Chapter 10

Matters of National Environmental Significance

PACIFIC **ALUMINIUM**

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10 Matters of National Environmental Significance

This Chapter describes the evaluation of potential impacts and management of issues relating to Matters of National Environmental Significance (Matters of NES) arising from the KGGP project. This is to facilitate assessment of the KGGP under the EPBC Act as per the accredited assessment arrangement for the KGGP Project determined by the Commonwealth Government.

10.1 INTRODUCTION

The EPBC Act provides for the protection of Matters of NES that include nationally and internationally significant flora, fauna, ecological communities, wetlands and heritage places. Under the EPBC Act, a proposal or action that impacts or is likely to impact a Matter of NES must be referred to the Commonwealth Government's Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) for a decision as to whether it is considered a controlled action and requires assessment by the Minister for Sustainability, Environment, Water, Population and Communities.

The KGGP Project was referred to the DSEWPaC on 4 November 2012 and was determined to be a controlled action on 3 December 2012 based on the potential for significant impacts to 'threatened species and ecological communities' and 'migratory species' (the controlling provisions). The DSEWPaC has advised that the Matters of NES relevant to the KGGP Project will be assessed by accredited assessment under the NT EA Act. The Federal Minister for Sustainability, Environment, Water, Population and Communities will at the conclusion of this assessment consider approval of the KGGP project, pursuant to the provisions of the EPBC Act. If approved, the Federal Minister will set conditions of approval that are separate to any conditions placed upon the KGGP project by the NT Minister for Mines and Energy.

The objectives relating to Matters of NES listed under the EPBC Act Guide (DEWHA 2010) that are relevant to this project are:

- To provide for the protection of the environment, especially Matters of NES.
- To conserve Australian biodiversity.
- To promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources.

10.2 APPROACH TO ASSESSMENT OF IMPACTS TO MATTERS OF NES

The assessment and approach to proposed management of potential impacts to Matters of NES has followed a step by step process:

- Identification of potential relevant Matters of NES.
- Evaluation of known, likely or possible presence of Matters of NES in areas to be directly (project area) or potentially indirectly affected by the KGGP through desktop review and on-ground surveys.
- Assessment of likely extent of impact to known, likely or possible MNES present, from aspects of construction or operation of the KGGP.
- Evaluation of the significance of these impacts in context of habitat quality present for each species (considering site condition, local and regional context, relative density of occurrence and the likely role of this habitat for the species). As part of this evaluation, species habitat

association mapping has been undertaken for a number of listed threatened species to provide further information on the extent of similar habitat or areas with the potential to support the species, as well as potential distribution.

- Application of specific management measures to minimise or rectify potential direct and indirect impacts to these Matters of NES.
- Determination of the likely outcome or residual impact to each Matter of MNES.
- Consideration of further mitigation for potentially significant residual impacts (if determined).

10.3 OVERVIEW OF RELEVANT MATTERS OF NES

A protected matters search using the DSEWPaC online Protected Matters Search Tool undertaken on 9 October 2012 was conducted in a broad search area (with a 1 km buffer) capturing the project area to determine an initial list of Matters of NES potentially occurring within the project area (Appendix K). This identified the following relevant Matters of NES:

- 26 listed threatened species (one flora species and 25 fauna species).
- One listed threatened ecological community.
- 34 listed migratory species.

The Protected Matters Search Tool provides indicative occurrence of species based on generalised information and distributions. The results, as well as the EIS guidelines, provide an initial screening of species relevant to the controlling provisions, with desktop and survey results also considered.

The identified species have then been subject to an evaluation of likely (or known) occurrence of these species through desktop review of existing data for the broader region, assessment of habitats present using aerial photography and broad scale vegetation mapping (where appropriate), compared with the known habitat requirements and distribution of each species or ecological community as well as on-ground fauna surveys along the KGGP corridor (Table 10-1). This evaluation has also considered the professional judgement of technical report authors in regards to the presence and extent of these species and ecological communities. As part of this report, survey reports were also reviewed for indication of the presence of any additional Matter of NES not identified in the protected matters search.

Implications of small mammal species decline in region

Table 10-2 includes an assessment of the likelihood and potential for occurrence of several small mammal species. There has been a documented decline in small mammal populations across the Top End due to a combination of threatening processes including the invasion and spread of Cane Toads (*Rhinella marina*), predation by feral cats, and increased intensity and frequency of fire in the tropical savannas resulting from invasive grass species such as Gamba Grass (*Andropogon gayanus*) (e.g. Woinarski et al. 2010). As suggested by a long-term monitoring study in Kakadu National Park conducted by Woinarski et al. (2010) there is no one factor responsible for the decline, rather several factors may be operating in a compound manner.

There is very little evidence to suggest that a number of these listed mammal species have extant populations within the project area or are using the habitat available to them within the project area. It is still possible that some remnant populations do exist within the region, despite an inability to detect them through surveys and anecdotal observations, however the potential for the KGGP Project to affect these species even if they do sparsely occur at low numbers is considered very low. Fauna management measures described in the Terrestrial and Aquatic Fauna and Habitat Management Plan (Appendix O), particularly those relating to trench clearing procedures, will further reduce any potential for impact to small mammal species.

Results of the assessment for each listed threatened species and ecological community; and listed migratory species are provided in Table 10-2, with the likelihood of occurrence categorised as follows:

Known to occur: The species or ecological community has been recorded within or beyond the project area e during recent or previous surveys.

Likely: There is a high probability that a species or ecological community occurs within the project area based on known distribution and habitat requirements or historical records.

Possible: Suitable habitat for a species or ecological community occurs within the project area; however, there is insufficient information to categorise the species or ecological community as likely to occur, or unlikely to occur.

Unlikely: There is a low to very low probability that a species or ecological community occurs within the project area based on known distribution and habitat requirements or historical records.

Table 10-2 incorporates an assessment of the potential for impacts to these species based on likelihood of occurrence and the level of threat posed by the KGGP Project, if present. Those species identified as having potential to be affected have been assessed in detail in the subsequent sections of this Chapter. Where relevant, some listed threatened species assessed as 'unlikely' as occurring are discussed in more detail, summarising how the low likelihood has been determined, if the species has been identified as important by stakeholders and/or was specifically identified in the EIS Guidelines issued by the NT EPA (e.g. Arenga Palm).

The potential for impacts to occur to marine species and coastal migratory species is considered very low as the KGGP is predominantly a terrestrial based project and has no construction on the immediate coast at Gove. Table 10-2 does provide an assessment of the extent and significance of impacts to these species as a result of the two ship movements expected as a result of construction requirements. They are not further dealt with in this chapter.

Some listed threatened species have been grouped for the purposes of detailed assessment and listed migratory species have been grouped into 'Other migratory species' for convenience of analysis and discussion

Table 10-1: Biological surveys within the KGGP corridor relevant to Matters of NES

SURVEY	TIMING	METHODOLOGY
Flora and vegetation surveys		
Pipeline corridor, construction camps and above ground facilities (by EcOz in 2003/4, Appendix C)	Two eight week periods from October to December 2003 and July to September 2004.	Sampling at intervals of 5 km in a continuous traverse along pipeline corridor, unless a community of specific interest to the survey team was identified
Terrestrial fauna surveys		
Pipeline corridor (by EcOz in 2004; Appendix D)	July 2004, six weeks	Targeted survey at 18 sites (3 locations). Each site comprised a 50 m x 50 m quadrat in which survey effort consisted of twenty elliot-type traps, four cage traps, four pitfall traps, three diurnal active searches, two nocturnal active searches and eight diurnal instantaneous bird counts.
Pipeline corridor (by Eco Logical Australia in 2012; Appendix D)	5-23 November 2012	Continuous survey using 4 remote cameras at each of 9 locations and 10 hair tubes at each of 10 locations. Targeted searches for Gouldian Finch and broadcast survey for Northern Crested Shrike-tit in the Beswick region. Nocturnal spotlight surveys at 6 locations. Opportunistic bird observations at 10 locations. Survey methodology generally consistent with DSEWPaC requirements with some variation (Refer to Table 10-13 in Appendix D)
Aquatic fauna surveys		
Pipeline corridor (by EoOz in 2003/4, Appendix E)	October to November 2003 June 2004	17 river sites crossed by the pipeline corridor using a mixture of multi-panel gill-nets, fine-mesh seine, scoop-nets or push-nets, hook and line, dip-net and torch at night, and sight observations from the bank or by snorkelling.

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Table 10-2: EPBC Act listed threatened species and ecological communities likelihood of occurrence in Project area and assessment of potential impact

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
Listed Threatened Ecological Communities (TECs)			
Arnhem Plateau Sandstone Shrubland Complex	Endangered	**Unlikely.** Approximately 65 km of the southern portion of the pipeline corridor is within an area that the Arnhem Plateau Sandstone Shrubland Complex has been previously considered to 'may occur' (as opposed to an area in which it is considered 'likely to occur' (Blake 2004, DSEWPaC 2012). After further assessment, the TEC is considered unlikely to occur because the topography is generally unsuitable, there is a general absence of heath species for this section of the pipeline corridor (or elsewhere) as ascertained from the 2004 flora survey, and there is an apparent absence of heath species as observed during aerial survey of a part of the section of pipeline corridor). Section 10.4.1 addresses this assessment in more detail. Not further assessed.	**10.4.1**
Listed Threatened and Migratory Species			
Birds			
Apus pacificus (Fork-tailed Swift)	Migratory	**Possible.** This species favours shallow, open, freshwater wetlands and swamps. The pipeline corridor is in the vicinity of nine regionally significant wetlands, three of which are not able to be avoided. While this species does not breed locally, and the site is not considered to be an area of important habitat for this species, it may fly over the pipeline corridor.	**10.16**
Ardea modesta (Eastern Great Egret)	Migratory	**Known to occur.** This species was recorded during the 2012 fauna survey conducted by ELA at KP locations; 92, 102, 108,117 and 123. This species is widely distributed in Australia and is known to occur in habitat including wetlands, flooded pastures, dams, estuarine mudflats, mangroves and reefs. This species may utilise the project area however habitat present is not considered to be important to the survival of the species.	**10.16**
Ardea ibis (Cattle Egret)	Migratory	**Known to occur.** One individual was recorded during the 2012 survey. The individual was observed at KP 517 via remote camera detection (Appendix D). Generally, this species is found in grasslands, woodlands and wetlands and is considered to be widespread and common. Breeding colonies have been observed in Arnhem Land.	**10.16**
Calidris tenuirostris (Great	Migratory	**Unlikely/Possible.** Not recorded during 2004 or 2012 field surveys. The Great Knot is a migratory wader mostly	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
Knot)		found in coastal habitats and wetlands, although rarely found on inland lakes and swamps (DSEWPaC 2013; Higgins and Davies 1996). The Great Knot occurs in the greatest numbers on the coastal fringes of the NT. There have been four records of Great Knot in the last 20 years within the region on the coast at the far north eastern extent of the pipeline however, there are no records within the project area and the Great Knot is unlikely to rely on any habitats within the Project area. These records and potential habitat within the pipeline region are not considered indicative of a site that supports important habitat for the Great Knot according to criteria listed in EPBC Act Policy Statement 3.21 for migratory shorebirds (DEWHA 2009a). Not further assessed as no impacts to coastal habitats and coastal wetlands from KGGP.	
Charadrius veredus (Oriental Plover, Oriental Dotterel)	Migratory	**Unlikely/Possible.** Not recorded during 2004 or 2012 field surveys. The Oriental Plover occurs in both coastal and inland areas. It is a migratory wader and in Australia usually inhabits flat, open, semi-arid or arid grasslands, interspersed with hard, bare ground, such as clay-pans (DSEWPaC 2013). The Oriental Plover has sparse records from within the region in which the Project area is located, on the north-east coastal Arnhem Land or around the town of Katherine (ALA 2013), although there are no records within the project area. These widespread records are few and are not indicative sites that supports important habitat for the Oriental Plover according to criteria listed in EPBC Act Policy Statement 3.21 for migratory shorebirds (DEWHA 2009a). Not further assessed	**N/A**
Coracina tenuirostris melvillensis (Melville Cicadabird)	Migratory	**Known to occur**. Five individuals were recorded during the fauna survey by ELA in November 2012. One individual was observed through incidental bird observations at each of the following KP locations; KPs 111, 116, 370, 393 and 497 (Appendix D). The Melville Cicadabird occurs in northern Australia from Broome in WA to the far eastern Top End of the NT. This species prefers diverse forests and woodlands, including mangroves and paperbark swamps.	**10.16**
Erythrotriorchis radiatus (Red Goshawk)	Vulnerable	**Likely**. There are several records of this species in the NT Fauna Atlas (ALA 2013) in proximity to the pipeline corridor. In the NT the Red Goshawk prefers tall open forest and woodland, or tall fringing woodlands along rivers in grasslands, shrub-lands, and low open woodlands.	**10.6**
Erythrura gouldiae (Gouldian Finch)	Endangered	**Known to occur.** Seven Gouldian Finches were recorded during the 2004 EcOz survey in the Chambers River region (approximately KP 110). During the 2012 survey by ELA, Gouldian Finches were recorded close by at	**10.7**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
	Migratory	Chambers River east of Beswick. Suitable habitat for this species is present between approximately KP0 and KP140 in the form of a range of annual and perennial grasses in lowlands, rocky hills with suitable smooth stem salmon gums (for breeding), and small pools that persist through the dry season. A number of historical records of the species exist for this area as well as north-east of Bulman coinciding with patches of potential suitable habitat in the central portion of the pipeline corridor.	
Falcunculus frontatus whitei (Crested Shrike-tit (northern))	Vulnerable Migratory	**Known to occur** Two individuals were recorded during the 2012 field survey. These were not visually observed but were heard calling in response to a call broadcast on November 15th 2012 at KP 106. Preferred habitat for the Northern Crested Shrike-tit occurs across the project area as woodlands, in particularly *Eucalyptus tectifica* and *Corymbia latifolia* woodlands. Few records of this species are known regionally. There have been recent records very near KP 40 (Appendix D; Ward 2008) and historical records near KP 500.	**10.8**
Glareola maldivarum (Oriental Pratincole)	Migratory	**Unlikely/Possible.** Not recorded during 2004 or 2012 field surveys. The Oriental Pratincole is widespread in northern areas of Australia, occurring predominantly in coastal areas including beaches, mudflats and islands, as well as near some terrestrial wetlands (DSEWPaC 2013). There is only one record from the last 20 years of the Oriental Pratincole within the region to the south of the project area near the junction of the Sturt Highway and Roper Highway. The lack of records and absence of the coastal habitats preferred by the Oriental Pratincole within the project area indicates that the project area does not support important habitat for the Oriental Pratincole according to criteria listed in EPBC Act Policy Statement 3.21 for migratory shorebirds (DEWHA 2009a). Not further assessed.	**N/A**
Haliaeetus leucogaster (White bellied Sea-eagle)	Migratory	**Known to occur** One individual was recorded during the EcOz (2004) survey at KP 449. This species is widely distributed and was recorded in the north-east of the pipeline corridor during the 2004 survey (EcOz 2004, Appendix D).	**10.16**
Hirundo rustica (Barn Swallow)	Migratory	**Possible.** The species has a wide recorded distribution across northern Australia and prefers open country in coastal lowlands (usually near towns or cities), and freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland.	**10.16**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
Limosa limosa (Black-tailed Godwit)	Migratory	**Unlikely/Possible.** Not recorded during 2004 or 2012 field surveys. The Black-tailed Godwit prefers coastal regions with the largest populations found on the north coast of Australia in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats between Darwin and Weipa (DSEWPaC 2013). Although there are records of this species within the pipeline region (ALA 2013), they are located around the coastal regions in the eastern extent of the region. The Black-tailed Godwit is unlikely to rely on any habitats within the project area and it is considered that the project area does not support important habitat for the Black-tailed Godwit according to criteria listed in EPBC Act Policy Statement 3.21 for migratory shorebirds (DEWHA 2009a). The KGGP does not affect coastal environments that this species would utilise. Not further assessed.	**N/A**
Merops ornatus (Rainbow Bee-eater)	Migratory	**Known to occur** Approximately 32 individuals were recorded across three locations (approximately KP 100, 500 and 570) during the 2004 EcOz survey. During the ELA survey in November 2012, the species was recorded at numerous locations. This species is distributed across much of inland Australia and occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. In northern Australia it often inhabits mangroves (DSEWPaC 2013).	**10.16**
Plegadis falcinellus (Glossy Ibis)	Migratory	**Known to occur** The Glossy Ibis was recorded through incidental bird observations at two locations in the 2012 survey; KP 92 and KP 370. Within Australia, this species is distributed east of the Kimberley in WA and in the Eyre Peninsula in SA. The species prefers fresh water marshes at the edges of lakes and rivers, flood-plains, swamps and cultivated areas under irrigation. The Glossy Ibis is commonly in largest numbers in drying Top End grass/sedge swamps and Channel Country grass/forb meadows.	**10.16**
Poecilodryas superciliosa cerviniventris (Derby White-browed Robin)	Migratory	**Possible.** The species has a wide recorded distribution across northern Australia and inhabits forests, shrublands and wetlands (Birdlife International 2012).	**10.16**
Rhipidura rufifrons (Rufous Fantail)	Migratory	**Known to occur** One individual of the Rufous Fantail was recorded in the north-east of the Pipeline corridor at approximately KP 570 during the 2004 survey by EcOz. This species occurs in coastal and near coastal areas of northern and eastern Australia.	**10.16**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
Rostratula australis (Australian Painted Snipe)	Vulnerable Migratory	**Possible**. Shallow inland wetlands comprise the preferred habitat of this species. Suitable wetland habitat occurs along the pipeline alignment.	**10.9**
Sterna albifrons (Little Tern)	Migratory	**Unlikely/Possible.** Not recorded during 2004 or 2012 field surveys. In Australia, Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches. Little Terns are widespread on islands off the Northern Territory coast (DSEWPaC 2013). In the Northern Territory, Little Terns are commonly seen in sandy coastal habitats and in mangrove-mudflat habitats along the coast or in bays and estuaries, but not recorded on wetlands more than 1 km from the coast. This species is widely distributed, occurring mostly around beaches and near-shore environments, which are a minor habitat in the project area. Not further assessed as no impact to coastal environment.	**N/A**
*Tyto novaehollandiae kimberli (*Masked Owl (northern))	Vulnerable	**Possible**. Preferred habitat consists of riverine forest, rainforest, open forest, paperbark swamp and the edge of mangroves. Some habitat present along pipeline corridor.	**10.10**
*Botaurus poiciloptilus (*Australasian bittern)	Endangered	**Possible.** Prefers densely vegetated freshwater wetlands. Suitable habitat occurs along the pipeline route in the form of three regionally significant wetlands within the project area and six other regionally significant wetlands occur in the vicinity. However, wetlands present within the project area are not considered to be densely vegetated so are unlikely to be important habitat for this species.	**10.9**
Geophaps smithii smithii (Partridge pigeon (eastern))	Vulnerable	**Likely.** Prefers primarily open forest and woodland habitat, which is present within the project area (DSEWPaC 2013.	**10.11**
Epthianura crocea tunneyi (Yellow-Chat (Alligator Rivers))	Endangered	**Unlikely.** Some potential habitat may be present for this species which prefers channels and depressions on seasonally inundated floodplains. However, the pipeline corridor lies well south of its known distribution (DSEWPaC 2013). Not further assessed.	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
Insects			
Euploea alcathoe enastri (Gove Crow Butterfly)	Endangered	**Possible**. Pipeline route has been designed to avoid habitat for this species. Prefers patches in the transitional zone (ecotone) between evergreen monsoon vine-forest and eucalypt/paperbark woodland associated with permanent creeks or swamps (DSEWPaC 2013.	**10.12**
Mammals			
Conilurus penicillatus (Brush-tailed Rabbit-rat, Brush-tailed Tree-rat)	Vulnerable	**Possible.** The Brush-tailed Rabbit-rat shelters in tree hollows, hollow logs and occasionally in the crowns of pandanus or sand-palms (Woinarski and Hill 2012). This species occurs in eucalypt tall open forest and in the coastal grasslands on the Coburg Peninsula (Woinarski and Hill 2012). The Brush-tailed Rabbit-rat was not recorded in either 2004 or 2012 fauna surveys and it has not been recently recorded within its historical range in the NT (DSEWPaC 2013; Woinarski and Hill 2012), including Kakadu National Park (Firth et al. 2010). The Brush-tailed Rabbit-rat is currently known to persist in the NT only on Coburg Peninsula, Bathurst, Melville and Inglis Islands and Groote Eylandt (Woinarski and Hill 2012). The recent decline of the species has most likely been caused by feral cats and other predators and/or disease (Woinarski and Hill 2012). Altered fire regimes, weeds and grazing may also have changed the availability of preferred food sources, hollow logs, tree hollows, fruit-bearing shrubs and grass species composition (Woinarski and Hill 2012). The project area is located well south of the primary distribution of this species. Fauna management measures described in the Terrestrial and Aquatic Fauna and Habitat Management Plan (Appendix O), particularly those relating to trench clearing procedures, will further reduce any potential for impact. Not further assessed.	**N/A**
Dasyurus hallucatus (Northern Quoll)	Endangered	**Possible.** Preferred (critical) habitat occurs across more than 50% of pipeline corridor and this species has been historically recorded to the west of the pipeline route however there have been no recent recordings and the species has been in significant decline due to threatening processes. This critical habitat consists of some form of rocky area or structurally diverse woodland or forest for denning/shelter purposes, with surrounding vegetated habitats used for foraging and dispersal (DSEWPaC 2011a, DSEWPaC 2013), with sandstone escarpment	**10.13**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
		considered prime habitat (Braithwaite & Griffiths 1994).	
Macrotis lagotis (Greater Bilby)	Vulnerable	**Unlikely**. Project area lies well north of the known distribution of this species and limited habitat present. Preferred habitat for this species includes a variety of habitats, usually on landforms with level to low slope topography and light to medium soils. It occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (DSEWPaC 2013). Not further assessed.	**N/A**
Megaptera novaeangliae (Humpback Whale)	Vulnerable	**Unlikely/possible**. Species is marine and not known, or considered to be present, in or immediately adjacent to the terrestrial environment of the Gove Peninsula area of the NT. Movement of two ship movements from Darwin to Gove for transport of materials is considered to represent an extremely low risk to the species given its likely absence from area and relative low numbers of ships compared to marine environment area. Not further assessed.	**N/A**
Notomys aquilo (Northern Hopping-mouse)	Vulnerable	**Unlikely**. Largely restricted to sandy substrates, particularly those supporting floristically diverse heathlands and/or grasslands (Woinarski et al. 1999 as cited in Alcan Gove 2004). Majority of specimens known from Groote Eylandt and coastal north-eastern Arnhem Land and preferred habitat not present. Not further assessed.	**N/A**
Phascogale pirata (Northern Brush-tailed Phascogale)	Vulnerable	**Possible.** The species is restricted to the Top End of the NT and considered taxonomically distinct from populations in the Kimberley and Cape York Peninsula (Woinarski and Ward 2012). Most records of the Northern Brush-tailed Phascogale are from tall open forests dominated by *Eucalyptus miniata* (Darwin Wollybutt) and *E. tetrodonta* (Darwin Stringybark) (Woinarski and Ward 2012). It was not recorded in either the 2004 or 2012 surveys and if present in region would be in very low numbers. There are relatively few records in the NT (Woinarski and Ward 2012). Records since 1980 are from the Tiwi Islands, Cobourg Peninsula, West Island (in the Sir Edward Pellew group, although the species is now considered extinct there), Kakadu National Park and Litchfield National Park (Woinarski and Ward 2012). There are older records from the Gove and Katherine areas (Woinarski and Ward 2012). Decline of the species in recent years coincides with the arrival of Cane Toads, which are potentially eaten by the species (DSEWPaC 2013; Woinarski and Ward 2012). The Northern Brush-tailed Phascogale is also threatened by other exotic predators (e.g. feral cats), disease, vegetation change due to altered fire regimes and/or pastoralism,	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
		and clearing of eucalypt forests, especially those with hollow-bearing trees (DSEWPaC 2013; Woinarski and Ward 2012). Fauna management measures described in the Terrestrial and Aquatic Fauna and Habitat Management Plan (Appendix O), particularly those relating to trench clearing procedures, will further reduce any potential for impact. Not further assessed.	
Saccolaimus saccolaimus nudicluniatus (Bare-rumped Sheathtail Bat)	Critically Endangered	**Unlikely**. The pipeline possibly overlaps with the known range of this species, however preferred habitat for this species (rugged sandstone environments, typically where there are many caves, crevices or boulders) is absent from the pipeline corridor and areas through which access roads and camps are proposed. The pipeline also lies well south of the few records of this species in the Northern Territory. The species has not been recorded in fauna surveys in 2003/4 or 2012. The KGGP is not anticipated to disturb preferred habitat for this species and even if present in the Pipeline region, which appears unlikely based on current knowledge. Not further assessed.	**N/A**
Xeromys myoides (Water Mouse, False Water Rat)	Vulnerable	**Unlikely.** Preferred habitat including mangroves and the associated saltmarsh, sedgelands and clay pans (DSEWPaC 2013) are not considered to be present and the project area lies well south of known records in the NT. Not further assessed.	**N/A**
*Mesembriomys macrurus (*Golden-backed Tree-rat*)*	Vulnerable	**Possible.** All records within the NT of the Golden-backed Tree-rat are from riverine vegetation, however, in the Kimberley, the species' habitat use is broad, including eucalypt open forests with tussock grass understorey, rainforest patches on a variety of landforms and soils, eucalypt woodlands with hummock grass understorey, rugged sandstone screes, beaches, and blacksoil plains with pandanus (Woinarski et al. 2012). Small areas of suitable riverine habitat may be present within the project area. The Golden-backed Tree-rat was not recorded within the project area during 2004 or 2012 surveys and there have been no confirmed records in the NT since 1969 (at Deaf Adder Gorge) despite targeted surveys in potential habitat over the last 40 years (Woinarski et al. 2012). Recent collation of Indigenous knowledge of this species has indicated its persistence in at least one site in the Arnhem Land plateau (M. Ziembicki pers. comm. as cited in Woinarski et al. 2012). However, recent targeted surveys in the area did not detect the species (Woinarski et al. 2012).	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
		Disease or exotic predators such as feral cats pose the key threat to the Golden-backed Tree-rat (DSEWPaC 2013; Woinarski et al. 2012). Broadscale habitat change may also have contributed to the species' decline, including as a result of changed fire regimes, weeds and grazing by livestock and feral animals, which may have changed the availability of preferred or vital food resources, and/or more frequent hot fires which may have reduced the availability of hollow logs, tree hollows and the tall fruit-bearing understorey shrubs (Woinarski et al. 2012). Fauna management measures described in the Terrestrial and Aquatic Fauna and Habitat Management Plan (Appendix O), particularly those relating to trench clearing procedures, will further reduce any potential for impact. Not further assessed.	
*Isoodon auratus auratus (*Golden bandicoot*)*	Vulnerable	**Unlikely.** Habitat preference comprises hummock grass and shrublands on sandstone and vine thicket. In the NT, the Golden Bandicoot is now known only from Marchinbar Island in the Wessel Islands group off north-east Arnhem Land (DSEWPaC 2013). Not further assessed.	**N/A**
Zyzomys main (Arnhem Rock-rat)	Vulnerable	**Unlikely.** The pipeline possibly overlaps with the known range of this species, however preferred habitat for this species (rugged sandstone environments, typically where there are many caves, crevices or boulders (DSEWPaC 2013) is absent from the site.	**N/A**
Plants			
Arenga australasica (Australian Arenga Palm)	Vulnerable	**Unlikely**. While database searches and the habitat association suggests that the Arenga Palm may occur in the littoral and near-coastal rainforests near the eastern end of the pipeline, recent review indicates that this species only occurs in Queensland. The NT taxon is no longer regarded as *A. australasica*, but *A. microcarpa*, which has no status under EPBC Act. This is discussed further in Section 10.4.2.	**10.4.2**
Reptiles			
*Bellatorias obiri (*Arnhem Land Egernia*)*	Endangered	**Unlikely.** Largely restricted to sandstone outcrops, typically with extensive fissures and cave systems (DSEWPaC 2013). Not further assessed.	**N/A**
Caretta caretta	Endangered	**Possible.** Occurs in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern,	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
(Loggerhead Turtle)		northern and western Australia. The Western Australian population is known to forage from Shark Bay, Western Australia through to Arnhem Land, Gove in the NT. In Australia, Loggerhead Turtles nest on open, sandy beaches and choose a wide variety of tidal and sub-tidal habitat as feeding areas (DSEWPaC 2013). Foraging may occur in the coastal waters off the Gove Peninsula but not in or immediately adjacent to project area. Although the KGGP terminates at the Gove refinery, which is situated very close to the associated port facilities on the Gove Peninsula, no construction activities will take place in or immediately adjacent to the coastal habitats and there will be no change to the port facilities or activities as part of the KGGP Project. At the closest point, the proposed pipeline lies approximately 30 m from the beach. Within the 2.5 km section near the coast at Gove, the pipeline traverses land associated with the Refinery that is highly disturbed and heavily lit from the Refinery operations. It is unlikely that marine turtles utilise this area due to the levels of high disturbance, human activity and heavy lighting from the Refinery operations. It is therefore expected that there will be no direct impacts or physical disturbance to marine habitats such that the Loggerhead Turtle could be affected. Two ship movements from Darwin to Gove for transport of materials is not considered to represent a significant risk to the species given its likely absence from area and relative low numbers of ships compared to marine environment area. Not further assessed.	
Chelonia mydas (Green Turtle)	Vulnerable	**Possible**. The Green Turtle nests, forages and migrates across tropical northern Australia where they spend the first five to ten years drifting on ocean currents before settling in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The coastal area between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land) is one of the key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) in the NT for this species (DSEWPaC 2013). Nhulunbuy is located approximately 3.5 km north east of the proposed pipeline. Although the KGGP terminates at the Gove refinery, which is situated very close to the associated port facilities on the Gove Peninsula, no construction activities will take place in or immediately adjacent to the coastal habitats and there will be no change to the port facilities or activities as part of the KGGP project. At the closest point, the proposed pipeline lies approximately 30 m from the beach. Within the 2.5 km section near the coast at Gove, the pipeline traverses land associated with the Refinery that is highly disturbed and heavily lit from the Refinery operations. It is unlikely that marine turtles utilise	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
		this area due to the levels of high disturbance, human activity and heavy lighting from the Refinery operations. It is therefore expected that there will be no direct impacts or physical disturbance to marine habitats such that the Green Turtle could be affected. Two ship movements from Darwin to Gove for transport of materials is not considered to represent a significant risk to the species given its likely absence from area and relative low numbers of ships compared to marine environment area. Not further assessed.	
Crocodylus porosus (Salt-water Crocodile)	Migratory	**Known to occur** This species was recorded from the Habgood River during the EcOz (2004) survey. This species occurs across northern Australia in tidal rivers, coastal floodplains and channels, billabongs and swamps. The pipeline crosses such rivers in the north eastern section of the alignment.	**10.16**
Dermochelys coriacea (Leatherback Turtle, Leathery Turtle, Luth)	Endangered	**Unlikely**. No records of nesting or foraging exist for the Gove Peninsula area of NT. The species is thought to occur more frequently in southern Australian waters. Not further assessed.	**N/A**
Elseya lavarackorum (Gulf Snapping Turtle)	Endangered	**Possible.** This species inhabits large rivers and associated overflow lagoons and oxbow lakes where it is often found in deeper permanent pools with muddy, sandy or rocky bottoms. It is also found in the middle reaches of rivers, upstream of saline regions and downstream of escarpments, including plunge pools (DSEWPaC 2013). Potential habitat is available within the pipeline corridor and close-by downstream.	**10.15**
Eretmochelys imbricate (Hawksbill Turtle)	Vulnerable	**Possible**. The Hawksbill Turtle occurs in tropical, subtropical and temperate waters in all the oceans of the world. Nesting is mainly confined to tropical beaches. In Australia, there are two genetically separate subpopulations; one in the northern Great Barrier Reef, Torres Strait and Arnhem Land; and the other on the North West Shelf of Western Australia. The coastal area between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land) is one of the key nesting and inter-nesting areas in the NT for this species as well as the Green Turtle (DSEWPaC 2013). Although the KGGP terminates at the Gove refinery, which is situated very close to the associated port facilities on the Gove Peninsula, no construction activities will take place in or immediately adjacent to the coastal habitats and there will be no change to the port facilities or activities as part of the KGGP Project. At the closest point, the proposed pipeline lies approximately 30 m from the beach. Within the 2.5 km section near the coast at Gove, the	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
		pipeline traverses land associated with the Refinery that is highly disturbed and heavily lit from the Refinery operations. It is unlikely that marine turtles utilise this area due to the levels of high disturbance, human activity and heavy lighting from the Refinery operations. It is therefore expected that there will be no direct impacts or physical disturbance to marine habitats such that the Hawksbill Turtle could be affected. Two ship movements from Darwin to Gove for transport of materials is not considered to represent a significant risk to the species given its likely absence from area and relative low numbers of ships compared to marine environment area. Not further assessed.	
Lepidochelys olivacea (Olive Ridley Turtle, Pacific Ridley Turtle)	Endangered	**Possible**. The Olive Ridley Turtle is the smallest of the Australian sea turtles and resides in coastal zones along the northern coast of Australia, and over soft bottomed habits of the northern Australian continental shelf waters. This species nests in low densities along the Arnhem Land coast of the Northern Territory, with some scattered nesting occurring in the Gulf of Carpentaria. Although the KGGP terminates at the Gove refinery, which is situated very close to the associated port facilities on the Gove Peninsula, no construction activities will take place in or immediately adjacent to the coastal habitats and there will be no change to the port facilities or activities as part of the KGGP Project. At the closest point, the proposed pipeline lies approximately 30 m from the beach. Within the 2.5 km section near the coast at Gove, the pipeline traverses land associated with the Refinery that is highly disturbed and heavily lit from the Refinery operations. It is unlikely that marine turtles utilise this area due to the levels of high disturbance, human activity and heavy lighting from the Refinery operations. It is therefore expected that there will be no direct impacts or physical disturbance to marine habitats such that the Olive Ridley Turtle could be affected. Two ship movements from Darwin to Gove for transport of materials is not considered to represent a significant risk to the species given its likely absence from area and relative low numbers of ships compared to marine environment area. Not further assessed.	**N/A**
Natator depressus (Flatback Turtle)	Vulnerable	**Unlikely**. Although Flatback Turtles nest on a wide variety of beach types around the entire coastline of the NT, the majority of nesting sites occur on islands off the Arnhem coast (DSEWPaC 2013), which well beyond the project area. Not further assessed.	**N/A**

SPECIES/COMMUNITY	EPBC STATUS	LIKELIHOOD OF OCCURRENCE AND ASSESSMENT OF POTENTIAL FOR IMPACT	Relevant section
Sharks			
Pristis clavata (Dwarf Sawfish, Queensland Sawfish)	Vulnerable	**Unlikely**. Preferred habitat for this species comprises coastal waters and estuarine habitats. No suitable habitat present along pipeline corridor or close-by downstream. Not further assessed.	**N/A**
Pristis microdon (Freshwater Sawfish)	Vulnerable	**Likely**. Historically recorded from the Roper River, and tributaries of the Roper River such as Mainoru River and Flying Fox Creek. Anecdotal records also exist for several rivers in eastern Arnhem Land, including Goyder River and Cato River.	**10.14**
Pristis zijsron (Green Sawfish, Dindagubba, Narrowsnout Sawfish)	Vulnerable	**Unlikely.** Preferred habitat comprises inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches. No suitable habitat present along pipeline corridor or close-by downstream. Not further assessed.	**N/A**
Rhincodon typus (Whale Shark)	Vulnerable	**Unlikely/Possible**. Occurs in coastal and offshore waters, outside the project area. Species is marine and not known, or considered to be present, in or immediately adjacent to the terrestrial environment of the Gove Peninsula area of the NT. Movement of two ship movements from Darwin to Gove for transport of materials is considered to represent an extremely low risk to the species given its likely absence from area and relative low numbers of ships compared to marine environment area. Not further assessed.	

