



Origin Energy

Spring Gully North-West and North-East EPBC Act Approval 2017/7881

Threatened Species and Ecological Communities Management Plan

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Abbreviations

Abbreviation	Description
APLNG	Australia Pacific LNG Pty Ltd
ATP	Authority to Prospect
BUA	Beneficial Use Approval
CM	Change Management
CoP	Code of Practice
CWMP	Coal Seam Gas Water Management Plan
DEHP	Department of Environment and Heritage Protection
DEWHA	Department of Environment, Heritage, Water and the Arts
DNRM	Department of Natural Resources and Mines
DOA	Delegation of Authority
DoEE	Department of Environment and Energy
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EA	Environmental Authority
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP Act	<i>Environmental Protection Act 1994</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act</i>
ESA	Environmentally Sensitive Areas
FEL	Front End Loading
GAB	Great Artesian Basin
GIS	Geographical Information System
GPF	Gas Processing Facilities
HSE	Health Safety and Environment
HSSE	Health, Safety Security and Environment
IESC	Independent Expert Scientific Committee
LNG	Liquefied Natural Gas
LWD	Landspray While Drilling
MBC	Mix Bury Cover
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NEDA	North-East Development Area
NWDA	North-West Development Area

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Abbreviation	Description
OCIS	Origin Collective Intelligence System
OEMP	Operations Environmental Management Plan
P&G Act	<i>Petroleum and Gas (Production and Safety) Act 2004</i>
PD	Preliminary Documentation
PL	Petroleum Lease
PRP	Permeate Reinjection Plant
RoW	Right of Way
RWF	Regulated Waste Facility
SEDA	South-East Development Area
SEVT	Semi-evergreen Vine Thicket
SGRA	Spring Gully Resource Area
SIA	Social Impact Assessment
SWDA	South-West Development Area
TAP	Threat Abatement Plan
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
UWIR	Underground Water Impact Report
WTF	Water Treatment Facility

Declaration of Accuracy

I declare that:

1. To the best of my knowledge, all information contained in, or accompanying this management plan in complete, current and correct.
2. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration
3. I am aware that:
 - a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.
 - b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act of the Environment Protection and Biodiversity Conservation Regulations 2000 where the person knows the information or document is false or misleading.
 - c. The above offences are punishable on conviction by imprisonment or a fine, or both.



Nicole Buchanski
Strategic Approvals Manager
Origin Energy

1. Introduction

This Threatened Species and Ecological Communities Management Plan has been written in accordance with the Australia Pacific LNG Spring Gully North-West and North-East Development Area EPBC Approval (2017/7881) (the Approval) conditions.

As required by condition 13 of the Approval, the Threatened Species and Ecological Communities Management Plan will be implemented for the duration of the approval. The Plan addresses 16 Matters of National Environmental Significant (MNES) species and habitats that are known or have the potential to occur within the Project area, listed in Section 1.1.

Information for the MNES described within this management plan have been obtained from relevant resources including the Department's Environmental Management Plan Guidelines, species Conservation Listing Advice, Approved Conservation Advices, Recovery Plans and the Species Profile and Threats (SPRAT) Database. The management plan has been prepared with consideration to the following Threat Abatement Plans:

- Threat abatement plan for competition and land degradation by rabbits (DoEE 2016)
- Threat abatement plan for predation by European red fox (DEWHA 2008)
- Threat abatement plan for predation by feral cats (DoE 2015)
- Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (DSWEPAC 2011); and
- Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses (DSEWPAC 2012).

1.1. Relevant Matters of National Environmental Significance

A total of 16 MNES are known or have the potential to occur within the Project area, as listed in Table 1. These include five threatened mammals, one threatened bird, four threatened reptiles, two threatened flora species and four Threatened Ecological Communities (TECs).

Table 1: Matters of national environmental significance relevant to the Project area

Common Name	Scientific Name	EPBC Act Status at time of Approval	Likelihood of Occurrence
Threatened mammals			
Koala	<i>Phascolarctos cinereus</i>	Vulnerable	Known
Greater Glider	<i>Petauroides volans</i>	Vulnerable	Known
Northern Quoll	<i>Dasyurus hallucatus</i>	Endangered	Potential
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Vulnerable	Potential
Corben's Long-eared Bat	<i>Nyctophilus corbeni</i>	Vulnerable	Potential
Threatened birds			
Squatter Pigeon	<i>Geophaps scripta scripta</i>	Vulnerable	Known
Threatened reptiles			
White-throated Snapping Turtle	<i>Elseya albagula</i>	Critically Endangered	Known
Collared Delma	<i>Delma torquata</i>	Vulnerable	Potential
Dunmall's Snake	<i>Furina dunmalli</i>	Vulnerable	Potential
Yakka Skink	<i>Egernia rugosa</i>	Vulnerable	Potential
Threatened flora			
-	<i>Bertya opposens</i>	Vulnerable	Potential
Ooline	<i>Cadellia pentastylis</i>	Vulnerable	Potential
Salt Pipewort	<i>Eriocaulon carsonii</i>	Endangered	Known
Threatened ecological communities			
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)		Endangered	Known
Coolibah - Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions		Endangered	Known
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions		Endangered	Known
The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin		Endangered	Known

2. Management practices and methods

The following sections of this Plan outline the general management practices and methods to minimise impacts for all MNES species and habitats relevant to the Approval. Species-specific management practices are provided in Sections 3, 4 and 5.

The relevant management practices and methods outlined in this section, and specifically the management measures in Table 3 (section 2.4) will be applied to these species to ensure individuals potentially occurring are not inadvertently harmed.

2.1. Health, safety and environment management system

Origin is committed to protecting the environment and consequently manages Health, Safety and Environment (HSE) matters as critical business activities. Origin has developed corporate environmental policies that provide a public statement of the corporate commitment to protecting the environment during operations.

In addition, Origin, as an operator of gas production activities, uses a structured approach to the management of HSE issues through a HSE Management System. This management system ensures that environmental risks associated with Origin's operations are either avoided or kept to as low as reasonably practicable. The HSE Management System drives continuous improvement in the company's environmental performance and assists in providing confidence to regulators, commercial partners and stakeholders that Origin manages its operations in an environmentally responsible way.

The HSE policy forms part of the Origin HSE Management System.

2.2. Field planning

The environmental management framework for the Project adopts a hierarchy of environmental management practices that will be implemented through planning, development and operation of the Project. The Environmental Constraints Planning and Field Development Protocol (the Protocol), in accordance with Condition 12 of the Approval documents the process for validating MNES, and outlines the hierarchy to manage disturbance to MNES for planning the location of petroleum activities.

A hierarchy of environmental management practices will be adopted to minimise potential impacts to MNES through:

1. **Avoidance** - Avoiding direct and indirect adverse environmental impacts where reasonable and practicably possible
2. **Minimise** - Minimise direct and indirect adverse environmental impacts where impacts cannot be avoided
3. **Mitigate** - Implement mitigation and management measures to minimise direct, indirect and cumulative adverse environmental impacts
4. **Remediation and Rehabilitation** - Actively remediate and rehabilitate impacted areas to promote and maintain long-term recovery; and
5. **Provide Offsets** - Where required, offsets will be provided for activities that result in an unavoidable significant residual adverse impact to MNES in accordance with the Approval.

2.3. Project-specific controls

All potential impacts to MNES will be managed through implementation of Project-specific controls presented in the management documents in Table 2.

Table 2: Management documents relevant to the Project

Relevant plans	EPBC Approval condition	Description
Environmental Constraints Planning and Field Development Protocol (the Protocol) (Q-8200-15-MP-1157)	Condition 12	<ul style="list-style-type: none"> • The Protocol provides a framework to guide placement of infrastructure. • The Protocol documents the process for validating MNES and implementing a hierarchy of avoidance, minimising disturbance, and mitigating potential impacts to MNES, while considering landowner, cultural heritage, and engineering / design requirements.
Decommissioning and Rehabilitation Management Plan (Q-8200-15-MP-0010)	N/A	<ul style="list-style-type: none"> • The Rehabilitation Management Plan outlines the rehabilitation strategies, criteria, methods and monitoring requirements for the Project. • The plan describes how rehabilitation and decommissioning will be carried out in accordance with the rehabilitation conditions of the EA and EPBC approval. • Overall, the state government specifies rehabilitation goals which require areas disturbed by petroleum and gas activities to be: <ol style="list-style-type: none"> 1. safe to humans and wildlife 2. non-polluting 3. stable 4. reinstated to pre-disturbed land-use, unless otherwise agreed to by the landholder.
Offset Area Management Plan	Condition 4	<ul style="list-style-type: none"> • The Offset Plan details the offset area for the approved disturbance limits to MNES for the Project.
Spring Gully Coal Seam Gas Water Management Plan	Condition 15	<ul style="list-style-type: none"> • The CSG Water Management Plan demonstrates how the predicted volume of produced water will be managed over the life of the Project. • The plan demonstrates how potential adverse impacts to MNES water resources will be monitored and managed, and details commitments under the Water Act and UWIR for the Surat CMA, including the Water Monitoring Strategy and Spring Impact Management Strategy.

