large ranges in response to food resources becoming exhausted in one area and being available elsewhere.

Bilbies can be highly mobile with large individual ranges utilised for seeking favourable habitats that fluctuate seasonally and in relation to fire. While limited regional information is available, it is expected that the Bilby species is probably present widely on the Dampier Peninsula at relatively low numbers.

The majority of the area for the proposed BLNG Downstream Development and Precinct comprises pindan habitat. The majority of the Bilby evidence presented in this report is from pindan vegetation habitat and seems to be preferred by the species. Pindan habitat occurs extensively across the Dampier Peninsula and of which the proposed BLNG development area is surrounded and constitutes only a small part. Therefore, the proposed BLNG Downstream Development and Precinct area is considered not likely to represent significant or restricted habitat for Bilby in this broader context.

Assessment for Bilby is likely to remain difficult in the Dampier Peninsula region when compared to other studies for the species undertaken in desert areas with vegetation cover dominated by low open spinifex (*Triodia* spp.). Pindan shrublands, woodlands and open forest habitats in the vicinity of the BLNG Downstream Development and Precinct plus the wider Dampier Peninsula are structurally taller and have denser vegetation cover than spinifex dominated vegetation. Aerial surveys supported by foot-based ground-truthing are likely to be considerably less effective for assessing Bilby in pindan habitat due to risks of not reliably identifying clear signs such as potential burrow locations (translating to creation of evidence such as higher rates of false-negative results).

It is recommended that an appropriate regional management plan is developed and implemented to mitigate against threatening processes to the Bilby, such as predation by foxes and cats, habitat degradation due to introduced herbivores and altered fire regimes. This is likely to offer the best approach for effective use of resources for improving conservation outcomes for the

species on the Dampier Peninsula. A strategy following this approach may align well as an expansion to existing conservation measures being applied for recovery of Bilbies. A regional management plan and recovery strategy for Bilbies may be used as a basis for guiding local management measures for the BLNG Downstream Development and Precinct.

# 1. Introduction

## 1.1. Background

Woodside Energy Limited (Woodside) is the operator of the Browse Liquefied Natural Gas (BLNG) Development on behalf of the Browse Joint Venture. The BLNG Development will recover natural gas and condensate resources from the Browse Basin gas fields (Torosa, Brecknock and Calliance) that are located offshore, approximately 450 km north-north-west of Broome, in the Kimberley region of Western Australia. Subject to government approvals, onshore site investigations and other technical studies, Woodside (as a foundation proponent with Joint Venture partners) proposes to develop the fields through an onshore gas processing facility (the Downstream Development) within a State Government approved gas processing LNG Precinct near James Price Point, 60 km north of Broome on the Dampier Peninsula. The proposed BLNG Precinct is designed to be a multiple-user Kimberley gas hub and has been defined in a Strategic Assessment Report (SAR) released for public comment by the Department of State Development (DSD) in December 2010. Woodside is the foundation proponent at the Precinct.

The draft Strategic Assessment Report (SAR) for the BLNG Precinct included reference to factors such as conservation significance of species (Department of State Development 2010). Specific flora and fauna assessments were undertaken to inform the SAR. Additional environmental assessments have occurred since the SAR was released (December 2010) in relation to the proposed BLNG Downstream Development and Precinct to inform the approvals process and to meet existing commitments presented within the SAR.

In November 2011, Woodside engaged Sinclair Knight Merz (SKM) to prepare a report to assess the current knowledge of distribution, abundance and regional significance of the Bilby (*Macrotis lagotis*), a conservation listed species, in relation to the Browse LNG Downstream Development.

## 1.2. Purpose and Scope of Report

The purpose of this report is to provide the findings of a consolidated review of relevant studies in relation to Bilby and to present information that can assist in understanding the likelihood of presence, distribution and abundance for the species in relation to the BLNG Downstream Development.

The report consists of a literature review, compilation of other relevant information, maps of existing data, description of existing survey methods, summary of findings and a discussion. A detailed literature review is presented to provide background information on the biology, ecology and threats to the Bilby. This includes reference to relevant Referrals under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), regarding potential impacts to the Bilby from other proposed developments. The findings of the report are discussed and conclusions are provided along with a recommendation for what is likely to be the best approach for achieving appropriate management of Bilbies at a local and regional level.

### 1.3. Historical and Recent Bilby Studies and Investigations

Extensive wet and dry season environmental assessments have been undertaken by a number of consultants between 2008 and 2011 for the BLNG Precinct and Downstream Development. These assessments include areas between Coloumb Point, James Price Point and Quondong Point, and inland of this region. Several other regional assessments have been conducted.

Level 2 and targeted vertebrate fauna surveys (as defined by the Environmental Protection Authority) have been undertaken to establish baseline data and to identify the presence and status of fauna species. Other environmental assessments including pre-clearance surveys have also been conducted in the BLNG Downstream Development and Precinct area between August 2010 and November 2011, which have included searches for evidence of conservation listed species such as the Bilby.

The vertebrate fauna surveys included targeted searches for the Bilby that have employed recognised and standard surveying techniques, in addition to extensive transect searches. Despite the significant amount of survey effort from repeated assessments conducted over extensive areas between 2008 and 2011 only limited evidence of Bilby has been recorded within the vicinity of the BLNG Downstream Development, Precinct and surrounding areas. This survey effort also includes a targeted assessment for the Bilby in the Quondong Point area (ENV 2012, in prep.) and for an BLNG Precinct Access Road survey (AECOM 2011) for Main Roads Western Australia (MRWA) south east of the development. The majority of the existing evidence in relation to potential Bilby presence in the broader area became available recently in the dry season (April to November) of 2011.

Bilbies create diggings and burrows, as do a number of other fauna species that may occur in the Downstream Development area. This has resulted in a relatively large number of potential burrows, diggings and tracks that were observed and/or recorded across different surveys in 2011. Images of the potential evidence were independently examined by Dr Ric How and Dr Richard Southgate as a part of developing this report and for previous studies. These images from 2011 surveys were classified as either Likely, Possible or Unlikely to have been produced by Bilby.

Evidence that appeared to be from relatively recent activity (e.g. ‘active’ burrows) and which was consistent with signs for Bilby was classified as Likely. Evidence with the potential to be from Bilby, but without a high level of certainty, was classified as Possible. Some of the potential evidence appeared to be associated with other species, or provided insufficient signs to permit a reliable assessment of the probable source species for burrows or tracks (due to decayed condition/not recent). In these instances, the evidence was therefore classified as Unlikely.

The classification of image evidence is consistent between this report and other source reports produced for Woodside in 2011. Classification of potential Bilby image evidence varies for several images provided in the AECOM (2011) BLNG Precinct Access Road survey report for MRWA. The classification of evidence likelihood in relation to Bilbies for earlier reports in which no images were provided to permit independent review, was based on the assessment level

provided in those reports, which generally translated to Possible. The general comments in relation to Bilby from previous assessment reports have also been summarised and included in a survey effort table in Section 3 of this report.

#### **1.4. Report Structure**

The remainder of this report is structured as follows:

- Section 2 presents a literature review including: Bilby description, ecology, distribution, previous records, fauna survey methods, legislation, conservation status and previous EPBC Act referrals that relate to the Bilby;
- Section 3 describes and summaries the survey effort and findings from currently available studies;
- Section 4 provides a discussion of the context of all existing evidence and likelihood of Bilby in the Downstream Development area.
- Section 5 presents a conclusion and provides a recommendation in relation to managing impacts to the Bilby at a regional and local scale.
- Section 6 outlines the reference cited within the report.
- Appendices: Tables of relevant EPBC Act referrals, existing potential photo evidence and coordinates relating to Bilbies.

## 2. Literature Review

### 2.1. Conservation and Protection Status

An overview has been provided of the designated conservation and protection status of the Bilby within Australia and Internationally (Table 2-1 below). In Western Australia, the Bilby is listed as Rare [Threatened] (rare or likely to become extinct) under the *Wildlife Conservation (Specially Protected Fauna) Notice 2010 (2)*. The Bilby is also protected under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) where it is listed as Vulnerable (not critically endangered or endangered; and facing a high risk of extinction in the wild in the medium-term future).

Given the historic decline and substantial contraction in distribution of the species, a *National Greater Bilby Recovery Plan* was formulated by Pavey (2006) for action in all state and territory jurisdictions.

■ **Table 2-1 Status of the Bilby (*Macrotis lagotis*) according to Commonwealth, State and International Legislation and Conventions**

Jurisdiction	Legislation and Conventions	Status
Commonwealth (National)	Schedule 1 of the <i>Environment Protection and Biodiversity Conservation Act 1999</i>	Vulnerable
Western Australia	Schedule 1 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2010 (2)</i> [Fauna that is rare or likely to become extinct]	Threatened
Northern Territory	Section 29, <i>Territory Parks and Wildlife Conservation Act 2000</i>	Threatened
Queensland	<i>Nature Conservation Act 1992</i>	Endangered
South Australia	Schedule 7, <i>National Parks and Wildlife Act 1972</i> , amended September 2000	Endangered
New South Wales	Schedule 1, <i>Threatened Species Conservation Act 1995</i>	Presumed Extinct
Victoria	Not listed.	
International	<i>2011 IUCN Red List of Threatened Species</i>	Vulnerable (C1)
	<i>Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)</i> ,	Appendix 1

## 2.2. Bilby Description

The Bilby (*Macrotis lagotis*, Reid 1837) is a native marsupial mammal and is the only surviving (extant) representative of the Family Thylacomyinae (Johnson 2008). The Bilby is classified in the same Order as bandicoots (Paull 2008). The Bilby is a small to medium-sized animal with long, soft, blue-grey fur over most of the body and white to cream fur on the belly (Johnson 2008). It has large ears, a long pointed snout and a long black crested tail with a white tip (Johnson 2008). It is equipped with strong forelimbs for digging, which have three stoutly clawed toes (and two unclawed toes) (Cronin 1991; Pavey 2006; Southgate *et al.* 2007; Johnson 2008). Females have a backwards facing pouch to avoid entry of soil during digging which is similar to other digging marsupials. Its hind limbs are slender and it is capable of bursts of substantial speed (Southgate 1987).

Bilby are sexually dimorphic in size, with males growing to on average more than twice the size of females (Southgate 1987, Johnson 2008). The size ranges from 30 cm to 55 cm long (males), 29 to 39 cm long (females) with a tail 20 cm to 29 cm long (which is relative to body size). The weight range for adult males is approximately 1000 g to 2500 g; and for adult females is approximately 800 g to 1200 g (Cronin 1991; Pavey 2006; Southgate *et al.* 2007; Johnson 2008). The Bilby is considered to be one of many mainland Australian arid zone ground dwelling marsupial mammal species that are within a ‘critical weight range’ (35 g to 5500 g), which is considered significant as it increases the exposure to the threat of predation by introduced foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) (Johnson and Issac 2009).

Reproductively, the Bilby has the potential for high fecundity when favourable conditions occur. If food resources become abundant in an area, Bilbies can congregate in higher densities, which can facilitate breeding (Southgate 1987). The lifespan of the Bilby, at least in captivity, exceeds five years (Southgate *et al.* 2000) and breeding continues in animals for up to five years (Southgate 1987). Bilby breeding can occur throughout the year (Pavey 2006b), with litter sizes typically two young, occasionally one, or very rarely three young (Southgate 1987 R. Southgate, personal communication). Under ideal conditions, there is potential for four litters to be produced in a year meaning that eight offspring (potentially up to twelve, but very unlikely) can potentially be produced over this time (Southgate 1987). Mature female Bilbies have a gestation period of 12 to 14 days, with young leaving the pouch after about three months to reach sexual maturity at five or six months (McCracken 1990, Southgate *et al.* 2000, Pavey 2006b). Males reach sexual maturity at eight months (Pavey 2006b). The young stay in the burrow and are weaned two to three weeks later before becoming independent (Southgate 1987). Genetic studies on populations from Western Australia, Queensland and the Northern Territory have confirmed that Bilby are a single Evolutionary Significant Unit (ESU) (Southgate and Adams 1993), meaning the species is distinct and does not interbreed or hybridise with any other species. The species was previously considered to contain a number of subspecies (Southgate 1987), but the current taxonomy treats the Bilby as a single species without further division.

From a cultural perspective, the Bilby holds important mythological and totemic status among many groups of Indigenous Aboriginal people (traditional owners) with the white tail-tip of the animal reported to be traditionally valued and used for decorative purposes (Southgate 1987, Johnson 2008). The Bilby has also been known by the names of Greater Bilby (the Lesser Bilby is presumed extinct), Dalgite (or Dalgyte) and Rabbit-bandicoot. Several indigenous names exist for the Bilby among language and cultural groups across Australia, including Mankarr, Warlpajirri, Ninu and Ahurt. Bindarrgoorr is the name given to Bilby in the Bardi language of the Dampier Peninsula. This name was supplied by Kevin George (Head Ranger of the Bardi Jawi Rangers) in July 2009 as part of an interview with Thomas Saunders (a Derby-based linguist) (T. Willing, personal communication, 2011). The Bilby has been used as a flagship species to raise awareness of arid zone conservation in Australia with the second Sunday of September designated as National Bilby Day (Pavey 2006b). The Bilby has also been adopted as an alternative commercial mascot to the rabbit at Easter (Pavey 2006b).

### 2.3. Habitat Preference and Diet

Habitat preference of the Bilby appears to be highly variable, with suitable habitat occurring in a wide range of soil, vegetation and landform types, where soil is suitable for burrow construction (Southgate 1987, 1990a). Example habitats where Bilby have been recorded are sandplains, clayey flats and gravelly flats (Southgate 1987). A relatively low amount (<38%) of ground cover is a common feature in habitats where Bilbies currently occur and is essential to permit foraging activity (Southgate 1987).

Southgate (1990) suggests that most of the area within its current distribution, except rocky hills or ranges, is potential habitat for the Bilby. Habitat of the existing wild populations includes tall shrublands and open woodlands of the semi-arid regions, plus hummock grasslands and sparse forblands in the arid areas of Australia (Pavey 2006). In its former range, the Bilby appears able to live in habitats from the driest desert areas to the temperate areas such as those found in the south, east, and west of Australia (Pavey 2006).