10.4 MATTERS OF NES CONSIDERED UNLIKELY TO OCCUR FOLLOWING FURTHER ASSESSMENT

10.4.1 Arnhem Plateau Sandstone Shrubland Complex TEC

The Arnhem Plateau Sandstone Shrubland Complex is listed as an Endangered Threatened Ecological Community (TEC) under the EPBC Act and has been since November 2011.

The Arnhem Plateau Sandstone Shrubland Complex ecological community was listed as Endangered under following criteria:

- The very restricted geographic distribution, based on the fragmentation of remnants into small patch sizes, makes it likely that the action of a threatening process could cause it to be lost in the near future.
- The loss or decline of functionally important species is severe.
- The reduction in integrity by degradation of the community is severe.
- The rate of continuing detrimental change is severe and is projected to continue in the near future.

Under this listing the Arnhem Plateau Sandstone Shrubland Complex is limited to patches that:

- Meet the key diagnostic characteristics.
- Condition thresholds.

Key diagnostic characteristics for the Arnhem Shrubland Complex ecological community include:

- Distribution mostly occurs within the Arnhem Plateau bioregion (IBRA v6.1).
- The ecological community is mainly restricted to the Buldiva and Bedford land systems.
- It typically occurs on substrates that range from rock pavements, shallow tenosols (skeletal to shallow sandsheets) which generally contain major rocky components. Bare rock is heavily prevalent (50% or greater of total area at typical sites, sometimes more than 70%).
- It typically occurs at elevations of 200 to 400 m above sea level on the main Arnhem Plateau massif but may occur lower (down to 100 m) on outlying rock outcrops.
- The tree canopy, when present, is typically absent to sparse and shows the following features:
    - Species composition is variable, typically comprising members of the genera *Acacia*, *Blepharocarya*, *Corymbia*, *Callitris, Eucalyptus*, *Ficus*, *Gardenia*, *Terminalia*, *Owenia*, *Xanthostemon* and/or *Persoonia*.
    - The trees are generally widely spaced emergents with a canopy cover typically less than 5% (Lewis et al. 2008).
- The mid layer shows these features:
    - Obligate seeder taxa comprise at least 10% of the shrub species present, but more usually comprise >50% of the shrub species present.
    - Obligate seeder species present include the genera: *Acacia*, *Boronia*, *Calytrix*, *Corchorus*, *Cryptandra*, *Dicarpidium*, *Grevillea*, *Hibbertia*, *Hibiscus*, *Jacksonia*, *Leptosema, Lithomyrtus*, *Petraeomyrtus punicea, Pityrodia*, *Tephrosia*, *Thryptomene* and/or *Triumfetta*.
    - Shrub species are predominantly sclerophyllous.
- The ground layer contains a variety of herbaceous and grass species, depending on seasonal conditions and site characteristics.

Condition thresholds for Arnhem Plateau Sandstone Shrubland Complex are:

- The minimum patch size is 5 ha. This may include areas of native vegetation that may be naturally open or contain regrowth.
- Four or more obligate seeder shrub species are present in the mid (or shrub) layer of the patch. Typically this includes species from the genera *Acacia* (Fabaceae), *Boronia* (Rutaceae), *Calytrix* (Myrtaceae), *Corchorus* (Malvaceae), *Cryptandra* (Rhamnaceae), *Dicarpidium* (Malvaceae), *Grevillea* (Proteaceae), *Hibbertia* (Dilleniaceae), *Hibiscus* (Malvaceae), *Jacksonia* (Fabaceae), *Leptosema* (Fabaceae), *Lithomyrtus* (Myrtaceae), *Petraeomyrtus* (Myrtaceae), *Pityrodia* (Lamiaceae), *Tephrosia* (Fabaceae), *Thryptomene* (Myrtaceae) and *Triumfetta* (Malvaceae). However, other obligate seeder species may be present and are included if the patch meets the description of the ecological community.
- 5% or less of the total vegetation cover in the ground and mid layers comprises perennial exotic species.

The condition thresholds outlined above are the minimum level at which patches are protected under the EPBC Act (TSSC 2011) and which may require referral to the Australian Government. There are additional factors regarding whether a patch should be considered under the Act including (but not limited to) its local and landscape context, level of weeds and feral animals, and the relative condition of the patch compared to surrounding areas, whether at the natural edge of its range, or show species assemblages that represent a unique variant of the ecological community.

The Arnhem Plateau Sandstone Shrubland Complex is found mainly on the Arnhem Plateau massif (200 – 400 m above sea level) (Russell-Smith et al. 2009) and on some outliers (<100 m above sea level) (Nott 2003; Blake 2004). The Arnhem Plateau is dissected with deep gorges and gullies containing monsoonal rainforest communities. Within this complex system the Arnhem Plateau Sandstone Shrubland Complex typically occurs on substrates of quartzose sandstone (skeletal to shallow sandsheets) and on rock pavements. The vegetation patterns within the Arnhem Plateau Sandstone Shrubland Complex are mainly determined by local variations in topography, rockiness, degree of fire protection and moisture supply (Bowman et al. 1990).

The Arnhem Plateau Sandstone Shrubland Complex are shrublands and heathlands that are dominated by an understorey of diverse, evergreen sclerophyllous shrubs and herbs (Gill & Groves 1981). The community contains a large proportion of obligate seeders along with some resprouter plant species (Russell-Smith et al. 2009).

A high number of endemic and fire sensitive shrub species are found on the Arnhem Plateau, which has been attributed to the plateau's isolation, dissected nature and protection from fire (Russell-Smith et al. 2009). The latter is particularly important for obligate seeder species, especially those without seed storage banks in the soil. Frequent fires would destroy the mature plants and without seed storage banks, the populations would be unable to regenerate (Russell-Smith 2006).

The principle threat to the Arnhem Plateau Sandstone Shrubland Complex is inappropriate fire regimes, a threat common to many adjoining ecosystems on the Arnhem Plateau (TSSC 2011). Other threats may include impacts from feral animals, weeds (including species such as Gamba Grass) and climate change.

Approximately 63 to 79.8% of the known extent of the TEC is protected in National Parks and Indigenous Protected Areas (Table 10-3; Figure 10-1).

Table 10-3: Estimates of protected Arnhem Plateau Sandstone Shrubland Complex ecological community in the NT (sourced from TSSC 2011)

NAME OF RESERVE	ESTIMATED AREA (HA) OF ARNHEM PLATEAU SANDSTONE SHRUBLAND COMPLEX CONTAINED WITHIN RESERVE (AND % OF CURRENT EXTENT)
Kakadu National Park	136 063* (22.5%)
Nitmiluk National Park	21 047* (3.5%)
Djelk and Warddeken Indigenous Protected Areas	224 000 – 324 635* (37–53.8%)

*Areas include intergrades of heath/woodland and heath/rainforest.

For the KGGP, the investigation and survey effort for the Arnhem Plateau Sandstone Shrubland Complex involved desktop literature review, consultations with NT Government agencies and botanical field survey in 2003/04 by EcOz (presented in Appendix C). The earlier survey work was undertaken prior to the listing of the Arnhem Plateau Sandstone Shrubland Complex as a TEC under the EPBC Act. The community was targeted in this survey as 'habitat of outstanding biodiversity value' and 'vegetation community of conservation value'.

Modelling (object-oriented approach) by a Charles Darwin University honours student (Blake 2004) is currently the only mapping available for the Arnhem Plateau Sandstone Shrubland Community and used by DSEWPaC as an indicative map for their listing advice (TSSC 2011; DSEWPaC 2012). The map suggests that the community may occur within about 65 km of the southern KGGP corridor (Figure 10-1). The topography in this area of the pipeline corridor is mainly flat.

Field surveys have not found any heath vegetation within the pipeline corridor, including the 65 km of the southern KGGP corridor, in which the TEC was mapped by Blake (2004) as 'may occur'. A rugged sandstone terrain was identified east of Beswick, which the survey found to be occupied by *Eucalyptus/Corymbia* woodlands/forests and not heath vegetation. Potential heath vegetation, such as *Acacia shirleyii* closed forest, was recorded for hilltops in the wider area (Appendix C). Database searches show no botanical records for the two rugged sandstone areas within the pipeline corridor, which indicates that no formal botanical surveys may have taken place prior to the 2003/04 survey.

A second rugged sandstone terrain was identified north of the Mitchell Ranges between KP420 and KP445 (Figure 10-1). Permit issues and adverse circumstances did not allow for ground and aerial surveys to take place in this area in the past. A botanical survey will be undertaken in this section in 2013 and the outcomes reported in the supplement to this Draft EIS. This area is not identified on the map used in the listing advice (DSEWPaC 2012) and broadscale Landsystem mapping (Lynch & Wilson 1998) indicates 'elevated rocky plateau and rolling steep hills dominated by open woodland of *Eucalyptus tetrodonta*, *E. miniata, E. phoenicea* and *Callitris intratropica* for this section. The likelihood of this area to qualify as Arnhem Plateau Sandstone Shrubland Complex is low. Even if there are some species of the Complex present, the vegetation community is unlikely to meet the stringent aforementioned condition thresholds, especially the minimum patch size of five hectares

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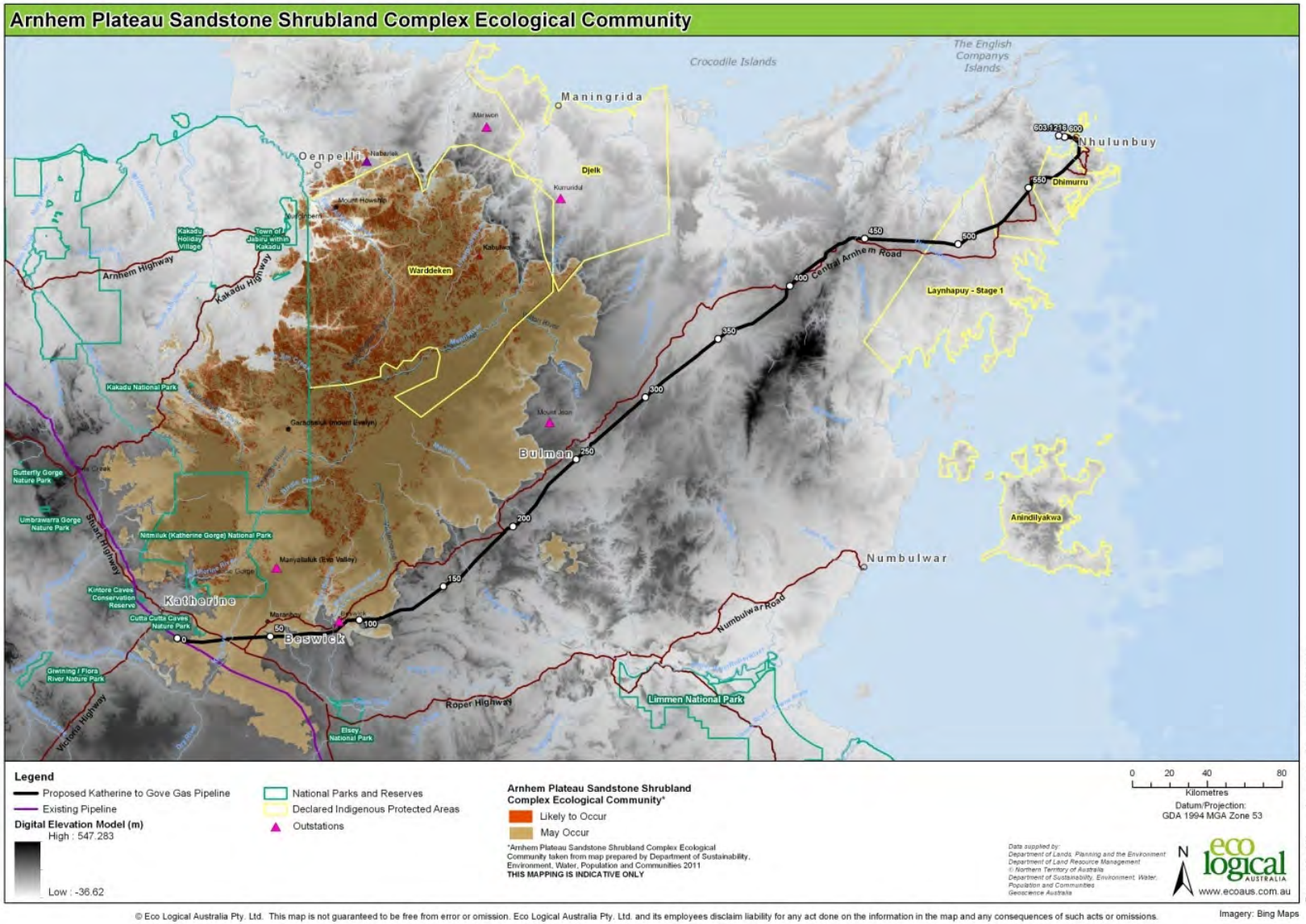

Figure 10-1: Arnhem Plateau Sandstone Shrubland Complex ecological community map by Blake (2004) (reproduced by DSEWPaC 2012) with digital elevation, protected areas and proposed KGGP.

It is acknowledged that the Blake (2004) mapping of the TEC has been derived at a large scale and as stated on the legend of the map, it is '*.an indicative map only and it is not intended for fine scale assessment'* (DSEWPaC 2012) and that a potential area to the north of the Mitchell Ranges in the northern section of the KGGP corridor is still to be surveyed. It has been concluded that the likelihood of the TEC to occur in this area is low as the vegetation is unlikely to meet the aforementioned condition thresholds. This will be confirmed in pending surveys, any change to the likely outcomes would be reported in the supplement to this Draft EIS.

More broadly, the pipeline route was designed to avoid hilly, rocky terrain as much as possible as it requires additional work during the construction of the pipeline and causes other difficulties, and hence there is little potential for the TEC to occur elsewhere along the pipeline alignment.

In conclusion, the Arnhem Plateau Sandstone Shrubland Complex is considered unlikely to occur and therefore has little potential to be affected by construction of the KGGP based on the following:

- Surveys of the 65 km section of the southern KGGP corridor within an area which the TEC was considered to 'may occur' have not recorded vegetation communities qualifying as Arnhem Plateau Sandstone Shrubland Complex.
- There is a low likelihood for the community to occur in the area north of the Mitchell Ranges (to be confirmed during the proposed 2013 survey).

10.4.2 Australian Arenga Palm

The Australian Arenga Palm (*Arenga australasica*) is listed as Vulnerable under the EPBC Act and Data Deficient under the TPWC Act.

The EPBC Act criteria for the listing of *A. australasica* are not provided in the Approved Conservation Advice (TSSC 2008).

An inquiry on the 12 February 2013 with the NT Herbarium revealed that *A. australasica* is no longer a recognized taxon in the NT. The species *A. australasica* and *A. microcarpa* have been synonymously used in the past in the NT, however, the NT now follows Dowe and Jones (2011) regarding taxonomic application for these species. Consequently, *A. australasica* may only occur in Queensland, where it is listed as Vulnerable under the Queensland *Nature Conservation Act 1992*. The following response from the NT Herbarium clarifies the previous taxonomic uncertainty for *A. australasica* in the NT (replicated with permission from Ian Cowie, Senior Botanist, NT Herbarium):

"*NT is now following Dowe and Jones (2011) in application of the names A. microcarpa and A. australasica. According to that treatment, A. australasica does not occur in NT, being restricted to QLD (and is listed under EPBC as Vulnerable). The NT taxon is now regarded as only A. microcarpa, which also occurs in New Guinea, has no status under EPBC and is regarded as least concern in NT. The NT checklist now includes only A. microcarpa, which is widely distributed across the Top End and thus not considered threatened (23 localities based on collections and some 45 survey records). The Commonwealth EPBC listing & alignment process has probably not caught up with these changed species concepts or the implications for listing. Also, there are possibly still issues with some data sets including NT plant records.*

The confusion has arisen because NT Arenga has in the past been treated by specialists first as A. australasica (e.g. Jones 1987) and then including both A. microcarpa and A. australasica. The treatment by Cowie & Kerrigan (2007) was published while the two-species concept was current. See the note there on taxonomic uncertainty and the 45 unvouchered survey records of Arenga which could not be reliably attributed to either species. Most of the NT collections are incomplete, thus not easy to work with and this has probably been a factor behind the confusion".

Based on this information supporting the taxonomic distinction in which *A. australasica* no longer occurs in the NT, there would be no potential or residual impacts from the KGGP Project on this species. The NT taxon is now treated as *A. microcarpa*, which has no status under the EPBC Act and is regarded as Least Concern in the NT. The NT checklist now includes only *A. microcarpa*, which also occurs in New Guinea and is widely distributed across the Top End, and thus not considered threatened. NT Herbarium data of *A. microcarpa* shows 23 localities based on collections and about 45 survey records.

10.5 ASSESSMENT OF RELEVANT IMPACTS TO MATTERS OF NES

There is potential for both direct and indirect impacts on Matters of NES to occur as a result of the KGGP proposal. The potential for and proposed management responses to the following impacts have been assessed for each of the relevant Matters of NES:

- Vegetation clearing from construction of the KGGP, resulting in:
    - The disturbance/loss/degradation of habitat (including aquatic habitat) for listed threatened or migratory fauna species.
    - Fragmentation of habitat (including aquatic habitat) that is important for listed threatened or migratory fauna species.
- Excavation of a trench for pipeline construction that may result in:
    - Death or injury to individuals of listed threatened or migratory species as result of fall and capture in the trench.
    - Degradation of surface water quality (contamination/ acidification) due to exposure of acid sulphate soils in respect of aquatic habitats used by listed threatened fauna species, in this case *Pristis microdon.*
- Vehicle movements during construction and operation resulting in the loss of individual fauna, through vehicle strikes.
- Changes to surface hydrology and localised groundwater changes within the pipeline ROW, which may affect the habitat of listed threatened or migratory species.
- Noise and vibration from construction and operation of the pipeline, including blasting (shallow depth rock fracturing), which could affect fauna behaviour and the habitat quality of listed threatened and migratory species.
- Introduction or spread of feral animals leading to:
    - Degradation of habitat for listed threatened and migratory species.
    - Loss of individual fauna due to predation.
    - Degradation of surface water quality and aquatic habitats.
- Introduction or spread of weeds leading to degradation of habitat for listed threatened or migratory species.
- Accidental fire ignition from construction or operational activities resulting in:
    - Disturbance/ loss of habitat for listed threatened or migratory species.
    - Disturbance/loss of listed threatened ecological community, in this case the Arnhem Plateau Sandstone Shrubland Complex.
    - Disturbance/loss of listed threatened flora species, in this case *Arenga australasica.*

    - Loss of individual fauna due to input of silt and ash.
    - Fragmentation of habitat that is important for listed threatened and migratory species.
    - Degradation of surface water quality and aquatic habitats due to input of silt and ash.
- Disposal of hydrotest water resulting in degradation/loss of fauna habitat or loss of individual listed threatened or migratory species.
- Degradation of water quality, which may occur through:
    - Increased sedimentation.
    - Chemical contamination.
    - Spills and leaks.
    - Inappropriate disposal of hydrotest water and wastewater.
    - Water use and over-extraction from groundwater use.
- Spills and leaks of hazardous materials resulting in degradation/loss of fauna habitat or loss of individual listed threatened or migratory species.
- Dust and light emissions resulting in degradation/loss of fauna habitat or loss of individual listed threatened or migratory species.

10.6 RED GOSHAWK

10.6.1 Conservation status

The Red Goshawk, *Erythrotriorchis radiatus*, is listed as Vulnerable under both the EPBC Act and the TPWC Act.

10.6.2 Regional distribution and ecology

The Red Goshawk is endemic to Australia and is sparsely distributed across approximately 15% of coastal and sub-coastal Australia, from the western Kimberley in WA to north-eastern NSW, and occasionally on continental islands (DERM 2012). A distribution map for the species is included in Appendix D.

The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia. In the NT, the Red Goshawk prefers tall open forest and woodland, or tall fringing woodlands along rivers in grasslands, shrub-lands, and low open woodlands (NSW National Parks & Wildlife Service 2002). The species prefers extensive open forest, open woodlands and riparian vegetation dominated by mature *Eucalyptus. tetrodonta*, *E. miniata*, and *Melaleuca leucadendron* (DERM 2012). Forests of intermediate density are preferred, or ecotones between habitats of diffusing densities (DSEWPaC 2013). Red Goshawks avoid very dense and very open habitats (DSEWPaC 2013).

The Red Goshawk is a solitarily breeder, preferring forested or wooded areas, close to permanent water, and in a large (over 20 m tall) trees. Nest trees have always been found located within 1 km of permanent water, often adjacent to rivers or clearings. Red Goshawks hunt and breed in both lowland and rugged terrain (DERM 2012), where their diet consists largely of birds (95%) (DSEWPaC 2013). Breeding records of this species indicate breeding activity occurs from August to November.

Habitat loss has been, and is likely to continue to be the biggest threat to the viability of the Red Goshawk, especially in eastern Australia (DSEWPaC 2013). Other potential threats to the Red Goshawk include:

- Residual pesticide exposure (e.g. DDT).
- Overgrazing (or other changes in land management that reduce prey availability, which may reduce productivity).

- Fire (and changed burning regimes, which have the potential to impact breeding sites and reduce prey availability, thus reducing productivity).
- Shooting, disease and catastrophic events (such as wildfire and tropical storms).
- Possible genetic bottlenecks in the population.
- Secondary poisoning.
- Persistent disturbance by birdwatchers at known nests (DSEWPaC 2013).

A *National recovery plan for the red goshawk Erythrotriorchis radiates* was prepared by the Queensland Department of Environment and Resource Management (DERM) in 2012 (DERM 2012), for DSEWPaC.

10.6.3 Potential habitat, survey effort and findings

Survey effort and findings were obtained from database searches (ALA 2013), and terrestrial fauna surveys undertaken by EcOz in 2003-2004 and ELA in November 2012 (both summarised in Appendix D). The ELA field survey methods were developed according to the techniques outlined in the EPBC survey guidelines (DEWHA 2008) and tailored in consultation with local experts to target the Red Goshawk as well as other target species. In addition, potential habitat for the Red Goshawk has been identified at a regional scale through broad habitat association mapping (Appendix F, Figure 10-2). Almost 90% of the records for the Red Goshawk are mapped within the moderate-higher probability areas giving a high degree of confidence in this mapping.

No Red Goshawks were recorded within the surveyed parts of the project area during either survey. The NT Fauna Atlas (ALA 2013) does indicate this species has been recorded in the vicinity of the pipeline corridor, the closest within one kilometre of corridor at approximately KP80 (Figure 10-2). It is expected that there is a high potential for the Red Goshawk to frequent the project area. The habitat association mapping indicated the project area traverses areas of high and medium probability of potential habitat for the Red Goshawk, which is available broadly in the region and beyond (Figure 10-2).

Areas of the highest potential for habitat for Red Goshawks are indicated to occur in the north-west of the region in which the KGGP is proposed to traverse. Given however, that the species occurs at low densities across habitats that are widespread, for the purpose of this assessment all the vegetation within the project area is considered as potential foraging habitat for the Red Goshawk. This is broadly applicable to large areas outside of the corridor and such potential habitat is considered well represented regionally. There is the potential for nesting areas to occur close to permanent water, where there are large trees, in and adjacent to the project area. No nesting areas have been found during either the 2004 or 2012 surveys however there remains the potential for unknown nesting sites to be present in such areas.

The habitat values for Red Goshawk in the project area in a local and regional context are summarised in Table 10-4.

Table 10-4: Summary of habitat values for Red Goshawk in project area

APPROXIMATE PROPORTION OF PROJECT AREA IS CONSIDERED AS HABITAT	AREAS OF POTENTIALLY HIGHER VALUE HABITAT	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS TYPE OF HABITAT	REGIONAL SIGNIFICANCE OF THIS HABITAT
100% foraging habitat	Nesting areas close to permanent water (and with large (over 20 m tall) trees).	None in corridor Closest record of any individual is 1 km from corridor.	Foraging habitat extends broadly outside of project area. Not locally restricted.	Foraging habitat not of particular regional significance No known nesting habitat, however could occur.

10.6.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential to directly impact the Red Goshawk through the destruction or disturbance of nests or nest sites, or by reducing prey availability from:

- Vegetation clearing and habitat removal.
- Degradation of water quality of permanent water on which species may depend
- Vehicle movements during construction and operation resulting in the loss of individual fauna, through vehicle strikes.
- Noise and vibration causing changes in behaviour (i.e. causing adults to abandon nest).
- Ignition of hot fires late in the dry season could destroy nest trees if present (DERM 2012).
- Dust and light emissions resulting in degradation/loss of habitat or change in behaviour of species.

Approximately 2200 ha of potential Red Goshawk foraging habitat is expected to be disturbed through vegetation clearing in the Project area. This includes 1850 ha in the ROW, approximately 75% of which represents low to moderate potential habitat and approximately 25% represents moderate to high potential habitat. Similar areas of potential foraging habitat for the Red Goshawk are not confined to the project area, and extend across the Top End.

The proposed clearing is a small proportion of the likely home range of any individual Red Goshawk which has been estimated as approximately 20,000 ha (Garnett et al. 2011). Impacts to the Red Goshawk from foraging habitat removal are therefore not anticipated to be significant.

Rehabilitation of disturbed land following construction is anticipated to restore approximately 62% of this habitat in the long term, with the residual impact being approximately 836 ha. Access roads, construction camps and temporary laydown areas not required following construction will be restored in the long term.

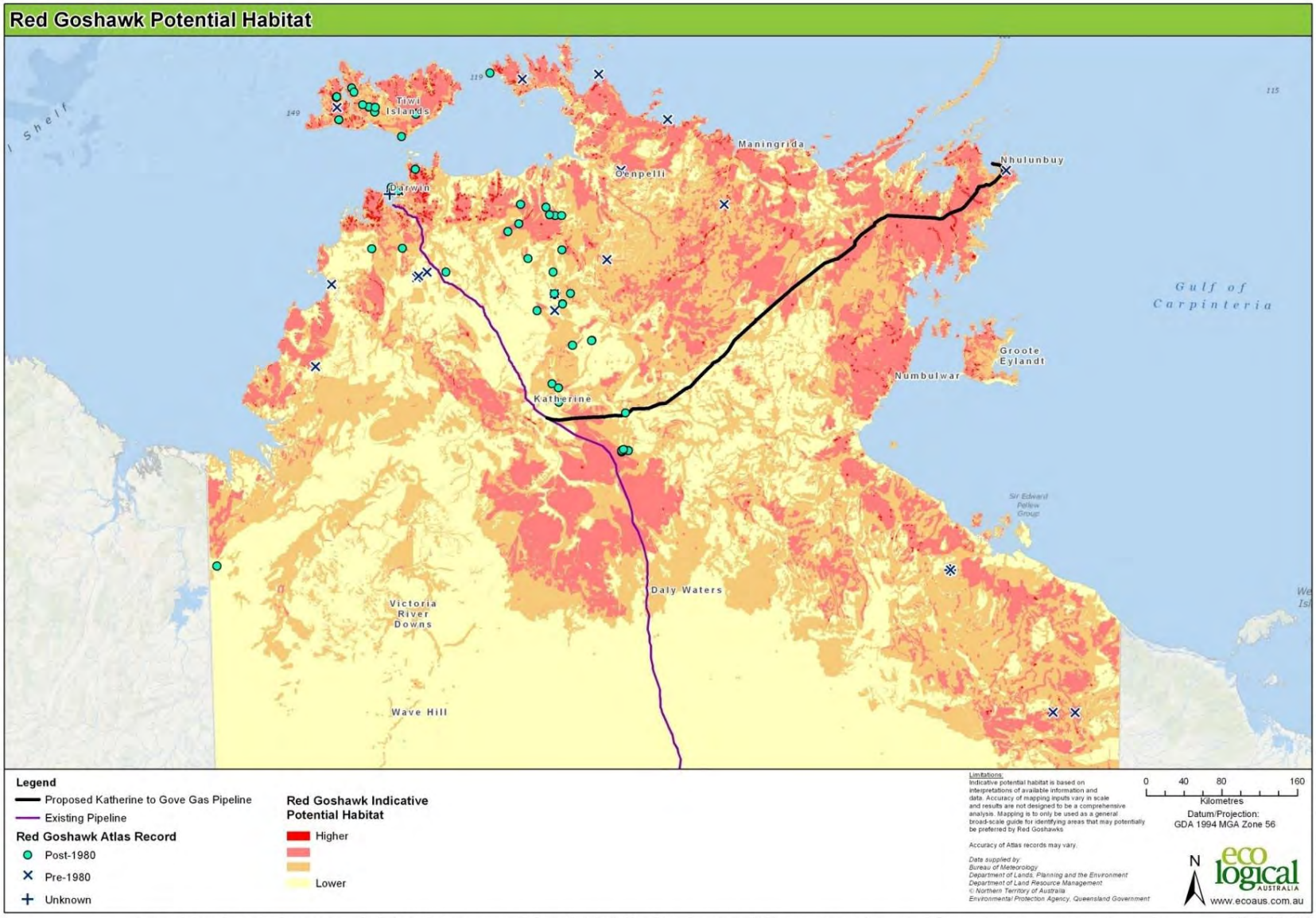

Figure 10-2: Red Goshawk indicative potential habitat (according to habitat associations) showing existing recordings

The proposed clearing does not affect a known important population and is unlikely to cause any long-term impact on this species unless a currently unrecorded nesting area is disturbed. Significant riparian vegetation potentially supporting nesting habitat has largely been avoided through route selection and use of HDD at a large number of river crossings. Clearing of tall woodland near permanent water will be minimised in final alignment of the ROW within pipeline corridor. It should be noted that opportunities for substantial pipeline re-alignment along short distances is somewhat constrained due to engineering constraints. The avoidance of tall woodland near permanent water will be a criteria in determining locations of ancillary infrastructure and camps and alignment of access roads wherever practicable.

Given the preference of the species to nest in close proximity to permanent water, the use of HDD construction techniques at significant water crossings which avoid or minimise disturbance to riparian vegetation will further reduce the risks of loss of breeding habitat. The narrow corridor is unlikely to represent a threat via fragmentation particularly once rehabilitation is implemented.

DERM (2012) indicates that as it is a widespread but sparse species, most developments (if occurring in an area inhabited by the species) are only likely to affect one or two pairs. This is significant where there is a cumulative threat of many small developments, which is not the case for the KGGP (within a region with few other projects).

Fauna management measures to be implemented include fauna awareness training in inductions and reducing vehicle speeds on the ROW in areas if and where the species is spotted.

Noise, vibration, dust and light generation will be intermittent and temporary as construction progresses along the corridor. Any changes to breeding or foraging behaviour would be highly localised, temporary, and likely to return to pre-construction conditions soon after works finish. There may be some edge deposition of dust on vegetation adjacent to construction areas however this is unlikely to cause degradation of habitat due to the short period of time over which construction occurs and the seasonal rains that will wash off dust from foliage.

Construction will be managed to reduce fire risk such that there are no implications for local fire regimes that may represent a threat to habitat.

Additional management measures may include managing potential nesting area disturbance, and managing fire and grazing (Table 10-5).

In summary, it is considered unlikely that the Red Goshawk will be significantly impacted as a result of the project if the proposed mitigation and management measures are implemented (Table 10-6). Suitable habitat for the Red Goshawk is broadly represented in the region and potential habitat to be cleared within the project area is unlikely to be locally or regionally significant and represents a small proportion of the home range for any individual Red Goshawk. Minimisation of disturbance to riparian vegetation will reduce the likelihood that nesting trees being within the disturbance footprint.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

As stated above, with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the KGGP Project on the Red Goshawk is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Red Goshawk would not be required under the Commonwealth offsets policy.

Table 10-5: Mitigation measures for Red Goshawk

Avoidance	• Significant riparian vegetation potentially supporting tall woodland (nesting habitat) has been avoided through route selection and use of HDD at a large number of river crossings. • Tall woodland near permanent water will be avoided in placement of ancillary infrastructure, camps and access roads wherever practicable.
Minimisation	• Best endeavours will be used to avoid clearing tall trees on along the edges of the pipeline corridor and and/or branches would be pruned (where feasible) rather than tree felled. • Clearing of tall woodland near permanent water will be minimised in final alignment of ROW in the pipeline corridor
Management	*Terrestrial and aquatic fauna management* • Construction activities in the vicinity of tall woodland watercourse crossings and along the access routes will be prioritised for as early as possible in the dry season with attention to timing of Red Goshawk breeding season at end of the dry season. • Fauna awareness training of personnel as part of inductions • Vehicle speeds will be maintained at low speed on the ROW if and where the species is spotted by personnel.
	Vegetation clearing management • Project design will avoid sensitive vegetation communities and habitats where practicable. • Vegetation will be cleared and rehabilitated progressively throughout construction to minimise the period that communities and habitats are disturbed.
	Fire management • Stockpiles of vegetation which cannot be used in rehabilitation will be burnt onsite by personnel trained in controlled burning • A fire fighting unit and persons trained in fire response will be readily available at all locations and at all times during construction

The KGGP does not compromise any actions of the Red Goshawk National Recovery Plan (DERM 2012). In particular the KGGP and its supporting studies are consistent with the following actions identified as needed to recover this species, which are to:

- Conduct searches to identify previously unknown pairs of red goshawks, nest sites, and habitats critical for red goshawk survival.
- Provide specific information and advice to assist with the identification, acquisition and management of important habitat for the Red Goshawk.
- Produce and distribute information on the conservation status and habitat requirements of the red goshawk.

Table 10-6: Summary of residual impacts for Red Goshawk after mitigation measures are applied

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Clearing of habitat causing loss of habitat, affecting important populations, fragmentation	Permanent loss of up to 836 ha of potential foraging habitat No known populations or nesting areas affected No significant fragmentation	Low	None
Vehicle/bird collisions causing mortalities	Some collisions possible	Negligible	None
Noise, vibration, dust and light effects	Localised and short term effect possible	Negligible	None
Fire management	No change to local or regional fire regimes as a result of KGGP	Negligible	None

10.7 GOULDIAN FINCH

10.7.1 Conservation status

The Gouldian Finch (*Erythrura gouldiae*) is listed as Endangered and Migratory under the EPBC Act (and included in JAMBA); and Vulnerable under the TPWC Act.

The conservation status of this species was relaxed in December 2012, from Endangered to Vulnerable, by the NT Government, based on a large series of Gouldian Finch sightings in new locations across the Top End in the past few years, including frequent records of hundreds of individuals near Maningrida, Mary River and the Gregory-Victory River District (DLRM 2012).

The cessation of commercial trapping and improvements in land management in relation to controlled fires and stocking rates are thought to have contributed to the observed recovery of Gouldian Finch populations (S. Ward, [NT Department of Land Resource Management], pers. comm., February 2013).

10.7.2 Regional distribution and ecology

The Gouldian Finch is a medium-sized (12-15 cm) granivorous bird found in the extensive savannah woodlands and grasslands of northern Australia (Tidemann and Woinarski 1994; Higgins *et al*. 2006). Large flocks of up to 1,000 birds used to be common in northern savannas, from the Kimberley region of WA to Far North QLD; however, their distribution is now restricted to isolated areas mostly within the NT and the Kimberley (DLRM 2012). A general distribution map for the species is included in Appendix D while Figure 10-3 shows a current distribution map based on records between 1993 and 2005.

Pairs mate for life and produce an average of three clutches of eggs annually, with an average of five eggs per clutch and a fledging rate of one to two young per pair. Annual survivorship is very low, with few recoveries of banded birds from one year to the next (Woinarski and Tidemann 1992). The largest known population is in the Yinberrie Hills and surrounds (approximately 40 km north of Katherine), where in 2003, the population was estimated at 150—250 adults (O'Malley 2006). The total (absolute) population for the NT is thought to be more than 1,000; however, the effective population size (reflecting high mortality rates of offspring and a sex ratio biased strongly in the favour of males) is thought to be under 1,000 mature birds, meeting the D1 Criterion for "Vulnerable" under the TPWC Act.

Gouldian Finches move seasonally between two different habitats (DLRM 2012). For most of the wet season (from about December/January), they occur in a variety of woodland types in lowland country with drainages, to feed on seeds of perennial grasses, such as soft spinifex, cockatoo grass and golden beard grass (available from mid-December; Dostine & Franklin 2002). In the late wet to dry season (February-August), they occur primarily in their breeding habitat of rocky hills with hollow-bearing smooth-barked gums (*Eucalyptus brevifolia* or *E. tintinnans*) within two to four kilometres of small waterholes or springs that persist throughout the dry season. They seek out hollows for nesting, preferentially selecting those hollowed out by termites in these trees (O'Malley 2006). Their dry season feeding habitat is dominated by annual spear grasses or native sorghum (*Sarga* species).