2.4. Mitigation and management measures

The following environmental management activities and controls will be implemented to mitigate and manage any adverse impacts to MNES relevant to the Project.

Table 3: Mitigation and management measures

Aspect	Mitigation and management measures
General Fauna Management Measures	<ul style="list-style-type: none"> • A fauna spotter catcher will be present during the clearing of confirmed MNES fauna habitat. • For disturbance of vegetation (and/or habitat) where MNES species are known, likely or potential to occur, the use of sequential disturbance to direct fauna away from the impact zone (disturbance area) will be conducted. • GIS and aerial imagery will be consulted during the desktop stage of infrastructure planning to investigate the presence of vegetation values. • The length of open pipeline trench will be minimised and progressively backfilled following pipeline construction. • Fauna egress devices (e.g. matting, ladders) will be installed in all excavations left open overnight. • Open excavations and trenches will be inspected daily with relocation of fauna if present. • Prior to backfilling, excavations or trenches will be inspected for the presence of fauna, and evidence of burrowing fauna or breeding places with relocation of fauna, if present. • The open ends of welded pipeline sections will be plugged at the end of each day using ‘night caps’ or similar to prevent the ingress of fauna. • Pipeline sections will be laid out with gaps to allow for fauna movement across the pipeline right-of-way.
Rehabilitation/ Decommissioning	<ul style="list-style-type: none"> • All significantly disturbed areas caused as a result of petroleum activities which are not being or intended to be utilised by the landholder or overlapping tenure holder, will be rehabilitated to meet regulatory requirements. • Disturbed open eucalypt forest/woodland or Brigalow vegetation will be rehabilitated in accordance with the Rehabilitation Plan for the Project as soon as practical following decommissioning works. • Cleared open eucalypt forest/woodland or brigalow vegetation will be allowed to naturally revegetate or will be directly seeded
Offsets	<ul style="list-style-type: none"> • Australia Pacific LNG will provide environmental offsets to compensate for unavoidable, residual, significant impacts of the Project on threatened fauna species and their habitat. • Approved Offset Area Management Plans will be implemented
Dust emissions	<ul style="list-style-type: none"> • Disturbed land will be minimised and progressively stabilised following construction. • Dust suppression will be undertaken as required during construction including the watering of disturbed areas. • Activities with the potential to generate increased dust (e.g. soil stripping) will be minimised during windy conditions.

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Aspect	Mitigation and management measures
Noise emissions	<ul style="list-style-type: none"> Noise attenuation devices (e.g. mufflers) will be installed and maintained on equipment when required during construction activities to minimise nuisance impacts to breeding or roosting of MNES fauna.
Light emissions	<ul style="list-style-type: none"> Directional lighting or shrouding of lights will be used when required to reduce light spill into adjacent roosting or breeding habitat areas of MNES fauna.
Fire risk	<ul style="list-style-type: none"> Fire extinguishers will be present at the location of hot works (e.g. pipeline welding). Site vehicles will be equipped with fire extinguishers. Flammable material will not be stockpiled or stored near hot work activities (including vegetation stockpiles). Smoking areas will be designated with provision for containers for safe disposal of cigarette butts. Hot works permits will be followed at all times where applicable.
Weeds and pests	<ul style="list-style-type: none"> Construction activities will be undertaken in accordance with the Risk Minimisation Requirements of the DAF <i>Queensland Biosecurity Manual</i> (Department of Agriculture and Fisheries, 2019). Weed and pest control measures will be implemented where they area identified as a threat to MNES. All vehicles/equipment carrying organic materials must have a valid biosecurity hygiene declaration for that load. Reinstated areas will be monitored for the presence of weeds.
Chemical and fuel use	<ul style="list-style-type: none"> Chemicals and fuel stored, transported and handled on-site will be effectively contained and where relevant, meet the appropriate Australian Standards (e.g. AS 1940:2017 for the storage and handling of flammable and combustible liquids).
Watercourses	<ul style="list-style-type: none"> Construction of linear infrastructure (e.g. pipelines and access tracks) requiring a watercourse crossing will be undertaken in accordance with the <i>Accepted development requirements for operational work that is constructing or raising waterway barrier works</i> under the <i>Fisheries Act 1994</i> and <i>Planning Act 2016</i>.
Erosion and Sediment	<ul style="list-style-type: none"> Erosion and sediment control measures will be implemented during construction to minimise the risk to MNES. Erosion and sediment control measures will be based on factors such as soil type, slope, catchment, climate, and the proximity to MNES habitat.
Waste management	<ul style="list-style-type: none"> All waste will be stored, handled and transported in accordance with the waste and resource management hierarchy, waste and resource management principles prescribed by the <i>Qld Waste Reduction and Recycling Act 2011</i> (WRR Act) or EA conditions.
Beneficial Use of Produced Water	<ul style="list-style-type: none"> Produced water will be managed to a standard required to facilitate beneficial use of water, including irrigation, construction, and operational uses. Water quality standards are prescribed by the relevant EAs, and/or the <i>End of Waste Code Irrigation of Associated Water</i>

Aspect	Mitigation and management measures
Produced Water Storage	<p>(including coal seam gas water) and End of Waste Code Associated Water (including coal seam gas water) under the WRR Act.</p> <ul style="list-style-type: none"> Irrigation practices will comply with water quality limits in accordance with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC Guidelines).
	<ul style="list-style-type: none"> Produced water and water treatment by-products will be stored in tanks or dams designed and constructed in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (Department of Environment and Science, 2016a) and the Guideline: <i>Structures which are dams or levees constructed as part of environmentally relevant activities</i> (Department of Environment and Science, 2019c).
Brine Disposal	<ul style="list-style-type: none"> Water treatment by-products will be disposed of at a facility licensed under the <i>Environmental Protection Act 1994</i> (EP Act).

3. Threatened Fauna Species Profiles

The listed threatened fauna species included in this Plan consist of the following:

Mammals

- Koala (*Phascolarctos cinereus*)
- Greater Glider (*Petauroides volans*)
- Northern Quoll (*Dasyurus hallucatus*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Corben's Long-eared Bat (*Nyctophilus corbeni*)

Birds

- Squatter Pigeon (southern subspecies) (*Geophaps scripta scripta*)

Reptiles

- Collared Delma (*Delma torquata*)
- Dunmall's Snake (*Furina dunmalli*)
- Yakka Skink (*Egernia rugosa*)
- White-throated Snapping-Turtle (*Elseya albagula*)

3.1. Koala (*Phascolarctos cinereus*)

3.1.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Endangered (Date effective 12-Feb-2022). Vulnerable at the time of Controlled Action Decision and Approval.

Nature Conservation Act 1992: Vulnerable

3.1.2. Habitat

Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus *Eucalyptus* (Martin & Handasyde 1999). This habitat is readily available within the Project area. The distribution of koalas is also affected by altitude (limited to <800 m ASL), temperature, leaf moisture in the drier areas of their range (Munks et al. 1996) and proximity to watercourses (Melzer et al. 2000).

Potential food trees occurring within the Project area include *Eucalyptus tereticornis*, *E. camaldulensis*, *E. populnea*, *E. melanophloia*, *E. orgadophila*, *E. crebra*, *E. coolabah*, *E. exserta*, *E. chloroclada*, *E. fibrosa*, *E. longirostrata* and *Corymbia citriodora* (Appendix E of GHD 2013).

Koala habitat consists of woodland and open forests that contain suitable food trees - these are predominantly Eucalypt species (DoEE 2018d). Koala habitat for the inland populations (< 800 mm of rainfall) is typically comprised of the following (TSSC 2012):

- woodlands/forests with koala food trees that have reliable access to soil moisture.
- remnant or regrowth Box/Red Gum woodlands formed on heavier soils, particularly on riparian areas.
- fragmented and sparsely distributed woodlands, shrublands and forests in modified agricultural-grazing landscapes or in the vicinity of rural towns - although, there are some larger patches of habitat as well.

Koalas are rather sedentary, only changing trees up to a few times a day (DoEE 2018d). As such, direct observation of the species during daylight hours can be difficult, especially when the species occurs in low densities.

Ongoing habitat loss and fragmentation, vehicle strikes, predation by domestic and feral animals are a major threat to the koala population. Maintaining lower density, fragmented or linear roadside vegetation is also important to the persistence of the species; these strips of vegetation provide habitat linkage and allow for koala dispersal (TSSC 2012; DoEE 2018d).