The location of home ranges for the species in the sandy deserts and other arid areas of Australia are therefore usually temporary and may suddenly shift in response to changes in food availability (Johnson, 1989). Bilby populations naturally occur as scattered solitary individuals or small groups (Smyth and Philpott 1968, Watts 1969, Southgate 1990a). The term ‘colony’ may generally constitute up to three animals (Southgate 1987). Bilbies are omnivorous and feed on a wide variety of food items. Their feeding is opportunistic, which is an ecological strategy that facilitates existence in arid regions where food resources are unpredictable over space and time. Free surface water is not typically available in the Bilby’s current range. As a result, they derive most of their water from food sources. However, the species has historically been recorded from a wider range that includes areas with relatively reliable rainfall and where surface water is more freely available. As such, it is expected that the species may utilise free surface water to an extent if it was available.



Bilbies obtain food from above ground and use burrows primarily for protection and raising young (Southgate 1987). Food is obtained mostly on the ground surface and in the first 20 cm below the ground surface, using powerful forelimbs to dig for food (Southgate 1987, Gibson *et al.* 2002). It is believed that this species also uses its senses of hearing and smell to locate food (Johnson 1989). Bilby diggings during foraging are reported to be classified into three distinct types (Newell 2008, Richard Southgate, personal communication, 2011):

- Patches of scratchings in irregular shapes;
- Shallow cylindrical or concave pits (5-20 cm wide and 4-15 cm deep) with soil piled up in all directions from the mouths; and
- Deep conical pits (5-20 cm deep) that ascend at an angle.

Most of the food resources used by Bilbies are small and inconspicuous (Southgate 1987). The diet of Bilbies is reported to vary depending on availability of different food items, which also varies with season and habitat (Southgate 1987, Gibson 2001). Diets are reported to include bulbs, grass and sedge seeds, fruits and fungi, as well as small invertebrates (e.g. ants, termites, spiders, grasshoppers, beetles) and invertebrate eggs and larvae (e.g. beetles, moths, grasshoppers). Seeds may be raided from grain stores from harvester ants. On rare occasions, Bilbies may consume small vertebrates (e.g. lizards) (Southgate 1987). It is reported that, when available, a major component of the diet of naturally occurring Bilby populations is the bulb of the bush onion (a sedge) *Cyperus bulbosus* (Southgate 1990b, Southgate and Carthew 2007). Seeds from the two grass species *Yakirra australiensis* and *Dactyloctenium radulans* are also widely used (Southgate 1987). The bush onion bulb and certain insects are important sources of moisture in the diet (Southgate 1987). Invertebrates are relied upon extensively when plant material is not available (e.g. during drought conditions) (Southgate 1987). The patchy distribution of bulbs and seed reserves due to the effects of unpredictable rainfall events and fire, are suggested to be an explanation for the patchiness of Bilby colonies and their density in a habitat type (Southgate 1987). Scats (faeces) are a distinctive broad elongated rounded shape, are low in water content, and usually have appreciable sand content via ingestion with food (Southgate 1987).

In limited parts of the Bilby's current range (i.e. particularly in the north of its range), fire may be an important factor in improving the habitat favourability for the species by promoting certain food resources and reducing ground cover where other environmental factors do not already limit the vegetation density (Southgate 1987, Southgate & Carthew 2007). For instance, important food resources for Bilbies such as *Cyperus bulbosus*, *Yakirra australiensis* and *Dactyloctenium radulans* are ephemeral plant species that have their growth promoted by disturbance effects including fire (Southgate 1987). The occurrence of the Bilby has been observed to be associated with close proximity to recently burnt (< 1 year) habitat (Southgate *et al.* 2007, Southgate & Carthew 2007). However the Bilby is also reported to be not fire-dependent as it occurs in habitats where foods and ground cover are not adapted to a specific fire regime (Southgate 1987).

## 2.4. Behaviour and Movements

The Bilby is unique among the bandicoot group of fauna in the construction of burrows (Johnson 2008). Bilbies are powerful diggers and can construct burrow systems that may be 3 m long and up to 1.8 m deep (Johnson 2008). The burrows have a circular entrance about 15 cm wide and usually descend spirally often with a few offshoots (Southgate 1987). Most of the burrows have a single entrance but multiple entrance warren formations are occasionally found (Southgate 1987). Burrows are often located between clumps of grass or shrubs. These burrows are used for refuge during the day from predators as well as offering a relatively stable micro-environment to avoid extremes of hot and cold, which is important as the species lacks sweat glands and does not pant under high temperatures (Hulbert 1982 cited in Southgate 1987). The use of burrows by Bilbies may also assist the species' ability to occupy an area and to survive and persist in the event of a fire. Within their home ranges, Bilbies typically have several burrows and change them frequently (Southgate 1987, Lavery and Kirkpatrick 1997, Moseby and O'Donnell 2003). Several different burrows may be visited each night (Southgate 1987). An individual may have over a dozen regularly used burrows (Southgate 1987, Pavey 2006). The number of burrows and condition is expected to directly relate to the time an area has been occupied and therefore offers value in determining presence, however R. Southgate (personal communication) has advised that the local abundance and distribution of burrows is not likely to provide an accurate assessment of the number of individuals in an area based on work done in the Tanami Desert.

As highly mobile, nocturnally active animals, Bilbies stay in their burrows during the day and begin foraging activity after twilight (Pavey 2006), moving over large foraging ranges (Southgate 1987, Lavery and Kirkpatrick 1997, Southgate *et al.* 2007). The Bilby is not sedentary and an occupied area will be periodically vacated for a new location (Southgate 1987). Depleted food resources are the probable stimulus that results in a Bilby vacating an area (Southgate 1987). This itinerant nature of the Bilby enables it to respond to patchy and uneven food availability (Southgate 1987). Males are reported to range more widely than females with considerable overlap of home ranges between males and females. However it appears there is little overlap between female's home ranges (Moseby and O'Donnell 2003). Adult females are reported to move up to 1.5 km between burrows on consecutive days. Adult males are reported to regularly move 2–3 km and up to 5 km between burrows on consecutive days (Southgate *et al.* 2007). In the Northern Territory, short-term home range size of the Bilby was estimated to range from 1.1 to 3 km<sup>2</sup> (Southgate and Paltridge 1998). For a reintroduced semi-wild population in South Australia, it was found that males had a greater average home range size (3.16 km<sup>2</sup>) than females (0.18 km<sup>2</sup>) (Moseby and O'Donnell 2003). The nightly home range movements of the Bilby are generally less than 4 km<sup>2</sup> (Southgate *et al.* 2007). Home ranges in the sandy deserts are usually temporary in location and may suddenly shift in response to changes in food availability (Johnson, 1989). Females in a reintroduced population in the Northern Territory were found to have an average dispersal distance of 3.3 km per year with one group dispersing 10.5 km from the release site after 3 years (Southgate and Possingham 1995).

## 2.5. Distribution and Abundance

Prior to European settlement, the Bilby was widespread over 70% of continental Australia from Adelaide north to around a latitude of 16° South, from the western side of the Great Dividing Range to the Western Australian coast (Southgate 1987). The species is also likely to have occupied parts of Victoria and central Queensland, although no confirmed records exist for these areas (Southgate 1987). Bilbies now occur in approximately 20% of their expected former range with restriction in populations in most areas occurring between the late 1800s and 1935 (Abbott 2001 and 2008, Gibson *et al.* 2002). The decline and local extinction of the Bilby first occurred in southern parts of its range, with Bilbies now only being found in the northern part of their former range (Southgate 1987). An indicative map of the present Bilby distribution in Australia (based on best available knowledge and including reintroduced populations) is presented (Figure 2-1).

In Western Australia, it is reported that the current distribution of the Bilby spans the Gibson Desert and Great Sandy Desert bioregions to as far south as Tjirrkal Community and to about Newman in the west (Southgate 1990). Bilby populations are also reported to exist in the Pilbara bioregion (including the Hamersley Range area, along the Fortescue River and north-east to Shay Gap), in the Dampierland bioregion (along 80 Mile Beach north to Beagle Bay) and in the Central Kimberley and Ord-Victoria Plains bioregions south of the Fitzroy and Margaret Rivers (Southgate 1990). In other states, wild Bilby populations are reported to be confined to the Tanami Desert in the Northern Territory (Johnson and Southgate 1990) and an outlying population between Boulia and Birdsville in south-west Queensland (Gordon *et al.* 1990). It is thought that the extent of occurrence for the Bilby has changed little in the past 20 years (Southgate *et al.* 2007). However, the density of Bilbies over this extent may have reduced substantially due to threatening processes such as predation by foxes and feral cats. A summary of all known Bilby location records in Western Australia (as compiled by DEC 2011 using the NatureMap online tool) is presented in

Figure 2-2.

A description for interpreting the potential meaning of the Western Australia records of Bilby has been provided below for the purpose of context. The summary of records suggests that little research or formal recording had been conducted prior to 1900, with only a single record known for W.A. The years 1900 – 1949 show a smaller number of records, primarily for the south-west of the state, with a small number presumably associated with exploration activities in the northern part of the state. The period of 1950 – 1979 shows a substantial increase in the number of records for the south-west, Murchison, Great Victoria Desert, Pilbara and Kimberley (specifically Broome and Dampier Peninsula) regions of W.A. This may reflect an increase in studies being conducted by trained biologists at these times around well-established towns. The Western Australia *Wildlife Conservation Act 1950* may also have had a positive influence on the number of assessment activities occurring for native species, including the Bilby.

The period 1980 – 1999 shows a decline in Bilby records across much of the former range of the south-west and Murchison region, which is likely to be directly attributed to predation from introduced foxes and cats, impacts from introduced herbivores, and habitat degradation. The period also shows a general increase in Bilby records from the arid northern regions of W.A. (Pilbara, Great Sandy Desert and Little Sandy Desert) with an apparent decline in the Kimberley region (Dampier Peninsula and Broome) which coincides with local knowledge (detailed under **Section 2.5.2**). This period probably experienced a generally higher level of assessments occurring across W.A. that could in part be attributed to requirements under the *Environmental Protection Act 1986*, which required among many things that development proponents undertake baseline biological assessments as part of the approval process for projects. It is reasonable to suggest that many qualified biologists including environmental consultants and researchers were actively contributing to the records of Bilby during this period. Thus, this period may well reflect the first clear picture of general terrestrial vertebrate fauna species presence and distribution for W.A.

The period 2000 to 2011 shows few records from most parts of W.A. indicating that widespread disappearance and localised extinction of the Bilby has probably occurred across much of its range, with limited records from the Pilbara region (presumably in relation to mining projects), a few records in the south-west (likely to be related to formal conservation programs), few records near Broome and arid areas to the east. During this period CALM/DEC commenced recovery programs for the species in response to widespread anecdotal evidence and concern for Bilby disappearing from their former range (T. Willing, personal communication, 2011). The coordinates for one of the records for this period is located offshore and is assume to be erroneous.



■ **Figure 2-1 Indicative Current Distribution of the Bilby – Australia (source: SEWPAC 2011)**

Despite the distribution of Bilby showing a reduced range, the species still extends over large areas but is patchily distributed, appearing to utilise small parts of the habitats that are thought to be suitable (Smyth and Philpott 1968, Pavey 2006, Friend *et al.* 2008). In other words, the area of occupancy is very small compared to the extent of occurrence (Southgate *et al.* 2007). Historical and current Bilby populations in the wild are believed to occur as scattered solitary individuals or small colonies (Smyth and Philpott 1968, Watts 1969, Southgate 1990a).

Individuals are mostly solitary and often occur in low densities ( $<1$  individual /km<sup>2</sup> or  $<1$  individual /100 ha) (Southgate *et al.* 1995). Bilbies appear to be sparse in their range with estimated population densities ranging from 0.01 individuals/km<sup>2</sup> (0.0001 individuals/ha) in central Australia to 16 individuals/ km<sup>2</sup> (0.16 individuals/ha) in south-west Queensland (Southgate 1990a, Southgate *et al.* 2007). In other areas, Bilbies can typically occur at densities of one or two per km<sup>2</sup> (0.02 to 0.01/ha) (Pavey 2006). This population density reflects current knowledge of the species. The density may have been greater or lesser historically but insufficient information exists to determine this.

Bilby numbers in an area can fluctuate substantially with changes in seasonal conditions (Southgate 1987). Where suitable food species of seeds and bulbs become locally abundant, Bilbies can reach densities of 12 - 16 individuals per km<sup>2</sup>, however, lower densities are more typical for the species (Pavey 2006). Bilbies living in low densities have a more diverse diet which may include a broad mix of invertebrate and plant material (Southgate 1990b).