Gouldian Finches rely on dry season fires to clear undergrowth and enable them to more easily find seeds on the ground released by native sorghum, and find water at small rocky waterholes that persist in the hills until the following wet season.

The Gouldian Finch is thought to disperse from breeding areas to nearby sites (up to 20 km away) during the wet season in response to local changes in food availability (Dostine et al. 2001). O'Malley (2006) has noted that records of Gouldian Finches at Ethabuka in south- western QLD indicate dispersal far from any known historical or current breeding sites; however, individual birds might travel as little as 2 km, or as much as 17 km in a single day (Woinarski & Tidemann 1992; O'Malley 2006).

The potential threats to the Gouldian Finch at present include further declines in the extent and/or quality of habitat due to grazing pressure, fire, disturbance of habitat around critical dry season water sources by cattle (*Bos taurus*) or Water Buffalo (*Bubalus bubalis*), direct and/or indirect detrimental effects caused by the introduced invasive Red Fire Ant (*Solenopsis invicta*), and the development of infrastructure for transport corridors or mining operations (DSEWPaC 2013). There is the risk of a possible elevated mortality rate caused by predation by a suite of native animals when numbers of the Gouldian Finch are very low. In addition, infections by the parasitic mite *Sternostoma tracheacolum* have also been implicated in declines in the populations and distribution of Gouldian Finches in the past (Tidemann et al. 1992, Bell 1996). Of particular relevance are threats from damage to, and reduction of, habitat and the food sources and nesting hollows used by this species, from clearing, altered fire regimes and grazing by cattle, horses and pigs (Garnett and Crowley 1994; Woinarski et al. 2005; O'Malley 2006). Large-scale late dry season fires reduce the amount of available seed that the species relies on, especially during the early wet season (Garnett and Crowley 1994; Woinarski et al. 2005).

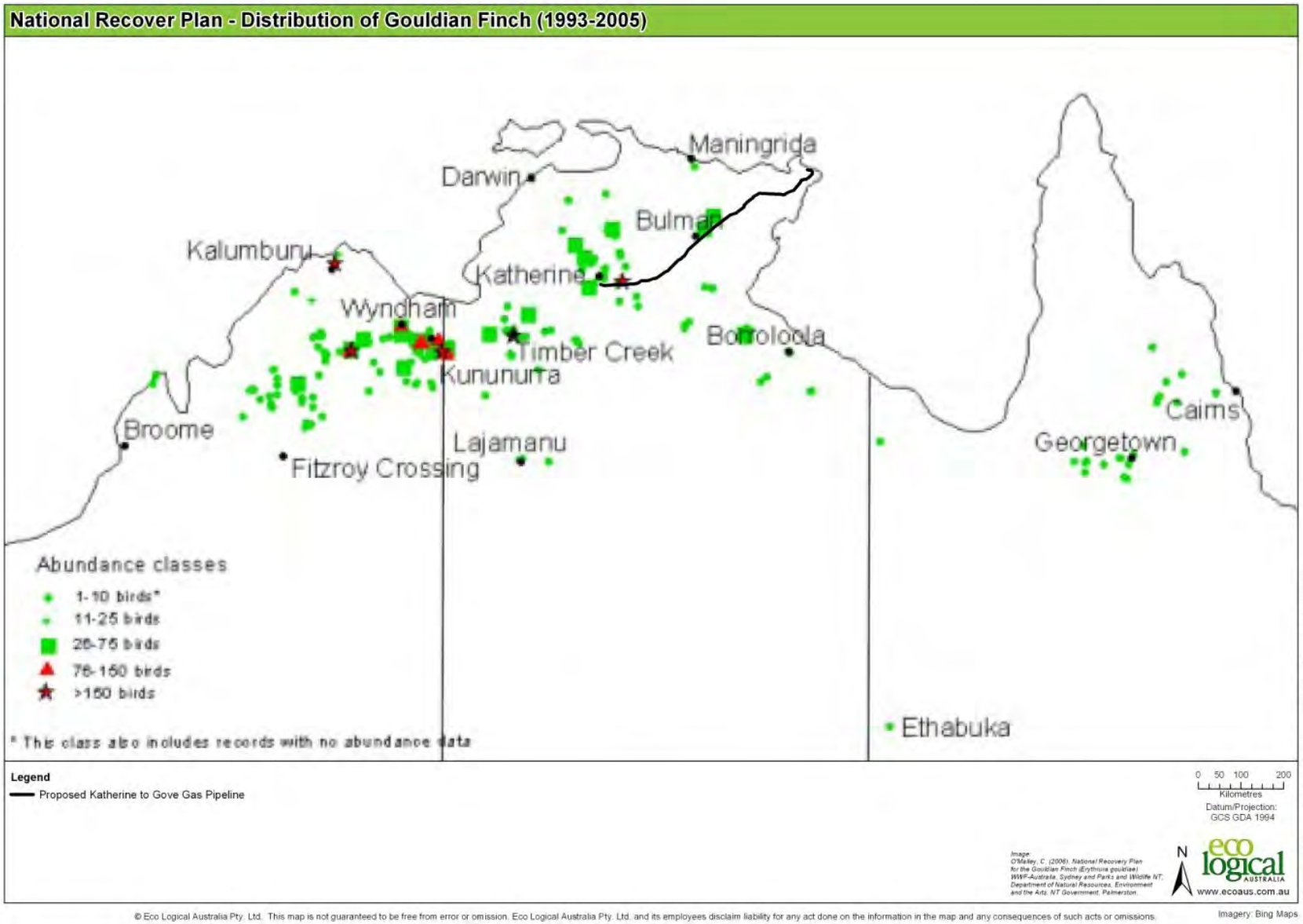

Figure 10-3: Current distribution of Gouldian Finches (1993 – 2005) (O'Malley 2006)

A *National Recovery Plan for the Gouldian Finch* (Erythrura gouldiae) was prepared by WWF-Australia the NT Department of Natural Resources, Environment and the Arts in 2006 (O'Malley 2006). The Recovery Plan indicates that it is not possible to map habitat critical for the species' survival but instead identifies key areas with significant populations of Gouldian Finches, where it is assumed the species is likely to persist if threatening processes can be minimised. These sites represent areas where populations of adults and juvenile birds (indicative of breeding events) have been recorded consistently over at least the past decade, either as part of on-going population monitoring programs or based on incidental sightings recorded on the Gouldian Finch national database (O'Malley 2006). One of these key areas is the 'Yinberrie Hills and surrounds' area. The key threats to this area have been identified as inappropriate fire regimes and feral pigs.

10.7.3 Potential habitat, survey effort and findings

Survey effort and findings were obtained from database searches (ALA 2013), and terrestrial fauna surveys undertaken by EcOz in 2003-2004 and ELA in November 2012 (both summarised in Appendix D). In addition, potential habitat for the Gouldian Finch has been identified at a regional scale through broad habitat association mapping (Appendix F, Figure 10-4). Almost 90% of the records for the Gouldian Finch are mapped within the moderate-higher probability areas giving a high degree of confidence in the mapping.

Gouldian Finches have been historically recorded most frequently to the north of Katherine (most notably the Yinberrie Hills) and to the south-west of Katherine towards the WA border. A cluster of records occur at the south-western end, within 15 km, of the pipeline corridor between KP0 and KP140. Notably, two isolated records occur within 15km of the pipeline corridor much further north-east between KP290 and KP320 (Figure 10-5). These records mostly occur within the moderate-higher probability of Gouldian Finch occurrence as per the habitat association mapping (Figure 10-4). The wide extent of areas mapped as having a moderate-higher probability of Gouldian Finches may indicate numerous currently unknown populations. It is noted that vast areas of potential habitat in remote regions of the NT and Western Australia have not been surveyed (DSEWPaC 2013).

There are previous records of Gouldian Finches within or near the project area itself. This includes from a dry season field survey for the TTP conducted by EcOz in 2004, which found seven birds at an Open Forest Site (4B1) and Woodland Site (4C1), approximately 1.5 - 2 km due south of the pipeline ROW (between KP103 and KP105) (Appendix D). This site was revisited in 2012 by ELA and no Gouldian Finches were recorded and there were no remnants of nests in several hollows investigated. This does not preclude the possibility that nests have previously been built and used.

A further targeted survey for Gouldian Finches was undertaken by ELA in the early wet season (November) 2012 between KP100 (just east of Beswick) and KP125 (Appendix D). This area was selected on the basis of desktop review regarding the historical recorded sightings indicating a high potential to find the species. Twelve survey sites generally representative of typical Gouldian Finch habitat within the vicinity of this 25 km section of the pipeline corridor were surveyed with an emphasis on small waterholes, which were likely to be favoured during this period when water in the landscape is severely limited (Figure 10-6). Additional sites typical of Gouldian Finch habitat including sites previously surveyed in the 2004 dry season in this area were also surveyed. Further information in regards to habitat characteristics of these sites, survey method and effort is contained in Appendix D. Targeted surveys for Gouldian Finches applied the techniques outlined in the DEWHA (2008) survey guidelines for the species (Table 10-13 in Appendix D).

Gouldian Finches were observed at one site (Site 12), within the 100 m pipeline corridor and approximately 20 m from the pipeline centreline (Figure 10-6), on 12 and 13 November 2012. On 12 November, around 200 individuals were observed drinking from a small, shallow, muddy pool

adjacent to a larger spring fed pool associated a minor drainage line. On 13 November, a flock of 400 individuals was observed drinking at the same pool and another 100 were observed at another small pool approximately 100 m along the same creek line. Flocks were made up of approximately 60% immature/moulting individuals, 30% adult females and 10% adult males.

These numbers suggest this may be an 'important population' as per the EPBC Act Significant Impact Guidelines (DEWHA 2009), in that it may be a 'key source population for breeding or dispersal'. The National Recovery Plan for this species considers 'key Gouldian Finch sites' as those with populations estimated between 50-250 adults (O'Malley 2006). The Beswick/Chambers River population (of adults) is approximately the same size as that observed for the nearby Yinberrie Hills population, which is considered a key Gouldian Finch site in the NT.

An aerial survey of potential breeding (smooth stemmed salmon gum) and watering (small waterholes) habitats in the Beswick/Chambers River survey area centred around the Gouldian Finch recording at the water resource This was undertaken by ELA in November 2012 (Appendix D). Observations were made during helicopter transects of the area around the spring where Gouldian Finches were observed drinking. Drainage lines in the area were not flowing, but had pools of water of various sizes mapped as Gouldian Finch watering resources (Figure 10-7). Scattered hilltops with salmon gums were observed and mapped as habitat in area surrounding the pipeline corridor, including in a fairly extensive area of smooth barked salmon gums to the southeast of the spring, approximately two kilometres from the pipeline corridor (Figure 10-7). There are a number of small waterholes and scattered groups of potential breeding trees within 50 m of centreline, but generally more substantial areas were found in the surrounding area. A targeted aerial survey has been planned for the 2013 dry season for other sections of the Pipeline ROW, the results of which will be used to inform final alignment of the pipeline within the corridor and management of construction.

Potential wet season feeding habitat and breeding habitat along the pipeline corridor has been determined at a broader scale using floristic data derived from the vegetation survey identifying where key flora species for Gouldian Finch habitat occur. This has been overlain on regional vegetation mapping 50 km either side of the pipeline centreline which allows some examination of whether the occurrence of these species, and hence potential habitat, correlates to particular regional vegetation units for the purpose of assessing the likely extent of similar potential habitat in the surrounding region. It should be noted that a section of the pipeline corridor at the Mitchell Ranges has not been subject to flora survey and hence could not be assessed for potential habitat on using the aforementioned method. The broad habitat association mapping for the species can be referred to for this area, which is also able to be used for comparison (Figure 10-4).

Potential breeding habitat within the pipeline corridor in areas outside of the Beswick/Chambers River resources survey area was identified by isolating vegetation survey sites where the dominant flora species was *Eucalyptus tintinnans* (Figure 10-8). Potential dry season feeding habitat was assumed to be coincident with breeding habitat. An examination of the plant species recorded in the vegetation survey for the pipeline corridor indicates two sites where *Eucalyptus tintinnans* was the dominant species and one site where *E. tintinnans* was recorded within the vegetation community. The three sites are between KP0 and KP50, which is consistent with historical recordings of Gouldian Finches more broadly in this locality (Figure 10-8).

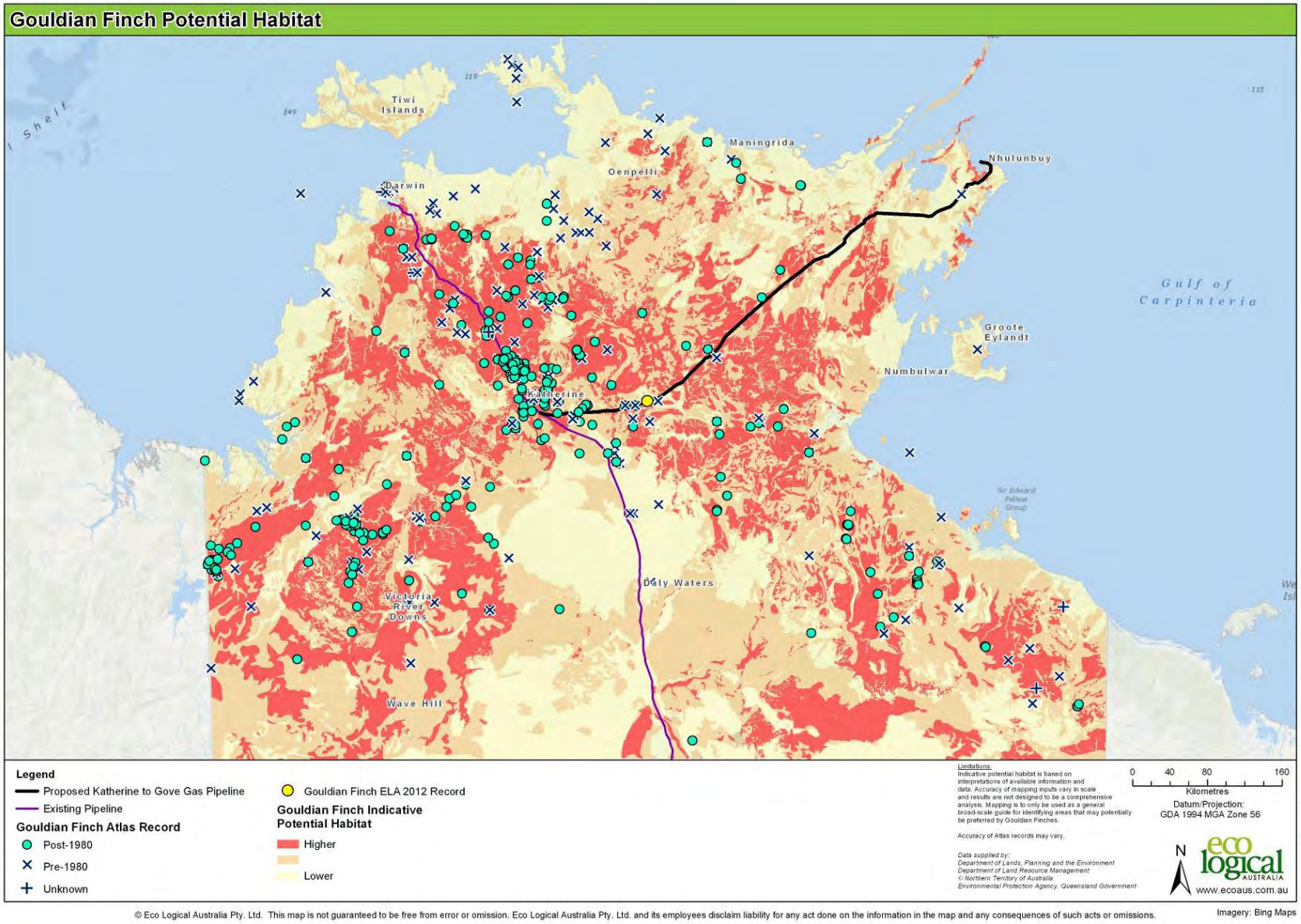

Figure 10-4: Gouldian Finch indicative potential habitat (according to habitat associations) showing existing recordings

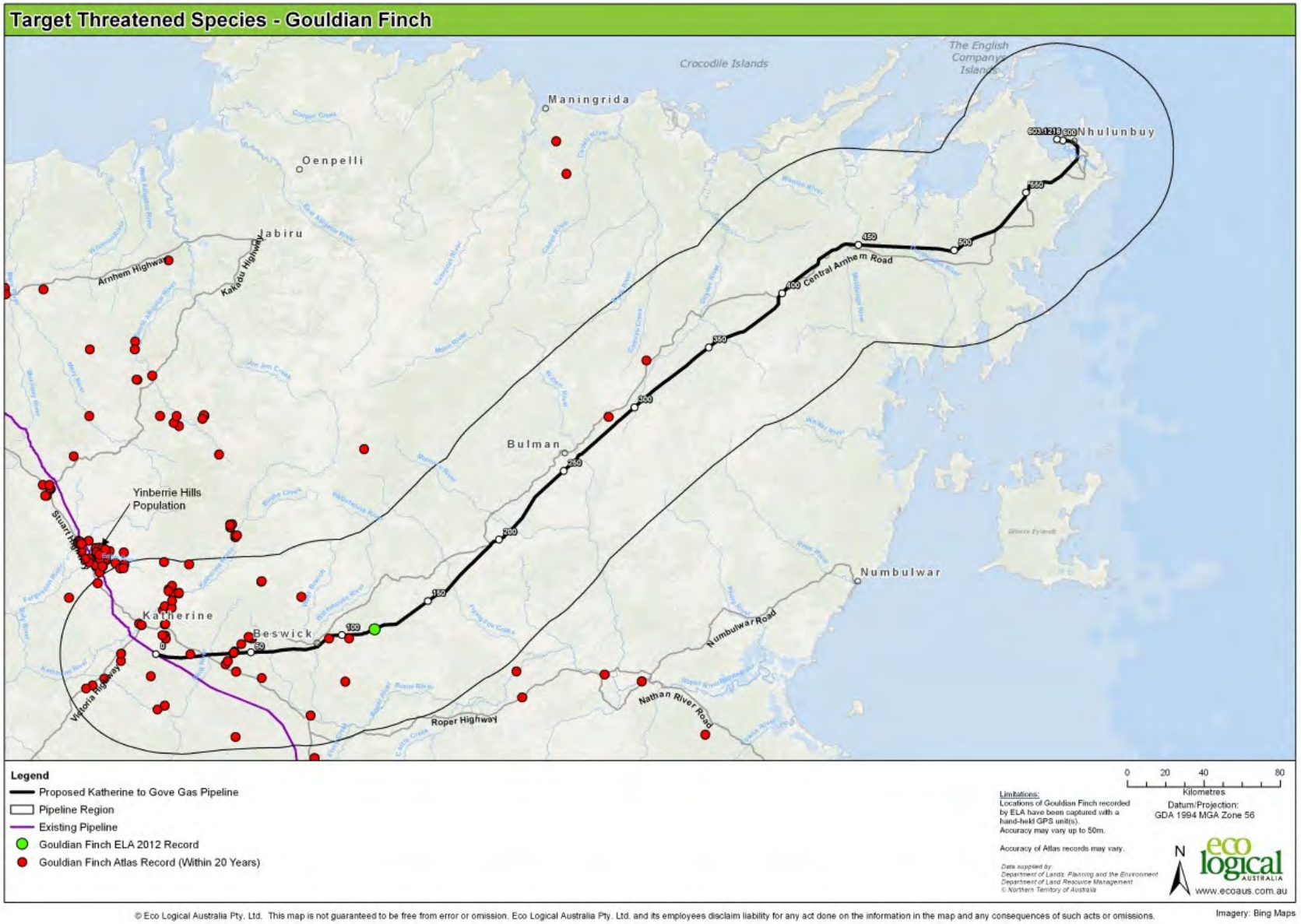

Figure 10-5: Gouldian Finch records in proximity to the project area

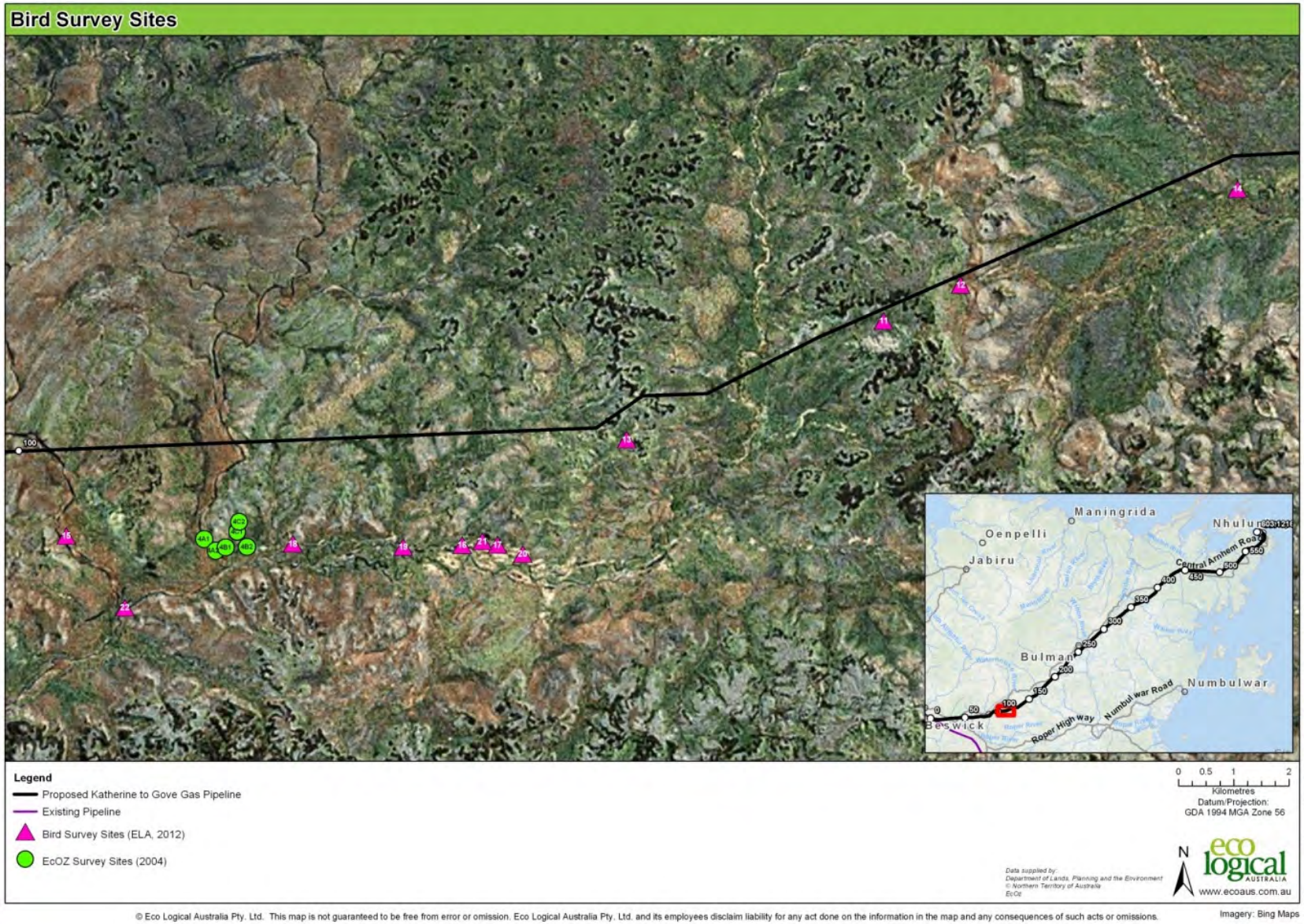

Figure 10-6: Gouldian Finch survey sites (east of Beswick)

Similarly, wet season feeding habitat was identified by isolating vegetation survey sites where the dominant flora species were grass species known to be important to Gouldian Finches (Figure 10-9, Figure 10-10). Approximately 500 km of the pipeline alignment (or 1,500 ha of the pipeline ROW), which accounts for 81% of the pipeline ROW, can be conservatively predicted to hold habitat with grass species important for wet season foraging by Gouldian Finches if breeding and watering habitat were also nearby. This generally corresponds with the habitat association mapping (Figure 10-4).

Potential feeding habitat identified in the pipeline corridor includes an area near that identified in the Recovery Plan (O'Malley 2006) in which there is an historical recording of 25-75 birds north-east of Bulman (Figure 10-3). This generally corresponds to areas of moderate-higher probability of Gouldian Finch occurrence around Bulman in the habitat association mapping (Figure 10-4). Although no potential breeding habitat has been identified in this section of the Pipeline corridor, it is possible that such habitat is in its vicinity given the Gouldian Finch population previously recorded in this locality.

Core habitat

The critical components of suitable core habitat for the Gouldian Finch are considered to be the presence of the species' favoured annual and perennial grasses, a nearby source of surface water and, in the breeding season, unburnt hollow-bearing Eucalyptus trees (in this case *E. tintinnans*) (DSEWPaC 2013). While a detailed resource survey has not been undertaken of the full length of pipeline corridor, it is apparent from the combination of desktop study and fauna, vegetation and aerial surveys and subsequent analysis, that such core habitat is traversed by the pipeline alignment. In particular, the Beswick/Chambers River survey area supports regionally significant core habitat of high quality in that it is characterised by:

- Patches of 1-5 ha of tall stands of *E. tintinnans* favoured for nesting.
- Such patches and the surrounding areas including favoured wet and dry season seed plant species (food) in the understory.
- Both of the above within 2-4 km of perennial waterholes or springs in some areas (considered critical by Dostine *et al.* 2001).

The widespread occurrence of wet season feeding habitat along the pipeline corridor may be associated with other core habitat where found in association with tall stands of *E. tintinnans* outside of the corridor. The full extent of these relationships will be further examined during a planned dry season survey in 2013, with a focus on higher habitat potential areas around the Beswick/Chambers River area.

The habitat values for Gouldian Finch in the project area in a local and regional context are summarised in Table 10-7.

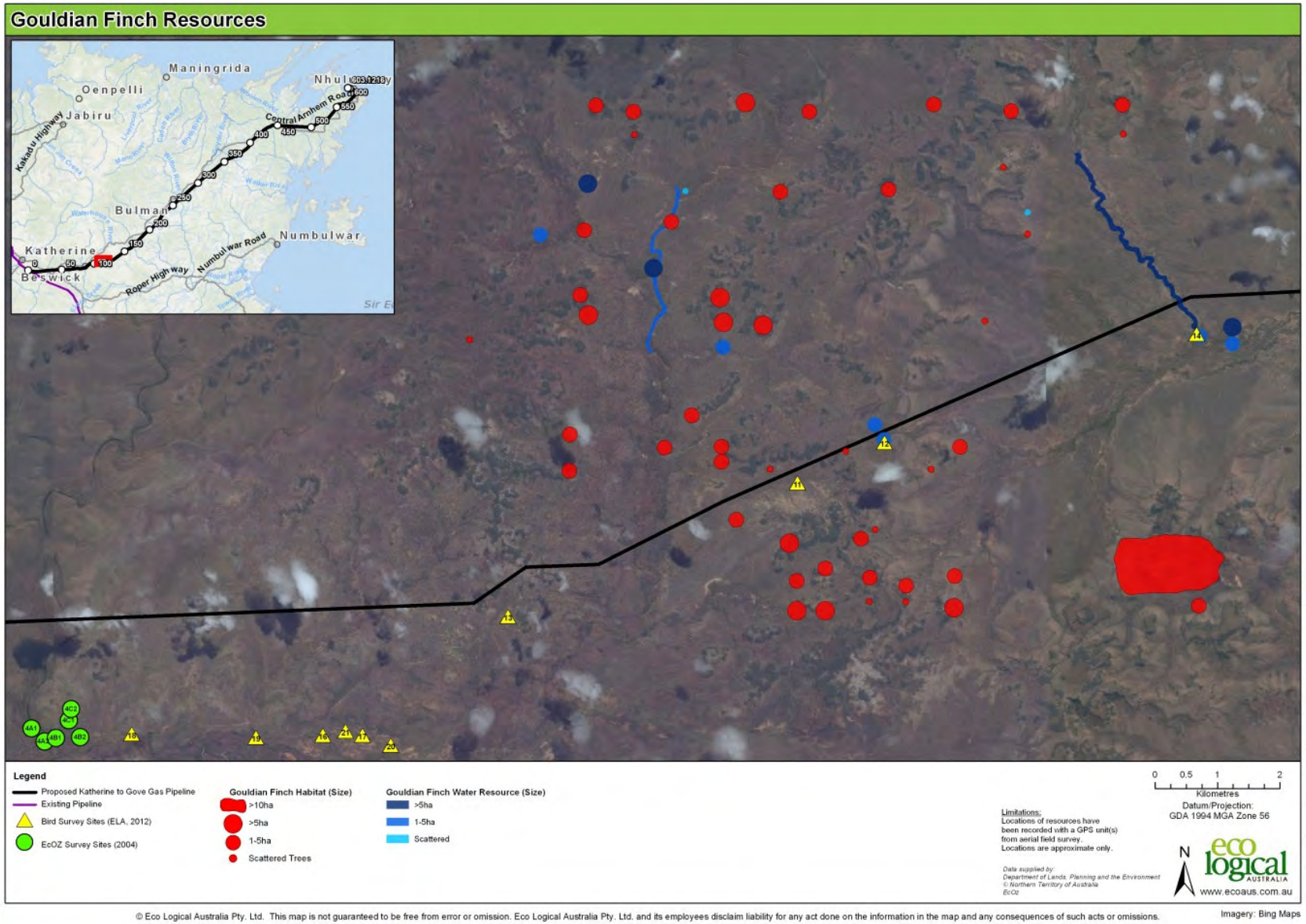

Figure 10-7: Gouldian Finch breeding and watering resources in surveyed area east of Beswick

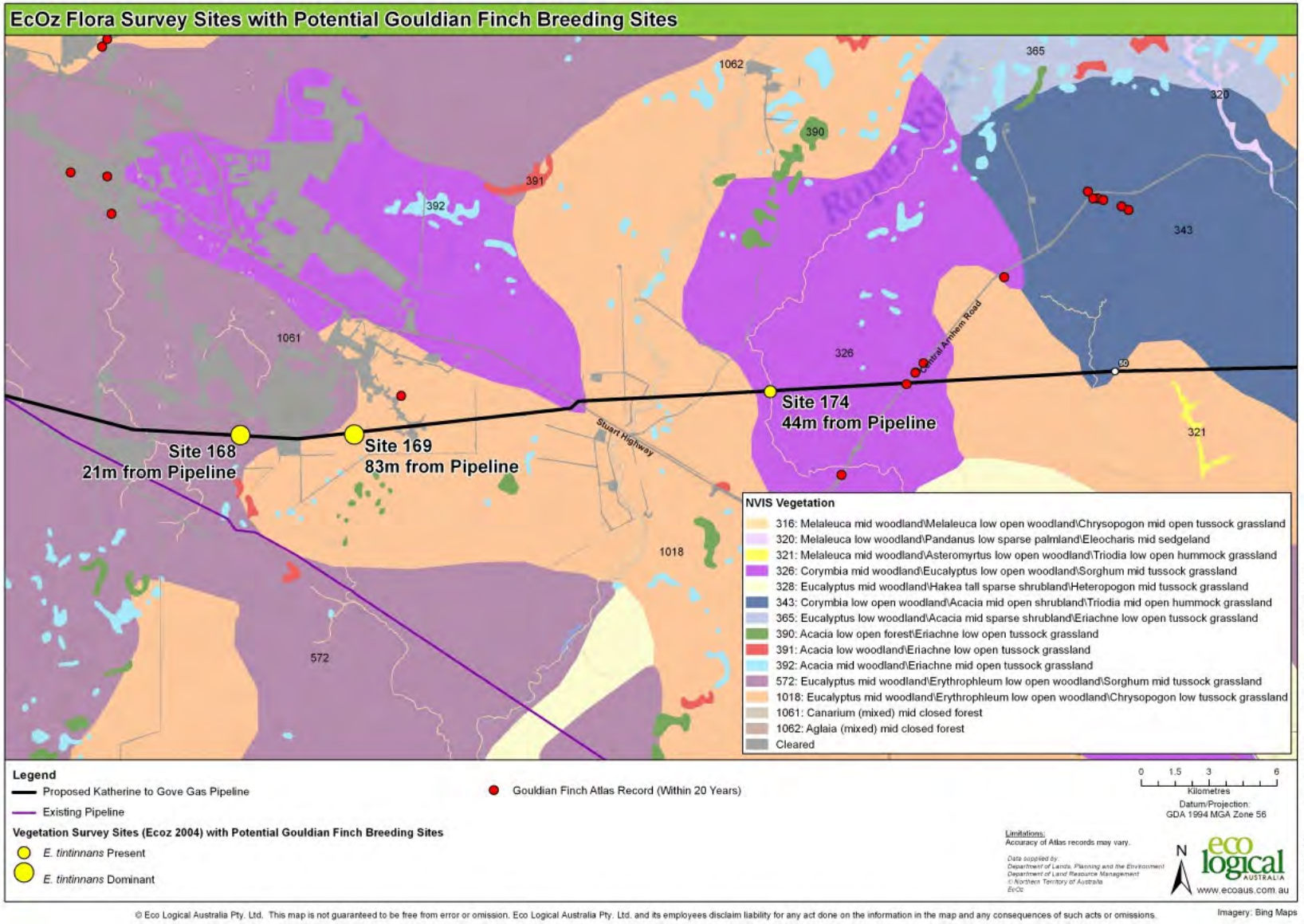

Figure 10-8: Potential Gouldian Finch breeding habitat with the pipeline corridor

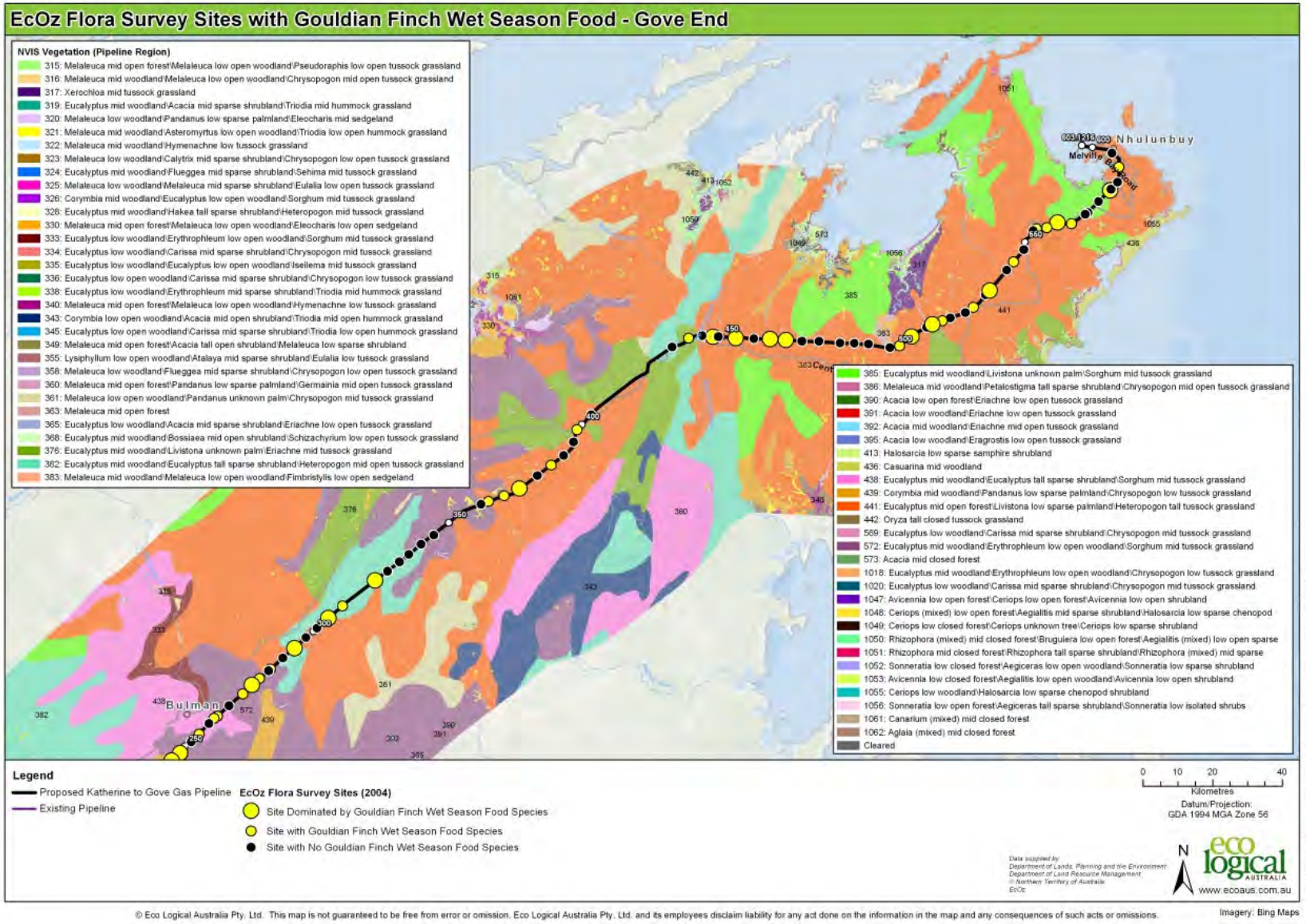

Figure 10-9: Potential wet season feeding habitat in north-eastern portion (Gove end) of Pipeline corridor