3.1.3. Koala within the Project area

The koala was recorded on two occasions during field surveys of the Project area (ELA 2018). Evidence of the species' occurrence throughout the Project area in the form of scats and scratches was also observed on several occasions (ELA 2018).

Habitat critical to the survival of the species and an important population of Koala occurs within the Project area (ELA 2018).

The referral guidelines define koala habitat as woodlands containing two or more known koala food tree species within a contiguous landscape (DoEE 2014). Areas within the Project area which meet this definition include both remnant and regrowth extents of the following habitat types:

- dry eucalypt woodland with shrubby understorey
- eucalyptus fibrosa grassy woodland
- open woodland on floodplains
- fringing riparian forest
- open woodland on sandstone upland / plateaux with open understorey
- sandstone cliff lines / escarpment
- valleys and plains
- woodlands on fine-grained sediments; and
- poplar box woodlands on coarse-grained sediments

Within the Project area, refuge habitat has been defined only as vegetation occurring within areas with reliable soil moisture (i.e. habitat types: open woodlands on floodplains, valleys and plains and fringing riparian forest) and where primary food or secondary food trees are dominant in the canopy. Foraging habitat has been defined as the habitat types including: dry eucalypt woodland with shrubby understorey, *Eucalyptus fibrosa* grassy woodland, open woodland on sandstone upland / plateaux with open understorey, sandstone cliff lines / escarpment, woodlands on fine-grained sediments and poplar box woodlands on coarse-grained sediments where a koala food tree was observed.

Using these definitions, it is estimated that a combined total of 17,643.49 ha of Koala habitat occurs within the Project area, comprising of 1,771.63 ha of refuge habitat and 15,871.86 ha of foraging habitat.

3.1.4. Relevant plans or advices

A recovery plan for the Koala did not exist at the time of the Controlled Action Decision or Approval for EPBC2017-7881. However, a *National Recovery Plan for the Koala* was published in March 2022 (DAWE 2022) and identifies a number of key threats:

- land use change
- climate change
- natural systems modification
- mortality from dogs and vehicles; and
- disease prevalence in the Koala and habitat

The approved Conservation Advice (DeSEWPAC 2012) identifies key threats and priority conservation objectives.

The key threats from the approved conservation advice for the species include:

- loss and fragmentation of habitat due to vegetation clearing

- loss of individuals as a result of vehicle strike
- disease including Chlamydia, which increases decline and extinctions in small isolated populations and reduces reproductive potential (NSW DECC 2008), and also Koala Retrovirus which is transmitted genetically (by inheritance) from parents to offspring
- predation by dogs (DSEWPac 2012).

3.2. Greater glider (*Petauroides volans*)

3.2.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Endangered (Date effective 05-Jul-2022). Vulnerable at time of Controlled Action Decision and Approval.

Nature Conservation Act 1992: Vulnerable

3.2.2. Habitat

The species is largely restricted to eucalypt forests and woodlands (TSSC 2016). During the day, the species shelters in tree hollows, with a particular selection for large hollows in large, old trees (TSSC 2016). It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC 2016). In response to seasonal variations in key resources, the greater glider exhibits a degree of flexibility in their social structures and mating systems. The species is an arboreal nocturnal marsupial; it shelters in tree hollows during the day, preferring bigger hollows in large, old trees. They tend to use a small number of 'primary dens' but will use as many hollows as they have available to them. Additionally, they appear to use hollows opportunistically, indicating that minor reductions in hollow-bearing trees may not impact on localised populations. The species is the largest of the Australian gliding possum species, with a head and body length of 35-46 cm and a tail of 45-53 cm. As such, it requires a hollow entrance of a minimum of 80 mm, with internal hollow measurements reaching 250 x 250 mm (TSSC 2016b).

The species has a relatively small home-range of 1-4ha. Modelling suggest that they require suitable habitat of at least 160km² to maintain viable populations (TSSC 2016). Although the greater glider has a relatively small home range, the species can be sensitive to fragmentation as it impacts on their capability to disperse. As a result, they have a low persistence in small forest fragments. They also exhibit poor dispersal tendencies across non-native vegetation, which adds to localised pressures. Aside from habitat loss as a result of clearing and fragmentation, fire and some forestry activities are also threats to the survival of this species (TSSC 2016b).

3.2.3. Greater glider within the Project area

During targeted ecological surveys (ELA 2018) 13 greater glider individuals were observed on 12 occasions across the study area. The species was observed in two distinct habitat types, seven individuals within Fringing Riparian Forest and six individuals within Open woodland on sandstone upland / plateau.

Confirmed, potential and marginal habitat was identified for greater glider and includes:

- breeding, denning, foraging and dispersal (confirmed and potential habitat) - the species prefers remnant eucalypt forest for denning, therefore remnant woodlands or forests were considered suitable denning habitat for the species. As the species requires a diversity of eucalypts to forage, and generally forages near denning sites (has a low dispersal ability), foraging, dispersal and denning was grouped as one habitat utilisation for the species. Habitat assessments conducted during the field survey found that vegetation communities dominated or co-dominant by *Angophora floribunda*, *A. leiocarpa*, *Eucalyptus populnea*, *E. tereticornis*, *E. orgadophila* and *Corymbia citriodora* contained hollow-bearing trees suitable for denning by greater glider. Where areas of lower suitability (i.e. ironbark dominant communities) were surrounded by confirmed / likely habitat, these areas were also included as denning, foraging and dispersal habitat for the species; and

- marginal habitat - where eucalypt species were dominant in the tree layer habitat, however, were dominated by eucalypt species which generally possess smaller sized hollows (i.e. ironbark's) or where habitat assessments identified infrequent hollows. These areas possess lower habitat quality for the species due to the presence of smaller, infrequent hollow-bearing trees.

Using these definitions, it is estimated that a combined total of 17,625.78 ha of greater glider habitat occurs within the Project area, comprising of 16,215.89 ha of breeding, denning, foraging and dispersal habitat and 1,409.89 ha of marginal habitat.

Habitat critical to the survival of the species and an important population of Greater Glider was also determined as likely to occur within the Project area.

3.2.4. Relevant plans or advices

The Greater Glider has been impacted appreciably since European settlement through vegetation clearing. There is currently no recovery plan or threat abatement plan for the Greater Glider; however, the approved Conservation Advice (TSSC 2016) identifies key threats and priority conservation objectives.

The ongoing key threats identified in the approved conservation advice for the species (TSSC 2016) include:

- habitat loss and fragmentation
- too intense or frequent fires
- timber production
- climate change causing water stress in eucalypt forests
- barbed wire fencing causing entanglement
- hyper-predation by owls
- competition by sulphur-crested cockatoos
- phytophthora root fungus related decline of Eucalypt forest

Primary conservation action identified in the approved conservation advice (TSSC 2016) include:

- reduce the frequency and intensity of prescribed burns
- identify appropriate levels of patch retention, habitat tree retention and logging rotation in hardwood production
- protect and retain hollow-bearing trees, suitable habitat and habitat connectivity

3.3. Northern quoll (*Dasyurus hallucatus*)

3.3.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Endangered

Nature Conservation Act 1992: Least Concern

3.3.2. Habitat

Habitat for the northern quoll is diverse across its extent and has been defined as:

- shelter (potential habitat) - areas of extensive rocky outcrops, large sandstone boulders and escarpments. Shelter habitat is important for breeding and refuge from fire and/or predation (DoE, 2016).
- foraging and dispersal (potential habitat) - woodlands and fertile valleys that comprise of predominant native vegetation within 1 km of shelter habitat. These areas occur on low hills, valleys and alluvial flats surrounding shelter habitat. This vegetation includes habitat types Open woodland on sandstone upland, Sandstone cliff lines, rocky outcrops or

escarpments, Cypress pine woodlands (remnant), Poplar box woodlands on coarse-grained sediments, *Eucalyptus fibrosa* grassy woodland, and Dry eucalypt woodland with shrubby understorey. Little is understood about the characteristics of foraging or dispersal habitat for the northern quoll. However, on current knowledge, foraging or dispersal habitat is recognised to be any land comprising predominantly native vegetation in the immediate area (i.e. within 1 km) of shelter habitat, quoll records or land comprising predominately native vegetation that is connected to shelter habitat within the range of the species (DoE 2016).

Research conducted by Woinarski et al. (2008) revealed that northern quoll declines in Queensland have largely been in lowland, less rugged areas (Hill and Ward 2010). Another survey found that the most abundant populations on the Queensland coast correlated with areas that had large boulders (Foster and Oakwood pers. comm. 2008) (Hill and Ward 2010).

Aside from poisoning by the Cane Toad, factors that have led to reductions in this species includes loss of habitat, changes in vegetation structure, the introduction of exotic herbivores, frequent fires, especially in northern Australia, and increased predation post fire (TSSC 2005).