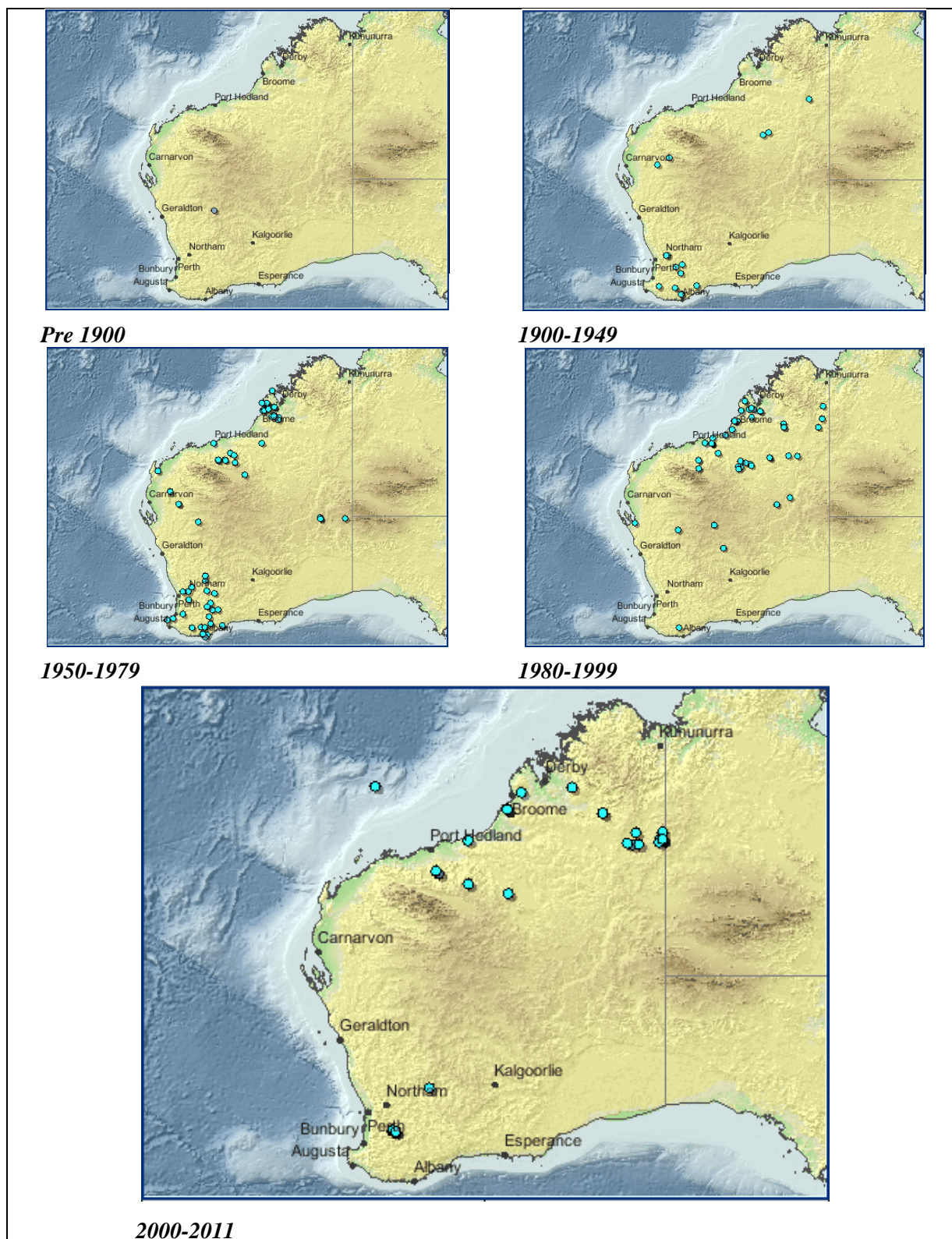
Population estimates for some reintroduced populations have been reported (Friend *et al.* 2008):

- Scotia Sanctuary (New South Wales) – about 40 individuals
- Arid Recovery Project at Roxby Downs – about 500 individuals
- Venus Bay Conservation Park – about 100 individuals
- Thistle Island – about 500 individuals; and
- François Peron National Park (Western Australia) – about 200 individuals

In Western Australia, wild (non-reintroduced) populations have been roughly estimated at 5,000 to 10,000 individuals (Friend *et al.* 2008). In the Northern Territory, coarse estimates of the Bilby population range from less than 1,000 individuals (Friend *et al.* 2008) to an estimated few thousand individuals (Parks and Wildlife Commission of the Northern Territory). In Queensland, the population is estimated to between 200-500 individuals (Friend *et al.* 2008).

The estimates provided above suggest that the wild Bilby population in Australia is potentially within the range of approximately 6,000 – 14,000 individuals. However, an overall population estimate of the wild Bilby population is unavailable. The population is thought to potentially be fewer than 10,000 mature individuals. Information is generally considered to be insufficient and researchers have made no attempt to provide a reliable population estimate (Friend *et al.* 2008). As described in Section 2.3. Bilbies have a large extent of occurrence and are not restricted to particular habitats.





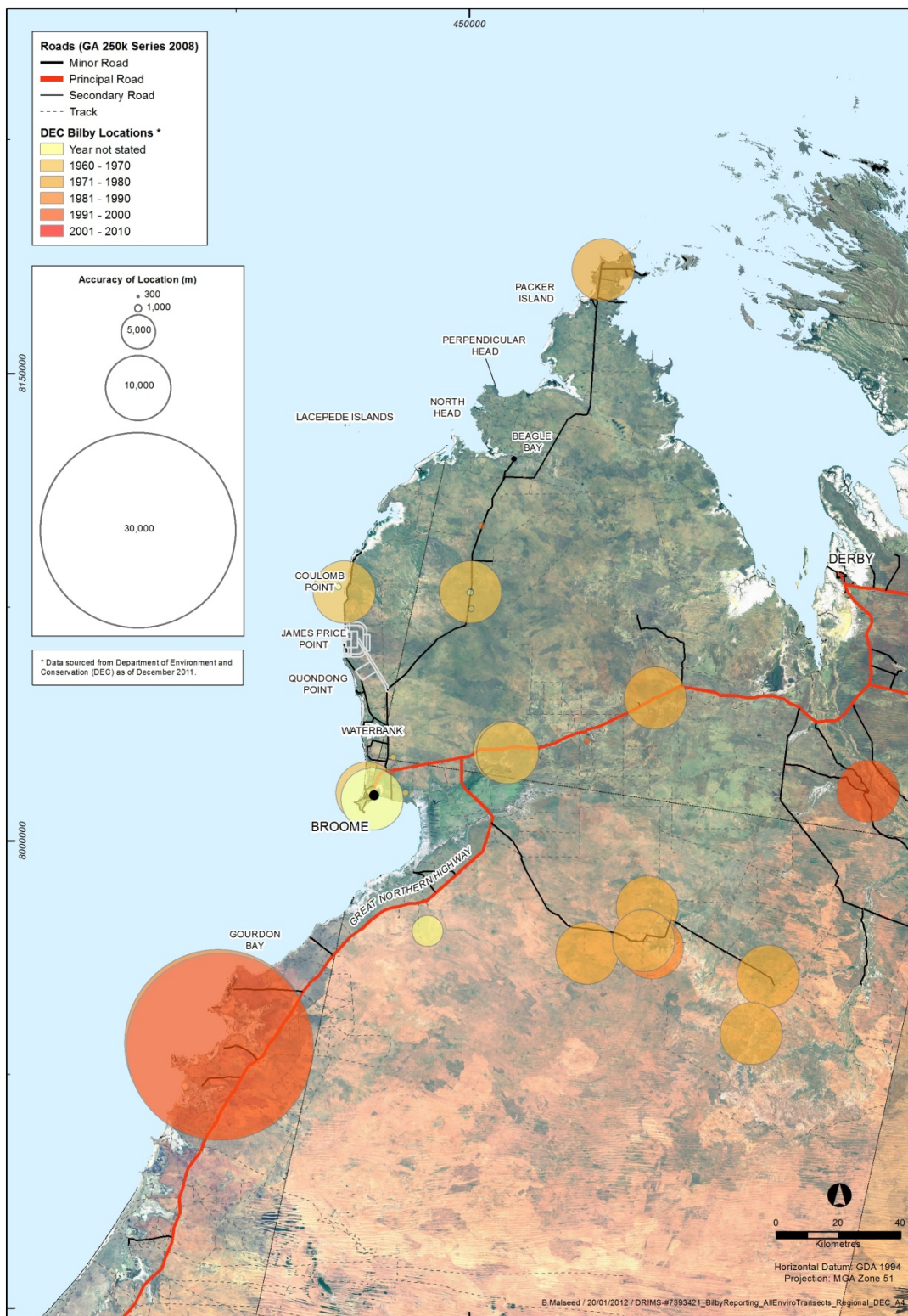
■ **Figure 2-2 Bilby Records in Western Australia Pre-1900 to 2011 (source: DEC 2011- NatureMap)**

### **2.5.1. Previous Records on the Dampier Peninsula**

There are forty previous Bilby records on the Dampier Peninsula and an area just to the south indicated in the results of a DEC Threatened Fauna Database search conducted in December 2011. These records are spread across the Dampier Peninsula, with a number of records based on observations along main roads such as between Broome and Derby, south of Broome and other locations shown in Figure 2-3 (DEC 2011b). Twenty records are from sightings along roads, mostly of individual Bilbies, four are from ‘recent burrow evidence’ at the time of recording and 16 are for specimens held by the Western Australian Museum. The earliest Bilby record for the Dampier Peninsula was from 1963 along Broome-Beagle Bay Road (Cape Leveque Road), approximately 45 kilometres south of Beagle Bay.

The DEC records of Bilby nearest to the BLNG Downstream Development and Precinct are two from near Coulomb Point Nature Reserve approximately 14 km north of the proposed development site. Like many of the records from the broader region, these points have marginal accuracy associated with each location. One point location has an accuracy of 5000 m, while the other is classified as accurate to 500 m. However, this appears to be incorrect as it plots to a location slightly offshore and requires a larger accuracy buffer (error) margin to be provided. The most recent records of Bilby for the broader Dampier Peninsula and surrounding search area on DEC’s Threatened Fauna Database are five that are dated 4 November 2001, four of these from Shamrock Pastoral Station and one from Roebuck Pastoral Station (both areas are south of Broome).





■ **Figure 2-3 Location of all DEC Bilby records (and accuracy) for the Dampier Peninsula and surrounds**



The Bilby is also known to occur at Gourdon Bay (through regular sightings by locals), and an individual was captured in recent years on the Cape Leveque Road near Beagle Bay (A. Wiggan, personal communication, in ENV 2008). Bilbies are historically known to occur in the Gourdon Bay area (K. Miller, personal communication, in ENV 2008), and traditional owners have reported seeing individuals of the species fairly regularly (including in the months leading up to the ENV 2008 study) on Port Smith road (in the Gourdon Bay area).

Bilbies are historically known to occur as far north as the Packer Island area, but generally more towards the Beagle Bay area (based on traditional owners' knowledge) north east of James Price Point. Bilby were reported in 2008 as continuing to be recorded at that area, including records of active burrows and road kill (K. Miller, personal communication, in ENV 2008). It is possible that this population extends and may even occur at Coulomb Point (ENV 2008), north of James Price Point. An historic Bilby record exists for Coloumb Point from fresh skeletal material collected in 1971 (McKenzie 1983). A Bilby record also exists from 1975, for a location approximately "5 to 10 miles north of the Lombadina Airstrip" based on evidence in the form of a colour slide provided in McKenzie (1983, page 43).

It has been suggested that it is likely the Bilby occupies most of the Dampier Peninsula in very low densities given it is a wide ranging and generalist species, occurring mainly on sandy substrates (ENV 2008). However, while existing data seems to support the claim that the species occurs at low densities or as vagrant individuals, there is insufficient evidence to accurately determine the current distribution or abundance of the species regionally or the actual area of occupancy (which is likely to change with fluctuating seasons and ecological conditions) over the entire Dampier Peninsula.

### **2.5.2. Other Local Observations from the Dampier Peninsula and Surrounds**

Mr Tim Willing has provided the source for information below of a reliable local account of Bilbies in relation to the Dampier Peninsula and surrounding areas, through personal communication as part of this report. Tim Willing is a respected person in the Kimberley region for his expertise in natural sciences, has been a Broome resident for approximately 30 years, was employed from 1996 to 2005 in the field of nature conservation for the Department of Conservation and Land Management (CALM) and later with Department of Environment and Conservation (DEC) at the West Kimberley Regional office (in Broome). He was a delegate for CALM/DEC Kimberley on a National Bilby Taskforce during this period and is an author of a number of scientific publications and books, including (as co-author) *Broome and Beyond* (Kenneally, Edinger & Willing 1997). Tim Willing's personal communication is provided below.

### **Personal Communication, T. Willing 2011**

In the late 1980s, evidence of Bilby was identified from clearing lines as part of a groundwater monitoring survey by the Geological Survey of Western Australia just south of Fraser River (east of the Peninsula). Phil Commander reported Bilby records to CALM at the time, but it is not certain whether these records have been included in any report, but is considered unlikely.

In the 1990's 'quite a few' reliable sightings (number not specified) of Bilby were made along Crab Creek Road, approximately 15 km east of Broome and around 55 km south of the BLNG Development. These sightings were reported to CALM by Chris Hassell from the Broome Bird Observatory. Apparently no sightings of Bilby have occurred in that area in the past 10 years to 2011.

In the late 1990s, the CALM in Broome was conducting a public education program to promote awareness of Bilbies. This increased the number of Bilby sightings that were reported. Many of the observations of Bilby reported were from along the Great Northern Highway, between Broome and Derby. One location where Bilbies had been sighted on more than one occasion was at a sand-hill approximately 75 km from Broome, near Taylor's Lagoon.

Around 1998 to 2000, George Morris (a Broome resident) was undertaking cut lines for seismic activities [geological/geotechnical investigations] in the adjacent Great Sandy Desert. George is considered to have a good knowledge of Bilbies in the Great Sandy Desert. Active Bilby burrow locations were often 'logged' for the work areas. George regarded that Bilby were "certainly recorded" for the Great Sandy Desert. In the late 1990's George approached the CALM in Broome, with concerns that Bilbies numbers were declining in the desert areas and that foxes were taking over Bilby burrows [and predating on them] as they moved northwards. He subsequently provided his Bilby data to the CALM [it is currently unclear whether any or all of these records are present in DEC's Threatened Fauna Database].

In 2001, in response to the apparent disappearance of Bilby over much of the southern part of its range, plus the decline in other areas as indicated by records such as those of George Morris, CALM initiated a Bilby capture program in the Kimberley and Great Sandy Desert. The purpose of the program was for translocation, breeding and reintroduction of the species into secure areas for conservation purposes. Five Bilby animals were captured at this time from Udialla Station, approximately 60 km south of Derby. It was known that people at Udialla Station were at the time conducting regular shooting at night for feral cats. It is believed that this reduced predation contributed to a healthier Bilby population relative to surrounding areas. This was also one of the reasons it was used as a source population for the translocations.

Around 2002 – 2003, plentiful Bilby tracks were able to be seen near the main entrance to Roebuck Plains Station. The location was approximately 0.5 to 1 km from the entrance on and near a sandy rise. Bilbies were definitely known to be at this location at the time.

**Personal Communication, T. Willing 2011 (continued)**

Around 2003 – 2004, Tim Willing and Kingsley Miller observed an active Bilby burrow [and other Bilby evidence] near the entrance to Barn Hill (~35 km south east of Broome), off the Great Northern Highway [which is consistent with other records from the Gourdon Bay area reported by ENV, 2008]. It has been indicated that most Indigenous people in the area are likely to have seen Bilby in this wider location.

It is believed that Bilby numbers have reduced in the northern part of the Dampier Peninsula and that this is related in a large part to fire regimes that are unfavourable to the species. It has been suggested that the Bilby is probably now absent from north of Pender Bay based on a lack of sightings in recent years.

## 2.6. Threats

It is reported that the major threats to Bilby populations occur at the broad landscape level and relate to predation from European red fox (*Vulpes vulpes*) and feral cat (*Felis catus*), degradation of suitable habitat due to introduced herbivores (e.g. rabbits and livestock) and altered fire regimes and the implications upon native vegetation (Southgate 1987, Morton 1990, Pavey 2006a, b, Friend *et al.* 2008).