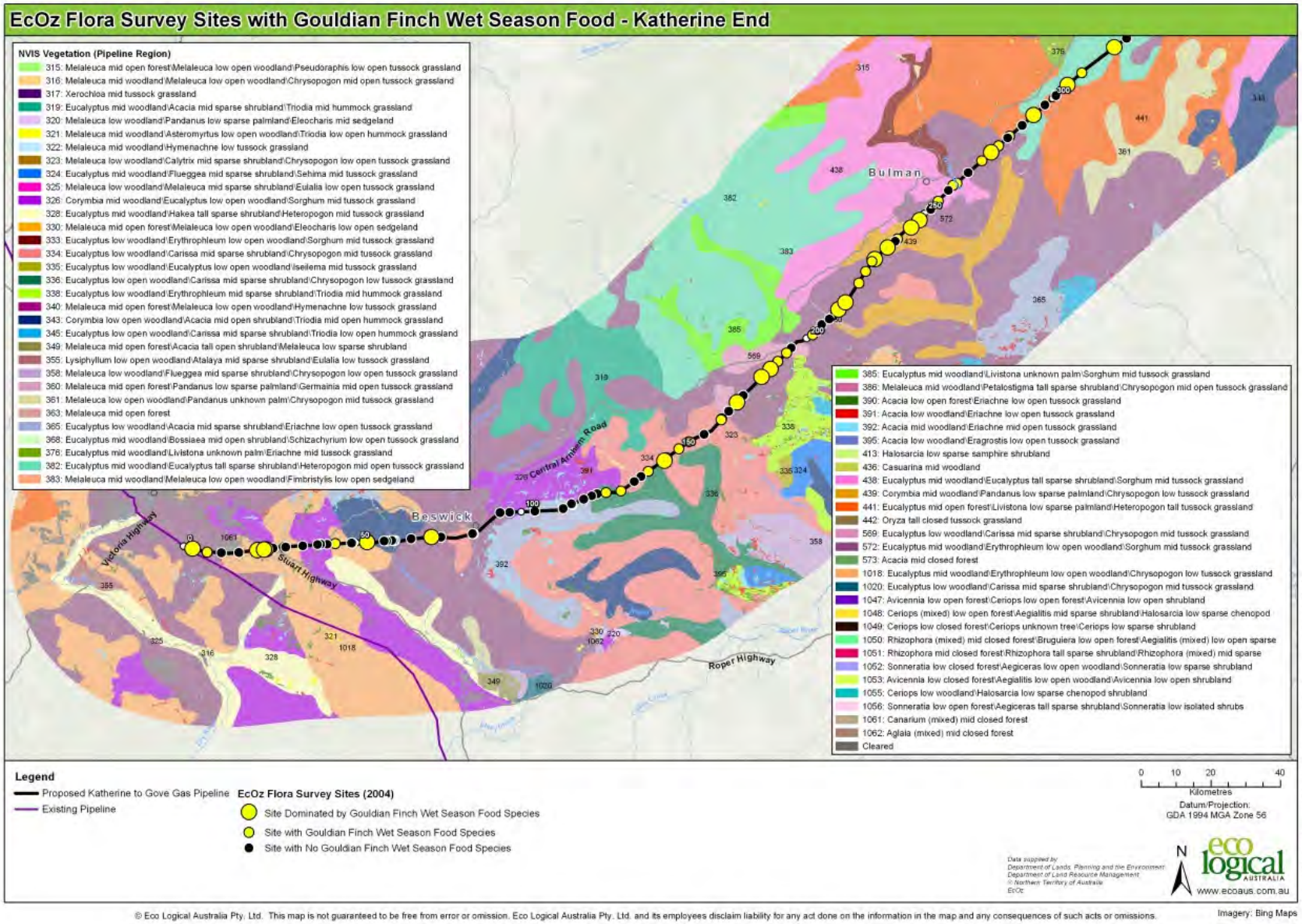

Figure 10-10: Potential wet season feeding habitat in south-western portion (Katherine end) of Pipeline corridor

Table 10-7: Summary of habitat values for Gouldian Finch in the Project area

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HABITAT
Majority of project area holds potential wet season feeding habitat although only those areas within 2-4 km of perennial waterholes and breeding habitat are likely to be utilised. Known potential breeding habitat confined to patches within KP0-50. Could also occur adjacent to Project area particularly where historical records of birds exist (e.g. between KP0 and KP140 and in Bulman locality)	Small perennial waterholes within 4 km of breeding and feeding habitat – one known to be located in Pipeline corridor Suitable wet season feeding habitat in Pipeline corridor near breeding habitat outside Individual nesting trees	Population of 200 adults and 300 moulting juveniles recorded in pipeline corridor (KP117). Population of similar size approximately 100km to the northwest (Yinberrie-Hills).	Breeding habitat extends outside of project area in patches 2-4 km from pipeline corridor. Wet season and dry season feeding habitat broadly represented locally. Scattered watering habitat occurs locally.	Regionally significant. 'Core' habitat identified (near KP117) where perennial waterhole occurs in proximity to breeding and feeding habitat.

10.7.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential to directly impact Gouldian Finches through destruction of nesting habitat or disturbance of nests; destruction of watering habitat; or by reducing seed availability from:

- Vegetation clearing and habitat removal.
- Physical disturbance to watering sites.
- Alteration to hydrological regimes that supply watering sites.
- Noise and vibration causing changes in behaviour (i.e. causing adults to abandon nest).
- Change to fire regimes.

A maximum of 1,500 ha of potential Gouldian Finch wet season feeding habitat is expected to be disturbed through clearing of the pipeline ROW. This type of vegetation/habitat is characteristic of

much of the land surrounding the pipeline as indicated by habitat association mapping (Figure 10-4) and regional vegetation mapping (Figure 10-9, Figure 10-10). For the purpose of this assessment it is assumed that up to an additional 180 ha would be cleared for ancillary infrastructure and 170 ha for access roads (being 1850 ha in total maximum). The actual use of these areas as feeding habitat is dependent on close proximity to nesting and watering habitat within and outside of the project area and hence this estimate represents an upper limit of impact on wet season feeding habitat. Feeding habitat between KP0 and KP140, including in the Beswick/Chambers River area, and potentially north-east of Bulman have the highest probability of actual use for feeding. The net impacts to the Gouldian Finch from clearing of wet season foraging habitat are expected to be low as the extent of clearing is small compared to the availability of similar habitat in the surrounding region. Rehabilitation in the project area following construction is anticipated to restore approximately 62% of this habitat in the long term, with a residual impact of a maximum of 703 ha. Active rehabilitation with a focus on return of grass species favoured in the wet season should ensure any local reduction in the supply of seed is temporary. The narrow corridor is unlikely to represent a permanent impact via fragmentation particularly with rehabilitation implemented.

Three patches of suitable breeding habitat are known to occur within or adjacent to the pipeline corridor near KP50 approximately 21 m – 83 m from the centreline of the pipeline corridor (Figure 10-8). There is a potential for the closest of these to be destroyed during vegetation clearing for the ROW. Further survey will be conducted in this area to clarify whether this patch can be avoided or impact minimised and confirm that the two more distant patches will be avoided. The resources mapping in the Beswick/Chambers River area indicate that significant patches of potential Gouldian Finch breeding habitat, including one patch of more than 100 ha and other isolated patches greater than five hectares in extent, occur outside of the pipeline corridor (Figure 10-7). It is anticipated that this may be the case in other areas between KP0 and KP140 to be subject to further survey. These patches would not be impacted by vegetation clearance from construction of the ROW or for ancillary infrastructure, which will be managed by a Site Selection Protocol preventing placement of infrastructure in proximity of such habitat (Appendix U). Further, the Gouldian Finch resource surveys will establish the broader availability of breeding habitat near the pipeline corridor in other potentially suitable areas between KP0 and KP140 and in areas in which access roads and construction camps are being proposed. Impacts on the Gouldian Finch from the potential loss of one known group of scattered breeding trees from construction of the ROW is expected to be low and not have implications for Gouldian Finch populations given the recorded availability of suitable breeding habitat in the surveyed areas outside of the pipeline corridor and likely occurrence in unsurveyed areas outside of the corridor, particularly where close to historical recordings of this species.

There remains the potential for breeding habitat to occur in unsurveyed areas through which access tracks and construction camps may be located. A subsequent dry season survey will include identification of potential nesting and dry season habitat in these areas to be avoided in the final design and alignment of access tracks and location of construction camps.

In regards to Gouldian Finch dry season feeding habitat, this coincides with the occurrence of breeding habitat and rocky slopes, which is known to occur between KP0 and KP50 and in the Beswick/Chambers River survey area, based on the vegetation information, and thought to occur potentially broader between KP0 and KP140 and potentially north-east of Bulman based on historical records. Impacts from construction of the pipeline on Gouldian Finch dry season feeding habitat is expected to be low as these rocky slopes have generally been avoided. Impacts to potential dry season feed habitat in the pipeline corridor in these areas will be minimised during final alignment of the ROW, supported by further resource mapping surveys this dry season. Ancillary infrastructure

locations will avoid dry season feeding habitat and similar alignment of access tracks and location of construction camps will take into account need to avoid such habitat.

The small waterhole/watering habitat coinciding with the finding of the Beswick/Chambers River Gouldian Finch population intercepted by the pipeline corridor has the potential to be partially directly disturbed through construction of the ROW. Dry season survey will confirm the extent to which the water resources can be avoided in final alignment of the ROW, subject to Aboriginal traditional owner consent if this involves realignment outside of the currently proposed 100 m pipeline corridor. Construction activity in the region between KP0 -140 which includes this watering habitat is scheduled for completion by mid-August, prior to the period in which Gouldian Finches were recorded utilising this site and more generally, prior to the early wet season period (October – November) in which Gouldian Finch access to water in the landscape becomes limited. Gouldian Finches have an absolute necessity for water however the water resources in the region are variable from year to year. It is known through the resource survey in this locality that more substantial water resources likely to be used by this population are present nearby and outside of the pipeline corridor (Figure 10-8).

The spatial and temporal variability of water resources coupled with similar variability in nesting and feeding habitat quality suggests that Gouldian Finches may adapt to varying water sources that become available over successive years. Regardless, it is possible the observed flock recorded in the 2012 survey may not have an absolute dependence on the resources at this site. Some birds have been recorded moving among other areas having the same or similar resources, such as Yinberrie Hills, Newry Station and Limmen National Park (S. Ward and G. Crowley, Gabriel Crowley Consulting, pers. comm., February 2013). Gouldian Finches have also been recorded from Wongalara Station, approximately 20 km south-east of the pipeline corridor (K. Tuft, Australian Wildlife Conservancy, pers. comm., October 2012), indicating other sites with the same or similar resources may be nearby.

In regard to potential water sources more broadly along the pipeline corridor, open trench crossings of water courses will occur only in circumstances when watercourses are not in flow or flow is minor and reinstatement will ensure the river profile is to pre-construction condition. Significant changes to the capacity and location retention of water within drainage systems along the ROW is therefore unlikely. Trenching is shallow and therefore unlikely to alter spring flow. Consequently impacts on Gouldian Finch watering habitat from construction of the ROW are expected to be low and short term.

Placement of groundwater bores for construction water will take into account findings of Gouldian Finch resources survey and not be placed in areas where extraction could foreseeably alter the hydrological regime of the species water sources.

Surface water hydrology impacts to Gouldian Finch water sources will be prevented by minimising disturbance in final alignment of the ROW and reinstating the ground following construction such that the ROW does not represent a barrier to any surface flow into such water sources.

Other potential indirect impacts, including habitat degradation through introduction or spread of weeds or changes to fire regimes, have the potential to cause longer-term impacts on Gouldian Finch feeding and nesting habitats. Construction of the pipeline will be managed to reduce fire risk such that there are no implications to local fire regimes that may represent a threat to habitat. Management measures contained in the EMP (Appendix O) and summarised in Table 10-8 will ensure the risk of fire and the spread of weeds is minimised.

Noise and vibration will be intermittent and temporary as construction progresses along the corridor. Any changes to breeding or foraging behaviour would be highly localised, temporary, and likely to return to pre-construction conditions soon after works finish.

Following construction, vehicles and workers will re-enter the ROW infrequently for monitoring, maintenance and repair. Disturbance from these activities would be localised and temporary and unlikely to displace Gouldian Finches from areas of habitat in proximity to the ROW.

Pacific Aluminium will implement a monitoring program for the known population of Gouldian Finch at Beswick/Chambers River. This will be implemented throughout construction and for the three years following completion of construction. The objective of the monitoring will be to confirm construction is not having/does not have a detrimental impact on the Gouldian Finch population and to provide further information on the population itself. Table 10-8 summarises the key mitigation measures that would be implemented for the Gouldian Finch. The residual impacts associated with the construction and operation of the KGGP Project on the Gouldian Finch may be considered moderately significant based on impacts occurring within core habitat for the species (Table 10-7) but minimised through proposed management measures.

In addition to these management measures, Pacific Aluminium is looking to work with the NLC to develop a habitat enhancement program that would be supported by funding of indigenous ranger groups to implement the program to improve habitat quality, with a focus on Gouldian Finch habitat. Indicatively, the enhancement program would involve an area up to ten times the area of potential Gouldian Finch habitat to be cleared, to be subject to a fire management program. This broad area would be likely to, or known to include habitat for Gouldian Finch that is similar to habitat to be disturbed for the project. Pacific Aluminium would fund indigenous ranger groups to undertake fire management in these areas in accordance with an agreed program, for the purpose of improving habitat quality for the Gouldian Finch. The initial part of this work would include evaluating where fire processes are likely to have had or continue to be causing decline in habitat quality for Gouldian Finch and to design an early dry season burn program to reduce occurrence of late season fires. Suitable monitoring methods would be developed as part of this program to measure its effectiveness.

The KGGP does not compromise any actions of the Gouldian Finch National Recovery Plan (O'Malley 2006). In particular the KGGP and its supporting habitat enhancement program are consistent with a number of actions identified in the Recovery Plan, which are to:

- Reduce the frequency, extent and/or intensity of late dry season fires at key sites in the Kimberley and Northern Territory.
- Develop indicators for optimal Gouldian Finch habitat health based on an assessment of grazing and fire impacts on wet season habitat in the Kimberley and the northern half of the NT.
- Incorporate grazing, feral herbivore and fire management actions and Gouldian Finch population monitoring programs into existing land management projects on key sites on pastoral and Aboriginal lands in the Kimberley and NT.

Table 10-8: Mitigation measures for Gouldian Finch

Avoidance	• All known potential breeding habitat will be avoided with the possible exception of one patch of trees at KP50. Further Gouldian Finch resources mapping will be undertake between KP0 and KP140 to confirm all other breeding habitat is able to be avoided. • Ancillary infrastructure Site Selection Protocol will ensure breeding habitat and water resources are avoided. • Assessments of areas in which construction camps and access roads are to be placed will be undertaken to identify potential breeding and dry season feeding habitat or water resources to be avoided in final design and placement of this infrastructure.
Minimisation	• Disturbance to known water resource in Beswick/Chambers River area and to potential breeding habitat at KP50 will be minimised through appropriate final alignment of ROW • Disturbance to wet and dry season feeding habitat from ancillary infrastructure, construction camps and access roads will be minimised in proximity to known or historical recordings of Gouldian Finch ie between KP0 and KP140 and north-east of Bulman. • Management measures will include controls to prevent spread of weeds
Management	*Terrestrial and aquatic fauna management* • Construction activities between KP0 and KP140 will be undertaken prior to the early wet season period (October – November) in which Gouldian Finch access to water in the landscape becomes limited. • The total area of habitat to be cleared will be restricted to the minimum area required to construct the pipeline, above ground infrastructure, temporary construction sites and access tracks. • Fauna awareness training of personnel as part of inductions • Vehicle speeds will be maintained at low speed on the ROW between KP0 and KP140 and north-east of Bulman and if and where the species is spotted by personnel. • Implementation of monitoring program for Beswick/Chambers River Gouldian Finch population *Surface water/groundwater management* • Construction groundwater bores will not be placed in areas where extraction could foreseeably alter the hydrological regime of known Gouldian Finch water sources. • Following installation of pipeline, ground will be reinstated such that the ROW does not represent a barrier to any surface flow that may feed Gouldian Finch water sources. *Fire management* • Fire prevention and management controls will be implemented to reduce risk of changes in fire regimes affecting Gouldian Finch habitat.

Table 10-9: Summary of residual impacts for Gouldian Finch after mitigation measures are applied

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Clearing of habitat causing loss of habitat, affecting important populations, fragmentation	Permanent loss of equivalent of up to 703 ha of potential wet season feeding habitat along pipeline corridor Clearing across 30 m ROW in habitat supporting important population in Beswick/Chambers River area Potential breeding habitat patch likely to be disturbed at KP50. Potential for some temporary fragmentation of habitat caused by ROW through habitat.	Low - Moderate	Threatened species habitat enhancement program through funding of indigenous ranger groups to improve habitat quality for threatened species.
Disturbance of water sources	Potential direct disturbance of minor water source in Beswick/Chambers River area.	Low	None
Alteration to hydrological regimes that supply watering sites.	No significant alteration of hydrology of known water sources.	Negligible	None
Vehicle/bird collisions causing mortalities	Some collisions possible.	Low	None
Noise and vibration	Localised and short term effect possible.	Negligible	None
Fire management	No change to local or regional fire regimes as a result of KGGP.	Negligible	None

10.8 NORTHERN CRESTED SHRIKE-TIT

10.8.1 Conservation status

The Northern Crested Shrike-tit (*Falcunculus frontatus whitei*) is listed as Vulnerable (Migratory) under the EPBC Act. This species is not listed under the TPWC Act.

10.8.2 Regional distribution and Ecology

The Northern Crested Shrike-tit is a subspecies of the Crested Shrike-tit of eastern and south-eastern Australia (Ward 2008). The species is sparsely distributed across the Top End of the NT and across to the western Kimberley in WA (Ward 2008). It is often seen in pairs or family groups; pairs occupy exclusive territories (approximately 22 ha in area) in which they are resident year-round.

No clear habitat preference has been described for the Northern Crested Shrike-tit (Woinarski 2004). However, the species has been recorded in eucalypt open forests and woodlands, such as those dominated by Bloodwood (*Eucalyptus opaca*), Darwin Box (*E. tectifica*) and Roughleaf Cabbage Gum (*E. confertiflora*). Factors that may increase the chances of the species inhabiting suitable areas include the presence of flaky-barked Bloodwood species and/or ironwood trees, areas not dominated by a thick shrub-layer, and areas that are prone to being waterlogged seasonally (DSEWPaC 2013).

Little is known of the ecology of the Northern Crested Shrike-tit. Nests have been recorded high in tree foliage (Woinarski 2004). Eggs of the species have been recorded in late January near Borroloola (approximately 400 km from the project area) in the NT; and in March in the Kimberley region of WA (DSEWPaC 2013). The diet of the Northern Crested Shrike-tit includes insect larvae, beetles, katydids, tree crickets, spiders and cicadas.

The Northern Crested Shrike-tit appears to have a fragmented distribution and occurs in very low densities in many isolated subpopulations (DSEWPaC 2013). The relatively small size of Northern Crested Shrike-tits, their quiet foraging behaviour and sparse distribution are thought to contribute to the paucity of records for the species (Ward 2008).

Recent records for the species in the Maranboy region (within 5 km of the project area) come from open mixed eucalypt woodland habitat with a grassy understorey on heavy soils that are shallowly inundated for much of the wet season (Ward 2008). Other recent records in northern Arnhem Land (near Maningrida and west of Nhulunbuy) come from low melaleuca woodlands in grassy drainage lines (Ward 2008). There are other reports of the species in more hilly areas (e.g. Borroloola, 400 km from the project area and Yinberrie Hills, 60 km from the project area), but details of the habitat are not available. Historically, the Northern Crested Shrike-tit has been recorded within the project area in the Beswick / Chambers River region.

The primary threatening process affecting the Northern Crested Shrike-tit is frequent hot fires in the late dry season which prevent invertebrates from becoming established beneath bark (DSEWPaC 2013). Grazing by livestock and feral animals, and invasion of native woodlands by exotic plants; particularly introduced pasture grasses has also had some effect (Woinarski 2004).

10.8.3 Potential habitat, survey effort and findings

Survey effort and findings were obtained from database searches (ALA 2013), and terrestrial fauna surveys undertaken by EcOz environmental in 2003-2004 and Eco Logical Australia (ELA) in November 2012 (Appendix D). The 2012 surveys for the Northern Crested Shrike-tit applied and adapted species specific methodology developed in the region by Ward (Ward 2008), and were broadcast surveys consistent with DSEWPaC survey guidelines for the areas surveyed (see Table 10-13 in Appendix D).

The 2004 surveys involved bird counts over six weeks in July 2004 at three locations in the project area; each location containing six survey sites. Eight diurnal bird counts were conducted at each of these sites. The Northern Crested Shrike-tit was not recorded during this survey.

The species was recorded during the 2012 survey. Two individuals were heard calling in response to a call broadcast on 15 November 2012 at KP106 (Table 10-11). The individuals weren't seen but were clearly heard. The broadcast was made in *Eucalyptus tectifica*, *E. latifolia* and *Erythrophleum chlorostachys* woodland habitat directly adjacent to the Central Arnhem Road and a power line easement. This habitat comprised dense woodland containing older trees, and the calls recorded in this survey were within 300 m of a nest site previously described by Ward (2008) (S. Ward, NT Department of Land Resource Management, pers. comm. February 2013).

Potential habitat for the Northern Crested Shrike-tit more broadly in the region has been identified using habitat associations (Table 10-11), the methodology for which is described in Appendix F. High, medium and low probability potential habitat for the Northern Crested Shrike-tit is available throughout the project area and broadly across the region. Preferred habitat for the Northern Crested Shrike-tit occurs within the project area as *Eucalyptus tectifica* and *Corymbia latifolia* woodlands (Ward 2008).

Areas of highest potential habitat for Northern Crested Shrike-tit are likely to occur in the north-east and south-west of the project area (Table 10-11). Given the species occurs at low densities across widespread habitat areas, for the purpose of this assessment all the vegetation within the project area is considered as potential habitat for the Northern Crested Shrike-tit. However, this habitat can be seen to likely be well represented outside of the corridor (Figure 10-11).

The National Multi-species Recovery Plan, which includes the Northern Crested Shrike-tit (Woinarski 2004), describes critical habitat for this species as being undefined due to limited ecological information being available. Woinarski (2004) does identify that this species has been recorded across a wide range of eucalypt open forests and woodlands and, less commonly, in woodlands dominated by *Terminalia* and *Melaleuca* species. Sites near Derby in the west Kimberley, WA and in an area around 100 km west and south of Katherine were identified as potentially important populations of the Northern Crested Shrike-tit by Woinarski (2004) as these areas have produced most records of this bird over the last few decades, suggesting that they may be unusually abundant in these locations. Given the undefined nature of critical habitat for this species and the wide availability of general habitat it is considered that all of the pipeline corridor could be in an area considered as potential foraging/nesting habitat but unlikely to be considered habitat critical to the survival of the species. No important populations of the species are known to occur within the project area but the section of the pipeline corridor south and within 100 km south of Katherine would be considered as having the most potential value for the species (Table 10-10).

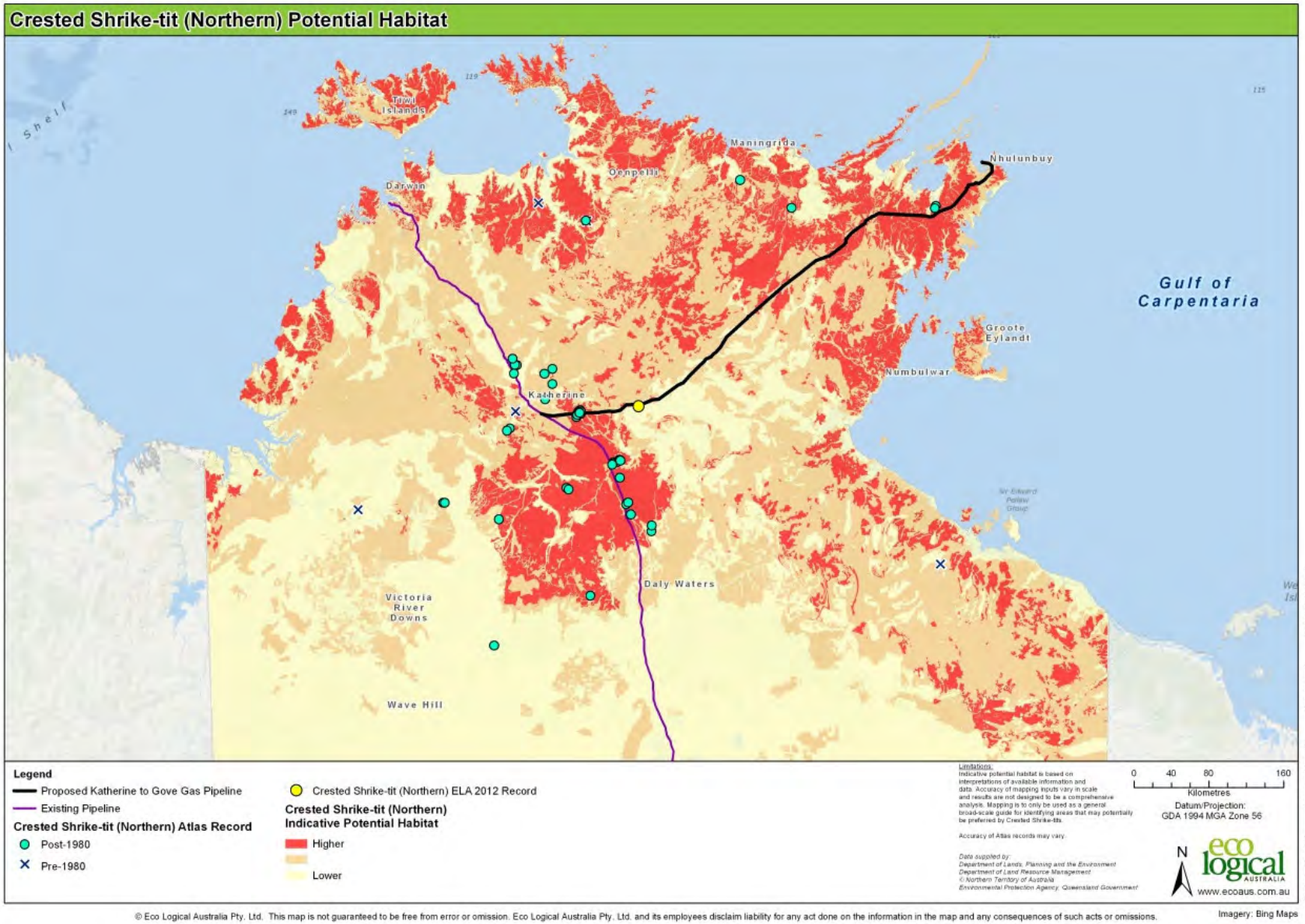

Figure 10-11: Northern Crested Shrike-tit indicative potential habitat (according to habitat associations) showing existing recordings

Table 10-10: Summary of habitat values for the Northern Crested Shrike-tit

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HABITAT
100% potential foraging/nesting habitat.	*Eucalyptus tectifica* and *Corymbia latifolia* woodlands and habitat containing denser vegetation and mature trees. Also flaky-barked Bloodwood species and seasonally waterlogged areas.	None known within the project area. Sites 100 km south of Katherine.	Extends broadly outside of project area. Not locally restricted.	Not of particular regional significance. No known critical habitat within the project area.

10.8.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential to directly impact the Northern Crested Shrike-tit through the destruction or disturbance of habitat, or by reducing prey availability from:

- Vegetation clearing and habitat removal.
- Change to fire regimes.
- Introduction/spread of invasive weeds.
- Noise and vibration causing changes in behaviour (i.e. causing adults to abandon nest).

Up to 2,200 ha of potential Northern Crested Shrike-tit foraging and/or nesting habitat is expected to be disturbed through vegetation clearing in the project area including for ancillary infrastructure and access roads. Potential habitat for the species is not confined to the project area, and extends across the Top End (Figure 10-11). The proposed clearing is a small proportion of the likely fragmented, yet broad distribution of the Northern Crested Shrike-tit.

Impacts on the Northern Crested Shrike-tit from habitat removal are therefore expected to be low. Rehabilitation of the project area following construction is intended to restore approximately 62% of this habitat in the long term, with the residual impact being equivalent to 836 ha. Access roads, construction camps and temporary laydown areas not required following construction will be rehabilitated in the long term.

The avoidance of areas of potentially higher value for the Northern Crested Shrike-tit, being taller stands of *Eucalyptus tectifica* and *Corymbia latifolia* woodlands and habitat containing denser vegetation and mature trees and flaky-barked Bloodwood species and seasonally waterlogged areas, will likely be achieved in the locating of ancillary infrastructure and camps and alignment of access roads. These will avoid tall treed areas near watercourses and wetland/damp areas, wherever practicable. Clearing of the narrow ROW corridor is unlikely to result in habitat fragmentation, particularly given that a large portion of this will be rehabilitated.

Noise and vibration will be intermittent and temporary as construction progresses along the corridor. Any changes to breeding or foraging behaviour would be highly localised, temporary, and likely to return to pre-construction conditions soon after works finish.

Construction will be managed to reduce fire risk such that there are no implications for local fire regimes that may represent a threat to habitat. Vehicle hygiene and weed control measures will be implemented to prevent the introduction of invasive weed species into new areas along the pipeline corridor.

Management measures will include implementing managing nest disturbance, fire and weeds. (Table 10-11).

Table 10-11: Mitigation measures for Northern Crested Shrike-tit

Avoidance	• Assessment of potential occurrence of Northern Crested Shrike-tit will be undertaken along proposed access roads, to avoid higher value habitat in final placement/alignment where practicable if the species is recorded or thought highly likely to occur.
Minimisation	• Best endeavours will be used to avoid clearing tall trees on along the edges of the pipeline corridor and and/or branches would be pruned (where feasible) rather than tree felled.
Management	T*errestrial and aquatic fauna management* • Clearing will be staged and performed on single 'fronts' to allow for the progressive movement of fauna into areas outside the proposed disturbance area. *Weed management* • Vehicle soil hygiene measures will be put in place to prevent introduction of invasive weed species into new areas along pipeline corridor. *Fire management* • Fire prevention and management controls will be implemented to reduce risk of changes in fire regimes affecting Northern Crested Shrike-tit habitat.

With the proposed mitigation measures implemented, it is considered unlikely that the Crested Shrike-tit will be significantly impacted as a result of the KGGP Project. Suitable habitat for the species is broadly represented in the vicinity of the project area and the wider region. Habitat to be cleared within the project area is unlikely to be locally or regionally significant and represents a small proportion of the habitat available for the species. Mitigation measures will focus on surveying for nest sites of significant fauna prior to construction, and in the event of a nest site being present, buffers and other management measures will be put in place.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

As stated above, with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the KGGP Project on the Northern Crested Shrike-tit is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Northern Crested Shrike-tit would not be required under the Commonwealth offsets policy.

The construction and operation of the KGGP will be consistent with the National Multi-species Recovery Plan (Woinarski 2004), in particular with reference to the following Recovery Plan actions:

- Maintain and enhance habitat suitability, through fire management.
- Minimise impacts of acute land-use factors.
- Minimise impacts of spread of exotic pasture plants.

Table 10-12 summarises the residual impacts for the Northern Crested Shrike-tit.

Table 10-12: Summary of residual impacts for Northern Crested Shrike-tit after mitigation measures applied

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Vegetation clearing and habitat removal.	Permanent loss of up to 836 ha of potential habitat. No known important populations affected No significant or permanent habitat fragmentation.	Low	None
Changes to fire regimes.	No change to local or regional fire regimes as a result of KGGP.	Negligible	None
Spread of invasive weeds.	No significant new weed infestations as result of KGGP.	Low	None
Noise and vibration causing changes in behaviour.	Localised and short term effect possible.	Negligible	None

10.9 AUSTRALIAN PAINTED SNIPE AND AUSTRALASIAN BITTERN

Potential impacts to the Australian Painted Snipe (*Rostratula australis*) and Australasian Bittern (*Botaurus poiciloptilus*) have both been addressed in this section on the basis of these species having similar habitat requirements and have been observed occurring together in floodplains and basin wetlands in other parts of Australia (DSEWPaC 2013).

10.9.1 Conservation status

The Australian Painted Snipe is listed as Vulnerable under both the EPBC Act and TPWC Act. The Australasian Bittern is listed as Endangered under the EPBC Act and is not listed under the TPWC Act.

10.9.2 Regional distribution and ecology

Australian Painted Snipe

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DSEWPaC 2013). The Australian Painted Snipe is generally seen singly or in pairs, or less often in small flocks and has been recorded at wetlands in all states of Australia (DSEWPaC 2013). It is likely that the species could occur on any shallow ephemeral wetlands in central or southern NT and could also occur in northern areas of the NT (Australian Government 2003).

The Australian Painted Snipe has been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land. The nest is usually placed in a scrape in the ground (DSEWPaC 2013). The Australian Painted Snipe feeds on vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates.

The primary factor in the decline of the Australian Painted Snipe is thought to have probably been from the loss and alteration of wetland habitat (DSEWPaC 2013). Grazing and associated trampling of wetland vegetation by cattle is a threat, particularly in arid regions where grazing tends to become concentrated around wetlands in the dry season. Other threats include changes to fire regimes, which might affect savannah vegetation around wetlands in northern Australia, and the replacement of endemic wetland vegetation by invasive, noxious weeds rendering habitats less suitable or unsuitable for the snipe e.g. *Parkinsonia aculeata* (DSEWPaC 2013)

Australasian Bittern

The Australasian Bittern occurs mainly in south-eastern and south-western Australia however, vagrants have been recorded from farther north, in the extreme north-east of WA and the NT (DSEWPaC 2013). The Australasian Bittern occurs in terrestrial wetlands and, rarely, estuarine habitats, mainly in the temperate south-east and south-west. In Australia, the Australasian Bittern has been recorded feeding on freshwater crayfish, fish (including goldfish), weevils, snakes, leaves and fruit.

The major threat to the Bittern in Australia is the loss or alteration of suitable wetland habitat, primarily through the diversion of water for irrigation, and the drainage and salinisation of swamps. The distribution of the Australasian Bittern in Australia is severely fragmented due to the species' narrow habitat preferences (i.e. densely vegetated wetlands) and the loss or alteration of suitable habitat (DSEWPaC 2013).

10.9.3 Potential habitat, survey effort and findings

Survey effort and findings were obtained from database searches (ALA 2013), and terrestrial fauna surveys undertaken by EcOz environmental in 2003-2004 and Eco Logical Australia (ELA) in November 2012 (Appendix D).