3.3.3. Northern quoll within the Project area

No direct observations were made or evidence of northern quoll identified during field surveys (ELA 2018). The species was likely to have been previously present throughout the Project area due to the extensive areas of potential habitat (rocky outcrops and continuous boulder lines). However, due to the presence of cane toads and subsequent consequences of their inhabitancy (poisonings through consumption) and presence of feral cats (predation), local declines / extinctions have likely occurred within the Project area.

The closest known confirmed record of northern quoll was over 135 km north-west of the NWDA, recorded in 2000 at the Mount Moffatt section of Carnarvon National Park (Eddie & Oakwood 2002). Two individuals were captured at a distinctive outcrop of Precipice Sandstone overlooking the Maranoa River and rising above the surrounding sandplain to an altitude of 740 m (Eddie & Oakwood 2002). An anecdotal record of northern quoll was recorded during a diurnal field survey conducted in January 2016, in which one individual was reported to have been observed in dense ground cover of exotic grasses within a cleared area adjacent to an existing access track in NWDA (ERM 2017). There is some uncertainty surrounding the validity of this record (ERM 2017).

Habitat providing shelter (i.e. potential denning habitat) is wide-spread throughout the Project area due to the presence of sandstone escarpments and vegetated valleys. Using the definitions of habitat critical to the survival of the species, as described in DoE (2016), it is estimated that 17,531.16 ha of habitat critical to the survival of the species occurs within the Project area, comprising of 3,096.36 ha of shelter habitat and 14,434.80 ha of foraging and dispersal habitat.

The appropriate survey effort conducted has determined that there is unlikely to be a high density of northern quoll due to the lack of any evidence of the species being present (ELA 2018). As such, the Project area is unlikely to support an important population of northern quoll.

3.3.4. Relevant plans and advices

There are a number of key threats to northern quoll, identified in both the Commonwealth Listing Advice (TSSC 2005) and the adopted *National Recovery Plan for the Northern Quoll* (Ward 2010). These include:

- lethal toxic ingestion of Cane Toad toxin
- predation by feral fauna
- inappropriate fire regimes
- habitat degradation
- habitat loss due to land clearing
- predation following fire; and
- inappropriate grazing regimes

3.4. Large-eared pied bat (*Chalinolobus dwyeri*)

3.4.1. Legal status

Environment Protection and Biodiversity Conservation Act: Vulnerable

Nature Conservation Act 1992: Vulnerable

3.4.2. Habitat

Large-eared pied bat are forest dwellers. They are found in tall open eucalypt forest with an understorey of scattered small trees and palms (Churchill 1998). The large-eared pied bat is dependent on the presence of suitable roost and breeding sites with adjacent foraging habitat (DERM 2011, DoEE 2018f). A higher abundance occurs in areas dominated by sandstone escarpments with nearby forests and woodlands, particularly box gum woodland or river/rainforest corridors. The species is also known to use disused mine shafts, caves, overhangs and abandoned Fairy Martin (*Petrochelidon ariel*) nests and may sometimes use tree hollows.

Available evidence indicates that requirements for breeding are more specific, with maternity sites located in domed-roof caves of sufficient size and depth to provide appropriate thermal qualities and sufficient room for young to practice flying (DoEE 2018f, Boobook 2017b).

High-relief areas in Land Zone 10 (coarse-grained sedimentary rocks) (Sattler and Williams 1999) provide potential roost sites for this species (Boobook 2017b).

In south-eastern Queensland, the species seems to be more associated with higher altitude moist forests and adjacent rainforest, while most records from New South Wales are from dry and wet sclerophyll forest including callitris forests, tall open eucalypt forests with a dry understorey, sub-alpine woodland, and sandstone outcrop country.

3.4.3. Large-eared Pied Bat within the Project area

A total of 5 suspected (“probable” confidence level) large-eared pied bat calls were recorded at two sites within the Project area (ELA 2018). No live-captures occurred, despite the live-trapping effort exceeding the minimum number of trap-nights (16 trap-nights over 4 days) stipulated within the Survey Guidelines for Australia’s threatened bats (DEHWA 2010).

Notwithstanding the lack of species detection, the Project area is still likely to contain both roosting and foraging habitat for the species due the presence of vast extents of sandstone cliffs and woodlands throughout the Project area. Further, the species was recorded approximately 20 km to the north of NEDA during a survey conducted in 2013 (GHD 2013), in which the habitat is broadly connected to the Project area.

Habitat for the species was defined in terms of the following potential habitat:

- roosting (potential habitat) - areas of sandstone cliffs occurring with woodlands or open forests (habitat type Sandstone cliff lines / escarpment)
- foraging (potential habitat) - woodlands and valleys (habitat types: Open woodland on sandstone upland / plateaux with open understorey, Dry eucalypt woodland with shrubby understorey, Cypress Pine woodlands and Valleys and plains) occurring within 1 km of roosting habitat.

Using the definitions, it is estimated a total of 17,304.75 ha of species habitat occurs within the Project area which is comprised of 3,096.36 ha of roosting habitat and 14,208.39 ha of foraging and dispersal habitat. This habitat is considered habitat critical to the survival based on the definitions described in the *National recovery plan for the large-eared pied bat Chalinolobus dwyeri* (DERM 2011).

Given the Project area is dominated by sandstone escarpments (habitat types ‘Sandstone cliff lines, rocky outcrops or escarpment’ and ‘Open woodland on sandstone upland / plateau’), there is potential that an important population of large-eared pied bat occurs within the Project area.

3.4.4. Relevant plans and advices

The approved Recovery Plan for the large-eared pied bat identifies the following as key threats to the species:

- destruction and interference with maternity and other roosts
- mining of roosts
- mine induced subsidence of cliff lines
- disturbance from human recreational activities
- disturbance from livestock and feral animals
- predation by introduced predators
- vegetation in the proximity of roosts
- fire; and
- loss of genetic diversity

The approved Conservation Advice for the large-eared pied bat identifies the following as likely threats to the species:

- habitat loss and fragmentation for agriculture and extractive industries
- increased fire frequency
- reduction in hollow availability
- exposure to agrichemicals
- livestock grazing; and
- predation by feral animals

3.5. Corben's long-eared bat (*Nyctophilus corbeni*)

3.5.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Vulnerable

Nature Conservation Act 1992: Vulnerable

3.5.2. Habitat

The species is known to be more abundant in extensive stands of vegetation in comparison to smaller woodland patches and is found to be much more abundant in habitats that have a distinct tree canopy and a dense, cluttered understorey layer (TSSC 2015). Areas with lower densities of hollows were also included as may provide connectivity between potential habitats types and be occasionally utilised whilst the species travels between roost sites, travelling up to 4 km per night (TSSC 2015).

This species is reliant upon tree hollows and decorticating bark for roosting purposes. The species roosts in a new hollow each day and travels approximately 5 km per night.

Preferred inland woodland vegetation types inhabited by the species, include the following (TSSC 2015):

- box/ironbark/cypress pine woodlands
- *Allocasuarina luehmannii* (Bullocke) woodlands
- *Acacia harpophylla* (Brigalow) woodland
- *Casuarina cristata* (Belah) woodland
- *Angophora leiocarpa* (Smooth-bark apple) woodland
- *Eucalyptus camaldulensis* (River red gum forest)

- *Eucalyptus largiflorens* (Black-box woodland); and
- mallee trees

3.5.3. Corben's Long-eared Bat within the Project area

Corben's long-eared bat was not detected within the Project area, despite the live trapping effort exceeding the minimum number of trap nights recommended in the Survey Guidelines for Australia's threatened bats (DEWHA 2010), however, due to the close-proximity of a recent record (approximately 5km north of NEDA, recorded in 2014) and the presence of suitable habitat, the species has been assessed as likely to occur within the Project area.

Habitat for the species was defined in terms of the following potential habitat:

- breeding, roosting, foraging and dispersal (potential habitat) - large tracts of remnant drier woodland have distinct tree canopy and a dense, cluttered understorey layer and a high abundance of fissures / loose bark and/or hollows for roosting (habitat types: Acacia or belah open forest, cypress pine woodlands, Dry eucalypt woodland with shrubby understorey, Open woodland on sandstone upland / plateaux with open understorey, Sandstone cliff lines, rocky outcrops or escarpment, Woodlands on fine-grained sediments, Poplar Box woodlands on coarse-grained sediments, *Eucalyptus fibrosa* grassy woodland, Woodland on floodplains, Fringing riparian forest and Valleys and plains).

Using the habitat definition, it is estimated a total of 19,083.49 ha of potential breeding, roosting, foraging and dispersal habitat occurs within the Project area, which assessments determined is likely to comprise of habitat critical to the survival of species.