The spread of foxes as the Bilby's most significant predator has by far been the largest factor contributing to the decline of the Bilby (Abbott 2001). Although dingoes may prey upon Bilbies, the presence of dingoes may also favour Bilby survival as they are a major predator of feral cats and possibly displace foxes either by direct predation or excluding them from carrion during drought periods (Pavey 2006b, Southgate *et al.* 2007). Foxes are generally not believed to occur on much of the Dampier Peninsula. The apparent absence of foxes is likely to be related to an apparent healthy population of dingoes. Foxes have been recorded by a local traditional owner as present in the Gourdon Bay area (ENV 2008). Foxes appear to prefer movement along coastal zones and through semi-arid areas in the northern parts of Australia (Richard Southgate, personal communication). Records were also made by Malcolm Douglas of foxes entering the Broome area either from the coast or Great Sandy Desert around circa 2009 (T. Willing, personal communication, 2011)

There is strong evidence that competition with rabbits for food resources (and potentially burrow resources) is another major threatening process to the Bilby. The distribution of the Bilby correlates to areas where rabbits are absent or present in low abundance (Southgate 1987, Pavey 2006b). Livestock such as cattle also present a threat to Bilbies, through mechanisms such as physical damage to soil structure, competition for preferred grass/food species, plus reduction in termite/ant abundance due to reduced grass seed biomass from grazing as previously reported in the eastern Pilbara, Dampierland and Northern Territory (Southgate 1987, 1990, Pavey 2006). It was reported that the Bilby's distribution appears to abruptly halt when it meets pastoral land (Southgate 1987, Southgate *et al.* 2007), although Bilbies have been recorded at low densities in

grazed areas. Feral camels are large animals, consume a wide variety of plant species and have the potential to seriously damage vegetation. Feral camels therefore have the potential to significantly impact Bilby habitat including in Western Australia (Pavey 2006b).

Unsuitable fire regimes, particularly uncontrolled high intensity wild fires that can burn across large areas of desert including in Western Australia, are reported to impede dispersal and colonisation by the Bilby of unoccupied areas within the current distribution range (Pavey 2006b). However, in limited parts of the species range, fire may be an important factor in improving the habitat favourability for the species. The occurrence of the Bilby has been associated with close proximity to recently burnt (< 1 year) habitat (Southgate *et al.* 2007). In some areas, high intensity of fire is important for thinning vegetation and encouraging growth of favoured seeding grass species following good rainfall, which may promote breeding of the Bilby (Richard Southgate, personal communication, 2011).

Prolonged drought can lead to a severe shortage of food resources. In addition, Bilby physiology is only partly adapted to arid environments, which aligns with knowledge of the former range for the species. Severe drought has therefore been linked to the local disappearance of some populations (Pavey 2006b).

Other threats on a more localised scale include mortality due to roads and development projects, particularly mining. The project proponents for such developments are required by regulatory authorities to undertake impact assessments and enact management plans to control potential impacts.

## **2.7. Survey Methodologies**

### **2.7.1. Survey Guidelines**

The Western Australian Environmental Protection Authority (EPA) has developed documents that relate to undertaking biological surveys for environmental impact assessment. These include the following position and guidance statements that specify the level of survey activity, timing, and level of experience required to undertake terrestrial fauna surveys:

- Position Statement No. 3 Biological Surveys as an element of Biodiversity Protection; and
- Guidance Statement No 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia.

The level of survey activity is defined as Level 1 (desktop with reconnaissance level field work) or Level 2 (detailed and targeted field investigation).

### **2.7.2. Survey Techniques**

Survey techniques for assessment of Bilby (and terrestrial ground dwelling native mammal communities generally) in Australia include:

- Trapping to capture live individuals, with suitable bait as an attractant, using cage traps. Elliot trap (box) designs (of varying size) and pitfall traps are also typically used as part of assessing fauna survey sites, but are not considered relevant to assessment of Bilby as the traps are not large enough (Elliot traps) or the species could readily escape (pitfall traps). Bilby are considered unlikely to enter either of these trap types. Trapping programs typically include assessment of each site for a number of consecutive days and nights. These sites are normally placed in a representation of habitat types in a defined area. Trapping sites are often also subjected to targeted searching for fauna species. Although trapping can provide definitive evidence of presence, Bilbies are known to be reluctant to enter free standing baited traps (i.e. can be ‘trap shy’) (Southgate *et al.* 1995). Cage traps are of a size that is more likely to capture Bilbies than Elliot traps. The cumulative amount of trapping for fauna surveys on the Dampier Peninsula has not been presented in this report as preference has been given to other measures for calculating effective survey effort for Bilbies through the use of other methods;
- Active diurnal foot traverse searching to identify ‘sign’ (tracks, scats, burrows and diggings), searching quadrats or line transects. Surveys conducted in the Tanami Desert, Northern Territory, by Southgate *et al.* (2007) have used a method of fixed transects (that were assessed every four months between 1995 to 1998), random plots (1996 to 1998) and aerial surveys (May and August 1999). Active searching can therefore be short-term or longer term in approach. Transect search lengths have been calculated from relevant fauna studies;
- Active searching can also include the ‘sand plot method’ described by Moseby *et al.* (2007). This technique involves conducting a detailed search within a defined 200 m x 100 m (2 ha) site, and recording all ‘sign’ of vertebrate fauna activity, including diggings, scratchings, burrows, scats and tracks through the use of a zig-zag search along one side of the site, returning back along the other side of the site. This technique has not been used by fauna studies on the Dampier Peninsula described in this report;
- Nocturnal searches using spotlights to detect active individuals or driving along roads in suitable habitat where animals may seek additional foraging material where water runoff collects and soil may be disturbed on the side. Most fauna studies on the Dampier Peninsula referred to in this report included this technique;
- Motion sensitive camera trapping to provide unobtrusive direct evidence of Bilby (or other fauna) presence or absence at a location during day or night. The effectiveness of this approach relies upon placing the equipment in a location that can directly capture presence in the line of sight of an individual fauna species (such as Bilby). For assessing Bilby, this would normally target burrow locations to capture individuals entering or exiting. It can be extremely difficult using this approach to record individuals where multiple burrows occur over large areas and where limited equipment is available. Due to the generally solitary nature of Bilbies, which can utilise a number of burrows (up to a dozen) in home ranges up to 5 km, capturing evidence of presence using camera traps relies upon placement at locations where recent activity has been confirmed;

- A targeted trapping technique has also been used for re-capturing Bilby that have been released from conservation re-introduction programs. This technique essentially involves establishing a small fenced area around active burrows with small exits into covered cage traps that remain *in-situ* for up to two nights.

The document *Survey guidelines for Australia's threatened mammals* (SEWPAC 2011) indicates that based on previous surveys, that the following techniques are recommended to detect Bilby in areas up to 5 ha:

- daytime searches of potentially suitable habitat;
- daytime searches for signs of activity (including burrows, tracks, scats and diggings);
- collection of predator scats targeting nests or dens; and
- soil plot surveys according to the technique and levels of recommended effort for the habitat.

No suggested methods are provided for conducting regional assessments on the species.

Southgate et al. (2005) developed and evaluated alternative techniques based on identifying signs of activity in the Northern Territory for assessing the conservation status of Bilby over much larger areas (i.e. regionally) using three methods:

- low level aerial surveys by helicopter with ground-truthing;
- fixed ground transects by all-terrain vehicle; and
- random plot foot searches.

A summary of the methods and results is provided here for example. Transect lengths were 10 km and were considered appropriate by those researchers. Plots used were a 300 m by 200 m (6 ha) quadrat. The study identified that of the 93 plots searched to determine the rate of false-negative error, three localities (or 3.2%) had 'sign' of Bilby (i.e. were evidence of false-negative results). Of the 55 plots where putative sign from the air was recorded, 23 localities (42%) were falsely identified as positive. False-positive results from that study were from mistaken signs that were created by rabbits, goannas and skinks. The principal benefit is that the passive survey techniques (searching for 'sign' such as burrow or track evidence) overcome the difficulty or limited capacity to observe Bilby (e.g. by spotlighting) where they occur at very low densities.

The above techniques can be cost effective under different circumstances, however the most reliable data are obtained by random plot foot searches, where more time can be taken to examine tracks and other signs. This technique relies on the assessment being conducted by suitably experience people who can reliably distinguish between the sign of different species. Tracks, burrows and diggings should also be given an age (up to four days if possible). The principal limitation is accuracy and that it is most suited to sparse to open habitats such as spinifex grassland (*Triodia* spp.) plains with limited shrub overstorey. The technique would probably not be effective where aerial surveys were limited by poor ground visibility due to taller and denser vegetation cover such as some pindan areas.

### 2.7.3. Survey Effectiveness

Efforts to accurately measure the size of Bilby populations at a fine scale by direct measures (e.g. spotlight counts or trapping) and indirect methods such as burrow counts have historically been



ineffective (Southgate *et al.* 1995). Where terrain is open and vegetation is sparse, burrow counts can be used effectively to map the presence/absence of Bilby and spatial patterns. However, an accurate measure of Bilby abundance has not been obtained because the relationship between the number of burrows and number of Bilbies is poorly understood (Lavery and Kirkpatrick 1997). This suggests that presence or absence of Bilby may be possible to determine using the techniques above (where the terrain and vegetation density permit), but determining the abundance/population size of the species in the area may likely require an intensive trapping program with identification of individuals such as a micro-chipping and capture/recapture program. Other approaches for determining abundance of Bilbies in areas where they are known to be active includes assessing scats in spoil aprons (soil piles) near burrow entrances, sweeping (wiping sand to a fresh, smooth surface) and daily checking of sand pads for tracks with comparison to other studies for similar habitats (Richard Southgate, personal communication).

## **2.8. EPBC Referral of Projects Relating to Bilby**

There have been several recent projects and proposals which have been situated in potential Bilby habitat or in areas where Bilbies are known to be active. A summary of the key aspects of these projects relating to Bilbies is provided below.

### **2.8.1. Cloud Break Iron Ore Mine**

Fortescue Metals Group Limited (FMG) submitted a proposal (under the EPBC Act) in 2005 to develop the Cloud Break Iron Ore Mine within the Chichester Range of the Pilbara region of Western Australia. The Cloud Break tenement is situated on Mulga Downs station and lies approximately 120 km north-west of Newman.

A Level 2 fauna assessment was carried out in April 2005 to identify species of conservation significance which supplemented past studies by Biota, Bamford Consulting Ecologists and Western Wildlife. Trapping mammals (together with amphibians and reptiles) took place on eight sites. Each trapping grid consisted of 10 Elliott traps and four wire cage traps, open for a minimum of five nights.

A small colony of Bilbies was located in the ecotone between spinifex grassland and chenopod shrubland east of Cloud Break. At least six burrows were located that had been used within the previous 10 days, as well as older burrows indicating that the area is occupied by the species with at least some regularity (FMG 2005). There are also other records from the last decade indicating that the Bilby is resident in the general area. A colony of Bilbies was recorded in the study area for the Cloud Break Project (but outside of the area proposed for disturbance), and more species may occur within the area based on the habitat types present.

As little historical biological work had been conducted in this area, the primary information sources used for the Cloud Break Iron Ore Mine referral were the systematic flora and fauna surveys that have been conducted along the proposed Hope Downs rail corridor (Biota 2001a, b)



and FMG Stage A and B project areas (Biota, 2004a, 2004b, 2005a) as these studies were conducted in close proximity to the Cloud Break project area.

Proposed management measures suggested by Bamford Consulting Ecologists and Western Wildlife (2005) included the requirement to find further information on the distribution and abundance of Bilbies in the area, which was implemented by the proponent. The referral was assessed as a ‘controlled action’ under the EPBC Act with the following conditions relevant to Bilbies:

- Implement and adopt a Bilby Management Plan; and
- Development of a fauna management plan for managing operational impacts including further info on direct and indirect impacts to Bilbies and management and monitoring strategies to ensure the Bilby is not significantly disturbed within the project area and surrounding environment.

### **2.8.2. Pilbara Iron Ore and Infrastructure Project (Stage A and Stage B)**

The Pilbara Iron Ore and Infrastructure Project is a series of mines, rail and port infrastructure referred under the EPBC Act by FMG in 2004 and 2005.

Stage A of the project comprised a 345 km north-south railway and a port. Stage A was referred under the EPBC act in 2004 for factors including potential impacts to Bilbies. Previous surveys in the proposed Hope Downs rail corridor identified three burrows that were confirmed as Bilby burrows (Biota 2001a). These burrows were not active. A follow-up targeted survey that searched 40 sites for evidence of Bilbies found no further evidence of Bilbies in the area (Biota 2002). Stage A of the project was assessed as ‘not a controlled action’ by the Minister for Environment and Heritage.

Stage B of the project comprised mining operations at four mines and an east-west rail spur. A comprehensive Level 2 fauna survey was carried out for Stage B by Biota (2005a). The survey comprised of 36 trapping grids with a total of 400 Elliott trap-nights in addition to other observational data. No evidence of Bilby presence was recorded from the survey, however, a recent record nearby (not within the project’s disturbance envelope) presented the potential for this species to occur. Stage B of the project was assessed as ‘not a controlled action’ by the Commonwealth Minister for Minister for Environment and Heritage.

In 2010 a further proposal was submitted under the EPBC Act to increase the dewatering limits at the Christmas Creek Iron Ore Mine (approved under Stage B of the Pilbara Iron Ore and Infrastructure Project). The proposed area of disturbance was 600 ha. Based on the information from the Biota (2005a) survey conducted for Stage B of the Pilbara Iron Ore and Infrastructure Project, surveys for previous projects in the area (Hope Downs rail corridor) and fauna surveys/observations during operations of the Christmas Creek mine, the Bilby was considered unlikely to occur in the vicinity of the Christmas Creek Mine.

Following the assessment of the proposed 2010 Christmas Creek activity, this proposal was declared as a ‘controlled action’ and at the request for further information, FMG produced an EPBC Fauna Impact Assessment for the proposed action in 2011. This report included an assessment of potential Bilby habitat present in the disturbance area, and likelihood of occurrence. Approximately 40% of the proposed area of disturbance was classified as potential Bilby habitat. A desktop study of the terrestrial vertebrate fauna of Christmas Creek concluded there was a medium likelihood of the Bilby occurring in the project area (Ecologia 2010). This was based on observations from previous environmental and targeted surveys in the region. Two direct offsets were proposed for the loss of habitat for EPBC listed fauna species, including the Bilby.