The 2012 fauna survey involved targeted stationary observations for the Australian Painted Snipe, which were undertaken during the bird survey around water holes in the Beswick region over five days. Incidental observations occurred over approximately 20 hours (2 hours per site). The survey methods generally complied with DSEWPaC guidelines for the area targeted, although habitat at many waterholes was marginal (Table 10-13, Appendix D). The species was not recorded in surveys.

The Australasian Bittern was not recorded in either the 2003/04 or 2012 survey. The species was not targeted during the 2012 survey as no suitably densely vegetated wetlands (preferred by this species) were in the survey areas. The DSEWPaC survey guidelines require area searches in suitable habitat for sightings, nests, indicative footprints and feathers (Table 10-13, Appendix D).

The Australian Painted Snipe and Australasian Bittern could potentially use wetlands in the vicinity of the project area, which may represent important habitat for these species if present. The project area traverses three regionally significant ephemeral wetlands comprising of one semi-permanent swamp (KP394) and two seasonally inundated swamps (KP516 and KP594) (Table 10-13). Six other regionally significant wetlands occur near the project area, however, they are outside any potential area that could be affected. It is noted that the majority of regional records of these species are at distance from the project area (Figure 10-12 showing the only record in the vicinity of the KGGP for the Australian Painted Snipe) and neither species was recorded during either survey. Important populations are not known to occur in the project area.

Despite habitat being available for these species within the project area, if present within the project area, these species are likely to occur at low densities. This is particularly the case for the Australasian Bittern as none of the wetlands observed in surveys appeared to be densely vegetated. Table 10-14 summarises the habitat values in the project area for these species.

Table 10-13: Regionally significant wetlands traversed by the Project area

KP RANGE	LATITUDE	LONGITUDE	HABITAT DESCRIPTION	WATER BODY
KP394	-12.9617	135.3418	*Platyzoma microphyllum* and *Aristida* sp. open grassland with emergent *Eucalyptus tetrodonta*, *Pandanus spiralis* and *Lophostemon lactifluus*	semi-permanent swamp
KP516	-12.6430	136.3236	*Corymbia polycarpa, Melaleuca viridiflora* and *Lophostemon lactifluus* open woodland with dense mid-storey of *Pandanus spiralis* and *Banksia dentata* and *Grevillea pteridifolia* with *Imperata cylindrica, Eriachne* sp.and *Cymbopogon refractus* understorey	seasonally inundated swamp
KP 594	-12.2045	136.7697	*Melaleuca viridiflora* and *Acacia leptocarpa* closed forest swamp with *Eriachne stipacea* and *Mnesithea rottboellioides*understorey	seasonally inundated swamp

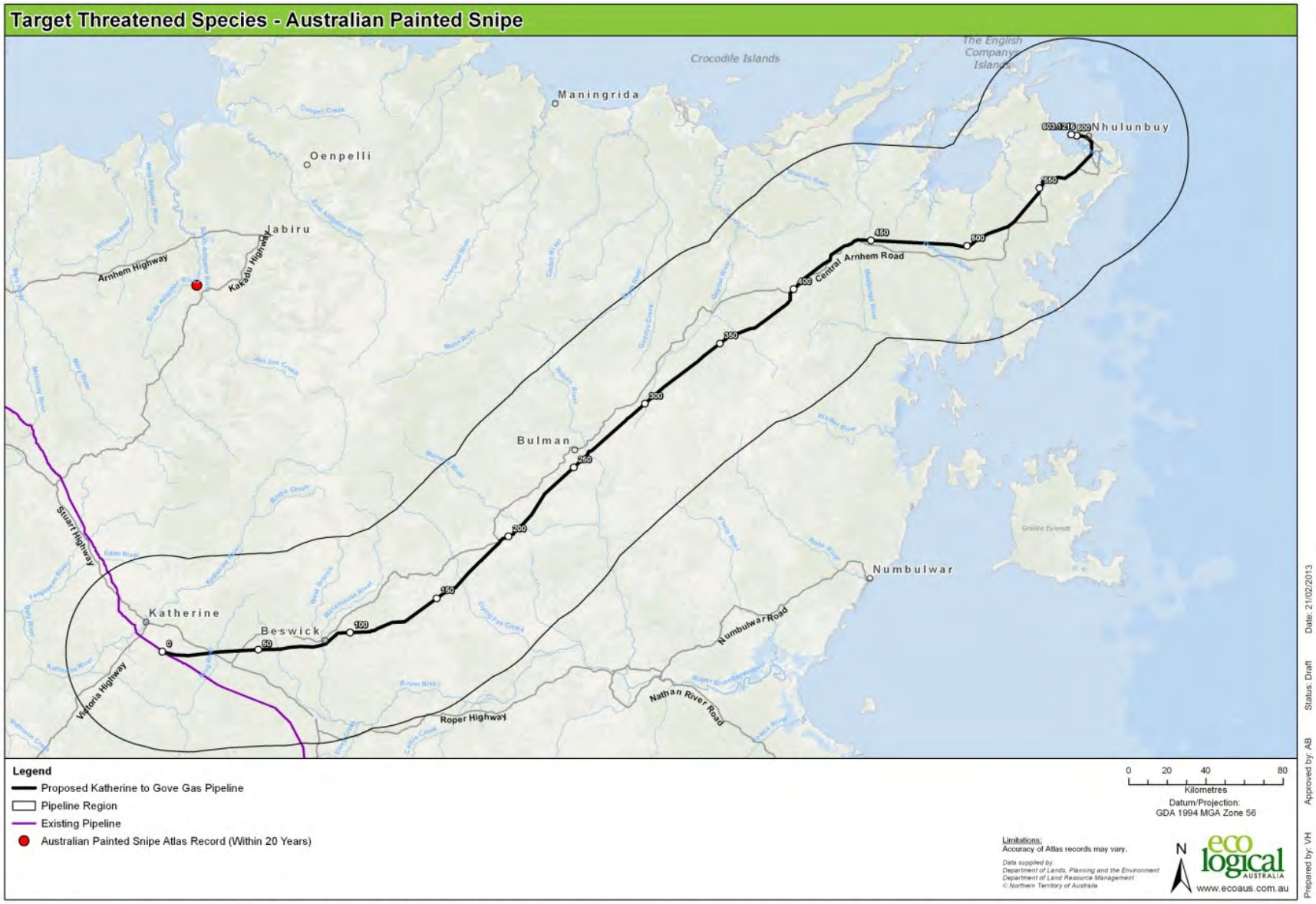

Figure 10-12: Existing records for Australian Painted Snipe in region around KGGP

Table 10-14: Summary of habitat values for the Australian Painted Snipe and Australasian Bittern

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HABITAT
< 1% could be considered potential foraging/nesting habitat.	Wetlands (if species present).	None	Extends outside of project area. Species more heavily distributed in south-eastern Australia.	Not of particular regional significance, majority of records have been at a distance from the project area.

10.9.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential to directly impact the Australian Painted Snipe and Australasian Bittern (if present) through the destruction or disturbance of habitat via:

- Wetland vegetation disturbance from pipeline construction.
- Changes to hydrological regime of wetland habitat from alteration of surface hydrology or groundwater extraction for construction water.
- Noise and vibration causing changes in behaviour.
- Change to fire regimes.
- Introduction/spread of invasive weeds.

The pipeline corridor has been aligned to avoid wetlands where practicable. Six out of nine significant wetlands in the region around the project area were potentially to be affected by the original alignment, following redesign this has been reduced to three. The three significant wetlands traversed by the project area are ephemeral (Table 10-13), and the wetland areas expected to be dry during construction, and will require open cut crossings as a result of the project. This would involve the excavation of a trench in a similar fashion to that employed for standard trenching, however the cross sectional profile of the wetlands subject to trenching would be reinstated to preconstruction condition, therefore minimising impacts to the wetland and associated vegetation. Wetland crossings in the project area will be constructed in accordance with accepted engineering standards and environmental protection guidelines.

In regard to indirect impacts from changes in hydrology of habitat, Pacific Aluminium has developed a preliminary water supply and adaptive management strategy for construction that proposes to predominantly use surface water from perennially flowing streams (not surface water from wetlands). This is primarily for dust suppression (800 kL/day) and camp potable water supply (300 kL/day). Groundwater, from existing or new bores, is likely to be required to supplement this as construction is during the dry season when surface water resources are highly variable. This has the potential to affect wetland habitats for Australian Painted Snipe and Australasian Bittern from causing groundwater drawdown under wetlands. In most cases for groundwater use, Pacific Aluminium is able to achieve the general NT guideline to restrict the amount of water extracted to 20% of recharge. Groundwater may only be required for small volumes of water where the surface water flow is not adequate to sustainably extract. At this stage, the only areas identified to potentially require supplementary groundwater supply are at King River, Beswick Creek, and Cato River. The water

supply and adaptive management strategy work program (Table 7-3 of Chapter 7) would be used to inform the potential maximum extraction from groundwater required for the Project. When the maximum groundwater supply is determined, field investigations would be undertaken during the 2013 dry season of existing groundwater bores that have been identified as a potential source of groundwater. Bores will not be placed in areas where abstraction could foreseeably significantly alter the hydrological regime of a wetland on which the Australian Painted Snipe and Australasian Bittern (and other waterbirds) could be dependent.

Similarly the construction of the pipeline should not affect surface hydrology such that it would affect runoff into wetland habitat. Following installation of pipeline, ground will be reinstated such that the ROW does not represent a barrier to any surface flow. Construction will take place in the dry season when the portions of these ephemeral wetlands traversed are anticipated to be generally dry.

Clearing of the narrow ROW corridor is unlikely to result in habitat fragmentation, particularly given that open-cut crossings will be rehabilitated once the pipeline is laid. It is likely that vegetation will quickly re-establish.

Noise and vibration will be intermittent and temporary as construction progresses along the corridor. Any changes to breeding or foraging behaviour would be highly localised, temporary, and likely to return to pre-construction conditions soon after works finish.

Construction will be managed to reduce fire risk such that there are no implications for local fire regimes that may represent a threat to habitat. Vehicle hygiene and weed control measures will be implemented to prevent the introduction of invasive weed species into new areas along the pipeline corridor.

Table 10-5 summarises the mitigation measures that would be implemented for the Australian Painted Snipe and Australasian Bittern.

With the proposed mitigation measures implemented, it is considered unlikely that the Australian Painted Snipe and Australasian Bittern will be significantly impacted as a result of the KGGP Project (Table 10-16). Suitable habitat for these species is broadly represented in the vicinity of the project area and wider region, with at least three wetlands with suitable habitat occurring in the vicinity of the project area.

Habitat to be disturbed within the project area is unlikely to be locally or regionally significant and represents a small proportion of the habitat available for these species. Mitigation measures for these species will focus on management of the construction of open-cut crossings through the specified wetland areas within the project area. Fire management will also be implemented to reduce any potential change in fire regimes.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

Table 10-15: Mitigation measures for Australian Painted Snipe and Australasian Bittern

Avoidance	• Design of the project has allowed for the avoidance of four out of the six significant wetlands potentially impacted. Another three were also in proximity but not affected by original or revised pipeline alignments. • Wetland habitat will be avoided in placement of ancillary infrastructure, camps and access roads wherever practicable.
Minimisation	• Wetland crossings in the project area will be constructed in accordance with accepted engineering standards and environmental protection guidelines. • Clearing of wetland habitat will be minimised in final alignment of ROW in pipeline corridor
Management	T*errestrial and aquatic fauna management* • Clearing will be staged and performed on single 'fronts' to allow for the progressive movement of fauna into areas outside the proposed disturbance area. *Surface water/groundwater management* • Construction groundwater bores will not be placed in areas where extraction could foreseeably alter the hydrological regime of a significant wetland. • Drainage in and adjacent to seasonal wetland areas will be reinstated as soon as practicable following construction. • Construction of pipeline through ephemeral wetlands will take place in dry season. *Weed management* • Vehicle soil hygiene measures will be put in place to prevent introduction of invasive weed species into new areas along pipeline corridor. *Fire management* Fire prevention and management controls will be implemented to reduce risk of changes in fire regimes affecting Australian Painted Snipe and Australasian Bittern habitat.

As stated above, with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the KGGP Project on the Australian Painted Snipe and Australasian Bittern is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Australian Painted Snipe and Australasian Bittern would not be required under the Commonwealth offsets policy.

The KGGP does not compromise the recovery plans for these species, in particular with the commitment and management controls in place to prevent drainage and/or changes in hydrology of significant wetlands on which the species' could be dependent, if they frequent.

Table 10-16 summarises the residual impacts for the Australian Painted Snipe and Australasian Bittern.

Table 10-16: Summary of residual impacts for Australian Painted Snipe and Australasian Bittern after mitigation measures applied

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Vegetation clearing and habitat removal.	Temporary disturbance of a portion of three wetland areas requiring open-cut crossings. No known important populations affected. No significant habitat fragmentation.	Low	None
Changes to hydrological regime of wetland habitat.	No significant changes anticipated.	Negligible	None
Noise and vibration causing changes in behaviour.	Localised and short term effect possible.	Negligible	None
Changes to fire regimes.	No change to local or regional fire regimes as a result of KGGP.	Negligible	None
Spread of invasive weeds.	No significant new weed infestations as result of KGGP.	Low	None

10.10 NORTHERN MASKED OWL

10.10.1 Conservation status

The Northern Masked Owl (*Tyto novaehollandiae kimberli*) is listed as Vulnerable under both the EPBC Act and the TPWC Act.

10.10.2 Regional distribution and ecology

The Northern Masked Owl is a subspecies of the Masked Owl (*Tyto novaehollandiae*). Little is known of the distribution of the Northern Masked Owl, and three subpopulations have been suggested: the Kimberley region of WA, the Top End of the NT and Cape York in far north QLD. In northern Australia, the Northern Masked Owl has been recorded from riparian forest, rainforest, open forest, *Melaleuca* swamps and the edges of mangroves and along the margins of sugar cane fields (DSEWPaC 2013).

The Northern Masked Owl breeds between March and October, typically nesting in tree hollows, within patches of closed forest (DSEWPaC 2013). The Northern Masked Owl feeds in open woodland on small to medium-sized terrestrial mammals (DSEWPaC 2013).

Although the reason for the low population density of the Northern Masked Owl (northern) is unknown, the subspecies has undoubtedly been affected by broad-scale changes to the environment of northern Australia caused by altered fire regimes, grazing by livestock and feral animals and the invasion of native woodlands by exotic plants, particularly introduced pasture grasses. There is some

evidence of a broad-scale decline in the numbers of small and medium-sized endemic mammals across northern Australia over the last century (DSEWPAC 2013).

10.10.3 Potential habitat, survey effort and findings

Survey effort and findings were obtained from database searches (ALA 2013), and terrestrial fauna surveys undertaken by EcOz in 2003-2004 and Eco Logical Australia (ELA) in November 2012 (Appendix D). Survey methodology was generally consistent DSEWPaC requirements with some variations (see Table 10-13 in Appendix D).

During the 2012 survey, broadcast surveys were undertaken for the Northern Masked Owl at two sites in the Beswick/Chambers River survey area. At each site the call of Northern Masked Owl was broadcast waiting for response calls. Survey effort focused on finding and watching waterholes as the most effective survey method in the late dry season. No calls were recorded.

Although the species was not recorded in either survey it is considered as possibly occurring since suitable habitat is in the project area in the form of rainforest and open forest. High value habitat may be present in the form of trees with hollows. However, the Northern Masked Owl is considered more likely to occur north of the project area, given the majority of records of this species are in the far north of the Top End. There is a record approximately 30 km north of the pipeline corridor, 25 km north-east of Katherine.

The National Multi-species Recovery Plan which includes the Northern Masked Owl (Woinarski 2004) identifies there are too few records of this species to characterise critical habitat, but it is very dependent on tree hollows. These may occur within the project area, however are likely to be available in the broader region also. The north-eastern Cape York Peninsula population of the Northern Masked Owl may be considered important, because it is possibly morphologically distinctive. Important populations of the species are not expected to occur within the project area (Table 10-17).

Table 10-17: Summary of habitat values for the Northern Masked Owl

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HA BITAT
100% foraging/nesting habitat	Tree hollows	None known within the project area.	Extends broadly outside of project area. Not locally restricted.	Not likely to be of particular regional significance, majority of records have been at distance from the project area.

10.10.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential to directly impact the Northern Masked Owl through the destruction or disturbance of habitat, or by reducing prey availability from:

- Vegetation clearing and habitat removal.
- Change to fire regimes.
- Introduction/spread of invasive weeds.
- Noise and vibration causing changes in behaviour (i.e. causing adults to abandon nest).

Up to 2,200 ha of potential Northern Masked Owl foraging and/or nesting habitat is expected to be disturbed through vegetation clearing in the project area. Potential habitat for the species is not confined to the project area, and is likely to extend across the Top End, particularly in the northern Top End where the majority of records of this species have occurred (ALA 2013). Impacts to the Northern Masked Owl (if present) from habitat removal associated with the project are therefore expected to be low. Rehabilitation of the project area following construction is intended to restore approximately 62% of this habitat in the long term, with the residual impact being approximately 836 ha. Access roads, construction camps and temporary laydown areas not required following construction will be restored in the long term.

Measures proposed to reduce impacts to tall woodland near water sources will reduce potential for unknown nest hollows in tall trees in these areas to be impacted.

Clearing of the narrow ROW corridor is unlikely to result in habitat fragmentation, particularly given that a large portion of this will be rehabilitated.

Noise and vibration will be intermittent and temporary as construction progresses along the corridor. Any changes to breeding or foraging behaviour would be highly localised, temporary, and likely to return to pre-construction conditions soon after works finish.

Construction will be managed to reduce fire risk such that there are no implications for local fire regimes that may represent a threat to habitat. Vehicle hygiene and weed control measures will be implemented to prevent the introduction of invasive weed species into new areas along the pipeline corridor.

Management measures will include implementing controls on disturbance, fire and weeds (Table 10-18).

With the proposed mitigation measures implemented, it is considered unlikely that the Northern Masked Owl will be significantly impacted as a result of the KGGP Project (Table 10-19). Suitable habitat for the species is broadly represented in the vicinity of the project and wider region. Habitat to be cleared within the project area is unlikely to be locally or regionally significant to the species and represents a small proportion of the habitat available for the species. Mitigation measures will focus on surveying for nest sites of significant fauna prior to construction, and avoidance where possible and also fire management to reduce any potential change in fire regimes. Table 10-19 summarises the residual impacts for the Northern Masked Owl.

Table 10-18: Mitigation measures for Northern Masked Owl

Avoidance	• Significant riparian vegetation potentially supporting tall woodland (nesting habitat) has been avoided through route selection and use of HDD at a large number of river crossings. • Tall woodland near permanent water will be avoided in placement of ancillary infrastructure, camps and access roads wherever practicable.
Minimisation	• Best endeavours will be used to avoid clearing tall trees on along the edges of the pipeline corridor and and/or branches would be pruned (where feasible) rather than tree felled. • Clearing of tall woodland near permanent water will be minimised in final alignment of ROW in pipeline corridor.
Management	T*errestrial and aquatic fauna management* • Clearing will be staged and performed on single 'fronts' to allow for the progressive movement of fauna into areas outside the proposed disturbance area. *Weed management* • Vehicle soil hygiene measures will be put in place to prevent introduction of invasive weed species into new areas along pipeline corridor. *Fire management* • Fire prevention and management controls will be implemented to reduce risk of changes in fire regimes affecting Northern Masked Owl habitat.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

As stated above, with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the Project on the Northern Masked Owl is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Northern Masked Owl would not be required under the Commonwealth offsets policy.

The construction and operation of the KGGP will be consistent with the National Multi-species Recovery Plan, in particular with reference to the following Recovery Plan actions:

- Maintain and enhance habitat suitability, through fire management.
- Minimise impacts of acute land-use factors.
- Minimise impacts of spread of exotic pasture plants.

Table 10-19: Summary of residual impacts for Northern Masked Owl after mitigation measures applied.

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Vegetation clearing and habitat removal	Permanent loss of up to 836 ha of potential habitat. No known important populations affected. No significant or permanent habitat fragmentation.	Low	None
Changes to fire regimes	No change to local or regional fire regimes as a result of KGGP.	Negligible	None
Spread of invasive weeds	No significant new weed infestations as result of KGGP.	Low	None
Noise and vibration causing changes in behaviour	Localised and short term effect possible.	Negligible	None

10.11 EASTERN PARTRIDGE PIGEON

10.11.1 Conservation status

The Eastern Partridge Pigeon (*Geophaps smithii smithii*) is listed as Vulnerable under both the EPBC Act and TPWC Act.

10.11.2 Regional distribution and ecology

The Eastern Partridge Pigeon is a subspecies of the Partridge Pigeon (*Geophaps smithii*). The Eastern Partridge Pigeon occurs only in sub-coastal areas of the Top End; most records are from Kakadu National Park and between Katherine and Darwin. The Eastern Partridge Pigeon prefers open forest and woodland dominated by Darwin Stringybark (*Eucalyptus tetrodonta*) and Darwin Woollybutt (*E. miniata*) that has a structurally diverse understorey.

The Eastern Partridge Pigeon is relatively sedentary and will commonly occupy the same area throughout the year if there is permanent water nearby. It nests on the ground usually in a shallow depression lined with grass or leaves. It has been known to lay eggs in all months of the year, although the bulk of nesting occurs in the early to mid-dry season. It forages on a wide variety of seeds from grasses, legumes, herbs and also shrubs and trees (DSEWPaC 2013).

Land use activities such as vegetation clearing, overgrazing and particularly the change from patchy fires over time to a late dry season fire regime can result in detrimental changes to the structure and floristic composition of the open forest and woodland habitat occupied by Eastern Partridge Pigeon DSEWPaC 2013).

10.11.3 Potential habitat, survey effort and findings

Survey effort and findings were obtained from database searches (ALA 2013) and terrestrial fauna surveys undertaken by EcOz in 2003/04 and Eco Logical Australia (ELA) in November 2012 (Appendix D).

EcOz (2004) conducted bird counts during a fauna survey over six weeks in July 2004. Three locations in the project area were surveyed; each location containing six survey sites. Eight diurnal bird counts were conducted at each of these sites. The Eastern Partridge Pigeon was not recorded during this survey.

No specific area searches were conducted for the Eastern Partridge Pigeon during the 2012 ELA survey. Incidental observations were allowed for whilst deploying remote cameras and hair tubes, which occurred over approximately 20 hours (two hours per site). Survey effort focused on finding and watching waterholes as the most effective survey method in the late dry season. Survey methodology generally was consistent to DSEWPaC requirements, with some variations (refer to Table 10-13 in Appendix D)

Potential habitat for the Eastern Partridge Pigeon in the region has been identified using habitat associations (Figure 10-13), the methodology for which is described in Appendix F. High, medium and low probability potential habitat for the species is available throughout the project area and broadly across the region.

Areas of highest potential habitat for the Eastern Partridge Pigeon are likely to occur as scattered areas of open forest and woodland across the project area. Potential habitat for this species is estimated to be well represented outside of the pipeline corridor. Although there are some records of this species near the project area, the majority of records of this species are from areas to the north and north-west of Katherine, at least 100 km away from the project area.

The National Multi-species Recovery Plan, which includes the Eastern Partridge Pigeon (Woinarski 2004), describes critical habitat for this species as being intricately burnt mosaics within its preferred open forests with grassy understorey (Fraser *et al*. 2003 as cited in Woinarski 2004). Burnt areas may occur within the project area however intricately burnt mosaics of vegetation are likely to be rare. The Tiwi Island population of the Eastern Partridge Pigeon is considered a potentially important population because it may be unusually abundant there, and its isolation may provide it some refuge from at least some threatening processes operating on the mainland. The population within Kakadu National Park may also be important because it is a high profile species there, and a focal species for the implementation of fire management. Important populations of the species are not expected to occur within the project area (Table 10-20).

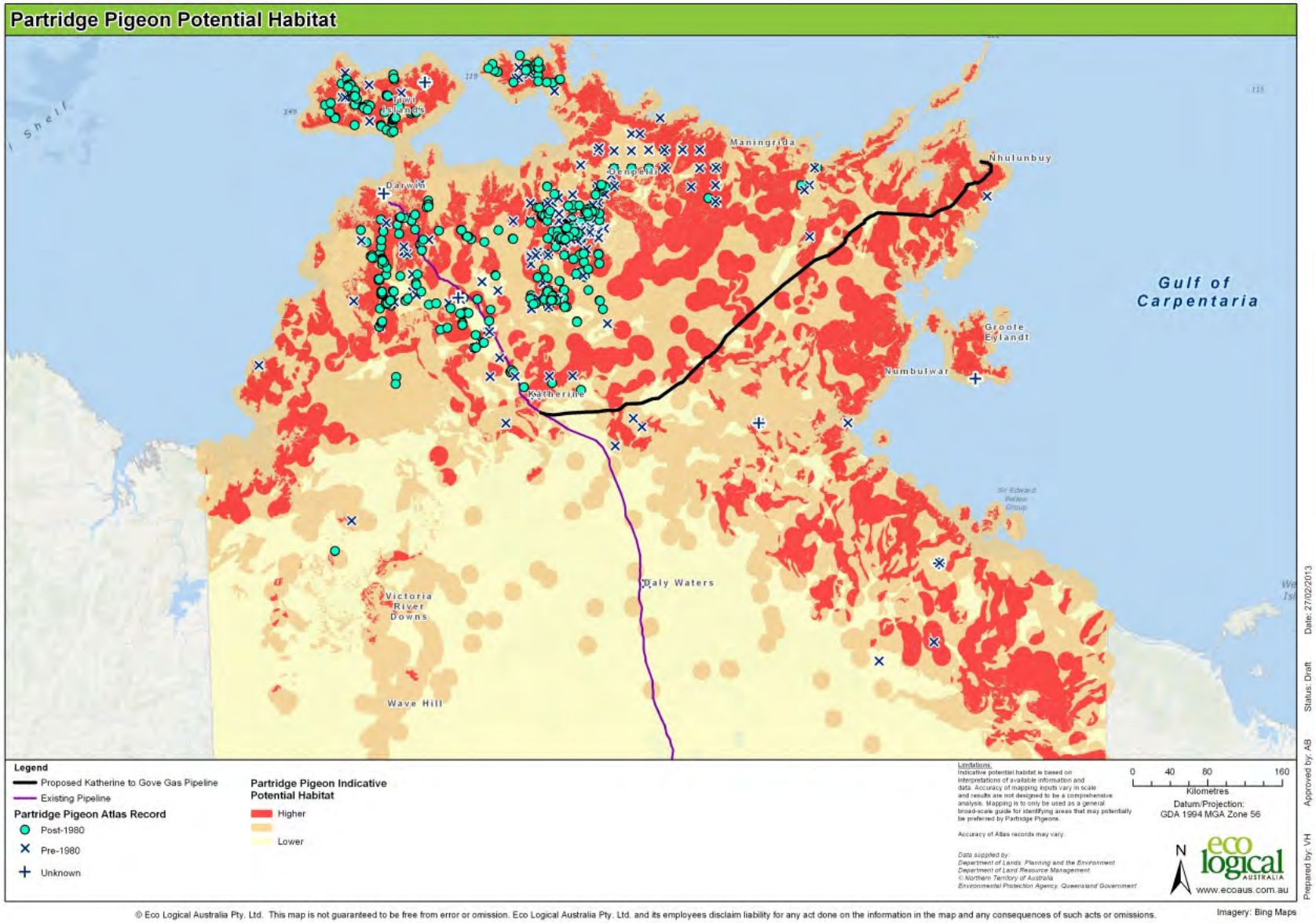

Figure 10-13: Eastern Partridge Pigeon indicative potential habitat (according to habitat associations) showing existing recordings

Table 10-20: Summary of habitat values for the Eastern Partridge Pigeon

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HABITAT
100% foraging/nesting habitat	Burnt mosaics of vegetation within preferred open forest and woodland habitat. Some of this habitat is likely to occur within the project area.	No important populations occur within the project area. Tiwi Islands and Kakadu NP.	Extends broadly outside of project area. Not locally restricted.	Not of particular regional significance (Figure 10-13).

10.11.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential to directly impact the Eastern Partridge Pigeon through the destruction or disturbance of habitat, or by reducing prey availability from:

- Vegetation clearing and habitat removal.
- Noise and vibration causing changes in behaviour (i.e. causing adults to abandon nest).
- Change to fire regimes.

This species' habitat is likely to be widespread throughout the region based on its broad habitat requirements. Up to 2,200 ha of potential Eastern Partridge Pigeon foraging and/or nesting habitat is expected to be disturbed through vegetation clearing in the project area. This is very small proportion of extent of available habitat and includes substantial areas of moderate compared to high potential habitat (Figure 10-13). Such potential habitat for the species is not confined to the project area, and extends across the Top End. Impacts on the Eastern Partridge Pigeon from habitat removal are therefore expected to be low. Rehabilitation of the project area following construction is intended to restore approximately 62% of this habitat in the long term, with the residual impact being approximately 836 ha. Access roads, construction camps and temporary laydown areas not required following construction will be rehabilitated in the long term.

The nests of the Eastern Partridge Pigeon are established on the ground in grassy areas. These nests and foraging habitat may be impacted by vegetation clearing however this is unlikely to cause any long-term impact on the species. Clearing of the narrow ROW corridor is unlikely to result in habitat fragmentation, particularly given that a large portion of this will be rehabilitated, and the species is naturally found in mosaic vegetation environments.

Noise and vibration will be intermittent and temporary as construction progresses along the corridor. Any changes to breeding or foraging behaviour would be highly localised, temporary, and likely to return to pre-construction conditions soon after works finish.

Increased frequency or extent of fires in the early season could result in increased mortality of eggs and/or young in nests of the Eastern Partridge Pigeon. However, the species is also disadvantaged by the absence of fire. Where unburnt, the very dense tall grass layer characteristic of open forests in northern Australia makes movement for ground-feeding vertebrates difficult, and reduces accessibility to food resources (Woinarski 2004). Construction will be managed to reduce fire risk such that there are no implications for local fire regimes that may represent a threat to habitat.

Vehicle hygiene and weed control measures will be implemented to prevent the introduction of invasive weed species into new areas along the pipeline corridor.

Management measures will include managing nest disturbance, fire and grazing (Table 10-21).

Table 10-21: Mitigation measures for Eastern Partridge Pigeon

Avoidance	• Assessment of potential occurrence of grassed areas in which nests may occur will be undertaken along proposed access roads, construction camps and ancillary infrastructure to avoid in final alignment where practicable.
Minimisation	• Clearing of mosaic grassland vegetation within preferred open forest and woodland habitat will be minimised where practicable in final alignment of ROW in Pipeline corridor if identified in 2013 dry season survey work to have higher potential for nesting areas.
Management	T*errestrial and aquatic fauna management* • Clearing will be staged and performed on single 'fronts' to allow for the progressive movement of fauna into areas outside the proposed disturbance area. *Weed management* • Vehicle soil hygiene measures will be put in place to prevent introduction of invasive weed species into new areas along pipeline corridor. *Fire management* • Fire prevention and management controls will be implemented to reduce risk of changes in fire regimes affecting Northern Masked Owl habitat..

With the implementation of the proposed mitigation measures, it is considered unlikely that the Eastern Partridge Pigeon will be significantly impacted as a result of the KGGP Project (Table 10-22). Suitable habitat for the species is broadly represented in the vicinity of the project area and wider region. Habitat to be cleared within the project area is unlikely to be locally or regionally significant to the species and represents a small proportion of the habitat available for the species. Mitigation measures will focus on minimising clearing, weed management and fire management to reduce any potential change in fire regimes.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

As stated above, with the implementation of the proposed mitigation measures, the residual impacts associated with the construction and operation of the KGGP Project on the Eastern Partridge Pigeon is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Eastern Partridge Pigeon would not be required under the Commonwealth offsets policy.

Table 10-22 summarises the residual impacts for the Eastern Partridge Pigeon.

Table 10-22: Summary of residual impacts for Eastern Partridge Pigeon after mitigation measures applied

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Vegetation clearing and habitat removal	Permanent loss of up to 836 ha of potential habitat. No known important populations affected No significant or permanent habitat fragmentation.	Low	None
Changes to fire regimes	No change to local or regional fire regimes as a result of KGGP.	Negligible	None
Spread of invasive weeds	No significant new weed infestations as result of KGGP.	Low	None
Noise and vibration causing changes in behaviour	Localised and short term effect possible.	Negligible	None

10.12 GOVE CROW BUTTERFLY

10.12.1 Conservation status

The conservation status of the Gove Crow Butterfly (*Euploea alcathoe enastri*) is listed as Endangered under the EPBC Act and Near Threatened under the TPWC Act.

10.12.2 Regional distribution and ecology

The Gove Crow Butterfly is an NT endemic sub-species, restricted to north-eastern Arnhem Land. Its larval stages are found associated with several species of vines (Family Apocynaceae), and the preferred larval food plant is *Parsonia alboflavescens* (Braby 2009; DLRM 2012a).

Gove Crow Butterflies are found in patches in the transitional zone (ecotone) between evergreen monsoon vine-forest and eucalypt/paperbark woodland. These wet monsoon forest patches are always associated with permanent creeks or perennial groundwater seepages or springs that form swamps, usually along drainage lines or floodplains in coastal or near-coastal lowland areas (DLRM 2012a).

The critical habitat of the subspecies (monsoon rainforest patches) is subject to natural disturbance by fire, flood and occasional cyclones.

The key threats to the habitat of Gove Crow Butterflies are:

- Habitat modification through altered fire regimes.
- Habitat loss through invasive species (grassy weeds, Yellow Crazy Ants).
- Habitat disturbance by feral animals (buffalo, pigs).
- Global climate change (Braby 2010).

Invasion of the region by Mission Grass has increased fuel loads three to five times and consequently increased the intensity of fires. As Mission Grass is a perennial, its infestation extends the fire season later in the year when conditions are drier and windier thereby increasing the potential for greater spread of fires, which bring destructive fires to the edges of the Butterfly's critical monsoon rainforest patch habitat (Panton 1993). This could result in continual shrinkage of habitat patches and eventual disappearance. As Mission Grass is already well-established in Nhulunbuy, the intensity of fires on the Gove Peninsula is likely to continue to increase, which may result in the eventual loss of many of the habitat patches on which the Gove Crow Butterfly depends.

Improvements and extension of roads to Nhulunbuy have increased vehicular access to the region, with a resulting increase in the frequency and extent of fires that have already been linked to loss of monsoon rainforest patches used by the Gove Crow Butterfly (Panton 1993).

The National Recovery Plan for the Gove Crow Butterfly (Braby 2007) identifies a potential threat to habitat and potential mortality of larvae at its early stages due to predation by Yellow Crazy Ants. The Yellow Crazy Ant (*Anoplolepis gracilipes)* is ranked among the 100 worst invasive species in the world and has been found at almost 100 locations throughout north-east Arnhem Land, predominantly in intact savannah woodland (Hoffman 2010). The Yellow Crazy Ant has had severe and demonstrable negative impacts on a suite of other invertebrates, through spraying formic acid and blinding them (Braby 2007). They have damaged vegetation in some regions (e.g. Christmas Island); however, there is no evidence that this has happened to butterfly habitat in north-eastern Arnhem Land (B. Hoffman, CSIRO pers. comm., February 2013). Currently, there is no direct evidence linking Yellow Crazy Ant infestations to loss of larvae of Gove Crow Butterflies or their habitat but it is a recognised potential threat; sightings of ants and butterflies have occurred within a few kilometres of each other. There is anecdotal evidence that they may have co-existed at one site in the past (Rocky Bay rainforest; B. Hoffman, CSIRO; pers. comm., February 2013).

Since 2004 there has been a management program involving the poisoning and eradication of Yellow Crazy Ant colonies targeting areas where the Butterfly occurs. This has eliminated ants from any area where they might have overlapped and from areas adjacent to the Gove Crow Butterfly habitat. Dhimurru and Yirralka Rangers have treated 100 infestations, and ants have been completely eliminated from 26 sites. Infestations at the remaining sites remain unassessed and presumably the ants have been eradicated from most sites (B. Hoffman, CSIRO. pers. comm., February 2013). The locations of extant infestations are known, and the program continues to eliminate infestations relative to available funds and priority of the site. Natural spread of colonies (for example, by winged

individuals) tends to be slow (less than 400 m/year, observed in the Seychelles, Holway *et al.* 2002). However, human-mediated dispersal has been responsible for the most significant translocations and establishment of colonies. A key vector for spread of the ants in the KGGP would be through transferring of soil to new areas.