Due to the uncertainty regarding species population and lack of detection, the precautionary principle has been applied and it has been assumed that the Project area contains a population of the species.

3.5.4. Relevant plans and advices

There is currently no Recovery Plan for Corben's long-eared bat; however, the approved Conservation Advice identified the following as likely key threats to the species:

- habitat loss and fragmentation for agriculture and extractive industries
- increased fire frequency
- reduction in hollow availability
- exposure to agrichemicals
- livestock grazing; and
- predation by feral animals

3.6. Squatter pigeon (*Geophaps scripta scripta*)

3.6.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Vulnerable

Nature Conservation Act 1992: Vulnerable

3.6.2. Habitat

Habitat of the squatter pigeon (southern) is typically open forests to sparse open woodlands and scrubs that contain the following features (DoEE 2018g):

- an overstorey dominated by Eucalyptus, Corymbia, Acacia or Callitris species
- remnant, regrowth or relatively modified vegetation communities; and
- a water source within 3 km

Well-drained, gravelly, sandy or loamy soils are indicative of natural foraging habitats for the squatter pigeon (southern). Such soil landscapes support the open-forest to woodland communities with tussock-grassy understories are preferred foraging and breeding habitats (DoEE 2018g).

The subspecies is mostly sedentary or locally nomadic, depending on resource availability. It uses vegetation corridors to access permanent water sources in nearby areas. It is often seen in pairs or small groups of around 20 birds (DoE, 2018). The species is often observed traversing gravel tracks and foraging in sparse grassy woodlands. Sandy areas dissected by gravel ridges are preferred and burnt areas are frequented (Frith 1982).

3.6.3. Squatter pigeon within the Project area

Several observations of the species have been observed within the Project area (ELA 2018). The southern boundary of the known distribution of the squatter pigeon (southern) is contracting northwards (DoEE 2018g). All sub-populations occurring south of the Carnarvon Ranges in Central Queensland are considered to be important sub-populations of the subspecies (Squatter Pigeon Workshop 2011). As the Project area is south of the Carnarvon Ranges, and the species was identified during baseline ecological surveys (ELA 2018) an important population of the subspecies occurs in the Project area.

Breeding habitat for the species within the Project area is defined as:

- areas supporting remnant or regrowth open-forest to sparse, open-woodland or low-woodland dominated by Eucalyptus, Corymbia, Acacia or Callitris species vegetation occurring on sandy or gravelly soils within 1 km of permanent water sources (Squatter pigeon workshop 2011).
- within the Project area, suitable water sources occur on lower, gentle slopes and plateaus of sandstone ranges (equivalent to Queensland Regional Ecosystem Land Zone 10) and alluvial clay soils on river or creek flats (presented by Queensland Regional Ecosystem Land Zone 3) (DoEE, 2018g) and consist of farm dams occurring throughout the Project area, water bodies associated with Eurombah, Scott and Slatehill Creeks, as well as wetlands and billabongs occurring to the south of NEDA.
- the ground cover vegetation of breeding habitat consists of patchy native grasses (dominated by *Dichanthium sericeum*, *Themeda triandra*, *Aristida species*, *Bothriochloa decipiens* and *Ancistrachne uncinulata*) comprising 10 to 40% of the ground-cover layer, with the remainder consisting of bare ground or gravelly substrate. Within these areas, non-native ground cover occurrence is low (less than 10%) ground cover.

Foraging habitat for the species within the Project area is defined as:

- areas supporting remnant or regrowth open forest to sparse, open-woodland or low-woodland dominated by Eucalyptus, Corymbia, Acacia or Callitris species vegetation occurring on sandy or gravelly soils within 3 km of permanent water sources; and
- the ground cover vegetation of foraging habitat consists of patchy native grasses comprising 10 to 40% of the ground-cover layer, with the remainder consisting of bare ground or gravelly substrate. Within these areas, non-native ground cover occurrence is low (less than 10%) ground cover.

Dispersal habitat for the species within the Project area is defined as:

- any forest or woodland occurring between patches of foraging or breeding habitat which facilitates movement between patches of foraging habitat, breeding habitat and/or permanent water sources. This includes vegetation where the groundcover layer has been thinned through current land-use practices in a way that suits the species; and
- highly modified or degraded habitats, including cleared areas which are within 100 metres of remnant trees or patches of habitat.

Using these habitat definitions, it is estimated that 5,191.24 ha of breeding habitat, 9,590.44 ha of foraging habitat and 5,376.16 ha of dispersal habitat occurs within the Project area.

3.6.4. Relevant plans and advices

Threats to the species are both historical and current. The combined effect of habitat loss, degradation, and predation is thought to have caused historical species decline and continues to threaten the subspecies today (DoEE 2018g).

There is currently no recovery plan for the squatter pigeon; however, the approved conservation advice (DoEE 2018g) identifies key threats and priorities conservation objectives. The key threats include:

- habitat loss and fragmentation due to clearing for agricultural purposes
- degradation of habitat by overstocking and overgrazing by domesticated herbivores (especially the sheep (*Ovis species*) and the cow (*Bos species*)) and degradation of habitat by invasive weeds such as Buffel Grass
- predation by birds of prey, snakes, the dingo (*Canis lupus dingo*), the fox (*Vulpes vulpes*) and the cat (*Felis catus*), with feral cats and fox likely to have the greatest impact upon the species
- drought and bushfires which may exacerbate the impacts of other threatening processes and contribute to, or accelerate, some population declines as a result; and
- changes in hydrological regimes can also affect squatter pigeons by changing the distance between water sources and feeding habitat; affecting their movement through the landscape (Reis 2012).

3.7. Collared delma (*Delma torquata*)

3.7.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Vulnerable

Nature Conservation Act 1992: Vulnerable

3.7.2. Habitat

Collared delma occupies a range of eucalypt woodlands and open forests and lives under surface rock, in leaf litter and woody debris (Wilson 2005, Peck 2012).

Any important habitat is defined as any suitable habitat within the known/likely to occur distribution of the species and any suitable habitat that occurs between grazed and cropped areas, including road side reserves and stock route areas.

Records within the southern Brigalow Belt (ALA 2017) are associated with sandstone uplands with diversity of dry woodland types and from alluvial REs (e.g. 11.3.2, 11.3.25) (Hines *et al.* 2000, DoEE 2018h). These sites frequently have rocky substrates but may also have clay soils (Boobook 2017b).

The Draft Recovery Plan for Brigalow Belt Reptiles (Richardson 2006) lists open-forests, woodlands and adjacent exposed rocky areas in Land Zones 3, 9 and 10 as the habitat for collared delma.

3.7.3. Collared Delma within the Project area

Collared delma was not detected within the Project area despite extensive searches including targeted searches, rock turning and pitfall trapping. Habitat for the species was defined in terms of the following potential habitat:

- shelter, foraging and breeding (potential habitat) - habitat types: Woodlands on floodplains, Valleys and plains, 'Woodlands of fine-grained sediments, Sandstone cliff lines / escarpment and Open woodland on sandstone upland / plateaux possessing essential microhabitat features such as native grasses, mats of dense leaf litter, coarse woody debris and/or rocks. These habitat types contained a diversity of rock sizes in high quantities rock and dense leaf litter for shelter. The abundance of loose surface rock and native grasses were suitable for foraging.

Using these definitions, it is estimated that 16,126.78 ha of potential shelter, foraging and breeding habitat occurs within the Project area.

Due to the cryptic nature of this species, the precautionary principle was applied and important habitat for this species was presumed to occur within the Project area. As important habitat is regarded as surrogate for an important population (DSEWPac 2011), the species is therefore assumed to have an 'important population' within suitable habitat of the Project area.

3.7.4. Relevant plans and advices

There is currently no Recovery Plan for the collared delma; however the approved conservation advice (DEWHA 2008) identifies key threats and priority conservation objectives. The key threats include:

- habitat loss and modification due to clearing for urban and agricultural development
- fire
- invasive weeds; and
- predation by feral animals

The main identified threat is loss and modification, in particular the removal of surface rocks which provide critical microhabitat for the species. The species is considered to be sedentary, occupying a very small home range and potentially using the same rock for shelter.

3.8. Dunmall's snake (*Furina dunmalli*)

3.8.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Vulnerable

Nature Conservation Act 1992: Vulnerable

3.8.2. Habitat

Dunmall's snake habitat is poorly known but most records appear in open forest and woodland, particularly brigalow forest and woodland, growing on floodplains of deep-cracking black clay and clay loam soils (Cogger et al. 2000). It has been suggested that it is unlikely that the species has specific habitat preferences and appears to be naturally rare (reptile expert Steve Wilson pers. comm., 2018).