### **2.8.3. Duchess Paradise Project**

The Duchess Paradise Project is a proposed coal mine in the West Kimberley, approximately 175 km south-east of Derby. It involves 1600 ha of ground disturbance (Rey Resources 2011). No evidence of Bilby presence was observed in or near the project area during Level 2 wet/dry season vertebrate fauna surveys in 2010 and a targeted search in October 2010 (Western Wildlife 2011). The proposed action was assessed as a ‘controlled action’ under the EPBC Act and is currently undergoing assessment through the Public Environmental Review (PER) process under the Western Australia *Environmental Protection Act 1986*. This assessment as a controlled action was due to potential impacts to a number of factors including threatened species such as the Bilby.

These survey efforts, relevance and recommended management measures of these projects are further detailed in Appendix A.

### 3. Survey Effort and Findings

#### 3.1. Overview

Extensive wet and dry season fauna studies were completed in and near the BLNG Downstream Development area between 2008 and 2010 in order to inform the baseline understanding and impact assessments presented in the Strategic Assessment Report (SAR). Since the release of the SAR, additional fauna surveys and other environmental studies, specifically in the proposed Downstream Development area, have been undertaken in 2010 and 2011 to support Woodside's approval process and meet existing SAR commitments. A summary of the fauna surveys and related studies undertaken, their survey effort and findings in relation to the Bilby, is presented in Table 3-1.

#### 3.2. Survey Effort for the BLNG Precinct and Downstream Development

The combined survey effort related to the presence of Bilbies in the Browse LNG Precinct, Downstream Development and regionally has been presented in Table 3-1 and Figure 3-1 (BLNG area) and Figure 3-2 (the Dampier Peninsula region). Bilby observations from these studies have been classified based on likelihood: Likely, Possible and Unlikely. Likely and Possible records are the primary information included in the relevant figures and appendices.

The following list summarises the targeted fauna survey effort (plus other local and regional survey effort detailed in Table 3-1) that has occurred in the vicinity of the proposed Browse LNG Downstream Development between 2008 and 2011:

- 8 separate targeted fauna survey programs over four years;
- 36 targeted fauna survey sites (of 202 sites regionally);
- 480 person days (of 896 person days regionally);
- 528 hours (of 612 hours regionally) of motion sensitive camera trapping (diurnal and nocturnal);
- 25.5 hours (of 47.5 regionally) of targeted nocturnal searching;
- 1957 person hours (of 2001 person hours regionally) of targeted daylight searching;
- 457.5 kilometres (of 1279.5 km) of foot traverse transect searching; and
- 181 hectares (of 291.25 ha) of survey area.

Thirteen records of Bilby evidence (burrows and diggings) classified as Likely were identified from these assessments and other opportunistic assessments in 2011 based on reviewed advice from Dr Richard Southgate. Five of these records were from targeted vertebrate fauna assessments and seven records were from opportunistic surveys. One of the Likely records was considered to be recent or a 'fresh' sign, while the remainder of the Likely records were from signs (burrows) that were not considered to be not 'active' or recently used (i.e. these generally

appeared to be from approximately two months previously). No records of Bilby evidence classified as Likely have been recorded between 2008 and 2010. The Likely records are located outside of the proposed development area and the majority occur along the North East Access Track (NEAT) and south of the main Downstream Development and Precinct area on the eastern side of Manari Road.

A total of 36 records of potential evidence have been classified as 'Possible' signs of Bilby. Four records of potential evidence were classified as 'Unlikely'. Observers from various surveys have also excluded other burrows as Unlikely based on appearance. No other direct evidence of Bilby presence has been recorded from these surveys. The images of Bilby evidence records are included in Appendix B. Coordinates and assessment of likelihood status for each record are included in Appendix C.

The eight targeted terrestrial vertebrate fauna assessments have been further detailed below.

ENV (2008) conducted a terrestrial vertebrate fauna assessment over four areas: Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb Point to Quondong Point (including James Price Point) in 2008. It included 28 sites (seven sites in each area), generally ten trapping nights per site and a total of 158 person days of survey effort. No Bilby evidence was recorded, but communication with local people indicated recent Bilby observations had occurred in the Gourdon Bay area.

Biota (2009) conducted a wet season terrestrial vertebrate fauna assessment (March 2009) of the James Price Point coastal area. This survey included 15 trapping sites, diurnal and nocturnal targeted searching and 156 person days of effort. No Bilby evidence was observed from the survey and the report concluded in relation to Bilby that the species could occur in the area.

AECOM (2010) conducted a supplementary terrestrial fauna and habitat assessment of the James Price Point coastal area in November 2009. This survey utilised predominantly daylight transect searching with limited nocturnal searching. A total of 20 person days of effort were used and 19.5 km of transect searching. Potential Bilby burrow evidence was recorded but not considered as confident observations. The report describes that the observations at best suggest potential presence of a few vagrant individuals rather than a colony. These potential Bilby records from AECOM (2010) are classified as Possible for the purposes of this report.

Biota (2011a) conducted a wet season targeted terrestrial vertebrate fauna assessment of the James Price Point area in March 2010. This included four survey trapping sites and 30 person days of daylight assessment. No Bilby observations or other potential evidence was recorded from the survey and concluded that Bilby may possibly occur in the area based on factors such as habitat.

Ecologia (2011) conducted a post-wet season/early dry season terrestrial vertebrate fauna assessment in April/May 2011 of the proposed Light Industrial Area, Workers' Accommodation

Camp and Southern Pipeline areas of Woodside's BLNG Downstream Development in the James Price Point coastal area. This assessment included five trapping sites, 101 person days, 432 hours of motion sensitive camera trapping, daylight targeted surveys and 223 kilometres of targeted transect searching for Bilby evidence. No direct Bilby observations were made, however a number of potential Bilby burrows and diggings were recorded. One Bilby burrow and three diggings were classified as Likely. A number of other potential burrows and diggings were classified as Possible. This assessment also visited potential burrow evidence identified by AECOM (2010) to the east of Manari Road near the turnoff to Quondong Point, but did not observe signs of any recent Bilby activity in the area. The report concludes that Bilby are likely to occur in the area however are unlikely to be resident individuals.

ENV (2012, in preparation) conducted a post-wet season/early dry season targeted Bilby assessment in May/June 2011 in the Quondong Point area. The assessment involved cage trapping, motion sensitive cameras at selected burrow locations and 18 km of targeted transect searches for potential Bilby evidence. A number of potential Bilby burrows were recorded from the assessment. One burrow system with multiple entrances and a 'pop hole' was observed as recently produced and was classified as Likely to be from Bilby. Other burrows were classified as Possible. This report also referred to burrows recorded by Ecologia in relation to the proposed Workers' Accommodation Camp area on the eastern side of Manari Road. The report concludes that there is not sufficient information to determine the status/abundance of Bilby in the area and may require further study.

AECOM (2011) conducted a targeted fauna assessment for Bilby along the proposed BLNG Precinct Access Road for Main Roads Western Australia. The assessment included targeted daylight and nocturnal transect searching at regular transects along the length of the alignment. The assessment identified potential Bilby evidence in the form of seven burrows. Six potential Bilby burrow images were recorded, of which three have been assessed as Possible, and three as Unlikely. One additional potential Bilby burrow (AECOM code B8) was recorded by field notes but was not supported by an image that could be independently assessed. The report notes that this burrow was similar to another burrow (AECOM code B3) recorded in a nearby area. This burrow has been classified as Unlikely consistent with the assessment of the earlier burrow, in the absence of any further supporting information for Bilby evidence. The report concluded that there was no strong evidence to indicate recent Bilby activity in the area.

CES has conducted targeted pre-clearance fauna and flora assessments of Woodside's proposed BLNG Downstream Development area between August and October 2010, plus April to November 2011. These assessments include an estimated 120 person days, 1600 hours and 160 kilometres of targeted transect surveys within the proposed development area. No Bilby evidence in the form of burrows, diggings, tracks or scats were recorded from these pre-clearance assessments. The conclusion was that no evidence exists of Bilbies in the area.

Other relevant assessments with the potential to identify potential Bilby evidence have occurred in the vicinity of the proposed BLNG Downstream Development and Precinct. These assessments have been summarised in Table 3-1. Eight Bilby burrows classified as Likely (and assessed as not recently active) have been recorded in 2011 along the North East Access Track (NEAT) (seven records) and on a Monsoon Vine Thicket (Evergreen) (1 record) sand dune area south of the main development through opportunistic assessments by Woodside and by Bamford Consulting Ecologists respectively.

■ **Table 3-1 Summary of Relevant Fauna Surveys and Findings in Relation to Bilby**

Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
<b>Studies referred to in the Browse LNG Precinct Strategic Assessment Report</b>											
Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb - Quondong Vertebrate Fauna Assessment (ENV 2008) – [Coulomb Point - Quondong Point area only] (*1)	Dry season: August 2008	Level 2 Fauna Survey	7	20	0	5	5	2	14	0	No evidence of the species observed from the survey.
Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb- Quondong Vertebrate Fauna Assessment (ENV 2008) – [Perpendicular Head – North Head area only] (*1)	Dry season: June 2008	Level 2 Fauna Survey	7	40	0	5	5	2	14	0	Not expected for the area based on existing evidence.

Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb- Quondong Vertebrate Fauna Assessment (ENV 2008) – <b>[Packer Island area only]</b> (*1)	Dry season: June 2008	Level 2 Fauna Survey	7	50	0	5	5	2	14	0	Bilby may occur in the area based on anecdotal evidence from the Beagle Bay area.
Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb- Quondong Vertebrate Fauna Assessment (ENV 2008) – <b>[Gourdon Bay area only]</b> (*1)	Dry season: June 2008	Level 2 Fauna Survey	7	48	0	5	5	2	14	0	Bilby known from the area (towards Bidyadanga) by local anecdotal evidence from observations and road kill.
James Price Point Terrestrial Fauna Survey: Wet Season 2009 (Biota 2009) (*2)	Wet season: March 2009	Level 2 Fauna Survey	15	156	0	15	30	4	20	0	Bilby could potentially occur in the area.



Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
Supplementary Terrestrial Fauna and Habitat Assessment James Price Point WA (AECOM 2010) (*3)	Dry season: November 2009	Level 2 Fauna Survey	0	20	0	2	26	19.5	7	0	Observations "at best" suggest potential presence of a few vagrant individuals rather than a colony.
<b>Studies undertaken for Woodside and Main Roads Western Australia since publication of the Browse LNG Precinct Strategic Assessment Report</b>											
James Price Point Browse LNG Precinct Targeted Terrestrial Fauna Survey – March 2010 (Biota 2011) (*4)	Wet season: March 2010	Level 2 Fauna Survey	4	30	0	0	20	5	4	0	Bilby may possibly occur in the area.

Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
James Price Point: Light Industrial Area, Workers' Accommodation Camp and Southern Pipeline Level 2 Vertebrate Fauna Assessment (Ecologia 2011a, report in preparation) (*5)	Post-wet season: April / May 2011	Level 2 Fauna Survey (WAC, SP and adjacent to LIA) and Level 1 (LIA)	5	101	432	0	186	223	38	4	Bilby likely to occur in the area, however unlikely to be any resident individuals
Bilby ( <i>Macrotis lagotis</i> ) Survey of the Quondong Point Area (ENV 2011, report in preparation) (*6)	Post-wet season: May / June 2011	Level 2 Targeted Bilby Survey	5	24	96	0	8	18	18	1	Not sufficient information available to determine status of bilbies in the area and may require further study.
Field summary note from Bamford Consulting Ecologists, May 2011 on targeted assessment of birds in vine thickets. (*7)	Post-wet season: May 2011	Bird survey: deciduous and evergreen vine thicket and open woodland.	10	15	84	3	20	20	20	1	If present, the Bilby probably occurs only as an occasional visitor to the area.

Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
Browse LNG Precinct Access Road: Targeted Fauna Survey – Bilby (AECOM 2011) (*8)	Dry season: June/ July 2011	Daytime transect site survey and nocturnal spot-lighting within suitable habitat	0	9	0	3.5	82	26	42	0	No strong evidence to indicate Bilby activity in the areas surveyed.
Pre-clearance environmental assessments for the Onshore Site Investigation areas (under CPS 3771/1). Woodside Downstream Development area. (*9)	Dry season Aug. & Oct. 2010, Wet & Dry season Apr. to Nov. 2011	Targeted transect searches for species of conservation significance	0	120	0	0	1600	160	38	0	No evidence of Bilby within any development area assessed
Browse LNG Development Vegetation Monitoring Program (VMP) Phase 1 (SKM and Biota) (Biota 2011b) (*10)	Phase 1 late dry season: Nov. to Dec. 2010	Flora Quadrats, nested transects, plus traverses.	40	67	0	0	0	300	10	0	No evidence of Bilby reported or observed.

Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
Browse LNG Development Vegetation Monitoring Program (VMP) Phase 2 (SKM and Western Botanical) (see Biota 2011c, in preparation) (*10)	Phase 2 late-wet season / early dry season: April to May 2011	Flora Quadrats with nested transects.	49	75	0	0	0	400	12.25	0	No evidence of Bilby reported or observed.
Browse LNG Development Vegetation Monitoring Program (VMP) Phase 3 (Ecologia, in prep.) (*11)	Phase 3 late dry season Nov. / Dec. 2011	Flora Quadrats with nested transects.	40	65	0	0	0	300	10	7	Likely burrows identified in the area of the NEAT (none from recent activity)

Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
<b>Relevant Regional Surveys</b>											
Beagle Bay Big Tree Country Tropical Timber Plantation Project (Ecologia 2004) (*12)	Wet Season, March 2003	Level 2 Fauna Survey	6	56	0	4	9	4	16	0	Records indicate that the species may still occur in the area.
<b>Total Targeted Fauna/Bilby Studies and observations near proposed Browse LNG Precinct</b>	<b>8 surveys</b>	<b>Level 2 fauna surveys and targeted surveys</b>	<b>36</b>	<b>480</b>	<b>528</b>	<b>25.5</b>	<b>1957</b>	<b>457.5</b>	<b>181</b>	<b>5</b>	No primary evidence from many surveys, limited number of likely burrows and other evidence
<b>Total of Other Studies near proposed Browse LNG Precinct</b>	<b>4 surveys</b>	<b>Other surveys</b>	<b>139</b>	<b>222</b>	<b>84</b>	<b>3</b>	<b>20</b>	<b>1020</b>	<b>52.25</b>	<b>8</b>	Confirmed secondary evidence in 2011.
<b>Total of Relevant Regional Fauna Studies</b>	<b>4 surveys</b>	<b>Fauna and targeted surveys</b>	<b>27</b>	<b>194</b>	<b>0</b>	<b>19</b>	<b>24</b>	<b>10</b>	<b>58</b>	<b>0</b>	

Study title	Timing	Survey Type	Number of Sites	Person days	Motion-sensitive camera trap-hours	Targeted Nocturnal searching (person hours)	Targeted Daylight searching (person hours)	Foot Transect search length (km)	Estimated Search area (ha) for the survey	Number of confirmed Bilby observations ('Likely' burrows or animals)	Summary Findings from assessment in relation to Bilby
<b>Total of all surveys</b>	<b>16 surveys</b>	<b>Targeted Fauna and other surveys</b>	<b>202</b>	<b>896</b>	<b>612</b>	<b>47.5</b>	<b>2001</b>	<b>1487.5</b>	<b>291.25</b>	<b>13</b>	
<b>Community reports</b>											
Evidence of the Greater Bilby, <i>Macrotis lagotis</i> , at the site of the proposed James Price Point Browse LNG Precinct (Report prepared by Malcolm Lindsay for the Goolarabooloo and Broome No Gas Community, October 2011)	Dry season, August 2011	Survey by community members, transects and opportunistic observations, camera trap and sandpad assessment.	Not provided in report	Not provided in report	Not provided in report	Not provided in report	Not provided in report	Not provided in report	Not provided in report	4 Bilby observations listed, two other individuals reported as active to the north east. Other burrows and tracks present.	Description of a breeding colony of Bilby present in the area surrounding the proposed Browse LNG Precinct during 2011.

## Legend

	Targeted terrestrial vertebrate fauna studies in the vicinity of the BLNG Precinct and Downstream Development 2008-2011
	Other relevant studies in the vicinity of the BLNG Precinct and Downstream Development 2010 - 2011
	Other relevant regional terrestrial vertebrate fauna studies on the Dampier Peninsula and surrounds 2003 - 2011
	Total of all surveys
	Community surveys

\*1 – Duration of hours for nocturnal searching not provided in the report and a conservative estimate has been added. Four nights of opportunistic observations are listed. Nocturnal searching was conducted in the form of car spotlighting along roads and foot searches of habitat with headlamps. Transect survey length not listed in the report, therefore a conservative estimate for each area has been provided based on 7 x trap lines 30 m apart (210m) with 7 sites (1.47 km, plus around 500m of opportunistic survey effort rounded up to a total transect search of 2 km). Search area calculated based on an estimated nominal survey site search area of 2 ha, with 7 sites per broader study area, giving 14 ha as a total.

\*2 – Person days estimate provided based on an average of six personnel for the duration of survey (including ten personnel for set-up). Estimate of nocturnal search hours based on these surveys being done on same 4 nights of bats surveys. Transect length estimated based on other survey effort. Estimates based on each systematic fauna trapping site as 1 ha search area x 15 sites = 15 ha, plus 5 ha of estimated opportunistic surveys outside of the trapping sites. Survey included diurnal searches and nocturnal road spotlighting and foot-based headtorch searches.

\*3 – Calculation based on 4 x fauna personnel and 5 days of survey. Nocturnal survey was a road spotlighting survey. Transect length calculated based on 39 transects at an average of 500 m in length each (as stated in the report).

\*4 – General opportunistic assessment done for Bilbies as part of this study and an estimate of search hours and transect has been provided.

\*5 – Camera traps located at potential Bilby burrow locations. The person hours of diurnal searching includes 35 hours of targeted surveys for secondary evidence of Bilbies. The survey search area is estimated based on the size and number of sites, plus transect data provided separately to Woodside.

\*6 – Motion sensitive camera trapping hours estimated based on 8 camera trap nights, with 12 hours per night. Transect search length and are based on 90 transects of 200m length (18 km), with 3 personnel.

\*7 – Camera trapping duration based on 7 camera trap nights (cumulative as listed in the field report) with 12 hours per night. Camera trapping occurred in vine thickets at sites of mammal tracks other than Bilby and not at a burrow or digging location. Number of diurnal survey hours based on all bird surveys periods also including opportunistic assessment for other fauna, as stated in the report. Transect length estimated for the survey based on the number of sites.

\*8 – Potential Bilby evidence was identified and recorded. Camera traps were not established as no locations with evidence of recent Bilby activity were identified.

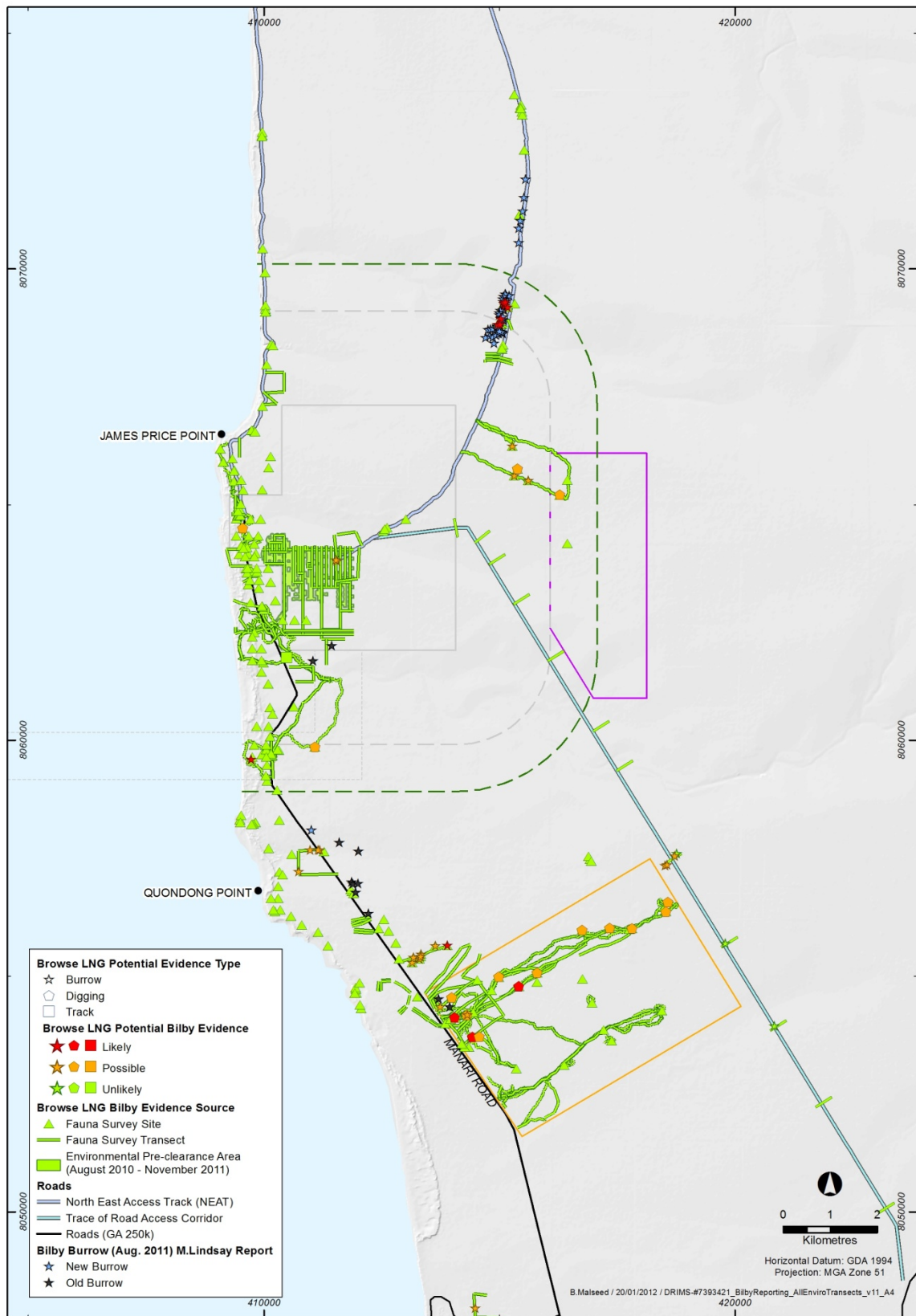
\*9 – Pre-clearance assessments are targeted foot traverse surveys that are exclusively search transects for evidence of species of conservation significance, such as Bilbies. Numerous repeat surveys of the precinct area have occurred between August 2010 and November 2011.

\*10 – Vegetation Monitoring Program (VMP) sites include intensive nested transect surveys within each 50 m by 50 m sites. Total transect search length is determined for assessments within each site only and excludes opportunistic searches conducted while traversing on foot between sites. It is determined with a high level of confidence that no Bilby burrows were present at any VMP site locations during the Phase 1 (Nov./Dec. 2010) or Phase 2 (Apr./May 2011) assessments.

\*11 – Vegetation Monitoring Program (VMP) Phase 3 (Nov./Dec. 2011). Likely Bilby burrows were recorded from at and near two sites along the North East Access Track (NEAT). These burrows appeared to not have been recently active and seem to correspond with several locations identified on a map provided in the Lindsay (2011) community report.

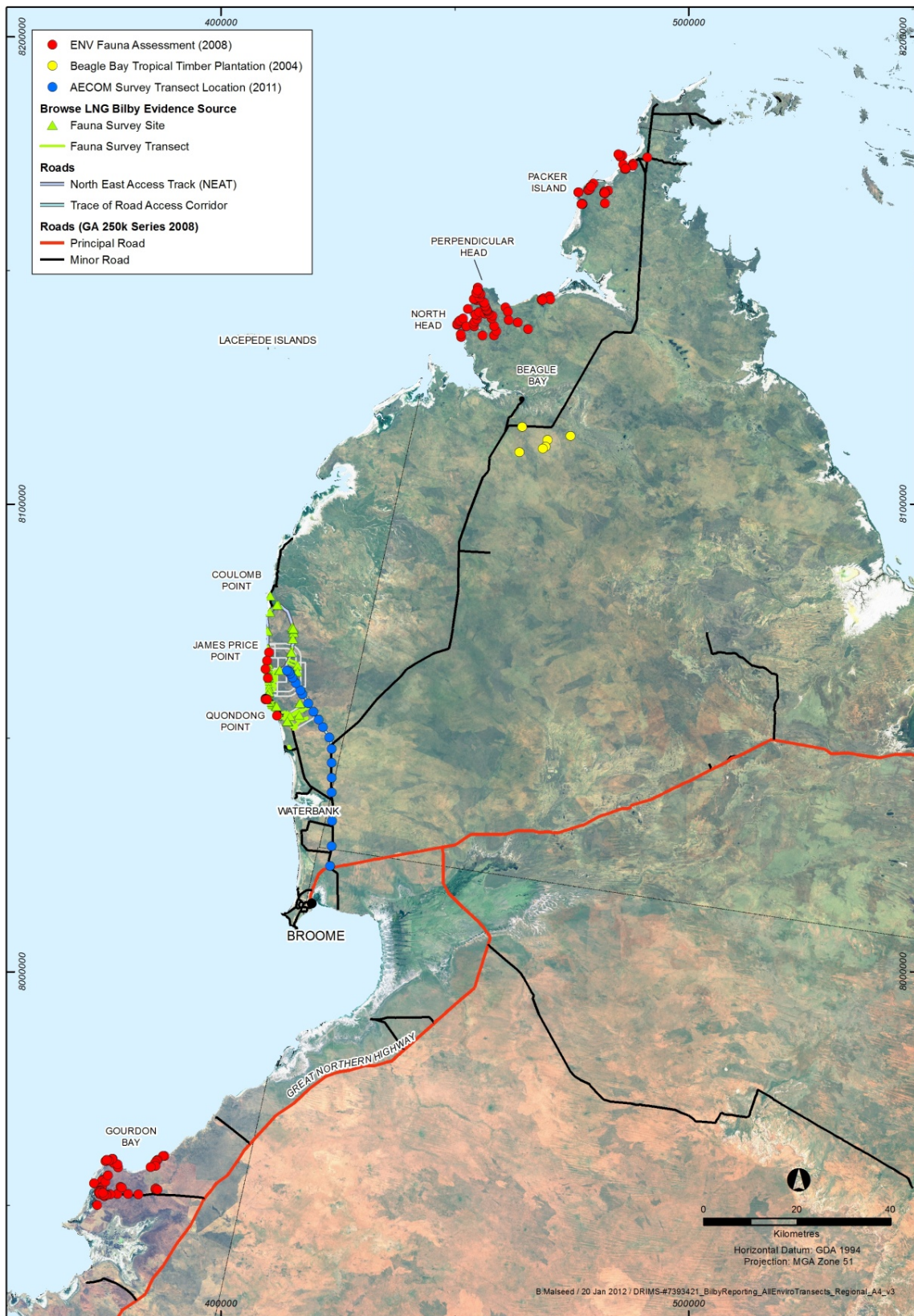
\*12 – Calculated based on 2 x 0.2 km trapping lines = 0.4 km transect search, with 6 sites equally 2.4 km, with an estimate of 1.6 km added for the opportunistic searching. Overall search area calculated based on each site trapping grid being approximately 100 x 200 m (as described in the report) = 2 ha per site and 12 ha for all six sites, plus an estimate of an additional 4 ha for opportunistic surveys. Estimate of 1 person hour for each of 4 nights for additional nocturnal searching time. Total person days has been calculated based on the 7 personnel listed for the study involved for the survey period 19 to 26 March 2003.

SINCLAIR KNIGHT MERZ



■ **Figure 3-1 Survey Effort and Bilby evidence for the Browse LNG area 2008-2011**





■ **Figure 3-2 Regional Terrestrial Vertebrate Fauna Survey Effort from 2003 - 2011**

### 3.3. Unpublished Report by Malcolm Lindsay

#### 3.3.1. Summary of the Report

An unpublished report prepared by Lindsay (2011) for the Goolarabooloo and Broome No Gas Community provides additional information regarding potential Bilby activity in the vicinity of the BLNG Precinct area from August 2011, but evidence reported cannot be independently verified. The report, *Evidence of the Greater Bilby, Macrotis lagotis, at the site of the proposed James Price Point Browse LNG Precinct*, proposes that at the time of its writing, an extant Bilby colony is present in the vicinity of the BLNG precinct area near James Price Point. Information presented in the report has been assessed and summarised below with points of interest previously presented in Figure 3-1. The actual coordinates of records are not provided in the report and therefore have been extracted from maps for the purpose of comparison.