Trampling of understory plants by pigs and buffalo are also damaging Gove Crow habitat.

In 2007, the first National Recovery Plan for the Gove Crow Butterfly was prepared, setting out actions required to arrest the decline of the subspecies and support its recovery (Braby 2007). The plan has been adopted under the provisions of the EPBC Act, and has the following objectives, which can be achieved through specific actions in the Plan:

- Develop and involve local Indigenous rangers.
- Educate landholders and increase community awareness.
- Monitor and assess threats, to determine appropriate abatement activities.
- Manage exotic species to reduce the extent of areas affected.
- Determine ecological requirements.

10.12.3 Potential habitat, survey effort and findings

Areas of potential habitat for Gove Crow Butterflies are rainforests and mixed paperbark forest with rainforest elements (and food plant species) in the north-eastern region of East Arnhem Land. These areas are where the larval food plants (several species of vines but particularly its preferred species *Parsonsia alboflavescens*) co-occur with mixed paperbark tall open forest with rainforest elements in the understorey and the transitional zone between this habitat and monsoon vine forest (rainforest), associated with permanent creeks or perennial groundwater seepages or springs (Figure 10-14, Figure 10-15). These habitats, considered critical for the survival of the species, are restricted to north-east Arnhem Land. They have not been found within the Pipeline corridor and are not anticipated to occur within at least several kilometres from the Pipeline centreline. Habitat areas could be in proximity to areas in which access roads may be placed. Table 10-23 summarises the habitat values for the Gove Crow Butterfly from the KGGP project.

Survey effort and findings

The distribution of the Gove Crow Butterfly was most recently determined by surveys conducted between 2006 and 2008 on the Gove Peninsula (M. Braby; CSIRO; personal communication, as reported in DLRM 2013c), based on site locations meeting a range of likelihood criteria:

- Presence of patches of its preferred habitat on aerial photos and GIS spatial data held by the NT Government: spring-fed and riparian evergreen monsoon vine forest (for which fine-scale mapping was available, as opposed to paperbark forest mapping done at a coarser scale).
- Areas and sites known to have its preferred larval food plant, the woody vine *Parsonia alboflavescens* (from NT Herbarium Holtze database).
- Areas in which the subspecies and/or its preferred larval food plant had been observed by traditional owners, indigenous rangers and local naturalists (Braby 2010).

This generated more than 100 potential sites to visit; however, only 46 of these were accessible by the survey team, the others too remote or difficult to access. Surveys were conducted during the dry season (between June and October).

Surveys indicated that the distribution of the subspecies is limited, with its range approximately 6,700 km2, and within this range, it was recorded from 11 locations (sub-populations) at a total of 21 sites (Braby 2010; Figure 10-15). Of the four habitat types in which the Gove Crow Butterfly was

found, its breeding habitats were restricted to mixed paperbark tall open forest with rainforest elements in the understorey and rainforest edge.

Extensive surveys west of this region, including on the Goyder River near the Central Arnhem Road crossing, failed to find the Gove Crow Butterfly, despite the presence of apparently suitable habitat and/or availability of the larval food plant *Parsonia alboflavesens* (Braby 2010).

Individuals were found only in coastal or near coastal lowland areas on the Gove Peninsula, predominantly in swampland along drainage lines or flood plains draining into Arnhem and Melville Bays (into Arafura Sea) or draining to Rocky Bay, Port Bradshaw, Caledon Bay, Grindall Bay and Jalma Bay (draining into the Gulf of Carpentaria).

All of the 21 sites where the survey team recorded Gove Crow Butterflies were at least 3 km away from the proposed pipeline corridor (Braby 2010). Two sites were just under 4 km away, and four sites were between 7.5 – 9.5 km away. The remaining 15 sites were at least 10 km away (Figure 10-15).

Table 10-23: Summary of habitat values for Gove Crow Butterfly

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HABITAT
None in pipeline corridor. Areas of rainforests and mixed paperbark forest in proximity to access roads.	Mixed paperbark tall open forest with rainforest elements and transitional zone between rainforest and paperbark woodland, with permanent creeks or perennial groundwater seepages or springs, with *P. alboflavescens* (the preferred larval food plant).	None known in corridor. Closest record of any individual is ~ 3.5 km from corridor. Could occur in proximity to access roads.	Occurs in patches between 4-35 km from the pipeline corridor, in the most north-eastern 150-200 km of East Arnhem Land.	Critical habitat occurs patchily in the region; however, does not occur in the project area.

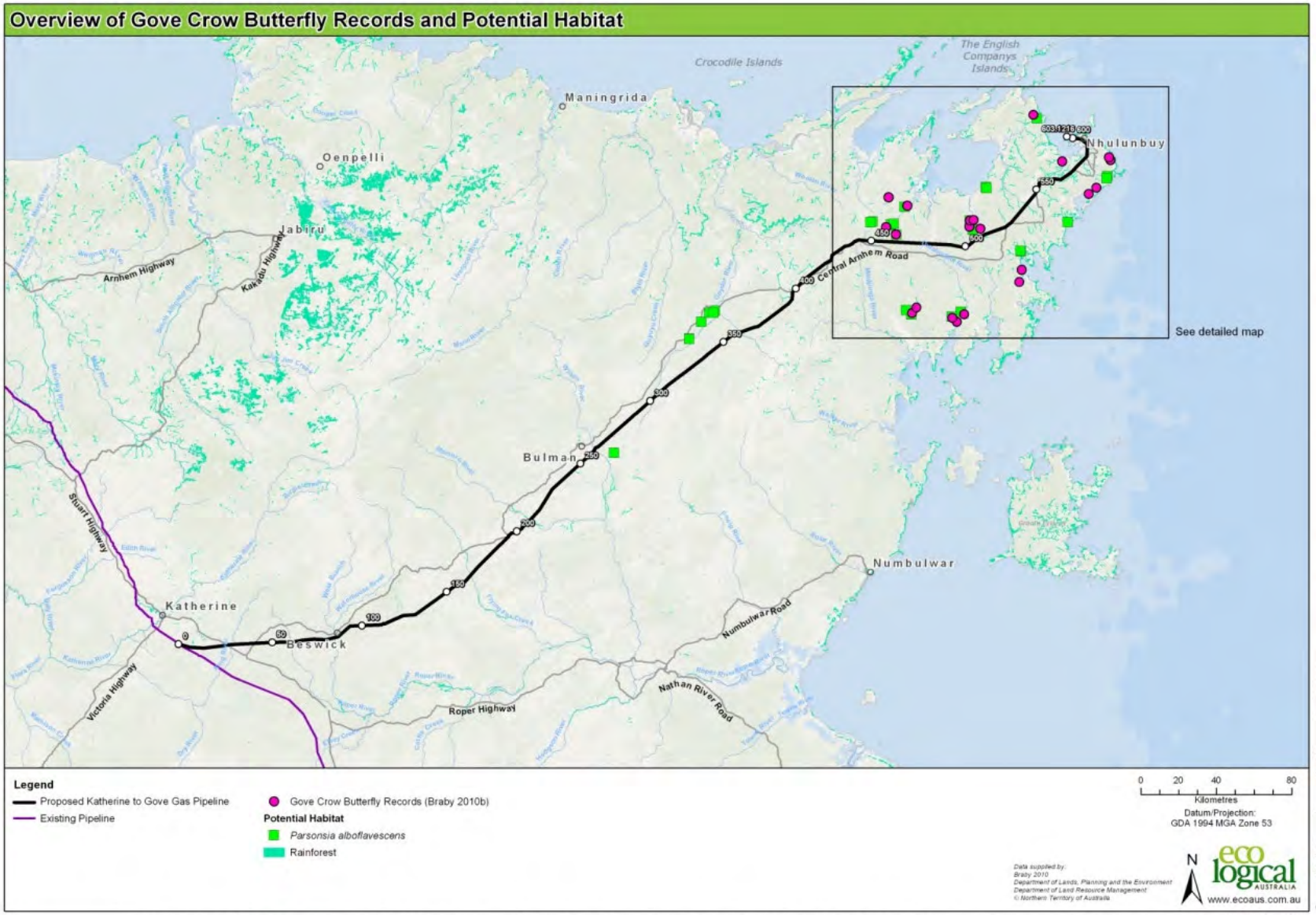

Figure 10-14: Gove Crow Butterfly records and potential habitat

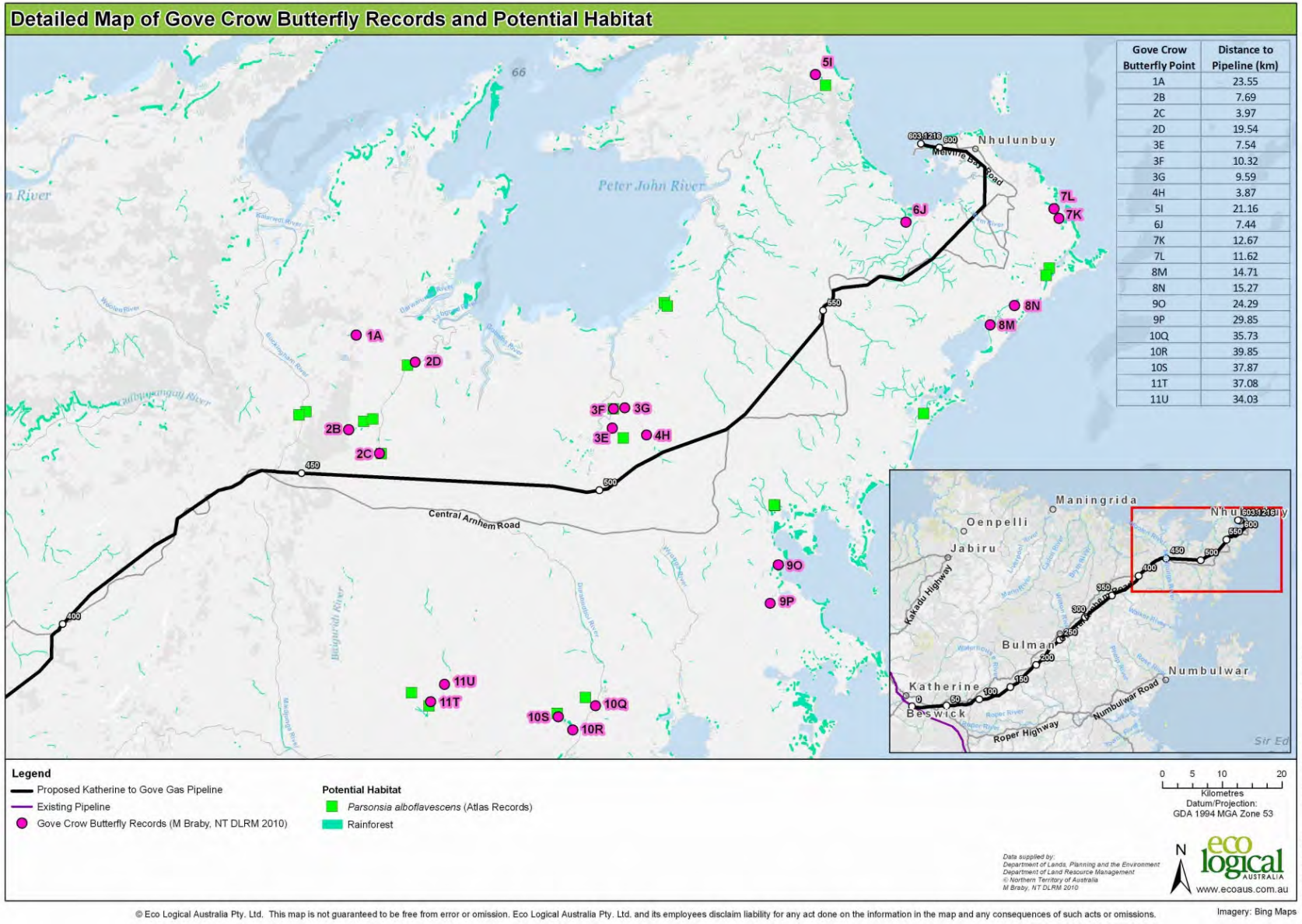

Figure 10-15: Gove Crow Butterfly survey sites with species recorded and distance to pipeline (Braby 2010)

10.12.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential for direct and indirect impacts on the Gove Crow Butterfly. However, this potential is considered very low because the pipeline corridor does not pass within 3-3.5 km of potential or preferred habitat or known occurences of the Butterfly. The proposed alignment of the pipeline has, by design, avoided rainforests and the preferred habitat of the Butterfly.

Critical habitat, comprising preferred forest and woodland types and larval food plants, is distributed patchily in the region but has not been recorded within the project area. Therefore, installation of the pipeline is unlikely to fragment the already patchy distribution of habitat of the Gove Crow Butterfly.

Construction camps would require 125 ha (five camps each 25 ha) of vegetation to be cleared outside the construction corridor. These sites would not be established in Gove Crow Butterfly habitat and would be rehabilitated and revegetated once construction is complete. The location of access tracks is not finalised and will be confirmed in the design phase to avoid habitat of the Gove Crow Butterfly.

Inadvertent fires that are not immediately extinguished have the potential to spread into critical habitat in the relatively few locations where individuals have been identified and/or into preferred habitat, some of which is within a few kilometres of the pipeline corridor.

Another potential impact on the Gove Crow Butterfly is infestation by exotic weed species, particularly Perennial Mission Grass and Gamba Grass, that can threaten the integrity and extent of the Gove Crow Butterfly's preferred feeding and breeding habitats, by promoting more frequent and more intense fires (Braby 2007 and 2007a).

The KGGP Project does not involve transferring substantial amounts of soil across long distances, and therefore the risk of spreading Yellow Crazy Ants to new areas or re-introducing them where they have been eradicated is considered to be very low. Also, literature indicates that machinery and vehicles placed within infested areas (including overnight) doesn't seem to pose any risk of spread of the ants. The greatest risk for spread, is from September to November, when the new queens are dispersing. At all other times, an entire colony would need to be dispersed, which is not likely for the project (B. Hoffman, CSIRO pers. comm., February 2013). Figure 10-16 indicates known Yellow Crazy Ant infestations in relation to Gove Crow Butterfly recordings.

The construction of the pipeline should not affect surface hydrology such that it would affect runoff into permanent creeks on the Gove Peninsula that may be associated with habitat for the Gove Crow Butterfly. Following installation of pipeline, ground will be reinstated such that the ROW does not represent a barrier to any surface flow.

Similarly, to prevent the risk of water extraction for construction affecting perennial groundwater seepages or springs, bores will not be placed or used in areas where abstraction could foreseeably alter the hydrological regime groundwater dependent critical habitat for the Gove Crow Butterfly.

The Terrestrial and Aquatic Fauna and Habitat Management Plan, Weed Management Plan, Fire Management Plan and Introduced Fauna Management Plan (Appendix O) outline management measures for potential indirect impacts including prevention of ignition of unintentional fires, the introduction of exotic weeds and the spread of Yellow Crazy Ants. Table 10-24 summarises the proposed mitigation measures for the Gove Crow Butterfly.

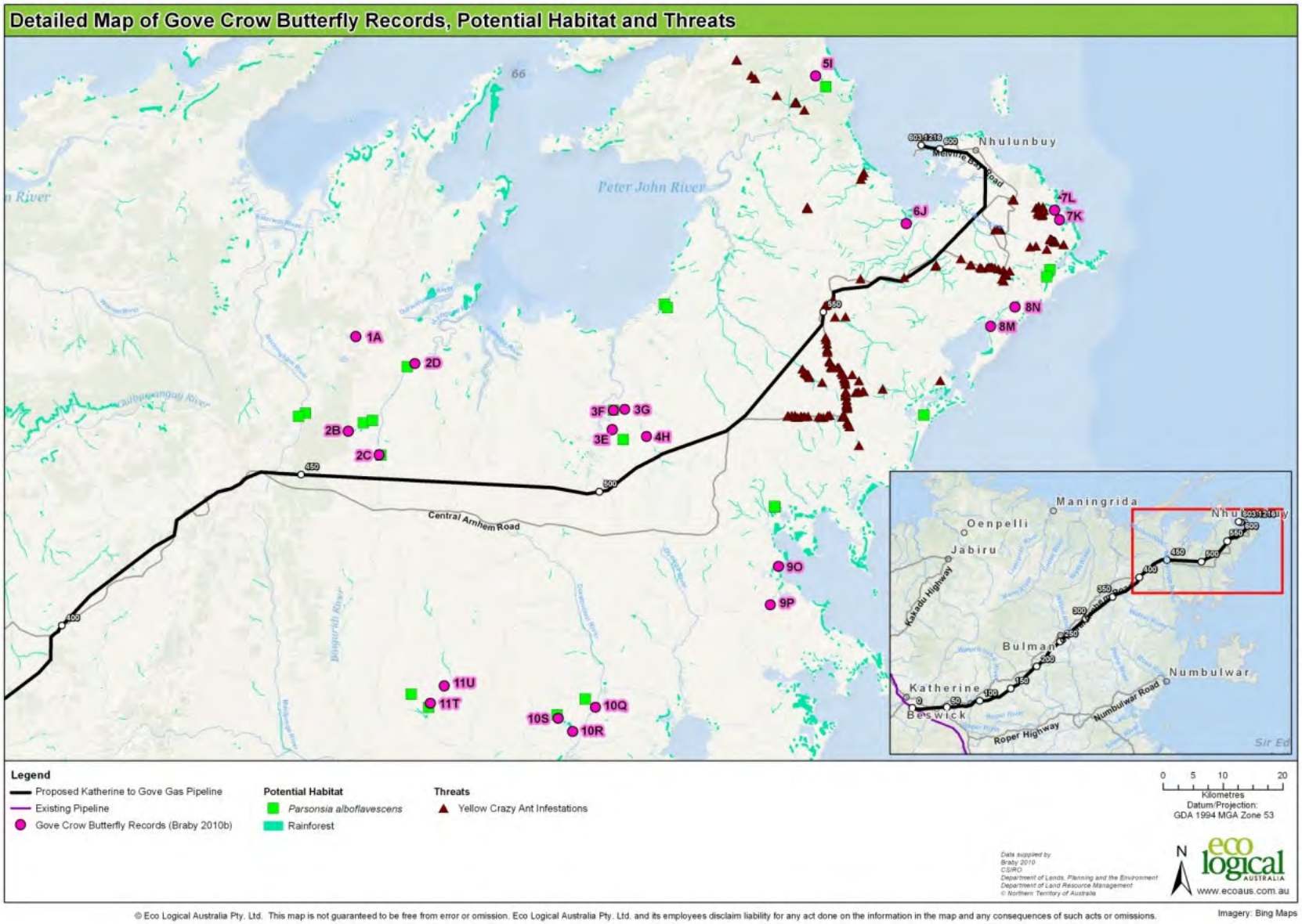

Figure 10-16: Habitat, records and larval food of Gove Crow Butterfly, and potential threats (records of Yellow Crazy Ants)

Table 10-24: Mitigation measures for Gove Crow Butterfly

Avoidance	• The alignment of the pipeline and its 100m-wide corridor would avoid Gove Crow Butterfly habitat. • Final placement of ancillary infrastructure, camps and access roads will avoid sensitive fauna habitats and known habitats of the Gove Crow Butterfly wherever practicable.
Minimisation	• Disturbance of land up-gradient of potential rainforest Gove Crow Butterfly habitat will be minimised in design of access roads and ancillary infrastructure alignment/placement..
	Vegetation clearing management • The total area of habitat to be cleared would be restricted to the minimum area required to construct the pipeline, above ground infrastructure, temporary construction sites and construction camps and access tracks. • Project design would avoid sensitive vegetation communities and habitats.
	Introduced species management • An Introduced Fauna Management Plan and Weed Management Plan would include measures to avoid or minimise introduction or spread of Yellow Crazy Ants, other feral animals or weeds, all of which could potentially spread far enough to impact Gove Crow Butterfly habitat.
	Surface water/groundwater management • Construction groundwater bores will not be placed or utilised in areas where extraction could foreseeably alter the hydrological regime of rainforest habitat for Gove Crow Butterfly. • Drainage across pipeline corridor will be reinstated as soon as practicable following construction.
	Fire management • Fire would not be used to clear vegetation. • Controls to prevent inadvertent ignition of fires, which could spread widely enough to impact Gove Crow Butterfly habitat (Fire Management Plan).

With the implementation of the proposed mitigation measures, it is considered unlikely that the Gove Crow Butterfly would be significantly impacted as a result of the project. This assessment is based on the expectation that neither the species nor its critical habitat occur within the project area, and therefore neither should be subject to direct or indirect impacts. Table 10-25 summarises the residual impacts for the Gove Crow Butterfly.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

The residual impacts associated with the construction and operation of the Project on the Gove Crow Butterfly is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Gove Crow Butterfly would not be required under the Commonwealth offsets policy.

Table 10-25: Summary of residual impacts for the Gove Crow Butterfly after mitigation measures applied

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Clearing of habitat causing loss of habitat, affecting important populations, fragmentation.	No loss of potential or preferred habitat. No known populations affected. No habitat fragmentation.	None	None
Loss of habitat from introduction and spread of weeds or feral animals	Minimal to none, as introductions and spread of exotic species will either not occur or be treated/removed before spread to potential or actual habitat.	Negligible	None
Loss of habitat from ignition and spread of inadvertent fires.	No change to local or regional fire regimes.	Negligible	None

The KGGP Project will not compromise the objectives of the National Recovery Plan for the Gove Crow Butterfly (Braby 2007) and will be consistent with the following actions of the Plan:

- Develop and involve local Indigenous rangers.
- Monitor and assess threats, to determine appropriate abatement activities.
- Manage exotic species to reduce the extent of areas affected.

10.13 NORTHERN QUOLL

10.13.1 Conservation status

The Northern Quoll (*Dasyurus hallucatus*) is listed as Endangered under the EPBC Act and Critically Endangered under the TPWC Act.

The EPBC Act considers the Northern Quoll eligible for listing as Endangered under the criterion:

- It has undergone, is suspected to have undergone or is likely to undergo in the immediate future, a very severe, severe or substantial reduction in numbers.

In the NT, this species is listed as Critically Endangered based on:

- An estimated population size reduction of >80% observed over a period of ten years in the past or projected over a 10-year period in the future.

10.13.2 Regional distribution and ecology

The historical distribution of the Northern Quoll ranged across northern Australia; the species occurred almost continuously from the Pilbara in WA to near Brisbane in Queensland (Braithwaite and Griffiths 1994). The Northern Quoll is now restricted to five regional distributions: central Qld coast, northern Qld, the Top End of the NT, the Kimberley (WA) and the Pilbara (DSEWPaC 2013).

In the NT the species is restricted to the Top End mainland and smaller islands such as Vanderlin, Marchinbar, Inglis, Groote Eylandt and Northeast Island (Woinarski et al. 2007a, as cited in DSEWPaC 2013).

The Northern Quoll is the smallest, most arboreal and aggressive of the four Australian quoll species (DSEWPaC 2013). Northern Quolls are nocturnal, carnivorous marsupials with moderately large home ranges (DSEWPaC 2013).

Northern Quolls reproduce once per year and have on average seven offspring per year. However, both male and female Northern Quolls have short life spans; the male often dies following the breeding season due to the intense physical effort from roving while the female usually survives only the one breeding season (Oakwood 2000). This unique life history can exacerbate the effects of population decline and habitat loss, and make population recovery very slow (DSEWPaC 2013).

Habitat for the Northern Quoll comprises some form of rocky area or structurally diverse woodland or forest for denning/shelter purposes, with surrounding vegetated habitats used for foraging and dispersal (DSEWPaC 2011a, DSEWPaC 2013). Sandstone escarpment is considered prime habitat (Braithwaite and Griffiths 1994). Denning/shelter habitat is important for breeding, refuge from fire and/or predation, and long term viability of the species (DSEWPaC 2011a).

The recent decline of small mammals in the Top End, NT, including the Northern Quoll, has affected the density and distribution of populations across the region. The decline of the Northern Quoll is one of the most marked of those species affected in the Top End. The most plausible causes for the decline of small mammals across the Top End are too frequent fire, predation by feral cats and invasion by Cane Toads (*Rhinella marina*) (Woinarski et al. 2010). However, the rapid decline of the Northern Quoll, formerly a common native mammal species in Kakadu National Park and elsewhere in the monsoonal tropics of the NT, is directly attributed to the Cane Toad invasion (Woinarski et al. 2010). Cane Toads are ingested by the Northern Quoll and cause lethal toxicity. The population has almost been entirely lost from the north east Top End, as well as the Cape York Peninsula and the Einasleigh Uplands of northern Queensland (DSEWPaC 2013).

The species population is expected to continue to decline over most of its mainland and some of its island range. Existing threats include lethal toxic ingestion caused by Cane Toads, removal, degradation and fragmentation of habitat as a result of development actions and agricultural activities, inappropriate fire regimes, weeds and predation by feral animals (DSEWPaC 2013).

A *National Recovery Plan for the Northern Quoll Dasyurus hallucatas* was prepared by the NT Department of National Resources, Environment, Arts and Sport in 2010 (Hill and Ward 2010).

10.13.3 Potential habitat, survey effort and findings

According to the EPBC Act Referral Guidelines for the Endangered Northern Quoll, Policy Statement 3.25 (DSEWPaC 2011a), where denning/shelter habitat occurs within the modelled distribution of the species (Figure 10-17), it is considered habitat critical to the survival of the species. Vegetated habitats surrounding denning/shelter habitat are used for foraging and dispersal. Habitat critical to the survival of the Northern Quoll occurs in three forms across the species' range which includes:

- Rocky habitats such as ranges, escarpments, mesas, ranges, gorges, breakaways, boulder fields, major drainage lines or treed creek lines.
- Structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs.
- Offshore islands where the Northern Quoll is known to exist.

The modelled distribution of the Northern Quoll for the NT shows the species has been previously known to occur in the region traversed by the KGGP (Figure 10-17) (DSEWPaC 2011a). Woodlands and open-woodlands dominated by *Eucalyptus tetrodonta* and *E. miniata* comprise 56% of the pipeline ROW, 56% of the pipeline corridor (100 m extent) and 57% of the pipeline region (100 km extent). These communities are similar in description to those identified as habitat for the Northern Quoll in Kakadu National Park (Oakwood 2000), although the project area terrain is substantially flatter. According to descriptions from DSEWPaC (2011a), these habitats may qualify as denning/shelter habitat, which is considered to be habitat critical to the survival of the species. The actual extent of use of these habitats by the species in the project area is expected to be low given the species is thought to have been almost entirely lost from the north east of the Top End (DSEWPaC 2013).

Two terrestrial vertebrate fauna surveys conducted in the project area have not recorded the Northern Quoll. The first was conducted in July 2004 by EcOz for the TTP EIS and the second was conducted by ELA in November 2012 to support the assessment of the KGGP project (refer to Appendix D for further detail). The 2012 survey included consultation with ranger groups, government agencies and experts, all of which reported no observations of the Northern Quoll in proximity of the project area. The survey methodologies used generally conformed with DSEWPaC survey requirements, with some deviations (as per Table 10-13 in Appendix D).

Based on the listing of the Northern Quoll as Endangered under the EPBC Act, it is considered that all populations are important for the long term conservation of the species (DEWHA 2009)). The lack of historical and contemporary occurrence of the Northern Quoll within the region traversed by the KGGP suggests that significant numbers belonging to an extant population are not present within the region or the project area.

Potential habitat for the Northern Quoll occurs along the pipeline corridor; however, when considered in conjunction with only a single record in the last 20 years within 100 km of the pipeline centreline and that the project area does not contain any particular habitat or shelter that is different from the surrounding region, it is considered highly unlikely that a significant population occurs. The single record of the Northern Quoll came from 1992 from a location near the town of Katherine, approximately 20 km north of the pipeline alignment (ALA 2013; Figure 10-18). Based on survey work and the paucity of recent records within the region, the Northern Quoll potentially might occur in a relatively low to very low density across this region, with a low likelihood of occurrence in the project area.

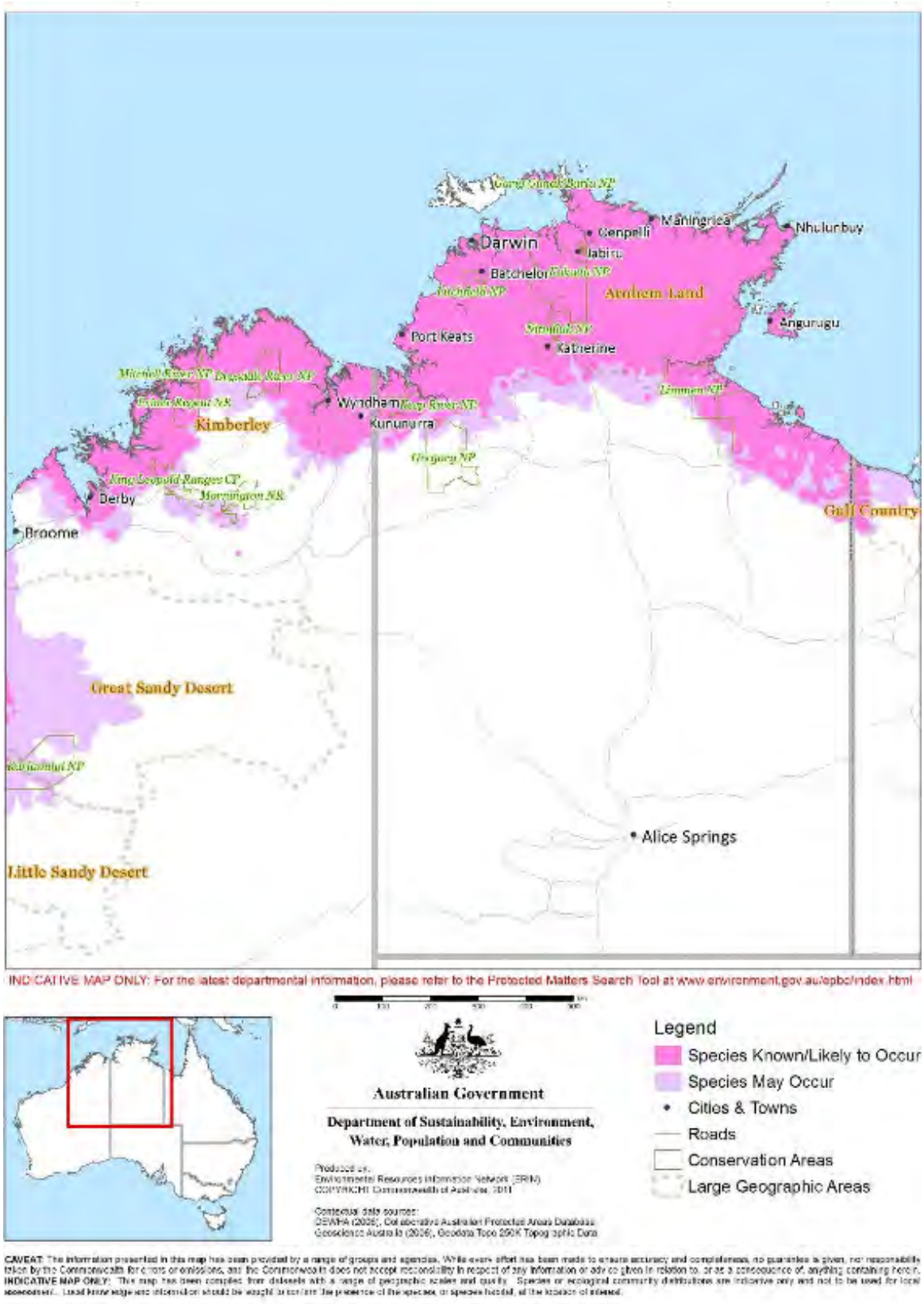

Figure 10-17: Modelled distribution of the Northern Quoll in the NT and WA Kimberley region (DSEWPaC 2011a)

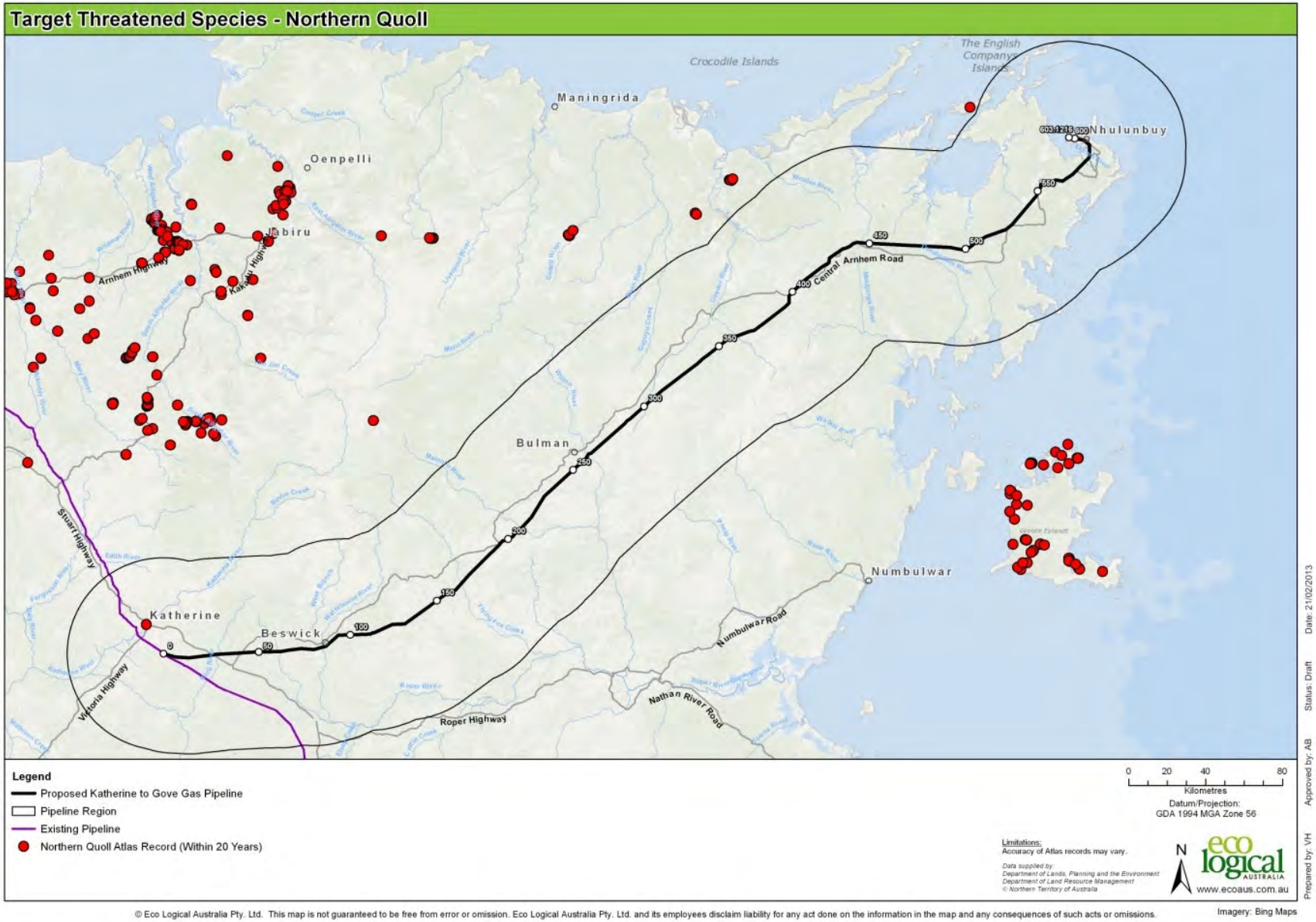

Figure 10-18: Records of Northern Quoll within the KGGP region in the last 20 years

The woodland and forest habitat within the pipeline corridor that could be considered potential denning/shelter habitat critical to the survival of the species, is considered to be of relatively low conservation importance for the Northern Quoll based on the following reasons:

- The close proximity of Kakadu National Park (and other protected areas) which contain extensive areas considered to represent habitat critical to the survival of the Northern Quoll and where the species has been recorded more recently.
- The low historical density of the species in the region traversed by the KGGP and its otherwise higher historical density in regions in the north-west of the Top End.
- The absence of observations of the species during recent surveys within the project area.