This species is known to occur in open forest and woodlands dominated by brigalow, cypress pine, and bull oak. Typically this species occurs on deep-cracking black clay to loamy soils. This species shelters under fallen timber embedded in deep cracking clay soils, under logs and possibly also leaf litter and earth cracks (Ehmann 1992, Wilson and Swan 2008, Wilson 2005).

While there are no species-specific guidelines for this species, the Draft Referral Guidelines for the nationally listed Brigalow Belt reptiles (DSWEPAC 2011) identifies suitable habitat considers as important as including:

- habitat where the species has been recorded during survey
- habitat near the limit of the species' range
- large areas of contiguous suitable habitat and viable landscape corridors which are necessary for breeding and dispersal, as well as maintaining genetic diversity
- a habitat type where the species has been recorded, but was not previously considered as habitat for the species

3.8.3. Dunmall's snake within the Project area

Dunmall's snake was not detected within the Project area; however, it was assessed as potentially occurring within the Project area. The closest known record is from Expedition National Park (DoEE

2018i). Their presence is thought to be dependent on the presence of soil cracks, abundant leaf litter and woody debris (TSSC 2014). As such, potential habitat for the Dunmall's snake includes all vegetation ecosystems within the Project area.

Habitat for the species within the Project area was defined in terms of the following potential habitat:

- shelter, foraging and breeding (potential habitat) - habitat types: Brigalow or belah open forest, Cypress pine woodlands, Dry eucalypt woodlands with shrubby understorey, Open woodland on sandstone upland / plateaux with open understorey, Eucalyptus fibrosa grassy woodland, Open woodlands on floodplains, Fringing riparian forest, Sandstone cliff lines / escarpment, Semi-evergreen vine-thicket, Valleys and plains, Woodlands on fine-grained sediments and Poplar box woodlands on coarse-grained sediments.

Using these definitions, it is estimated that a total of 19,335.09 ha of potential shelter, foraging and breeding habitat occurs within the Project area. The habitat was deemed to be important habitat based on the description in the Draft Referral Guidelines for the nationally listed Brigalow Belt reptiles (DSWEPAC 2011).

At present, there are no species-specific policy guidelines on what constitutes an important population for the Dunmall's snake. However, in accordance with DSEWPAC 2011, important habitat is a surrogate for an important population. As important habitat has been assessed as occurring within the Project area, an important population is inferred.

Relevant plans and advices There is currently no Recovery Plan for Dunmall's snake; however, the approved Conservation Advice identifies key threats and priority conservation objectives (DoE 2014). The key threats include:

- clearing of habitat for mining and urban development
- overgrazing by livestock
- loss of fallen timber and ground litter due to fire and firewood collection
- predation by feral fauna
- inappropriate fire regimes
- habitat degradation by weed invasion; and
- drainage of swamps

3.9. Yakka skink (*Egernia rugosa*)

3.9.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Vulnerable

Nature Conservation Act 1992: Vulnerable

3.9.2. Habitat

The yakka skink occurs in a patchy distribution throughout subhumid areas in the Queensland interior, in wide range of vegetation communities. Core habitat is within Mulga Lands and Brigalow Belt South bioregions where it occupies open dry sclerophyll forest or woodland and takes refuge among dense ground vegetation, hollow logs, and cavities in soil-bound root systems of fallen trees and beneath rocks (Wilson & Knowles 1988; Cogger 2000). Alternatively, they may also excavate burrow systems among low vegetation.

The yakka skink is considered most likely to occur in association with Poplar Box (*Eucalyptus populnea*), Ironbark (*Eucalyptus* spp.), Brigalow, White Cypress Pine (*Callitris glaucophylla*) and Lancewood (*Acacia shirleyi*) woodlands and open forests formed on rocky, sandy or loamy red earth substrates - these substrates correspond to Queensland RE Land Zones 3, 4, 5, 7, 9 and 10 (DoEE 2018j). According to published literature, the species is known to inhabit Brigalow TEC and generally requires large, healthy connected patches of suitable habitat (DEHP 2017b). However, a recent

research project also found that vegetation on clay or silt soils provided sub-optimal habitat for the species, which may be due to heavy clays being unsuitable for burrowing (unpublished, Boobook 2017b).

Colonies of the yakka skink have been found in the following microhabitats (DoEE 2018j):

- large hollow logs
- cavities or borrows under large fallen trees
- tree stumps
- logs
- stick-racked piles
- large rocks and rock piles
- dense ground-covering vegetation
- dense leaf litter and fallen bark; and
- deeply eroded gullies, tunnels and sinkholes.

This species shares communal burrow systems, often excavated in earth and timber that have been bulldozed into heaps. It may also occupy disused rabbit warrens (Wilson & Swan 2008) and deep rock crevices (Wilson 2005).

3.9.3. Yakka Skink within the Project area

Yakka skink was not detected within the Project area; however, microhabitats capable of supporting the species were identified. Habitat for the species was defined in terms of the following potential and marginal habitat:

- shelter, foraging and breeding (potential habitat): suitable substrate, high abundance of logs, vegetation communities on suitable burrowing substrates (habitat types (where microhabitat occurs): non-remnant or pastures, Poplar box woodlands on coarse-grained sediments, Cypress pine woodlands, Valley and plains, Open woodland on floodplains, Woodlands on fine-grained sediments).

Using this definition, it is estimated that 2,521.64 ha of potential shelter, foraging and breeding habitat occurs within the Project area. The habitat was determined to be important habitat due to the presence of large areas of suitable habitat (suitable substrate) and microhabitat features (log mass) occurring.

Due to the cryptic nature of this species, the precautionary principle was applied and important habitat for this species was presumed to occur within the Project area. An important habitat is regarded as surrogate for an important population (DSEWPaC, 2011), the species is therefore assumed to have an 'important population' within suitable habitat of the Project area.

Relevant plans and advices There is currently no Recovery Plan for yakka skink; however, the approved Conservation Advice identifies key threats and priority conservation objectives (DoE 2014c). The key threats include:

- broadscale land clearing
- habitat degradation
- inappropriate roadside management
- removal of woody debris and rocky microhabitat features
- ripping of rabbit warrens; and
- predation by feral animals

3.10. White-throated snapping turtle (*Elseya albagula*)

3.10.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Critically Endangered

Nature Conservation Act 1992: Endangered

3.10.2. Habitat

The species is considered a habitat specialist, preferring clear, flowing, well-oxygenated waters that are permanent flowing reaches of streams (DoE 2017). However, more recent studies have identified the species feeding on filamentous algae and crustaceans obtained from the shallow margins of deep water pools, rather than foraging in shallow inter-pool riffles with higher flow rates (Micheli-Campbell et al. 2017). The species requires microhabitat (fallen trees, rocky or sand-gravel substrates and/or steep undercut banks) for shelters (DoE 2017a). The species nests on alluvial sand - loam banks formed from previous flooding events, between 1 to 86m from the water's edge (DoE 2017a). Important habitat for the survival of the species includes all in-stream and adjacent habitat within approximately 50m (TSSC 2014).

3.10.3. White-throated snapping turtle within the Project area

white-throated snapping turtle is known to occur at two locations within the Project area, Eurombah and Scott Creek. Confirmed and potential habitat was identified within the Project area as the following:

- nesting and aquatic foraging habitat (confirmed and potential habitat) - within the extent of permanent waterholes and seasonal waterholes within both Eurombah and Scott Creeks. 50m buffer of these creeks onto associated banks of RE 11.3.25 (*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines).

Using this definition, it is estimated that a combined total of 163.38 ha of habitat occurs within the Project area which is comprised of 62.07 ha of aquatic and 101.31 of nesting habitat (areas of confirmed and potential). Based on the *Draft National recovery plan for the white-throated snapping turtle (Elseya albagula)* (DoE, 2017), 163.38 ha of critical habitat occurs within the Project area.

Due to its limited distribution, all white-throated snapping turtles within the Mary Burnett and Fitzroy River catchments are deemed important populations (TSSC 2014). As the Project area is located within the Fitzroy Basin (Dawson sub-basin), and detected within the Project area, an important population occurs.

Relevant plans and advices There is currently no Recovery Plan or Threat Abatement Plan for the white-throated snapping turtle; however, the approved Conservation Advice (DoE 2014) identifies key threats and priority conservation objectives.

The principal threat to the white-throated snapping turtle is predation of eggs and hatchlings by feral fauna predators. Trampling of nests by cattle is also a key threat (TSSC 2014).

Additional threats relate to construction of dam and infrastructure in areas of habitat, including:

- habitat fragmentation by infrastructure
- obstruction of migration in rivers
- injury and death during overtopping and water releases
- inappropriate water allocation
- flooding of nesting areas; and
- loss of riparian vegetation overhanging riparian habitat

Other known threats to the species include:

- recreational fish stocking of dams
- recreation fishing causing injury or mortality
- dense aquatic weed infestation in river and river banks

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- extended drought periods exacerbated by agricultural water demands
- loss of nesting habitat and deep pool habitat; and
- increased salinity within watercourses

The Project is not expected to have a significant impact on this species.