Specifically, the report provides:

- A brief background to the Browse LNG Development;
- A description that the report was principally developed for the Goolarabooloo and ‘Broome No-Gas Community’;
- A basic description of the broad methods used to gather data presented in the report;
- ‘Evidence of presence’ for a potential Bilby colony near the BLNG precinct;
- Map and photographic support of the presented evidence for Bilby presence; and
- Discussion and suggested recommendations in relation to assessment of the Bilby in the BLNG development area and regionally.

The report has a number of limitations in that it does not provide:

- An assessment of all existing information in relation to other formal vertebrate fauna studies that have occurred in the area (particularly since the release of the SAR);
- A detailed description of the methods used (e.g. selection of sites and locations) to an extent that would allow another researcher to repeat the study quantitatively and temporally to permit confirmation or validation of the results;
- Specific information about survey effort (e.g. how many transect surveys, location of camera traps, how many camera trap nights or number of person hours of survey time);
- Details of exactly who undertook the survey and any relevant qualifications;
- Dates and/or duration of the survey/s to present survey effort required to collect the presented data;
- ‘Evidence of absence’ from surveys and related camera trapping (described as ‘unsuccessful’ or ‘failed’ in the report);

- Raw data; and
- Analysis of the dataset to place the results/evidence in the overall context of presence/absence of potential Bilby records from the area.

The report notes that Bilbies are notoriously difficult to capture or photograph and that consequently “numerous” trapping nights occurred that yielded no evidence of Bilby (which were not reported). The value of providing ‘evidence of absence’ has been emphasised previously in relation to sharing research knowledge on the success or otherwise of Bilby re-introduction programs (Southgate 1990a), and is well recognised as a core component of reporting ecological surveys.

The report presents evidence that areas to the southwest of the defined precinct contained old and recent evidence of Bilbies, while an area along the North East Access Track (NEAT) provided visual evidence for presence and successful breeding of Bilby based on fresh burrows, diggings, tracks and camera traps images. The report cites image evidence from a camera trap of a female adult Bilby, with three young at a burrow near the NEAT outside of the BLNG Downstream Development and Precinct area (but just within a broader buffer zone). Given that production of three young in a single litter is rare for the species, this is likely to reflect the favourable conditions and may have also occurred elsewhere in the region around the same time. Other evidence is presented based on tracks to suggest one large male Bilby and one small male/large female Bilby were present at the time of recording also along the NEAT. The report describes six individuals plus one or more other Bilbies present along the NEAT at the time of the assessment. Any short term population growth or a ‘boom’ in colony sizes is unlikely to have been isolated to the NEAT area with favourable conditions more likely to have extended over wider areas of the Dampier Peninsula in 2011.

## 4. Discussion: Bilby Observations for the Broader BLNG Downstream Area

### 4.1. Overview of Bilby in Relation to the BLNG Downstream Development

There have been a number of specific studies targeting vertebrate fauna (including Bilby) in the vicinity of the BLNG Downstream Development and Precinct near James Price Point as detailed in Section 3. Several vertebrate fauna studies were undertaken to support development of the SAR document and a number of other targeted fauna studies have been commissioned for the general BLNG Downstream Development and Precinct since the completion of the SAR was released.

These include:

- A targeted terrestrial fauna assessment of the James Price Point area conducted in March 2010 (Biota 2011a);
- A targeted Bilby survey in the Quondong Point area May-June 2011 (ENV 2012, in prep.);
- Vertebrate fauna assessments in and near the proposed Light Industrial Area, Workers' Accommodation Camp and Southern Pipeline areas in April-May 2011 (Ecologia 2011);
- Browse LNG Precinct Access Road Targeted Fauna Survey - Greater Bilby June-July 2011 for Main Roads Western Australia (AECOM 2011)
- Bird and associated fauna assessments in vine thickets in May 2011 (interim field report by Bamford Consulting);
- Vegetation Monitoring Program Phase 1 (dry season 2010), Phase 2 (wet season 2011) and Phase 3 (dry season 2011) (Biota 2011b, c, Ecologia 2012, in prep.);
- Multiple repeated targeted environmental pre-clearance assessments for conservation significant species and communities by CES/SKM over a period between August 2010 and November 2011 as part of Onshore Site Investigations (unpublished areas that have been mapped as part of this report). The environmental pre-clearance assessments included the proposed geotechnical track lines in Woodside's Downstream Development area as part of Woodside's Environmental Management Plan (EMP) commitments under the native vegetation clearing permit CPS 3771/1 issued by the DEC.

These studies used a range of techniques and combined represent a substantial quantity of spatial and temporal assessment aimed at identifying the potential presence or absence of Bilby, including but not limited to camera trapping and extensive foot traverse transect searches for burrows, tracks and diggings. None of these studies identified any direct evidence of individual Bilby animals, however 13 Likely burrows and diggings were identified with the majority of these located to the north east of the main proposed BLNG Downstream Development and



Precinct area. However, only one of these Likely records of Bilby evidence was considered to be recent and this was the ‘active’ burrow system to the south of this area.

Of significant interest is that a number of locations were assessed as part of a detailed Vegetation Monitoring Program in November/December 2010 (late dry season, Phase 1) and April/May 2011 (late wet season, Phase 2) for Woodside along the North East Access Track (NEAT). These surveys occurred prior to the assessment presented in the Lindsay (2011) report. The monitoring sites were virtually at the same locations along the NEAT as a number of active Bilby burrow and digging records and camera trap images that were reported by Lindsay (2011), based on inferred positions from mapping. Survey sites and traverse transects in this area were also conducted as part these assessments. No Bilby evidence in the form of burrows was observed at these sites along the NEAT at the time of the surveys. In addition, targeted fauna assessment near the NEAT in April-May 2011 by Ecologia (2011) recorded limited potential evidence of Bilbies.

Opportunistic observations made by Woodside in the same area along the NEAT in November 2011 as part of Phase 3 of a Vegetation Monitoring Program have identified a selection of burrows that have been classified as Likely to be from Bilby. However, the burrows show signs that they had not been recently used (i.e. not ‘active’) in the previous two to three months (September to November 2011).

In this instance, it appears based on the evidence that no Bilby activity was recorded along the NEAT in 2010 or for early to mid 2011. Following the particularly good wet season in early 2011, it appears that temporarily favourable conditions resulted in Bilby entering the area between June and August 2011 and that by November 2011 that the individuals may have been less active or absent from the area.

The cumulative evidence from 2011 along the NEAT suggests that any Bilbies recorded are probably few in number, transient and may have migrated through the area in the middle of the dry season following temporarily favourable conditions. These observations align with current knowledge regarding Bilby behaviour, in that higher densities of individuals and colonies may congregate spatially if conditions are favourable, but that this may not be maintained over longer periods, with transient patterns expected with the animals dispersing once food resources become exhausted.

The extensive environmental pre-clearance assessments undertaken by CES/SKM for Woodside at the BLNG Downstream Development area as part of the geotechnical activities and EMP commitments have yielded no evidence of Bilbies during the repeated surveys of many transects (as mapped) of at least 20 km in August 2010, October 2010 and effectively every month between April to November 2011.

Records from surveys by AECOM (2011) for a new road access corridor by MRWA to the southeast of the BLNG Precinct, identified burrows possibly from Bilbies, but no evidence of active recent use.

The current limited evidence of Bilbies outside and nearby to the proposed BLNG Downstream Development and Precinct area suggests that individuals seem to prefer open woodland and open forest pindan habitat (along the NEAT and southwest of the proposed development), with lower preference for pindan shrubland and other vegetation communities. Given that the BLNG Downstream Development and Precinct area is composed primarily of pindan shrubland vegetation with only relatively small patches of open woodland and open forest, it appears that the area is less likely to suit the Bilbies that appear to occupy the broader area at low densities in transient patterns. In addition, pindan vegetation habitat is known to be extensive across the Dampier Peninsula and thus the habitat within the BLNG Downstream Development and Precinct area is considered not likely to be significant or restricted habitat for Bilby in this broader context.

Bilbies are known to have large home ranges to facilitate survival in habitats with variable resources, as described earlier in this report. As such, it is possible that one or more Bilbies may have entered the BLNG Downstream Development and Precinct areas historically and may do so again in the future, either on transit to other areas or to forage if access and conditions are suitable. The area however does not appear to constitute significant or isolated habitat for the species.

This report suggests that given the evidence of repeated environmental assessments between 2008 and 2011 that Bilbies appear to be absent in the main Downstream Development area and present in low and probably transient numbers in the surrounding BLNG Precinct area and wider development buffer zone.

#### **4.2. Likelihood of Presence**

The current evidence from eight targeted fauna survey programs over four years in the vicinity of the BLNG Downstream Development and Precinct suggests that few Bilbies are present and appear to be highly mobile.

The majority of the area for the proposed BLNG Downstream Development and Precinct comprises pindan vegetation. The majority of the Bilby evidence presented in this report is from pindan vegetation habitats, which are extensively represented on the Dampier Peninsula and surround the proposed development areas. Bilbies can be highly mobile with large individual ranges while seeking favourable habitats that fluctuate seasonally and in relation to fire. While limited regional information is available, it is expected that the Bilby species is present widely on the peninsula at low numbers, and observations from the broader BLNG Downstream Development and Precinct area are not likely to represent an isolated population or colony.

Regionally, there have been a number of terrestrial vertebrate fauna surveys conducted between 2003 and 2011 on the Dampier Peninsula and surrounding areas. In addition to this, observations of Bilby evidence can be reported to the DEC. There are no direct records of Bilbies from other surveys in the region conducted on the Dampier Peninsula over this period. It appears that based on regional survey effort, historical records and anecdotal evidence that Bilbies occur at very low densities on the Dampier Peninsula, which is consistent with current knowledge of distribution for the species in the region.

Conducting a thorough regional assessment for Bilby on the Dampier Peninsula may be problematic due to the higher density of vegetation coverage in areas that have not been recently burnt and the apparently very low density of Bilbies. Assessment approaches used in arid desert areas may not be appropriate for the Kimberley region in general, or for the Dampier Peninsula in particular. Ground-truthing would be important for any detailed large scale regional assessment of Bilby on the Dampier Peninsula.

Aerial (helicopter) surveys would be likely to be quite challenging due to expected poor ground visibility in areas of higher vegetation densities. Aerial surveys supported by ground searching are expected to have limitations due poor ground visibility in areas of higher density of pindan vegetation. Poor ground visibility may compromise the ability to obtain valid data through issues such as risks of higher levels of false-negative results.

Bilbies may occur at low densities and be widespread in the Dampier Peninsula region, but the current status is not able to be determined due to the low number of recent records, limited regional surveys and apparent relatively high intensity of survey effort required to determine presence of the species in an area (which has generally not occurred in many other locations on the Dampier Peninsula).

## 5. Conclusion

The evidence presented indicates that low numbers of Bilbies have been present in the areas surrounding the main BLNG Downstream Development and Precinct area and these are unlikely to represent a significant isolated colony or population in the region. Therefore, the expected status of Bilby in the area is that Bilbies appear to be present in very low numbers in the area and probably occupy large ranges over widespread pindan habitat in response to food resources becoming exhausted in one area and being available elsewhere.

Assessment for Bilby is likely to continue to be difficult in the Dampier Peninsula region when compared to other studies undertaken in desert areas with open vegetation cover dominated by low spinifex (*Triodia* spp.). Pindan shrublands, woodlands and open forest environments in the vicinity of the Downstream Development and the wider Dampier Peninsula are structurally taller and denser than spinifex dominated vegetation.

Aerial surveys supported by foot-based ground-truthing that can otherwise be quite effective for identifying Bilby signs in spinifex vegetation, is expected to be considerably less effective for Pindan vegetation communities. The risk of not identifying clear signs such as potential burrows and digging locations during aerial (helicopter) transect surveys is expected to be quite high in pindan areas, and may result in the creation of false-negative evidence.

It is recommended that an appropriate regional management plan is developed and implemented to mitigate against threatening processes to the Bilby, such as predation by foxes and cats, habitat degradation due to introduced herbivores and altered fire regimes. This is likely to offer the best approach for effective use of resources for improving conservation outcomes for the species on the Dampier Peninsula. A strategy that follows this approach may align well as an expansion to existing conservation measures being applied for recovery of Bilbies. A regional management plan and recovery strategy for Bilbies may be used as a basis for guiding local management measures for the BLNG Downstream Development and Precinct.



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## **Appendix A Details of Relevant Projects Assessed for Bilby under the EPBC Act.**



Study No. & Aspect	Title of Study and author	Study Location	Purpose of Study	Key Findings/Potential impacts to Bilby/Fauna	Relevance to Browse LNG Downstream Development	Additional Information
Referral	Pilbara Iron Ore and Infrastructure Project: Stage A north-south railway and Port infrastructure (FMG 2004)	Western Australia – Pilbara Region	EPBC Act Referral	<p>The likelihood of Bilby occurrence assessed based on previous surveys conducted in the project area for the proposed Hope Downs rail corridor and complemented by a survey of areas not covered by the Hope Downs surveys (Biota 2004a, b)</p> <p>Three Bilby burrows recorded adjacent to the Hope Downs rail alignment near a tributary of the Turner River (Biota 2001a). These were confirmed as Bilby burrows following analysis of photographs by Dr Peter Kendrick (CALM/DEC Pilbara Regional Ecologist).</p> <p>No Bilbies were sighted or trapped, and none of the burrows were apparently active.</p> <p>A targeted follow up survey for Bilby and</p>	Potential for occurrence, however none recorded in surveys	Project referral was assessed as 'not a controlled action' under the EPBC Act 1999.