Table 10-26 summarises the habitat values for the Northern Quoll in the project area.

Table 10-26: Summary of habitat values for Northern Quoll

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT – 100 M CORRIDOR	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HABITAT
56% woodlands and open-woodlands dominated by *Eucalyptus tetrodonta* and *E. miniata* (potential denning/shelter habitat).	None	None known or expected to occur in the project area (If was to occur within the project area, it would be considered an important population given its regional paucity).	Extends broadly outside project area Not locally restricted.	Not regionally significant as no known populations and habitat typical of region.

10.13.4 Assessment of potential impact, mitigation and residual impact

The extent and significance of potential impacts is limited in this case due to the lack of confirmed records and survey observations. However, despite the very low probability of occurrence of the Northern Quoll, potential habitat does occur within the project area.

If the species was to occur, the KGGP project could affect the Northern Quoll from the following potential impacts:

- Clearing of habitat during the construction of the pipeline.
- Mortality and injury of individuals from encounters with vehicles and machinery during trenching, construction and operations.
- Injuries or mortalities of individuals from trench falls (during open pipeline trenching).
- Invasion and spread of feral animals and weed species.
- Increased risk of fire through ignition sources.
- Spread of weed species that yield greater fuel loads for fires.

Clearing for construction will result in the removal of approximately1,232 ha potential denning/shelter habitat in form of forest and woodland (56% of project area). Such potential habitat for the species is not confined to the project area, and extends across the Top End. Impacts on the Northern Quoll from habitat removal are therefore expected to be low. Rehabilitation of the project area following construction is intended to restore habitat in the very long term but it is acknowledged the extent of time required for restoration of woodland and forest, hence the residual impact will be considered the same as the extent of clearing at 1,232 ha for the purpose of this assessment. This is a conservative estimate as it is expected that this habitat will recover to equivalent of approximately 60% of its pre-clearing extent in the project area.

Mortality and injury of individuals is possible from trench falls (during open pipeline trenching) and from encounters with vehicles and machinery during trenching, construction and operations if the species occurs in or adjacent to the project area. To reduce potential for such incidents, fauna management measures include ramps being installed in trenches, early morning trench inspections relocation of fauna (if found) from trench by qualified fauna handlers, vehicle speed restrictions, and induction/training programs for awareness of personnel to significant fauna including the Northern Quoll. Planned construction in daylight hours with little in the way of night-time traffic in ROW and on access roads will greatly reduce potential for encounters with fauna such as the Northern Quoll, if it occurs in the project area.

Fire management measures will be put in place to reduce risk of fire through ignition from construction-related machinery.

Vehicle hygiene and weed control measures will be implemented to prevent the introduction of invasive weed species that yield greater fuel loads for fires than native grasses, including such exotics as Gamba Grass and Mission Grass, into new areas along the pipeline corridor.

A range of mitigation measures that would be implemented to avoid, mitigate and manage the potential impacts on the Northern Quoll summarised in Table 10-27.

Based on the application of proposed mitigation measures, it is expected that there would be no significant residual impacts on the Northern Quoll in relation to vegetation clearing, mortality of individuals, feral animal and weed invasion and altered fire regimes.

In addition, significant impacts to the Northern Quoll as a result of the KGGP project are considered to be highly unlikely based on the following:

- The lack of recent records (since 1992), documented small mammal decline (e.g. Woinarski et al. 2010) and observations during field surveys suggests there is no local extant population within the project area and, at best, a sparse distribution and very low density of the species within the region surrounding its alignment.
- Fragmentation of the local population is unlikely as there is no evidence to suggest individuals utilise even the most suitable habitat within the project area such as the forests and woodlands.
- Suitable habitat is considered widespread and common across the region.
- The Cane Toad (identified as a key threat to the Northern Quoll in Woinarski et al. 2010) is likely to have already severely impacted any populations that may have historically or potentially occurred within the region traversed by the KGGP.

Table 10-27: **Mitigation measures for Northern Quoll**

Avoidance	Woodland habitat not able to be avoided as broadly represented across region. No known populations to avoid.
Minimisation	Disturbance through woodland habitat will be minimised in final alignment of access roads and placement of camps and ancillary infrastructure as much as practicable.
Management	T*errestrial and aquatic fauna management* • Clearing will be staged and performed on single 'fronts' to allow for the progressive movement of fauna into areas outside the proposed disturbance area. • Trench clearing procedures, installation of escape ramps in trenches and minimising period that trenches are open to prevent prolonged trapping. • Vehicle speed and access restrictions to minimise collisions with fauna. • Fauna awareness in training and inductions. *Introduced species management* • Feral animal control where appropriate. *Weed management* • Vehicle soil hygiene measures will be put in place to prevent introduction of invasive weed species, which could increase fire intensity, into new areas along pipeline corridor. *Fire management* • Fire prevention and management controls will be implemented to reduce risk of changes in fire regimes affecting habitat quality.

Table 10-28 summarises the residual impacts for the Northern Quoll.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

There is little potential for a significant residual impact from the construction and operation of the Project on the Northern Quoll based on the information that is currently available. As such, offsets relating to the Northern Quoll would not be required under the Commonwealth offsets policy.

Table 10-28: Summary of residual impacts for Northern Quoll after mitigation measures applied.

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/ PROPOSED
Clearing of habitat	Removal of 1232 ha of woodland habitat that could represent potential shelter/denning habitat.	Low	None Although 1232ha of potential critical habitat may be removed, based on the evidence, it is unlikely that this species occurs within these areas within the project area
Mortality/injury	Loss/injury of individuals.	Negligible - unlikely to occur given daytime construction and species if occurs is at very low numbers.	None
Introduction and spread of weeds increasing late season fire intensity leading to destruction of habitat	No significant new weed infestations as result of KGGP.	Low	None
Introduction and spread of feral animals	Project will have little effect given management measures and as Cane Toad already widespread.	Low	None
Increased risk of fire	No fire as a result of KGGP	Low	None

10.14 FRESHWATER SAWFISH

10.14.1 Conservation status

The Freshwater Sawfish (*Pristis microdon*) is listed as Vulnerable under both the EPBC Act and the TPWC Act.

10.14.2 Regional distribution and ecology

The Freshwater Sawfish is a large ray that displays long gestation periods, gives birth to live young, reaches sexual maturity relatively late (around eight years of age) and breeds intermittently (DEWHA 2008a). The Freshwater Sawfish has a complex life strategy, utilizing both fresh and marine water environments, although the distribution, abundance and feeding habits, as well as the location of important nursery areas, are largely unknown for the species.

The ecology of the Freshwater Sawfish is described in further detail in Appendix Q.

The distribution and abundance of Freshwater Sawfish populations in the NT is not fully known, mainly due to lack of reliable historical catch and biological data. The Freshwater Sawfish may potentially occur in all large rivers of northern Australia from the Fitzroy River in Western Australia, to the western side of Cape York Peninsula in Queensland (Thornburn et al. 2003). The species has

previously been recorded from a number of river systems across the NT, including the Adelaide, Alligator, Daly, Katherine, MacArthur, Mainoru, Robinson, Roper, Wearyan, Wilton and Victoria (Midgley 1979; Thornburn et al. 2003). There is also anecdotal evidence of Freshwater Sawfish occurring in the Cato, Goyder, and Mainoru rivers of East Arnhem Land, although occurrence in the Goyder and Cato Rivers was from areas far downstream of the proposed pipeline route (Appendix E). Of all of these rivers, the pipeline crosses the Cato, Goyder, Mainoru, and Wilton rivers, and crosses tributaries and associated surface waters of the Roper River where the Freshwater Sawfish has previously been recorded (Thornburn et al. 2003).

Threats to the Freshwater Sawfish as listed by DSEWPaC (2013) comprise fishing (including over-fishing, bycatch, and recreational 'trophy' fishing), Indigenous harvest, habitat modification, capture for the aquarium trade, and the shark fin trade. Figure 10-19 shows the known records and watercourses that may provide potential habitat for the Freshwater Sawfish within the pipeline corridor.

10.14.3 Potential habitat, survey effort and findings

Aquatic surveys were conducted by EcOz during 2003-2004 at 17 sites on 17 watercourses (Table 10-1 in Appendix E), all located within 30 km of the KGGP corridor. Sampling was undertaken using a range of techniques which included: multi-panel gill-nets, fine-mesh seine, scoop-nets or push-nets, hook and line, dip-net and torch at night, and sight observations from the bank or by snorkelling. Each site was sampled for a day and night for accurate census of aquatic fauna. Methods and detailed site information are provided in Appendix E.

Informal interviews with Aboriginal traditional owners and pastoralists were conducted to supplement the information collected during the surveys and to identify species that are likely to occur in each watercourse.

The Freshwater Sawfish was not recorded during the 2003-04 survey. One anecdotal record of the Freshwater Sawfish occurring within the Mainoru River was obtained from a local landowner (Appendix E). The Mainoru River terminates in the Roper River, where Freshwater Sawfish have previously been recorded. In addition, the Mainoru River has been identified as likely habitat for the Freshwater Sawfish (Table 10-29).

The KGGP corridor traverses 319 surface drainage features, including 12 major rivers and streams: King River, Roper Creek, Beswick Creek, Waterhouse River, Flying Fox Creek, Mainoru River, Wilton River, Goyder River, Boggy Creek, Cato River, Giddy River and Latram River. Of these, the Freshwater Sawfish has previously been recorded from Flying Fox Creek (Midgley 1979), Mainoru River (Appendix E) and the Wilton River, all of which are tributaries of the Roper River, where Freshwater Sawfish have also been recorded (Thornburn et. al. 2003). Anecdotal records also exist for the Cato, Goyder and Mainoru rivers (Appendix E).

While the pipeline route avoids crossing large bodies of water, it does traverse creek systems upstream of large estuaries. Some of these creeks will hold freshwater all year round, while the majority are likely to be ephemeral and cease to flow during the dry season. Some watercourses may form disconnected billabongs which provide suitable refuge pools for juveniles and sub-adults, and rivers that branch out into broad floodplains during the wet season are likely to provide suitable habitat for Freshwater Sawfish.

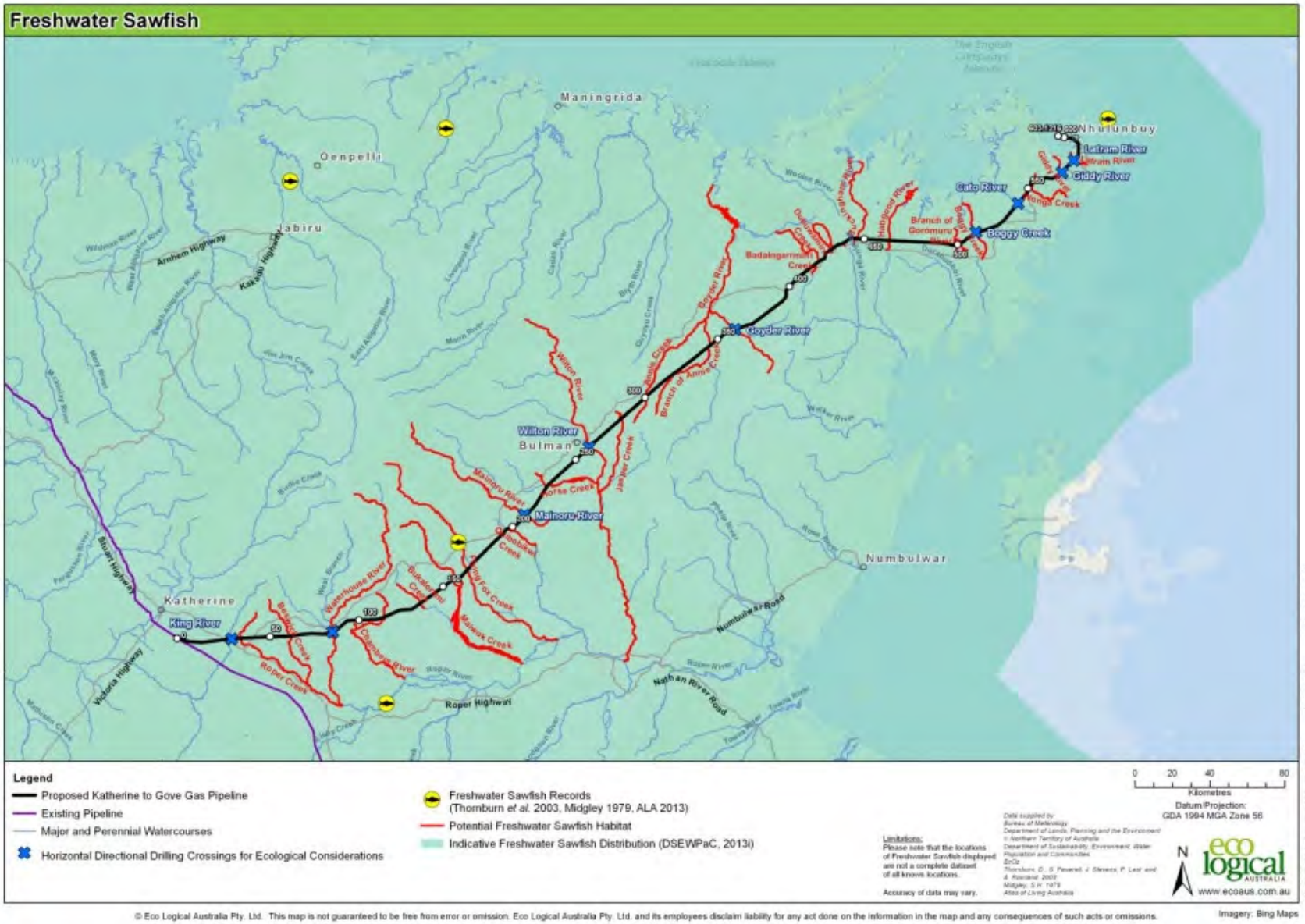

Figure 10-19: Known records of the Freshwater Sawfish and watercourses traversed by the pipeline that provide potential habitat

The proposed pipeline corridor does not cross the lower (saline) reaches of estuaries or open coast, which are the habitats predominantly favoured by adult Freshwater Sawfish. Discussion of potential impacts therefore focuses on juveniles and sub-adults, although it is noted that the species is thought to possibly breed in fresh water (DSEWPaC 2013).

A habitat analysis of the watercourses traversed by the pipeline, and the likelihood of Freshwater Sawfish occurrence was originally undertaken by EcOz in 2003-2004, and later updated during 2012 (Appendix E). Due to changes in pipeline design, updated literature and increased knowledge of the Freshwater Sawfish, further analysis was required. Watercourses were further assessed for Freshwater Sawfish occurrence by Eco Logical Australia (Appendix Q) based on updated mapping and advice from a local expert on Freshwater Sawfish (Dr Peter Kyne, Charles Darwin University) during 2013.

A total of 29 watercourse crossings were assessed for likelihood of Freshwater Sawfish occurrence. Freshwater Sawfish were considered as 'possibly' occurring in all perennial watercourses (except for King River which is too far inland and does not have tidal connections), and 'likely' to occur in any watercourses where known records already exist. The species was considered as unlikely to occur if no tidal connections were present, or if a watercourse was seasonal and likely to completely dry out during the dry season (Dr P. Kyne, Charles Darwin University, pers. comm., February 2013). It should be noted that there is some evidence that Freshwater Sawfish are not associated with areas of riparian vegetation (DSEWPaC 2013). However, a conservative approach was taken in assessing likelihood of occurrence so even watercourse crossings with riparian vegetation present may have been assessed as likely or possible, due to other favourable aspects such as upstream waterholes or previously known records.

A total of 24 watercourses or drainage lines traversed by the pipeline were found to provide potential habitat for Freshwater Sawfish and five watercourses were found unlikely to provide potential habitat (Table 10-29; Figure 10-19). Habitat values for the Freshwater Sawfish in the project area are summarised in Table 10-29. A summary of habitat values are provided in Table 10-30.

Table 10-29: Assessment for likelihood of Freshwater Sawfish occurrence at major water crossings

RIVER NAME	LIKELIHOOD OF OCCURRENCE	FRESHWATER SAWFISH HABITAT
Freshwater river/streams either with permanent water or potentially some pools/waterholes in dry season		
King River	Unlikely	Too far inland with no connection to a tidal river.
Roper Creek	Possible	Connects to Roper River where FWS have previously been recorded.
Beswick Creek	Possible	Permanent waterholes exist which may provide suitable refuge for juveniles and sub-adults during the dry season.
Waterhouse River	Possible	Tidal connections (Roper) and contains waterholes upstream from the pipeline that persist during the dry season (i.e. Alligator waterhole).
Chambers River	Possible	Tidal connections to Roper River where Freshwater Sawfish have previously been recorded.

RIVER NAME	LIKELIHOOD OF OCCURRENCE	FRESHWATER SAWFISH HABITAT
Bukalorkmi creek	Possible	Middle reaches of watercourse, connects to Roper River and extensive floodplains.
Maiwok Creek	Possible	Connects to a floodplain and permanent waterholes exist at Dulcaruk Billabong that may provide suitable refuge. Tidal connections to Roper River.
Flying Fox Creek	Likely	Freshwater Sawfish previously recorded upstream of the pipeline.
Quibobikwi Creek	Possible	Upper reaches of watercourse, extensive floodplains that have tidal connections (Roper River).
Mainoru River	Likely	Previously recorded. Middle reaches of estuary and connects to tidal river (Roper).
Horse Creek	Possible	Middle reaches of estuary and connects to a floodplain and a tidal river (Roper).
Wilton River	Likely	Previously recorded. Middle reaches, connects to tidal river (Roper).
Jasper Creek	Possible	Upper reaches. Connects to Wilton River which connects to tidal river (Roper).
Annie Creek	Possible	Connects with tidal river (Goyder) and likely to have refuge pools and upstream billabongs that would persist through the dry season providing suitable habitat.
Branch of Annie Creek	Possible	Middle reaches. Connects to Goyder which is likely to have refuge pools and upstream billabongs.
Goyder River	Likely	Anecdotal evidence exists of occurrence although from downstream of the pipeline. Likely to have refuge pools and upstream billabongs.
Badalngarrmirri Creek	Possible	Upper reaches of Goyder River. May provide refuge pools and upstream billabongs that would persist through the dry season.
Dubumirrami Creek	Possible	Upper reaches of Goyder River. May provide refuge pools and upstream billabongs that would persist through the dry season.
Unnamed watercourse	Possible	Tributary of Goyder River. May provide refuge pools and upstream billabongs that would persist through the dry season.
Habgood River	Possible	Upper reaches of estuary with tidal connections.
Latram River	Possible	Middle reaches of estuary. Lower reaches may be too saline for juveniles and sub-adults, but middle to upper reaches may provide suitable refuge.

RIVER NAME	LIKELIHOOD OF OCCURRENCE	FRESHWATER SAWFISH HABITAT
Non-freshwater (i.e. estuaries) or rivers/streams likely to have no water at all in dry season		
Buckingham River	Possible	Upper reaches of estuary.
Goromuru River	Unlikely	Upper reaches of large river. Possibly too far upstream and likely to be dry most of the year.
Branch of Goromuru River	Unlikely	Upper reaches of large river. Possibly too far upstream and likely to be dry most of the year.
Branch of Goromuru River	Unlikely	Upper reaches of large river. Possibly too far upstream and likely to be dry most of the year.
Boggy Creek	Possible	Upper reaches of large river. Appears to have substantial freshwater that will become disconnected billabongs in the dry season.
Cato River	Unlikely	There is anecdotal evidence of Freshwater Sawfish occurring in the Cato River, however these records are from far downstream of the proposed pipeline. The upper reaches are likely to be completely dry during the dry season, and it is unlikely that the sawfish occurs in this watercourse anywhere near the pipeline.
Giddy River	Possible	Upper reaches of estuary. Possible refuge and likely passageway for juvenile and sub-adults.
Wonga Creek	Possible	Upper reaches of estuary that may provide refuge for juveniles and sub-adults in billabongs during the dry season.

10.14.4 Assessment of potential impact, mitigation and residual impact

The construction of a pipeline across watercourse crossings has the potential to directly impact the Freshwater Sawfish through the destruction or disturbance of in-stream habitat (including refuge pools) or by creating barriers to movement. Indirect impacts may occur from a decrease in water quality, as a result of chemical contamination or inappropriate disposal of hydrotest water and wastewater, or through changes to hydrology as a result of groundwater extraction in alluvial aquifers.

In this case, the construction of the pipeline across watercourse crossings will not affect any known important populations of the Freshwater Sawfish. The closest record of Freshwater Sawfish was approximately 16 km upstream of the proposed pipeline in Flying Fox Creek (Figure 10-19). Critical habitat for the species has not yet been defined: however, watercourses that provide potential habitat extend beyond the boundaries of the project area. Impacts to watercourses that may provide suitable habitat for the Freshwater Sawfish are expected to be short-term and temporary, with all in-stream habitats and riparian corridors expected to be restored /rehabilitated to original condition after construction of the pipeline is completed.

Table 10-30: Summary of habitat values for Freshwater Sawfish

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS OF POTENTIALLY RELATIVELY HIGHER VALUE TO SPECIES.	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF PREFERRED HABITAT	REGIONAL SIGNIFICANCE OF PREFERRED HABITAT
24 watercourses traversed are considered to support habitat.	Waterholes or pools that persist into dry season. Floodplains. Deeper channels.	None in corridor. Closest record of any individual is 16 km from pipeline.	Extends broadly outside of project area. Not locally restricted.	Not of particular regional significance. Critical habitat yet to be defined.

Management measures will be based on a conservative approach of assuming that the Freshwater Sawfish is either present within the project area or further downstream.

The primary potential source of impact would be from direct interference of a flowing watercourse in which the Freshwater Sawfish is present. This will be avoided by employing the Horizontal Directional Drilling (HDD) pipeline construction technique at any watercourse that has significant flows at the time of construction. In HDD, no bed excavation or flow diversion is required as the pipeline is pushed and fed under the river/stream bed via entry points beyond the banks and immediate riparian zone of the watercourse. HDD techniques will be used for watercourse construction at nine major rivers (section 2.6.5 and Table 2-6) including six watercourses where the Freshwater Sawfish potentially occurs. In addition, HDD will also be used at any other watercourse that is identified to continue to have significant flow during the dry season. Minor flows lower than needed for Freshwater Sawfish pass would not require HDD. Although Appendix C and E indicate that Beswick Creek would be crossed using HDD, subsequent review has suggested that this creek might not be in flow across the pipeline route when the crossing is to be done. Therefore, consistent with the project's overall approach regarding watercourse crossings, if Beswick Creek is not in flow, this watercourse will be crossed using open trenching.

Within seasonal, ephemeral and/or temporary watercourses, any potential impacts to the Freshwater Sawfish habitat will be completely avoided because work will take place in and across dry river beds. In these cases open trenching is used, with riparian vegetation cleared and earthworks undertaken across the watercourse. Subsequently, river bed and bank morphology would be reformed following completion of construction activities, and riverbanks and areas of riparian vegetation would be rehabilitated progressively and prior to the onset of the first wet season.

Increased erosion, scouring and changes to channel morphology as a result of riparian vegetation removal can cause increases in nutrient loadings and impacts on light penetration (increases from loss of shading; decreases from increased sediment loads and turbidity) and associated unfavourable algal blooms and increases in water temperatures. This in turn may affect prey species composition or increase unfavourable conditions for the Freshwater Sawfish. This will be managed through the Hydrology and Water Quality Management Plan and Rehabilitation Management Plan (Appendix O), which includes measures for reinstatement of the watercourse and to minimise and monitor erosion.

Open trench techniques would also be used if unforeseen geotechnical considerations preclude HDD for a crossing at a watercourse that is in flow. Flow would be temporarily diverted around the work

area while ensuring minimal hydrological impact. Stream flow would be maintained by use of flume pipes or partial weirs. Silt fencing would be installed where required to reduce silt movement beyond the excavation and to contain stockpiled spoil. It is however, considered very unlikely that such techniques would be required. The implications in such an unlikely situation and approach to management of Freshwater Sawfish passage will be discussed with the NTEPA if this occurs.

The installation of causeways across watercourses to facilitate access during construction has the potential to cause significant negative impacts to the Freshwater Sawfish by restricting passage up and down watercourses if they are not removed and river/stream beds reinstated in time for wet season flows. Barriers to movement may prohibit the sawfish from moving out of watercourses that dry up, and may result in increased mortality. Any such temporary crossings will be managed under the Rehabilitation Management Plan (Appendix O), which will ensure they are completely removed and river/stream bed reinstated in time for wet season flows.

In regard to indirect impacts from changes in hydrology of habitat, Pacific Aluminium has developed a preliminary Water Supply and Adaptive Management Strategy for construction that proposes to predominantly use surface water from perennially flowing streams supplemented by groundwater and municipal water supply from Katherine and Gove. This has the potential to affect river/stream habitats for the Freshwater Sawfish from reducing river/stream levels and/or causing groundwater drawdown in alluvium aquifers that maintain refuge pools for the species. Pacific Aluminium expects to be able to generally restrict the amount of water used to considerably less than 20% of instantaneous flow in watercourses it is accessing, consistent with typical NT guideline for extraction. Water extraction will be short term and temporary; and will not be undertaken in any watercourse where this volume of extraction could cause barriers to movement of the species in the watercourse occurring. Where dry season flows may be too low for sustainable extraction, extraction from groundwater resources would be considered.

Groundwater may only be required for small volumes of water where the surface water flow is not adequate to sustainably extract. At this stage, the only areas identified to potentially require supplementary groundwater supply are at King River, Beswick Creek, and Cato River. Bores will not be placed in areas where abstraction could foreseeably significantly alter the hydrological regime of waterholes that could function as refuge for the Freshwater Sawfish in the dry season.

Degradation of water quality may occur from a number of factors including increased sedimentation, chemical contamination, spills and leaks, incorrect disposal of hydrotest water, wastewater and water use and over-extraction. A decrease in water quality may cause changes to the prey species composition, cause direct mortality of the Freshwater Sawfish (especially chemical contamination of refuge pools) or cause a decline in health of wetland ecosystems which may result in indirect impacts to the Freshwater Sawfish.

The KGGP is not anticipated to have any significant impacts on the Freshwater Sawfish with the water crossing management measures proposed to reduce potential impacts, including:

- Pre-clearance inspections to identify waterholes or pools that may provide potential refuge for the Freshwater Sawfish. In the event that a potential refuge waterhole or pool is encountered, measures will be put in place to avoid the area, and minimise disturbance, where practicable.
- Rehabilitation works will commence as soon as practical after the disturbance, and will focus on maximising rehabilitation success through undertaking rehabilitation progressively immediately following completion of construction in an area and adequately stabilising disturbed areas prior to the wet season.

- During construction, all appropriate and practical measures will be taken to minimise restricting the free movement of fish, the release of sediment into freshwater creeks or rivers, and damage to or the removal of bank vegetation, particularly vegetation that shades low-flow channels in the river system (highlighted by Fairfull and Witheridge (2003) as important).
- Construction and maintenance works at watercourses would be confined to the dry season to reduce the potential for degradation of water quality. A Hydrology and Water Quality Management Plan (Appendix O) would be developed to ensure construction activities do not impact on water quality to the extent that species that utilised aquatic habitats may be significantly impacted.

Further details of the assessment of potential impacts at each of the watercourse crossings in which Freshwater Sawfish habitat is likely to occur is provided in Appendix Q (Table 3).

Table 10-31 summarises the mitigation measures for the species.

Table 10-31: Mitigation measures for Freshwater Sawfish

Avoidance	• HDD at six river crossings where the Freshwater Sawfish potentially occurs to avoid direct impacts on habitat. • Construction of crossings will occur during the dry season. • Pre-clearance surveys will identify potential refuge pools and in the case that a pool is identified, it will be avoided either through pipeline design or HDD.
Minimisation	• Vegetation will be cleared and rehabilitated progressively to minimise erosion. • Access tracks will be used at existing formed crossing locations where possible. • The removal of large trees that stabilise river banks and bank vegetation, particularly vegetation that shades low-flow channels in the river system, will be minimised as far as practicable. • Hydrotest water will be sourced in accordance with Water Supply and Adaptive Management Strategy (Chapter 7), and disposed of in accordance with Hydrology and Water Quality Management Plan (Appendix O).
Management	*Terrestrial and Aquatic Fauna management* • Sensitive fauna habitats in proximity to working areas will be clearly marked and access to these areas will be prohibited i.e. refuge waterholes. • HDD would be used at any watercourse that is determined to be in flow by the construction contractor at the time of constructing the watercourse crossing. • No long-term impacts on sensitive fauna habitats. • Project design will avoid sensitive fauna habitats and known habitats of threatened species.
	Vegetation clearing management • The total area to be cleared will be restricted to the minimum area required. • Vegetation will be cleared and rehabilitated progressively throughout construction to minimise the period that communities and habitats are disturbed.
	Hydrology and water quality management. • HDD would be used at any watercourse that is determined to be in flow by the construction contractor at the time of constructing the watercourse crossing. • No water will be extracted from a surface water body or river/stream alluvium for any purpose prior to an assessment of the potential environmental impacts of the amount of

	water that will be extracted – consistent with the Water Supply and Adaptive Management Strategy (Chapter 7). Construction or use of groundwater bores will not be placed in areas where extraction could foreseeably significantly alter the hydrological regime of a river/stream, or waterhole (potential refuge) in which Freshwater Sawfish could potentially inhabit • Drainage across the pipeline corridor will be reinstated as soon as practicable following construction • Fuel and chemical storage will be above ground and will be located an appropriate distance from surface waters and high quality groundwater resources. • Waste will be contained appropriately, taking into consideration protection of water and soil resources. • Sewage and putrescibles will be treated and/or disposed of in accordance with regulatory requirements. • Hydrotest water will be sourced in accordance with Water Supply and Adaptive Management Strategy (Chapter 7), and disposed of in accordance with Hydrology and Water Quality Management Plan (Appendix O).
	Rehabilitation management • Disturbed areas adequately stabilised prior to the wet season. • Rehabilitation and revegetation works completed following the wet season.

With the avoidance of direct impacts to flowing watercourse and implementation of the proposed mitigation measures (including watercrossing management and rehabilitation and the Water Supply and Adaptive Management Strategy), it is considered unlikely that the Freshwater Sawfish would be significantly impacted as a result of the project. Table 10-32 summarises the residual impacts for the Freshwater Sawfish.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

The residual impacts associated with the construction and operation of the Project on the Freshwater Sawfish is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Freshwater Sawfish would not be required under the Commonwealth offsets policy.

Table 10-32: Summary of residual impacts for Freshwater Sawfish after mitigation measures applied.

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/ PROPOSED
Disturbance of habitat.	Disturbed river/stream beds at 18 watercourse crossings from open trenching, reinstated prior to wet season flows.	Low (assuming permanent pools able to be avoided).	None
Changes to hydrological regime of river/stream habitat.	No significant changes anticipated with assessment of impacts inherent	Low	None

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/ PROPOSED
	component of water abstraction licensing process and groundwater bores to be preferentially placed away from Freshwater Sawfish habitat. No change surface water flow into habitat.		
Changes to water quality of habitat due to contaminating sources from KGGP.	No impact anticipated with proposed controls.	Negligible , unlikely to occur given daytime construction and species if occurs is at very low numbers.	None

10.15 GULF SNAPPING TURTLE

10.15.1 Conservation status

The Gulf Snapping Turtle (*Elseya lavarackorum*) is listed as Endangered under the EPBC Act and Least Concern under the TPWC Act.

10.15.2 Regional distribution and ecology

The Gulf Snapping Turtle is a freshwater species of turtle endemic to Australia. It inhabits large rivers and associated overflow lagoons and oxbow lakes where it is often found in deeper permanent pools with muddy, sandy or rocky bottoms. It is also found in the middle reaches of rivers, upstream of saline regions and downstream of escarpments, including plunge pools (DSEWPaC 2013). Steep rocky gorges, and river reaches with intact river banks seem to be preferred habitats for Gulf Snapping Turtles, and large pools that persist throughout the dry season may act as refuge sites until flow resumes in the wet season (Clark 2010). Nesting tends to occur on various soil types close to the water's edge, within both sandy banks and riverine banks, often with *Melaleuca* and *Casuarina* growth (DSEWPaC 2013).

The Gulf Snapping Turtle is currently known from the NT and QLD. In the NT, the species has been recorded from the Calvert River to the Nicholson River systems (Figure 10-20), including the Roper, Limmen Bight, Robinson and Nicholson Rivers all of which discharge into the Gulf of Carpentaria (DSEWPaC 2013). The KGGP would cross tributaries and associated surface waters of the Roper River, such as Flying Fox Creek and Maiwok Creek (Figure 10-20).

Key threatening processes for the Gulf Snapping Turtle include degradation by livestock of river banks, which can affect water quality, food sources and nesting sites; disturbance or loss of riparian habitats; and, disturbance to nest sites from feral animals (Woinarski 2006; DSEWPaC 2013).

10.15.3 Potential habitat, survey effort and findings

Records of the Gulf Snapping Turtle within the project area have been obtained from database searches conducted by ELA (Appendix K; ALA 2013), and aquatic fauna surveys undertaken in 2003-2004 by EcOz (Appendix E).

No Gulf Snapping Turtles were recorded within the KGGP project area during the surveys, and there are currently no known records of this species occurring within watercourses intersected by the pipeline. However, the Gulf Snapping Turtle has previously been recorded within the Roper River, approximately 38 km south of the pipeline (Figure 10-20). The KGGP crosses tributaries and associated surface waters of the Roper River where suitable nesting and/or foraging habitat for the Gulf Snapping Turtle may occur (EcOz 2011). Potential habitat for the Gulf Snapping Turtle exists along the length of the pipeline within riparian habitats which the species relies on for most of its dietary intake (DSEWPaC 2013). Preferred nesting habitat is also associated with riparian habitats where *Melaleuca* and/or *Casuarina* species are present. Riparian vegetation within the project area is typically characterised by a canopy dominated by *Melaleuca* spp. with other riparian tree species and a dense mid storey comprised tree and shrub species including *Pandanus* spp. which the Gulf Snapping Turtle is known to feed on (DSEWPaC 2013).

The Gulf Snapping Turtle only occurs within rivers that drain into the Gulf of Carpentaria (DSEWPaC 2013), but may also occur in temporary and/or permanent waterholes which may act as refuge sites during the dry season.

Habitat critical to the survival of the Gulf Snapping Turtle has not yet been defined by DSEWPaC (DSEWPaC 2013) although an indicative distribution range is shown in Table 9 of Appendix D Given that so little is currently understood about the distribution and habitat preferences of the Gulf Snapping Turtle, all the riverine habitats that connect to the Gulf of Carpentaria, or tributaries that have tidal connections to watercourses that connect to the Gulf of Carpentaria, within the pipeline region are considered as potential foraging and/or nesting habitat for the purpose of this assessment (Table 10-33; Figure 10-20). Rivers and watercourses north of the Jasper Creek are outside of the indicative distribution range, and do not connect to the Gulf of Carpentaria (DSEWPaC 2013) so are not considered further in this assessment.

An assessment of the watercourses intersected by the pipeline and likelihood of occurrence of Gulf Snapping Turtle is summarised in Table 10-33 (excluding watercourses outside of distribution range). There are 15 watercourses that are intersected by the pipeline where the Gulf Snapping Turtle is considered as likely or possible to occur, and approximately 7.35 ha of significant riparian vegetation, that may provide potential nesting and foraging habitat for the Gulf Snapping Turtle, within the pipeline ROW. As a proportion of project area (2,325 ha), this comprises approximately 0.3%. Habitat values for the Gulf Snapping Turtle are summarised in Table 10-34. The extent of potential Gulf Snapping Turtle habitat within the project area has been assessed.