4. Threatened Flora Species Profiles

The listed threatened flora species included in this Plan consist of the following:

- *Bertya opposens* (a shrub);
- Salt pipewort (*Eriocaulon carsonii*); and
- Ooline (*Cadellia pentastylis*).

4.1. *Bertya opposens* (a shrub)

4.1.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Vulnerable

Nature Conservation Act 1992: Least Concern

4.1.2. Habitat

The species has been found at various sites in NSW and Queensland. It is widely distributed throughout Queensland, extending from Emerald in the north and Charleville in the west, with an outlier near Charters Tower (DoEE, 2018a). *B. opposens* has been recorded growing in a variety of vegetation community types including mixed shrubland, lancewood woodland, mallee woodland, eucalypt/acacia open forest with shrubby understorey, Eucalyptus/Callitris open woodland and semi-evergreen vine-thicket (SEVT). Soils are typically shallow sandy loams or red earths associated with sandstone, rhyolite, shale and metasediments (DoEE 2018a). Although potentially suitable habitat is extensive within the Central Queensland Sandstone Belt populations are naturally patchy (ALA 2017, C. Eddie pers. obs.).

4.1.3. *Bertya opposens* within the Project area

No populations of *B. opposens* were observed within the Project area, with closest records of the species occurs approximately 9.8 km to the north west of NWDA. Available records of the species are all from sandstone plateaux and ridge slopes in remnant and regrowth eucalypt/acacia woodland including ecotones where these vegetation communities adjoin SEVT.

Habitat for the species was defined in terms of the following potential habitat:

- potential habitat - habitat types: Dry eucalypt woodland with shrubby understorey, Open woodland on sandstone upland / plateaux with open understorey, Eucalyptus fibrosa grassy woodland and Sandstone cliff lines / escarpment.

Using this definition, it is estimated that 14,922.12 ha of potential species habitat occurs within the Project area. This habitat is attributable to RE 11.10.1 and RE 11.10.7 as the vegetation composition and substrate / soils the species requires are present within these vegetation communities.

As populations of *B. opposens* were not observed within the Project area despite the widespread presence of apparently suitable habitat, it is unlikely that habitat critical to the survival of the species or an important population occurs within the Project area.

4.1.4. Relevant plans and advices

There are a number of key threats to *B. opposens*, identified in both the Commonwealth Conservation Advice (TSSC 2016) and the adopted *Bertya sp. Cobar-Coolabah Recovery Plan* (NPWS 2002). These threats include:

- grazing by feral goats
- inappropriate disturbance and fire regimes
- clearing; and
- drought

4.2. Ooline (*Cadellia pentastylis*)

4.2.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999: Vulnerable

Nature Conservation Act 1992: Vulnerable

4.2.2. Habitat

Ooline is found in semi-evergreen vine thickets in association with native quinine (*Petalostigma pubescens*), hard alectryon (*Alectryon subdentatus*), leopard ash (*Flindersia collina*), wilga (*Geijera parviflora*) and narrow-leaved bottle tree (*Brachychiton rupestris*) on sandstone and basalt slopes and Kurrajong (*Brachychiton populneus*), Brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*) communities on undulating clay plains and low hills at altitudes from 200 m to 500 m.

4.2.3. Ooline within the Project area

Suitable habitat for this species is expected to occur in the Project area, in association with the REs identified in Table 4 below.

Table 4: REs Likely to support ooline

RE	Short Description
11.9.4	Semi-evergreen vine thicket or <i>Acacia harpophylla</i> with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks

4.2.4. Relevant plans and advices

The approved conservation advice (DEWHA 2008) identifies key threats and priorities conservation objectives for ooline, key threats include:

- clearing for agriculture
- grazing and soil compaction by domestic stock, feral goats and pigs
- invasion of habitat by weeds (including tiger pear)
- frequent fires; and
- tunnel and sheet erosion

4.3. Salt pipewort (*Eriocaulon carsonii*)

4.3.1. Legal status

Environment Protection and Biodiversity Conservation Act 1999 Endangered

Nature Conservation Act 1992: Endangered

4.3.2. Habitat

Salt pipewort grows in running water and forms dense mats in wet soil around shallow springs. The species is an endemic of active or flowing artesian mound springs on the margins of the Great Artesian Basin (NSW NPWS 2003).

Mound springs are natural outlets of the Basin, associated with fractures and fault lines, often having mounds of various sizes. Accumulated evaporite and mud deposits form mounds 1m to 10m high and 2m over 100m in diameter. The faults provide direct access for the artesian water to reach the surface. These landforms are probably one of the rarest habitats in Australia (Fensham et al. 2010).

Salt pipewort was initially known from only a single mound at Peery Lake in New South Wales, in an area of many mounds. More recent surveys have extended the range into Queensland (Wilson 1995; and Fensham 1998).

The population structure of Salt pipewort changed after fencing at Elizabeth Springs in Queensland, with large numbers of small immature plants replaced by a smaller number of larger plants.

Observations of density of macropod scats at Peery Lake suggest that macropods heavily graze the mounds. Macropod grazing apparently limits the growth of sedges on the mounds, reducing competition, thus benefiting salt pipewort.

The species is often recorded growing in dense mats of numerous individuals.

4.3.3. Salt Pipewort within the Project area

Salt pipewort is known to occur in the Scott Creek spring complex which is located on the eastern boundary of the Project area.

4.3.4. Relevant plans and advices

There is currently no Recovery Plan for salt pipewort; however, the approved conservation advice (DoEE 2018b) identifies key threats and priorities conservation objectives. The key threats include:

- aquifer draw-down
- excavation of spring (to improve access to water)
- ponded pastures
- stock and feral animal disturbance (grazing and trampling); and
- managing wooding vegetation around springs

5. Threatened Ecological Communities Profiles

The threatened ecological communities included in this Plan consist of the following::

- Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow TEC)
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC)
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions (Coolibah TEC)
- The community of native species dependent on natural discharge of groundwater from the Great Artesian Bore (GAB Springs TEC)

5.1. Brigalow (*Acacia harpophylla* dominant and co-dominant)

5.1.1. Legal status

The Brigalow TEC is listed as endangered under the EPBC Act.

5.1.2. Characteristics and thresholds

Characteristics

The community is characterised by the tree species *Acacia harpophylla* (Brigalow) as either dominant or co-dominant with *Casuarina cristata* (Belah) or other *Acacia* and *Eucalyptus* species.

The structure of the vegetation ranges from open forest to open woodland. The height of the tree layer varies from about 9 m in low rainfall areas (averaging around 500 mm per annum) to around 25 m in higher rainfall areas (averaging around 750 mm per annum) (DoE 2017). A moderately dense low tree layer or low to tall shrub layer is frequently present, with typical species including *Terminalia oblongata* (Yellowwood), *Eremophila mitchellii* (False Sandalwood) and/or *Geijera parviflora* (Wilga).

The ground layer of the community is typically sparse and comprised of graminoids such as *Enteropogon acicularis*, *Panicum decompositum*, *Paspalidium* spp. and the sedge *Cyperus gracilis* (DoE 2015). Sub-shrubs such as *Sclerolaena* spp. and *Enchylaena tomentosa* (Ruby Saltbush) are also commonly present (DoE 2015). The ground layer of the community is typically dominated by a thick leaf litter layer and ample fallen woody debris (DoE 2015).

In Queensland, about 85% of the TEC's remnants occur on flat to gently undulating Cainozoic clay plains that are not associated with current alluvium, and on gently undulating landscapes on more or less horizontally bedded fine grained sedimentary rocks. About 10% of remnants are associated with river and creek flats, and the remainder with old loamy and sandy plains, basalt plains and hills, or hills and lowlands on metamorphic or granitic rocks (DoE 2015). The soils are predominantly cracking clays where Brigalow is dominant, however where *Eucalyptus* species are co-dominant, texture contrast soils are common (DoE 2015).

Condition thresholds

The approved conservation advice for the Brigalow ecological community describes and specifies the diagnostic and condition thresholds which define the community (TSSC 2013). The community is limited to vegetation patches that meet key diagnostic characteristics and condition thresholds:

- the presence of *Acacia harpophylla* as one of the most abundant tree species in the patch; and
- in Queensland, the vegetation in the patch is remnant meeting one of the 16 regional ecosystems; and/or
- the vegetation in the patch is Brigalow regrowth with species composition and structural elements broadly typical of one of the 16 REs (although species density may be reduced); and

- the patch is 0.5 ha or more in size; and
- exotic perennial plants comprise less than 50% of the total vegetation cover (assess over a minimum 0.5 ha sample area representative of the patch).