Study No. & Aspect	Title of Study and author	Study Location	Purpose of Study	Key Findings/Potential impacts to Bilby/Fauna	Relevance to Browse LNG Downstream Development	Additional Information
				Mulgara surveyed 40 sites and found no further evidence of Bilby (in the form of tracks, scats, burrows) (Biota 2002).		
<b>Fauna Survey</b>	Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage B Rail Corridor and Mindy Mindy, Christmas Creek, Mt Lewin and Mt Nicholas Mine Areas (Biota 2005a).	Western Australia – Pilbara Region	Railway and Mine construction proposal	<p>36 trapping grids, with a total of 400 Elliott trap nights.</p> <p>The trapping design replicates that used by Biota along the proposed FMG Stage A rail corridor (Biota 2004b) and within the Hope Downs rail corridor (Biota 2002, 2004c and 2004d). This was done with the intention of using the two datasets to provide some regional context.</p> <p>There were no Bilby records from the FMG Stage B study area, however the species is still considered to possibly occur in the area. A recent record has been obtained from Mulga Downs Station (Dr Peter Kendrick, DEC [CALM] Karratha, pers. comm.). The location of</p>	Potential for occurrence. However none recorded in systematic surveys (traps) or non-systematic general surveys (aimed at identification of secondary signs)	Project referral was assessed as 'not a controlled action' under the EPBC Act 1999.

Study No. & Aspect	Title of Study and author	Study Location	Purpose of Study	Key Findings/Potential impacts to Bilby/Fauna	Relevance to Browse LNG Downstream Development	Additional Information
				this record (711250 mE; 7534400 mS, Datum: WGS84) is to the south of the proposed rail corridor but is from habitat equivalent to that intersected by much of the corridor.		
<b>Referral, fauna survey data, management</b>	Cloud Break Iron Ore Mine	Western Australia – Pilbara Region	Referral	<p>Trapping took place at eight sites. There were a total of 180 Cage trap-nights and 510 medium Elliott trap-nights.</p> <p>A small colony of Bilbies was located east of Cloud Break; there were at least 6 burrows that had been used within the previous 10 days, and older burrows indicating that the area is occupied by the species with at least some regularity. There are also some other records from the last decade indicating that the species is resident in the general area.</p>	<p>Potential for occurrence. Although the Bilby colony is outside areas of proposed mining activity, it is possible that suitable habitat may occur in such areas.</p>	<p>The project referral was assessed as a 'controlled action' under the EPBC Act 1999.</p> <p>FMG has prepared a Bilby Management Plan which includes input from CALM and similar measures such as:</p> <ul style="list-style-type: none"> <li>- keeping vegetation clearing during construction to the minimum required for safe working practices and engineering constraints;</li> <li>- restricting road speeds (particularly at night);</li> <li>- implementing a workforce environmental awareness training course;</li> <li>- Further detailed surveys of potential habitat to be impacted by mining activities prior to construction, and monitoring of the existing population; and</li> <li>- Developing a fire</li> </ul>






Study No. & Aspect	Title of Study and author	Study Location	Purpose of Study	Key Findings/Potential impacts to Bilby/Fauna	Relevance to Browse LNG Downstream Development	Additional Information
						management plan which takes into account Bilby requirements for habitat.
<b>Referral, fauna survey data</b>	Referral of Proposed Action Under the Environment Protection and Biodiversity Conservation Act 1999. Duchess Paradise Project, Canning Basin Western Australia (Rey Resources Ltd)	Western Australia – West Kimberley	Referral	General survey: 574 Cage trap-nights, 2870 Elliott trap-nights Targeted survey (Northern Quoll): 84 Cage trap-nights and 490 Elliott trap-nights. No Bilbies recorded from traps. No secondary evidence of Bilbies	Project location (West Kimberly)	Proposed general management measures: - Clearing activities will be managed to ensure clearing is strictly limited to that necessary for the operations. - Disturbed areas will be rehabilitated as they become available. - Open holes, trenches, slots, the reject impoundment and any water holding facilities will be inspected regularly for fauna. - An induction program will familiarise personnel with fauna of conservation significance including their appearance and usual habitats. - Domestic waste facilities will be fenced and putrescible wastes will be regularly covered. - At closure, all water storage facilities will be removed and surface mining slots backfilled such that no artificial water storage areas remain.





Study No. & Aspect	Title of Study and author	Study Location	Purpose of Study	Key Findings/Potential impacts to Bilby/Fauna	Relevance to Browse LNG Downstream Development	Additional Information
<b>Referral</b>	Christmas Creek Water Management Scheme: EPBC Fauna Impact Assessment (Fortescue Metals Group)	Western Australia – Pilbara Region	Referral	400 Elliott trap-nights (Biota 2005) No Bilbies recorded		Offsets for consideration: Establish a 720 ha conservation area to be managed in similar way to Arid Recovery Centre associated with the BHP Billiton's Olympic Dam project in South Australia. Involve Traditional Owners wherever possible. Conservation area to include 600 ha of area fenced with predator proof fencing.





## Appendix B Images of Potential Bilby Evidence





Photo	New Code	Easting (mE)	Northing (mN)	Field Code	Source	Likelihood Classification of Bilby Evidence
	1-A	415119	8069232	A-1	Woodside opportunistic assessment VMP Phase 3, 2011	Likely
	1-B	415119	8069232	A-2	Woodside opportunistic assessment VMP Phase 3, 2011	Likely (same as above)
	2-A	415101	8069276	B-1	Woodside opportunistic assessment VMP Phase 3, 2011	Likely
	2-B	415101	8069276	B-2	Woodside opportunistic assessment VMP Phase 3, 2011	Likely (same as above)
	3-A	415120	8069303	C	Woodside opportunistic assessment VMP Phase 3, 2011	Likely








	4-A	415174	8069195	D	Woodside opportunistic assessment VMP Phase 3, 2011	Likely
	5-A	415033	8068950	E-1	Woodside opportunistic assessment VMP Phase 3, 2011	Likely
	5-B	415033	8068950	E-2	Woodside opportunistic assessment VMP Phase 3, 2011	Likely (same as above)
	6-A	414961	8068832	F-1	Woodside opportunistic assessment VMP Phase 3, 2011	Likely
	6-B	414961	8068832	F-2	Woodside opportunistic assessment VMP Phase 3, 2011	Likely (same as above)






	7-A	415012	8068825	G-1	Woodside opportunistic assessment VMP Phase 3, 2011	Likely
	7-B	415012	8068825	G-2	Woodside opportunistic assessment VMP Phase 3, 2011	Likely (same as above)
	11-A	414048	8054119	Bilby Burrow WA	Ecologia 2011	Likely
	11-B	414048	8054119	Bilby Burrow WA	Ecologia 2011	Likely (same as above)





	11-C	414048	8054119	Bilby Burrow WA	Ecologia 2011	Likely (same as above)
	11-D	414048	8054119	Bilby Burrow WA	Ecologia 2011	Likely (same as above)
	11-E	414048	8054119	Bilby Digging WAC1	Ecologia 2011	Likely
	11-F	414048	8054119	Bilby Digging WAC1	Ecologia 2011	Likely (same as above)

	16-A	414318	8054174	Digging WAC3/4	Ecologia 2011	Likely
	16-B	414318	8054174	Digging WAC3/4	Ecologia 2011	Likely (same as above)
	18-A	414318	8054175	WGS84	Ecologia	Possible
	19-A	414428	8053698	Digging WAC 5/6	Ecologia 2011 (10 April - 21 April 27 April - 8 May)	Likely






	19-B	414428	8053698	Digging WAC 5/6	Ecologia 2011	Likely (same as above)
	22-A	415412	8054781	Digging WAC 10	Ecologia 2011	Likely
	22-B	415412	8054781	Digging WAC 10	Ecologia 2011	Likely (same as above)
	29-A	410482	8061754	DCS 00875	CES-SKM opportunistic observation	Unlikely
	30-A	410482	8061754	Area 5	Bamford Consulting 2011	Likely

	31-A	418523	8057340	B1	AECOM 2011	Possible
	32-A	418559	8057360	B2	AECOM 2011	Possible
	33-A	418766	8057596	B3	AECOM 2011	Unlikely
	34-A	418726	8057549	B4	AECOM 2011	Possible
	35-A	419800	8055695	B5	AECOM 2011	Unlikely

	36-A	420839	8053935	B6a	AECOM 2011	Unlikely
	40-A	413739	8054345	Bilby Dig 4	ENV 2011	Possible
	41-A	413987	8054539	Bilby Dig 5	ENV 2011	Possible
	42-A	413177	8055392	Bilby Dig 7	ENV 2011	Possible



	43-A	413331	8055413	Bilby Dig 8	ENV 2011	Possible
	45-A	413895	8055646	Bilby Dig 9	ENV 2011	Likely
	45-B	413895	8055646	Bilby Dig 9 (other image)	ENV 2011	Likely (same burrow as above)

Note: All coordinates provided in Datum GDA94, Zone 51K.

## Appendix C Locations of Potential Bilby Evidence

New Code	Photo	Easting	Northing	Date	Source	Type	Status	Consultant Code
01-A	A	415119	8069232	Nov. 2011	WEL 2011	Burrow	Likely	
02-A	B	415101	8069276	Nov. 2011	WEL 2011	Burrow	Likely	
03-A	C	415120	8069303	Nov. 2011	WEL 2011	Burrow	Likely	
04-A	D	415174	8069195	Nov. 2011	WEL 2011	Burrow	Likely	
05-A	E	415033	8068950	Nov. 2011	WEL 2011	Burrow	Likely	
06-A	F	414961	8068832	Nov. 2011	WEL 2011	Burrow	Likely	
07-A	G	415012	8068825	Nov. 2011	WEL 2011	Burrow	Likely	
08-A	none	415612	8065513	May 2011	Ecologia 2011	Burrow	Possible	Bilby Burrow LIA1
09-A	none	415320	8065620	May 2011	Ecologia 2011	Burrow	Possible	Bilby Burrow LIA2
10-A	none	415275	8066247	May 2011	Ecologia 2011	Burrow	Possible	Bilby Burrow LIA3
11-A	J-1/J-2	414048	8054119	May 2011	Ecologia 2011	Burrow	Likely	Bilby Burrow WA
12-A	none	416286	8065208	May 2011	Ecologia 2011	Digging	Possible	Digging LIA1
13-A	none	415389	8065766	May 2011	Ecologia 2011	Digging	Possible	Digging LIA2
14-A	none	409549	8064500	May 2011	Ecologia 2011	Digging	Possible	Digging SP1
15-A	none	411084	8059862	May 2011	Ecologia 2011	Digging	Possible	Digging SP2
16-A	K-1/2	414048	8054119	May 2011	Ecologia 2011	Digging	Likely	Digging WA1
17-A	none	414314	8054163	May 2011	Ecologia 2011	Digging	Possible	Digging WA2
18-A	H	414318	8054175	May 2011	Ecologia 2011	Burrow	Possible	Digging WA3/WA4
19-A	L-1/2	414428	8053698	May 2011	Ecologia 2011	Digging	Likely	Digging WA5/WA6
20-A	none	414571	8053706	May 2011	Ecologia 2011	Digging	Possible	Digging WA7
21-A	none	414992	8054976	May 2011	Ecologia 2011	Digging	Possible	Digging WA8/WA9
22-A	none	415412	8054781	May 2011	Ecologia 2011	Digging	Likely	Digging WA10
23-A	none	415798	8055068	May 2011	Ecologia 2011	Digging	Possible	Digging WA11/WA12
24-A	none	416759	8055973	May 2011	Ecologia 2011	Digging	Possible	Digging WA13
25-A	none	417346	8056010	May 2011	Ecologia 2011	Digging	Possible	Digging WA14/WA15
26-A	none	417820	8056001	May 2011	Ecologia 2011	Digging	Possible	Digging WA16
27-A	none	418540	8056365	May 2011	Ecologia 2011	Digging	Possible	Digging WA17/WA17
28-A	none	418581	8056562	May 2011	Ecologia 2011	Digging	Possible	Digging WA19

29-A	N-1	410482	8061754	April 2011	CES 2011	Tracks	Unlikely	Photo DCS00875 GPS- Camera
30-A	N-3	409728	8059595	May 2011	Bamford 2011	Burrow	Likely	Area 5
31-A	Q	418523	8057340	May 2011	AECOM 2011	Burrow	Possible	B1
32-A	R	418560	8057360	May 2011	AECOM 2011	Burrow	Possible	B2
33-A	S	418767	8057600	May 2011	AECOM 2011	Burrow	Unlikely	B3
34-A	T	418726	8057549	May 2011	AECOM 2011	Burrow	Possible	B4
35-A	U	419801	8055696	May 2011	AECOM 2011	Burrow	Unlikely	B5
36-A	V	420839	8053936	May 2011	AECOM 2011	Burrow	Unlikely	B6a/B6b
37-A	none	413303	8055360	May 2011	ENV 2011	Burrow	Possible	BilbyDig1
38-A	none	413337	8055459	May 2011	ENV 2011	Burrow	Possible	BilbyDig2
39-A	none	413152	8055288	May 2011	ENV 2011	Burrow	Possible	BilbyDig3
40-A	W	413739	8054345	May 2011	ENV 2011	Burrow	Possible	BilbyDig4
41-A	X	413987	8054539	May 2011	ENV 2011	Digging	Possible	BilbyDig5
42-A	Y	413177	8055392	May 2011	ENV 2011	Burrow	Possible	BilbyDig6
43-A	Z	413331	8055413	May 2011	ENV 2011	Burrow	Possible	BilbyDig7
44-A	none	413331	8055413	May 2011	ENV 2011	Burrow	Possible	BilbyDig8
45-A	O/P	413895	8055646	May 2011	ENV 2011	Burrow	Likely	BilbyDig9
46-A	none	413645	8055640	May 2011	ENV 2011	Burrow	Possible	BilbyDig10
47-A	none	411546	8063806	Nov. 2009	AECOM 2010	Burrow	Possible	T9-A
48-A	none	411535	8063833	Nov. 2009	AECOM 2010	Burrow	Possible	T9-B
49-A	none	414485	8047946	Nov. 2009	AECOM 2010	Burrow	Possible	T-22
50-A	none	411182	8057673	Nov. 2009	AECOM 2010	Burrow	Possible	T-24
51-A	none	411154	8057670	Nov. 2009	AECOM 2010	Burrow	Possible	T-24
52-A	none	410983	8057670	Nov. 2009	AECOM 2010	Burrow	Possible	T-24
53-A	none	410733	8057216	Nov. 2009	AECOM 2010	Burrow	Possible	T-25

Note: All coordinates provided in Datum GDA94, Zone 51K.