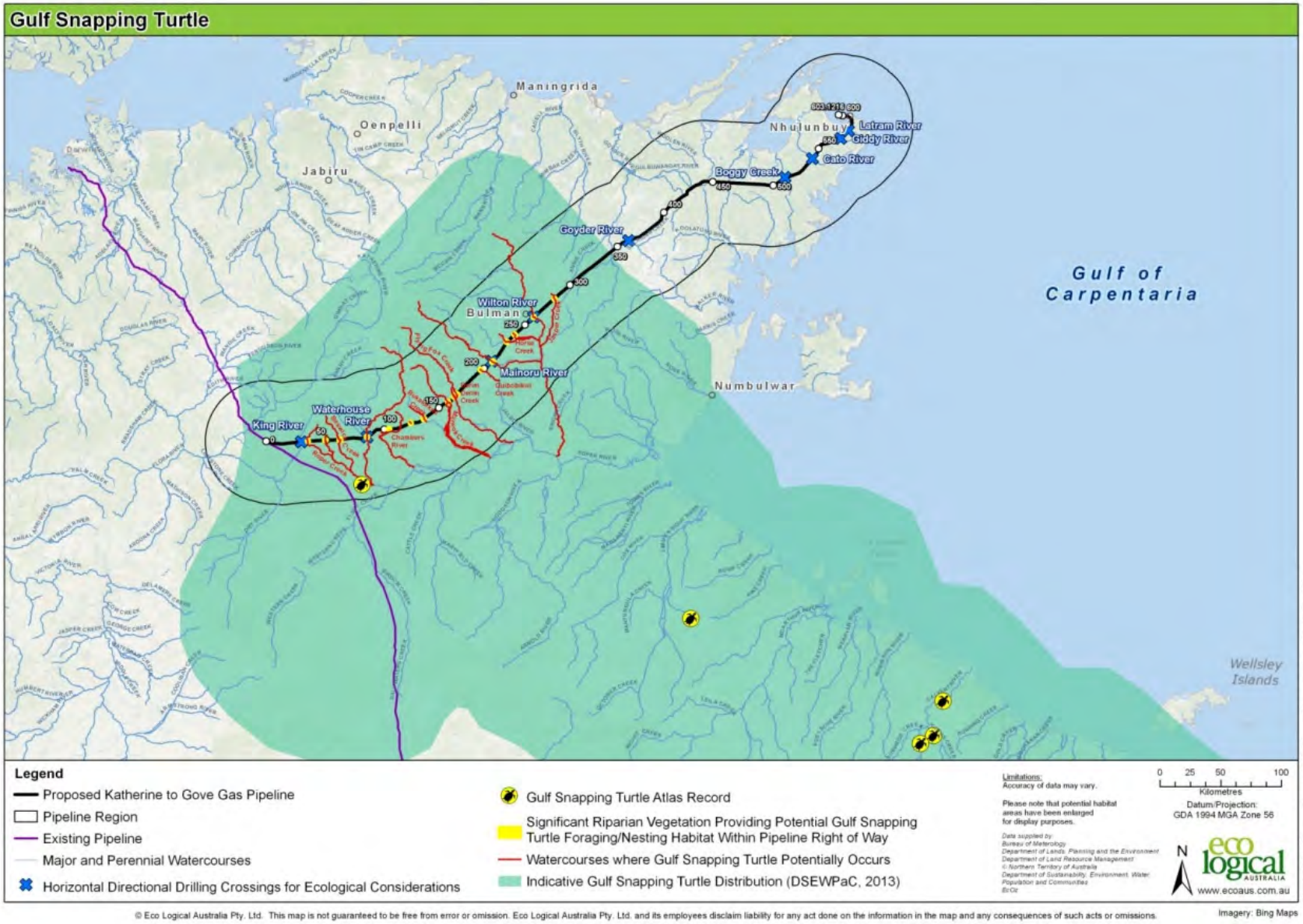

Figure 10-20: General distribution and potential foraging/nesting habitat within the pipeline region of the Gulf Snapping Turtle

Table 10-33: Assessment of watercourses traversed by the pipeline and likelihood of occurrence of Gulf Snapping Turtle

WATER COURSE	DESCRIPTION	LIKELIHOOD OF OCCURRENCE OF GULF SNAPPING TURTLE
King River	*Eucalyptus camaldulensis* and *Melaleuca leucadendra* open forest with *Brachyachne convergens* and *Lomandra sp*. understorey.	**Unlikely**: River does not drain into the Gulf of Carpentaria.
Maranboy Creek	Eucalyptus\Corymbia species open woodland with a mid-storey of *Terminalia platyphylla* and *Erythrophleum chlorostachys* and *Mnesithea rottboellioides* understorey.	**Possible**: Connects to the Roper River which drains into the Gulf of Carpentaria.
Beswick Creek	*Melaleuca leucadendra* closed forest with a dense mid storey of *Pandanus aquaticus* and *Grevillea pteridifolia* and *Eriachne sp*. understorey.	**Possible**: Preferred nesting habitat and preferred food source *Pandanus* sp.; connects to the Roper River which drains into the Gulf of Carpentaria.
Waterhouse River	*Melaleuca argentea* and *Eucalyptus camaldulensis* closed forest with mid-storey of *Barringtonia acutangula* and *Mnesithea rottboellioides* understorey.	**Possible**: Preferred nesting tree species present; connects to the Roper River which drains into the Gulf of Carpentaria.
Chambers River	*Eucalyptus camaldulensis* closed forest with a grassy understorey.	**Possible**: Connects to the Roper River which drains into the Gulf of Carpentaria.
Unnamed drainage	Closed forest dominated by *Lophostemon* sp. and *Eucalyptus* sp.	**Possible.** Connects to Bukalorkmi creek which joins onto Roper River.
Bukalorkmi drainage	Closed forest dominated by *Lophostemon grandiflora, Eucalyptus camaldulensis, Eucalyptus patellaris* and *Corymbia latifolia* with *Mnesithea rottboellioides* and *Heteropogon contortus* understorey.	**Possible**: Connects to the Roper River which drains into the Gulf of Carpentaria.
Maiwok Creek	*Eucalyptus camaldulensis* and *Melaleuca leucadendra* closed forest with a dense mid-storey dominated by *Diospyros humilis* and *Arundinella nepalensis* understorey.	**Possible**: Preferred nesting tree species present; connects to the Roper River which drains into the Gulf of Carpentaria.
Flying Fox Creek	*Melaleuca leucadendra* closed forest with a dense mid-storey dominated by *Acacia pellita*, and *Heteropogon contortus* understorey.	**Possible**: Preferred nesting tree species present; connects to the Roper River which drains into the Gulf of Carpentaria.
Derim Derim Creek	*Eucalyptus camaldulensis* and *Melaleuca leucadendra* closed forest with dense mid-storey dominated by *Antidesma ghesaembilla,* and *Arundinella nepalensis* understorey.	**Possible**: Preferred nesting tree species present; connects to the Roper River which drains into the Gulf of Carpentaria.
Quibobikwi	*Acacia umbellata* and *Acacia holosericea* open woodland with *Excoecaria parvifolia*	**Possibl**e: Connects to the Roper River

WATER COURSE	DESCRIPTION	LIKELIHOOD OF OCCURRENCE OF GULF SNAPPING TURTLE
Creek	understorey.	which drains into the Gulf of Carpentaria.
Mainoru River	*Melaleuca cajuputi* closed forest with a dense midstory of *Pandanus spiralis* and *Barringtonia acutangula,* and mixed grass\sedge species understorey.	**Possible**: Preferred nesting habitat (*Melaleuca*) and preferred food source *Pandanus* sp are present, and river connects to the Roper River which drains into the Gulf of Carpentaria.
Horse Creek	*Lophostemon grandiflora* and *Terminalia platyphylla* open woodland with *Heteropogon contortus* understorey.	**Possible**: Connects to the Roper River which drains into the Gulf of Carpentaria.
Branch of Horse Creek	*Lophostemon grandiflorus* and *Terminalia platyphylla* closed forest with *Pandanus spiralis* mid-storey and *Heteropogon contortus* understorey.	**Possible**: Preferred food source *Pandanus* sp. is present; connects to the Roper River which drains into the Gulf of Carpentaria.
Wilton River	*Casuarina cunninghamiana* and *Lophostemon lactifluus* closed forest with *Mnesithea rottboellioides* understorey.	**Possible**: Preferred nesting tree species present; connects to the Roper River which drains into the Gulf of Carpentaria.
Jasper Creek	*Casuarina cunninghamiana* open forest with *Eriachne sp.* understorey.	**Possible:** Tributary of the Wilton River which connects to the Roper River. Preferred nesting tree species present.

Table 10-34: Summary of habitat values for Gulf Snapping Turtle

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS POTENTIAL HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER HABITAT VALUE	KNOWN POPULATIONS	LOCAL REPRESENTATION OF POTENTIAL HABITAT	REGIONAL SIGNIFICANCE OF THIS HABITAT
0.3 %	• Larger rivers • Riparian corridors • Permanent/ temporary waterholes	No known populations within project area. Closest known record of any individual is 35 km south from the pipeline corridor in Roper River.	Extends broadly outside of project area. Not locally restricted.	Critical habitat has not yet been defined for this species.

10.15.4 Assessment of potential impact, mitigation and residual impact

The project has the potential to directly impact the Gulf Snapping Turtle through the destruction or disturbance of potential foraging and nesting habitat from:

- Riparian vegetation clearing.
- Watercourse construction causing increased sedimentation and erosion.
- Chemical contamination from wastewater, spills or incorrect disposal of hydrotest water.

Indirect impacts including egg predation, and nest destruction may also occur as a result of:

- Spread of feral animals.
- Changes in fire regimes.
- Dust emissions.

Management measures will be based on a conservative approach of assuming that the Gulf Snapping Turtle is either present within the project area or further downstream.

The Gulf Snapping Turtle may potentially occur within 15 watercourses (Table 10-33; Figure 10-20) that would be traversed by the pipeline. Within these 15 watercourses there are approximately 7.35 ha of associated riparian vegetation (within the pipeline ROW) that may be directly impacted through vegetation clearing. Impacts to approximately 1.9 ha of significant riparian vegetation (potential Gulf Snapping Turtle habitat) will be avoided through the use of HDD construction techniques (described in section 2.6.5 and Table 2-6). HDD construction techniques will also be used to avoid potential impacts to the in-stream habitat, and are proposed for three watercourse crossings where the Gulf Snapping Turtle is considered likely or possible to occur. These watercourses include: Waterhouse River, Mainoru River and Wilton River. Any watercourses that are identified as continuing to flow during the dry season, and that may provide potential habitat for the Gulf Snapping Turtle will be considered for HDD crossing construction.

Riparian vegetation that may provide potential habitat for the Gulf Snapping Turtle is not confined to the project area, and extends across much of the NT and into Queensland where the Gulf Snapping Turtle has been previously recorded. The proposed clearing will not affect any known populations of Gulf Snapping Turtle as there are currently no known records of the Gulf Snapping Turtle within the project area, with the closest record of any individual being approximately 35 km south of the pipeline.

Construction and in-stream maintenance will take place as early as possible in the dry season. Gulf Snapping Turtles nest and forage within very close proximity to water (DSEWPaC 2013), and are unlikely to be present at watercourses that have dried up. Where a watercourse still has significant flows, HDD construction techniques will be employed, which will avoid direct riparian habitat impacts and minimise disturbance to the in-stream habitat.

Construction of pipeline watercourse crossings where open trench construction techniques are proposed will result in mobilisation of adjacent sediments that wash into the watercourse until river banks and adjacent disturbed land are stabilised (including through re-vegetation). Increased sediment loading could potentially have a variety of effects on the Gulf Snapping Turtle by decreasing water quality and the in-stream habitat, smothering eggs and young, and altering the downstream aquatic habitat if not appropriately managed. The construction will be managed with minimum possible work area and rehabilitation works will be completed progressively to allow for sufficient revegetation of riparian habitats prior to the onset of the first wet season. Disturbance of watercourse banks and riparian corridors along the construction corridor will be further minimised by using access tracks to cross at existing formed crossing locations, where practicable. The removal of large trees that stabilise the banks of will also be avoided as much as possible. Pre clearance surveys will be

undertaken along the pipeline corridor prior to survey and pegging of the ROW and any construction activity to identify potential nesting habitat i.e. sandy banks or riverine banks with Melaleuca and Casuarina growth close to the water. In the event that a nest of the Gulf Snapping Turtle is encountered, measures will be put in place to avoid the nest area, and minimise disturbance. Given the preference of the species to nest in close proximity to permanent water, the use of HDD construction techniques at water crossings which avoid or minimise disturbance to riparian vegetation will further reduce the risks of loss of breeding habitat.

Rehabilitation will be undertaken progressively immediately following completion of construction in an area in order to adequately stabilise habitats and river banks prior to the wet season. This will reduce any potential impacts from erosion and sedimentation. These crossings are constructed using open trench construction techniques. This will be managed through the Hydrology and Water Quality Management Plan and Rehabilitation Management Plan (Appendix O), which includes measures for reinstatement of the watercourse and to minimise and monitor erosion.

Chemical contamination of watercourses could potentially occur from a number of sources including wastewater from construction camps, spills of fuels and oils from vehicles and plant, drilling muds used at HDD crossings and disposal of hydrotest water. Management measures are aimed at reducing the risk of spills, sourcing and disposing of hydrotest water appropriately and in accordance with regulations, and maintaining the existing quality of water resources. It is expected that the risk of chemical contamination of water and associated negative impacts on the Gulf Snapping Turtle will be minimal.

An increase in the occurrence and spread of introduced species may indirectly impact the Gulf Snapping Turtle, either through degradation of potential nesting habitat from weed invasion or nest destruction by feral animals i.e. feral pigs. The spread of introduced species will be prevented and managed throughout the construction phase of the project.

Construction will be managed to reduce fire risk and dust emissions such that there are no implications that may represent a threat to potential Gulf Snapping Turtle habitat. The management and mitigation measures are summarised in Table 10-35.

Table 10-35: Mitigation measures for Gulf Snapping Turtle

MITIGATION	DESCRIPTION
Avoidance	• Significant riparian vegetation that could potentially support nesting and foraging habitat have been avoided through route selection and use of HDD at a large number of river crossings. • Construction will occur during dry season.
Minimisation	• Vegetation will be cleared and rehabilitated progressively to minimise the period that potential nesting habitat of the Gulf Snapping Turtle is disturbed. • Access tracks will be used at existing formed crossing locations where possible. • The removal of large trees that stabilise river banks will be minimised where practicable.
Management	*Terrestrial and Aquatic Fauna Management Plan* • Sensitive fauna habitats in proximity to working areas will be clearly marked and access to these areas will be prohibited. • Clearing of large trees at watercourse crossings will be avoided where possible to reduce erosion and increased sedimentation.

MITIGATION	DESCRIPTION
	Vegetation clearing management • The total area to be cleared will be restricted to the minimum area required to practicably construct the pipeline, above ground infrastructure, temporary construction sites and access tracks. • Vegetation will be cleared and rehabilitated progressively throughout construction to minimise the period that communities and habitats are disturbed • Sensitive vegetation communities and habitats in proximity to working areas will be clearly marked and access to these areas will be prohibited.
	Hydrology and water quality management • A Watercourse Crossing Construction Management Plan will be developed to provide site specific environmental management guidelines for design and construction of the pipeline. • HDD would be used at any watercourse that is determined to be in flow by the construction contractor at the time of constructing the watercourse crossing. • Fuel and chemical storage will be above ground and will be located an appropriate distance from surface waters and high quality groundwater resources. • No water will be extracted from a surface water body for any purpose prior to an assessment of the potential environmental impacts of the amount of water that will be extracted. • Waste will be contained appropriately, taking into consideration protection of water and soil resources. • Sewage and putrescibles will be treated and/or disposed of in accordance with regulatory requirements. • Hydrotest water will be sourced from approved sources, and disposed of in accordance with Hydrology and Water Quality Management Plan (Appendix O).
	Introduced Species management • Existing weed infestations will be identified and treated prior to construction. • Construction and operation workforces will be trained in weed, introduced species and feral animal identification and awareness. • Systems will be established for reporting of new weed infestations, and feral animal sightings. • Machinery used in in-stream watercourse crossing construction will be washed down prior to use in other waterbodies to prevent translocation of biota and disease.

Based on the implementation of proposed mitigation measures, it is considered unlikely that the Gulf Snapping Turtle (if present) will be significantly impacted as a result of the KGGP Project (Table 10-36). Suitable habitat for the Gulf Snapping Turtle is broadly represented in the region (large rivers and areas of riparian vegetation). The habitat to be cleared within the project area (5.5 ha) represents a small proportion of the potential habitat available within the region. Disturbance to riparian vegetation and in-stream habitats will be avoided at a number of major watercourse crossings that may provide potential Gulf Snapping Turtle habitat, through the use of HDD construction techniques. At the remaining watercourses, disturbance to potential habitat will be temporary and reduced through a number of mitigation measures including minimisation of vegetation clearing at ecologically sensitive areas, prohibited removal of large trees on river banks, and progressive rehabilitation occurring prior to the following wet season.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on Matters of NES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

The residual impacts associated with the construction and operation of the Project on the Gulf Snapping Turtle is unlikely to be significant based on the information that is currently available. As such, offsets relating to the Gulf Snapping Turtle would not be required under the Commonwealth offsets policy.

Table 10-36: Summary of residual impacts for Gulf Snapping Turtle after mitigation applied.

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Clearing of riparian vegetation causing loss of potential foraging and/or nesting habitat	Short-term, temporary disturbance to 5.5 ha of riparian vegetation. No permanent loss of potential habitat. No known populations affected.	Low	None
Increased erosion and sedimentation causing changes to in-stream habitats, or causing mortality of individual animals.	Localised and short term effect possible.	Low	None
Chemical contamination causing a decrease in water quality.	Localised and short term effect possible.	Negligible	None
Dust emissions causing mortality of eggs/young.	Localised and short term effect possible.	Negligible	None
Changes in fire regimes.	No change to local or regional fire regimes.	Negligible	None

10.16 OTHER MIGRATORY SPECIES

10.16.1 Conservation status

There are a range of migratory species that are relevant to the region proposed to be traversed by the KGGP, the potential for occurrence and impact for which was assessed in Table 10-2. Of these, 11 have been identified to have potential to be affected and have been subject to further assessment (Table 10-37).

Table 10-37: Migratory species listed under the EPBC Act considered for further assessment

Common name	Scientific name	Conservation status	
		EPBC Act	TPWC Act
Barn Swallow	*Hirundo rustica*	Migratory	Not evaluated
Cattle Egret	*Ardea ibis*	Migratory (Terrestrial)	Least concern
Derby White-browed Robin	*Poecilodryas superciliosa cerviniventris*	Migratory	Not evaluated
Fork-tailed Swift	*Apus pacificus*	Migratory (marine)	Least concern
Glossy Ibis*	*Plegadis falcinellus*	Migratory (marine)	Not listed
Eastern Great Egret	*Ardea modesta*	Migratory (marine)	Least concern
Melville Cicadabird	*Coracina tenuirostris melvillensis*	Migratory	Least concern
Rainbow Bee-eater	*Merops ornatus*	Migratory (marine)	Least concern
Rufous Fantail	*Rhipidura rufifrons*	Migratory (Marine)	Not listed
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Migratory (Marine)	Least concern
Salt-water Crocodile	*Crocodylus porosus*	Migratory (Marine)	Least concern

* This species was not returned in the Protected Matters Search Tool results, however was recorded during the ELA 2012 survey

10.16.2 Regional distribution and Ecology

The **Barn Swallow** (*Hirundo rustica*) is a small bird that usually occurs in northern Australia, and patchily along the north coast of the mainland from the Pilbara region, Western Australia, to Fraser Island in Queensland. The species prefers open country in coastal lowlands, often near water, towns and cities where birds are often sighted perched on overhead wires and also in or over freshwater wetlands, paperbark *Melaleuca* woodland, mesophyll shrub thickets and tussock grassland. Barn Swallows may nest solitarily or in colonial groups of up to 100 pairs on small ledges on vertical surfaces, such as beams or window-ledges of buildings. The species consumes mainly flying insects (DSEWPaC 2013). A past and current threat to the Barn Swallow is loss of habitat (DSEWPaC 2013).

The **Cattle Egret** (*Ardea ibis*) occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Two major distributions have been located within Australia; from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. In Western Australia and the Northern Territory, the Cattle Egret is located from Wyndham to Arnhem Land where it breeds in colonies (DSEWPaC 2013). The species feeds insects and small reptiles, amphibians and mammals (DSEWPaC 2013). The major threats facing the Cattle Egret are persecution of large colonies in urban areas, loss of breeding habitats through wetland degradation and destruction, hunting, and in Australia, exotic species, especially feral cats (*Felis catus*) (DSEWPaC 2013).

The **Derby White-browed Robin** (*Poecilodryas superciliosa cerviniventris*) has a broad distribution across the northern NT (DSEWPaC 2013). This species is found in woodlands, forests and wetlands (Birdlife International 2012). Known and perceived threats to the Derby White-browed Robin include agriculture, aquaculture, habitat alteration due to trampling and grazing by livestock, and predation, competition, habitat degradation and/or spread of pathogens by introduced species (DSEWPaC 2013).

The **Fork-tailed Swift** (*Apus pacificus*) is a non-breeding visitor to all states and territories of Australia where it usually arrives around October. In the Northern Territory, there are widespread but scattered records in the north. The Fork-tailed Swift is almost exclusively aerial, and mostly occurs over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh (DSEWPaC 2013). They forage aerially, up to hundreds of metres above ground, consuming mainly insects. There are no significant threats to the Fork-tailed Swift in Australia. Potential threats include habitat destruction and predation by feral animals; however, due to the wide range of the species, these are thought to be negligible (DSEWPaC 2013).

The **Glossy Ibis** (*Plegadis falcinellus*) patchily distributed in Australia, though WA and more commonly east of the Kimberly in the north, and east of the Eyre Peninsula in the south. Habitats include fresh or brackish shallow water swamps, marshes, flood plains, reservoirs, sewerage ponds and cultivated irrigation. Individuals forage singly or in small flocks although flocks of up to 60,000 individuals have been noted in the Alligator River region (DSEWPaC 2013). Breeding occurs in colonies with other species of ibis, herons and egrets. The diet is mainly invertebrates but may also include fish, tadpoles, lizards and small snakes and nestling birds. Wetland destruction or degradation is the major threat to the Glossy Ibis. Clearing, grazing, burning, increased salinity, groundwater extraction and invasion by exotic plants and fish species are also threats to the species through habitat modification (DSEWPaC 2013).

The **Eastern Great Egret** (*Ardea modesta*) is widespread in Australia, occurring in all states/territories. In Australia, the largest breeding colonies, and greatest concentrations of breeding colonies, are located in near-coastal regions of the Top End of the NT. This species roosts in large flocks that may consist of hundreds of birds. The Great Egret has been reported in a wide range of wetland habitats (e.g. inland and coastal, freshwater and saline). In Australia, breeding sites are located in wooded and shrubby swamps including mangrove forests (the main habitat of the species in the Top End) (DSEWPaC 2013). The Eastern Great Egret has a diverse diet that includes fish, insects, reptiles, small birds and mammals (DSEWPaC 2013). In Australia, the Eastern Great Egret is threatened by loss and/or degradation of foraging and especially breeding habitat through alteration of water flows, drainage and/or clearing of wetlands for development, frequent burning of wetland vegetation used as nest sites, salinisation and invasion by exotic plants (DSEWPaC 2013).

The **Melville Cicadabird** (*Coracina tenuirostris melvillensis*) occurs in northern Australia from Broome in WA to the far eastern Top End. This species is a geographical variant of the Common Cicadabird (*Coracina tenuirostris*). These species use foliage in the canopy of diverse forests and woodlands, including mangroves and paperbark swamps. These species feed on insects and breed from September to June (peaking during November to February), building high nests below the canopy (Morecombe 2010). Known and perceived threats to the species include agriculture, aquaculture, land clearing, habitat fragmentation and habitat degradation (DSEWPaC 2013).

The **Rainbow Bee-eater** (*Merops ornatus*) is distributed across much of mainland Australia, and occurs on several near-shore islands. The population size has not been determined but is assumed to be reasonably large based on reporting rates for the species. The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, various cleared or mangroves. Nests are constructed in an enlarged chamber at the end of long burrow or tunnel that is excavated, by both sexes in flat or sloping ground, in the banks of rivers, creeks or dams, in roadside cuttings, in the walls of gravel pits or quarries, in mounds of gravel, or in cliff-faces (DSEWPaC 2013). The Rainbow Bee-eater mainly feeds on insects. The only actual, identified threat to the Rainbow Bee-eater is the Cane Toad, which reduces the breeding success and productivity of the Rainbow Bee-eater by feeding on eggs and especially nestlings, and usurping and occupying nesting burrows (DSEWPaC 2013).

The **Rufous Fantail** (*Rhipidura rufifrons*) occurs in coastal and near coastal districts of northern and eastern Australia and has breeding populations occurring from about the South Australia-Victoria border, through to the Cairns-Atherton region, Queensland (DSEWPaC 2013) . The Rufous Fantail is considered a common and secure species (DSEWPaC 2013). This species is usually seen singly or in pairs, but occasionally in small groups and in north and north-eastern Australia, they often occur in tropical rainforest and monsoon rainforests. The species breeds from about September to February and are insectivorous, foraging mainly in the low to middle strata of forests. The main threat to populations of Rufous Fantail is probably fragmentation and loss of core moist forest breeding habitat through land clearing and urbanisation, especially forest remnants and corridors along the species' migration routes (DSEWPaC 2013).

The **White-bellied Sea-eagle** (*Haliaeetus leucogaster*) is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania and also extends inland along some of the larger waterways, especially in eastern Australia. Breeding records are patchily distributed, mainly along the coastline also, and especially the eastern coast, extending from Queensland to Victoria, and to Tasmania. This species is found in coastal habitats and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Breeding territories are located close to water, and mainly in tall open forest or woodland (DSEWPaC 2013). The White-bellied Sea-Eagle feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal. The main threats to the White-bellied Sea-Eagle are loss of habitat due to land development, and disturbance of nesting pairs by human activity (DSEWPaC 2013).

The **Salt-water Crocodile** (*Crocodylus porosus*) is a large member of Crocodylidae Family and is found in Australian coastal waters, estuaries, freshwater sections of lakes, inland swamps and marshes. The species' distribution ranges from Rockhampton in Queensland throughout coastal NT to King Sound (near Broome) in Western Australia. In the NT, the Salt-water Crocodile has been found in many rivers including the Mary, Adelaide, Daly and Moyle Rivers (DEWPaC 2013). Preferred nesting habitat for the Salt-water Crocodile includes elevated isolated freshwater swamps that do not have the influence of tidal movements (DSEWPaC 2013). The species feeds on crustaceans, insects and mammals. In Australia, threats to the Salt-water Crocodile include incidental mortality from fishing

nets, habitat destruction, and in Arnhem Land destruction of wetland habitat by feral animals such as buffalo (DSEWPaC 2013).

10.16.3 Potential habitat, survey effort and findings

Surveys by EcOz in 2004 involved bird counts during a fauna survey over six weeks in July. Three locations in the project area were surveyed; each location containing six survey sites (refer to Appendix D for locations). Eight diurnal bird counts were conducted at each of these sites.

Subsequently ELA conducted field surveys in the project area in November 2012 (Appendix D). Field survey methods were developed to follow the techniques outlined in the EPBC survey guidelines (DEWHA 2008 and DSEWPaC 2011b).

Eight of the eleven migratory species thought to be potentially affected by the KGGP Project (Table 10-37) have been recorded in the project area (Table 10-38).

Table 10-38: Migratory species recorded in the project area

COMMON NAME	SCIENTIFIC NAME	RECORDED DURING SURVEYS	
		EcOz (2004)	**ELA (2012)**
Barn Swallow	*Hirundo rustica*		
Derby White-browed Robin	*Poecilodryas superciliosa cerviniventris*		
Fork-tailed Swift	*Apus pacificus*		
Eastern Great Egret	*Ardea alba / Ardea*		✓
Glossy Ibis	*Plegadis falcinellus*		✓
Melville Cicadabird	*Coracina tenuirostris*		✓
Rainbow Bee-eater	*Merops ornatus*	✓	✓
Rufous Fantail	*Rhipidura rufifrons*	✓	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	✓	
Salt-water Crocodile	*Crocodylus porosus*	✓	
Cattle Egret	*Ardea ibis*		✓

The majority of the eight migratory species recorded during surveys, and those considered likely to occur or possibly occurring, are considered to be widespread across Australia. Four species; Derby White-browed Robin, Melville Cicadabird, Barn Swallow and Salt-water Crocodile, are not found across Australia, but based on distribution mapping (DSEWPaC 2013) are considered to be relatively widespread across northern Australia.

Common habitat preferences for the majority of these species includes wetlands, swamps and open forests and woodlands. Each of these habitat types is present in the project area including three regionally significant wetlands; one semi-permanent swamp (KP394) and two seasonally inundated swamps (KP516 and KP594). Six other regionally significant wetlands occur near the project area however, for each of these the project design either avoided their location or was realigned to reduce potential impacts to the wetlands.

The Salt-water Crocodile prefers coastal waters, estuaries, freshwater sections of lakes and inland swamps. These habitats are available broadly in the Top End, however important habitat for this species in the project area includes major rivers crossed by the pipeline ROW (Table 10-33).

A summary of the habitat values for the migratory species recorded/likely to occur is presented in Table 10-39.

Table 10-39: Summary of habitat values for migratory species recorded/likely to occur

APPROXIMATE PROPORTION OF PROJECT AREA CONSIDERED AS HABITAT	AREAS POTENTIALLY OF RELATIVELY HIGHER VALUE TO SPECIES	KNOWN IMPORTANT POPULATIONS	LOCAL REPRESENTATION OF THIS HABITAT	REGIONAL SIGNIFICANCE OF HABITAT
100% foraging/nesting habitat (based on species as a collective, and their known distribution)	Wetlands, swamps, coastal areas and open forests and woodlands.	Unknown, the majority of these species have broad distributions across Australia.	Extends broadly outside of project area. Not locally restricted.	Not of significance

10.16.4 Assessment of potential impact, mitigation and residual impact

The KGGP Project has the potential to directly impact migratory species through the destruction or disturbance of habitat, or by reducing prey availability from:

- Vegetation clearing and habitat removal
- Change to fire regimes
- Introduction/spread of invasive weeds
- Noise and vibration causing changes in behaviour.

For the purpose of this assessment, up to the full 2,200 ha of clearing required for the KGGP could support combined potential habitat for migratory species. Potential habitat for each of these species is not confined to the project area, and generally is available across the Top End. The project area represents a small proportion of the widespread distributions of these species, either across the Top End or across wider Australia (refer to Table 10-9 of Appendix D).

Impacts to migratory species from habitat removal are not likely to be significant in regard to the small area of impact compared to available habitat in the region. Rehabilitation of the project area following construction is anticipated to restore approximately 62% of habitat in the long term, with the residual impact being approximately 836 ha of cleared land (including that for ancillary infrastructure). Access roads, construction camps and temporary laydown areas not required following construction will be restored in the long term.

To further minimise impacts, pre-clearance inspections for nests of significant bird species will be undertaken along the pipeline corridor prior to survey and pegging of the ROW and any construction activity. These will either be flagged and worked around where practicable or relocated by a qualified fauna handler if the nest is suitable (i.e. not tree hollow or burrow). Ancillary infrastructure and access tracks will be located to avoid any wetland areas with higher potential for wetland migratory bird nests. Clearing of the narrow ROW corridor is unlikely to result in habitat fragmentation, particularly given that a large portion of this will be rehabilitated.

The three ephemeral significant wetlands in the project area (Table 10-13) will require open cut crossings as a result of the project. This will be undertaken in the dry season when the areas of the wetlands are not expected to have water. The cross sectional profile of the wetlands subject to trenching would be reinstated to preconstruction condition, therefore minimising impacts to the wetland and associated vegetation. Wetland crossings in the project area will be constructed in accordance with accepted engineering standards and environmental protection guidelines.

In regard to indirect impacts from changes in hydrology of wetland habitat for migratory bird species, groundwater, from existing or new bores, is likely to be required to surface water supplies for construction water as surface water resources are highly variable in the dry season. In most cases for groundwater use, Pacific Aluminium is able to achieve the general NT guideline to restrict the amount of water extracted to 20% of recharge. Groundwater may only be required for small volumes of water where the surface water flow is not adequate to sustainably extract. At this stage, the only areas identified to potentially require supplementary groundwater supply are at King River, Beswick Creek, and Cato River. The water supply and adaptive management strategy work program (Table 7-3 of Chapter 7) would be used to inform the potential maximum extraction from groundwater required for the Project. When the maximum groundwater supply is determined, field investigations would be undertaken during the 2013 dry season of existing groundwater bores that have been identified as a potential source of groundwater. Bores will not be placed in areas where abstraction could foreseeably significantly alter the hydrological regime of a wetland on which migratory bird species could be dependent.

To minimise disturbance to in-stream habitat of rivers, Horizontal Directional Drilling (HDD) techniques will be used for watercourse construction at the nine major rivers where the Salt-water Crocodile could potentially occur. In addition, HDD will also be used at any watercourses that continue to flow during the dry season. These construction methods will further reduce any potential impacts to the Salt-water Crocodile.

Noise and vibration will be intermittent and temporary as construction progresses along the corridor. Any changes to breeding or foraging behaviour would be highly localised, temporary, and likely to return to pre-construction conditions soon after works finish.

Construction will be managed to reduce fire risk such that there are no implications for local fire regimes that may represent a threat to habitat.

Management measures will include minimising impacts to watercourses through HDD, reinstatement of ROW following construction and managing fire and weeds. (Table 10-40).

Table 10-40: Mitigation measures for migratory species

Avoidance	• Wetland areas will be avoided for ancillary infrastructure, camps and proposed access roads to avoid potential nesting areas for migratory wetland species. • Pre-clearance inspections for nests of migratory birds will be undertaken along the pipeline corridor prior to survey and pegging. In the event that a nest is found, measures to minimise disturbance of the nest will be investigated or, if the nest is suitable (i.e. not tree hollow or burrow), it will be relocated by a qualified fauna handler.
Minimisation	• Best endeavours will be used to avoid clearing tall trees on along the edges of the pipeline corridor and and/or branches would be pruned (where feasible) rather than tree felled. • HDD crossing techniques will be used at major rivers to minimise disturbance to in-stream habitat and open-cut crossings of wetlands will be rehabilitated.
Management	T*errestrial and aquatic fauna management* • Clearing will be staged and performed on single 'fronts' to allow for the progressive movement of fauna into areas outside the proposed disturbance area. *Weed management* • Vehicle soil hygiene measures will be put in place to prevent introduction of invasive weed species into new areas along Pipeline corridor. *Fire management* • Fire prevention and management controls will be implemented to reduce risk of changes in fire regimes affecting migratory bird habitat.

It is considered unlikely that migratory species will be significantly impacted as a result of the KGGP Project (Table 10-41). The habitat present within the project area is not considered to be significant habitat for the listed migratory species, but is likely to be used periodically by the species recorded or considered likely to occur. The habitat is not restricted to inside the project area and expands across much of the region. In addition, given that the migratory species recorded are all distributed across broader ranges, those present within the project area are unlikely to represent a significant proportion of their populations.

Mitigation measures will focus on appropriate crossing techniques for watercourses and wetlands and surveying for nest sites of significant fauna prior to construction, and in the event of a nest site being present, buffers and other management measures will be put in place.

Under the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a), offsets are not required where the residual impact is not likely to be significant on MNES (with reference to the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DEWHA 2009)).

The residual impacts associated with the construction and operation of the Project on the aforementioned migratory species is unlikely to be significant based on the information that is currently available. As such, offsets relating to these migratory species would not be required under the Commonwealth offsets policy.

Table 10-41: Summary of residual impacts for migratory species after mitigation applied.

POTENTIAL IMPACT	MAGNITUDE OF RESIDUAL IMPACT FOLLOWING MITIGATION	REGIONAL SIGNIFICANCE OF RESIDUAL IMPACT	FURTHER MITIGATION REQUIRED/PROPOSED
Vegetation clearing and habitat removal	Permanent loss of up to 836 ha of potential habitat. No known important populations affected. No significant habitat fragmentation. Temporary disturbance of a portion of three wetland areas requiring open-cut crossings. No permanent impacts to riparian environment.	Low	None
Changes to hydrological regime of wetland habitat	No significant changes anticipated.	Negligible	None
Noise and vibration causing changes in behaviour	Localised and short term effect possible.	Negligible	None
Changes to fire regimes	No change to local or regional fire regimes as a result of KGGP.	Negligible	None
Spread of invasive weeds	No significant new weed infestations as result of KGGP.	Low	None