Not all vegetation in which Brigalow is the prominent component is included within the listed Brigalow ecological community.

5.1.3. Brigalow within the Project area

Brigalow TEC has been recorded in the Project area, in both the north west and north east development areas, with several patches recorded in proximity to Eurombah Creek. It covers an estimated total of 539.13 ha within the Project area (ELA 2018).

Of the 16 REs which have potential to meet the diagnostic and condition thresholds of the Brigalow ecological community, one RE has been ground-truthed by a suitably qualified ecologist as meeting the Brigalow TEC; RE 11.9.4.

5.1.4. Relevant plans and advices

There is currently no Recovery Plan for the Brigalow TEC; however, the approved Conservation Advice (DoE 2013) identifies key threats and priority conservation objectives. The key threats include:

- land clearing
- inappropriate fire regimes
- invasive plants and feral animals
- inappropriate grazing regimes
- habitat fragmentation; and
- climate changes

5.2. Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

5.2.1. Legal status

The SEVT TEC is listed as endangered under the EPBC Act.

5.2.2. Characteristics and thresholds

Characteristics

The SEVT community is considered an extreme form of dry seasonal subtropical rainforest, which occurs in areas with a subtropical, seasonally dry climate on soils of high to medium fertility (McDonald 2010). The community is generally characterised by the prominence of trees with microphyll sized leaves (2.5-7.5cm long) and the frequent presence of swollen-stemmed bottle trees (*Brachychiton australis*, *B. rupestris*) as emergent species from the vegetation.

In Queensland, SEVT TEC includes 10 regional ecosystems within the Brigalow Belt. The floristic composition of the vegetation varies from north to south and from east to west, but communities form a continuum rather than discrete entities. There are three geographic units of the community:

1. Northern SEVT (Brigalow Belt North (Queensland))
2. Central SEVT (Brigalow Belt South (Queensland))
3. Southern SEVT (Brigalow Belt South and Nandewar (New South Wales))

The semi-evergreen vine thickets in the Central SEVT (the geographic unit of the Project area) are floristically diverse, especially in the canopy layer and often also in the shrub layer *Brachychiton rupestris* (Narrow-leaved Bottle Tree) is generally always present as an emergent. Other species that may be locally present as emergent species include *Acacia harpophylla* (Brigalow), *Brachychiton australis* (Broad-leaved Bottle Tree) and *Casuarina cristata* (Belah) (McDonald 2010).

Emergent species generally range in height from 11±3m to 16±3m but may reach 25m, and contain a mixture of evergreen, semi-evergreen and deciduous species. The canopy trees range in height from 6±2m to 8±3m or less often 12±3m. The Central SEVT commonly have a shrub understorey 2±1m high, although in places where the canopy is very dense, shrubs may be absent. The herbaceous ground layer is usually sparse or may be absent (McDonald 2010).

Condition thresholds

There is no approved listing advice of condition thresholds for the SEVT TEC. All areas of remnant vegetation consistent with the regional ecosystems that comprise the TEC are considered to be the TEC.

5.2.3. SEVT within the Project area

A total of 179.61 ha of SEVT TEC has been ground-truthed in the Project area, scattered in the south for the NWDA and the central and north areas of the NEDA. The SEVT is comprised of RE 11.9.4, which was commonly observed on crests or mid-slopes of undulating plains and in narrow gorges within the Project area.

5.2.4. Relevant plans and advices

The National recovery plan for the “*Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions*” ecological community (McDonald 2010) identifies the following key threats:

- land clearing
- inappropriate fire regimes
- invasion by introduced plant species; and
- increased grazing by domestic stock and native animals

5.3. Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South

5.3.1. Legal status

The Coolibah TEC is listed as endangered under the EPBC Act

5.3.2. Characteristics and thresholds

Characteristics

The Coolibah TEC is found on grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, and stream levees (TSSC 2011). The ecological community occurs on a landscape of flat to low relief where small changes in slope and height can influence the species composition.

The structure of the ecological community may vary from tall woodland in the riparian zones to very open woodland with a sparse mid layer of shrubs and a grassy ground layer (TSSC 2011). *Eucalyptus coolabah* subsp. *coolabah* (Coolibah) must be present in the tree canopy and is a dominant or subdominant species, in associated with *E. largiflorens* (Black Box). The mid or shrub layer may or may not be present and when present is typically sparse or clumped of variable composition. The ground layer is also of variable composition and ranges from sparse to dense cover. Ground cover lifeforms typically comprise native graminoids, other herbs, chenopods and other low shrubs that are typically under 50 cm tall (TSSC 2011).

In Queensland, five regional ecosystems form part of or align with the characteristics of the Coolibah TEC.

Condition thresholds

The approved listing advice (TSSC 2011) details that the ecological community is limited to patches that meet the following condition thresholds:

- the minimum patch size is 5 ha. This may include area of native vegetation that may be naturally open or contain regrowth;
- the crown cover of trees in the patch must be $\geq 8\%$; and
- Coolibah and/or Black Box in the tree canopy must be present in the patch that are either:
 - Mature trees with a main stem that has a diameter at breast height of ≥ 30 cm; or
 - Hollow-bearing trees (live or dead); or
 - Coppiced trees with a main stem that has a diameter at breast height of ≥ 20 cm; and
- 10% or more of the ground cover comprises native graminoids, other herbs, chenopods and/or native low shrubs; and
- in the ground layer, the percentage of non-native perennial species does not exceed the percentage cover of native plant species (perennial or annual).

5.3.3. Coolibah within the Project area

A total of 36 ha of Coolibah TEC that met the diagnostic and condition criteria was ground-truthed in the Project area. It is comprised of RE 11.3.3 and was found to occur in the south of the NEDA in a single linear patch of vegetation.

5.3.4. Relevant plans and advices

There is currently no Recovery Plan for the Coolibah TEC; however, the approved Conservation Advice (DoE 2013) identifies key threats and priority conservation objectives. The key threats include:

- clearing and fragmentation
- hydrological changes and altered water flow and flooding regimes
- inappropriate grazing regimes; and
- invasion by weeds

5.4. The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin

5.4.1. Legal status

The GAB Springs TEC is listed as endangered under the EPBC Act.

5.4.2. Characteristics and thresholds

The ecological community is characterised by the following features (DoEE 2018):

- the native species that comprise the ecological community are assemblages of plant and animal taxa associated with and dependent on the springs and wetland areas located at points where the Great Artesian Basin groundwater is discharged naturally. The species include plants and animals that are endemic to one or more springs/wetlands and species that occur more widely in the Great Artesian Basin or beyond it.
- the groundwater is artesian water that has its origin in the Great Artesian Basin aquifer; and
- the groundwater comes to the surface at points within Great Artesian Basin discharge areas which are the natural surface discharge points of aquifers in the Triassic, Jurassic and Cretaceous sedimentary sequences of the Basin. The discharge points and their associated wetland areas are variously called springs, artesian springs, mound springs, mud springs, boggomoss springs (springs with raised mounds of organic matter), spring pools and groundwater seeps.

5.4.3. GAB Springs within the Project area

Two springs associated with the Scott Creek spring complex occurs within the Project area. The springs form a Palustrine wetland (e.g. vegetated swamp) associated with RE 11.3.22. The wetlands form small, sparsely vegetated wetlands with minor mounding. The springs occur amongst RE 11.3.25, with *E. tereticornis* dominant in the tree layer. The wetland consists of distinct vegetation assemblages associated with continuous inundation, including sedges of *Cyperus* spp. and *Fimbristylis* sp. and the endangered *Eriocaulon carsonii* in the ground layer.

5.4.4. Relevant plans and advices

The *Recovery plan for the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin* (Fensham et al 2010) identifies the following key threats:

- aquifer draw-down
- excavation of springs
- invasion by exotic plants
- disturbance and grazing pressure from stock and feral animals; and
- invasion by exotic aquatic animals

6. Data, Record Keeping and Reporting

All records of EPBC Act listed threatened species or areas of TECs identified within the Project area during ecological surveys (pre-clearance surveys or monitoring events) and data on threatened species captured by qualified fauna experts will be provided to Origin Energy for integration into their GIS system.

Origin Energy will provide a summary of findings arising from the above data, and any corrective actions implemented to the Department as required in Annual Compliance Reports.

7. Audit and Review

This plan will be routinely reviewed at least once every five years to take into account any new information, including any information and advice provided by Commonwealth or Queensland Government agencies, or available from other CSG proponents.

The review shall:

- assess the appropriateness of the Plan to the construction and operational activities based on audit information.
- determine if any changes to the Plan are required as a result of scope, legislative or organisational changes.

Where required, the plan will be resubmitted to the Department for approval, prior to implementation.

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