APPENDIX 26 – OFFSET AREA MANAGEMENT PLAN

NEW LENTON COAL PTY LTD

NEW LENTON COAL PROJECT

April 2025

Kemmis Creek Offset Area Management Plan

New Lenton Coal Project

Bowen Coking Coal

VERSION CONTROL

Rev	Date	Description
0-4	5 November 2024	Draft OAMP for client review
5	12 November 2024	Finalised for submission
6	23 April 2025	Updated based on DCCEEW feedback
7	24 April 2025	Finalised for submission

	Name	Position	Date
ORIGINATORS	Anai Fien Briana Clifton Dr Cath Bowler	Ecologist Ecologist Senior Ecologist	23 April 2025
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1. To the best of my knowledge, all the information contained in, or accompanying this Kemmis Creek Offset Area Management Plan is complete, current and correct.
2. I am duly authorised to sign this declaration on behalf of the approval holder.
3. I am aware that:
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Signed: _____

Full name: _____

Organisation:

Date: ___ / ___/ _____

ABBREVIATIONS AND ACRONYMS

ATP	Authority to Prospect
BCC	Bowen Coking Coal
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Strategy
°C	degrees Celsius
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of Environment and Science
EA	Environmental Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
EPC	Exploration Permits for Coal
EPM	Exploration Permits for Minerals
GTDTHQ	Guide to Determining Terrestrial Habitat Quality Version 1.3 (DEHP 2020)
ha	hectare
km	kilometre
LJV	Lenton Joint Venture
MNES	Matters of National Environmental Significance
MDL	Mineral Development Licence
ML	Mining Lease
mm	millimetre
NC Act	*Nature Conservation Act 1992* (Qld)
NLC	New Lenton Coal
OAG	EPBC Act Offsets Assessment Guide
OAMP	Offset area management plan
PER	Public Environment Report
The Project	New Lenton Coal Project
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
SPRAT	Species Profile and Threats Database
TEC	Threatened Ecological Community
VM Act	*Vegetation Management Act 1999* (Qld)

EXECUTIVE SUMMARY

New Lenton Coal Pty Ltd (NLC) is a wholly owned subsidiary of Bowen Coking Coal Ltd (BCC). The Lenton Joint Venture (LJV) is an unincorporated joint venture between NLC and MPC Lenton Pty Ltd (MPC). NLC and MPC own the LJV assets as tenants in common in the participating interests of 90% and 10% respectively. The New Lenton Coal Project (the Project) is proposed to be developed across mining leases (ML) 70337, ML 700053 and ML 700054 (referred to as the New Lenton MLs), held by LJV. The New Lenton MLs are subject to an existing State approved environmental authority (EA; EPML0047551), granted on 20 January 2021.

The Project is situated in the Brigalow Belt (North) Bioregion and lies within the northern Bowen Basin of central Queensland. It is approximately 65 kilometres (km) north of Moranbah and 120 km southwest of Mackay, within the Isaac Regional Council local government area. The proposed open-cut coal mine will produce coking coal (a primary input for the production of steel) and thermal product for export. The Project plans to mine the coal resources at an average rate of up to 1.9 million tonnes per annum over a life of approximately 17 years.

NLC submitted the Referral for the Project in September 2020 (EPBC 2020/8778). As part of the assessment approach, the Department of Climate Change, Energy, the Environment and Water (previously Department of Agriculture, Water and the Environment; [DCCEEW]) required NLC to prepare a Public Environment Report (PER), including a Biodiversity Offset Strategy (BOS) and an Offset Area Management Plan (OAMP; this document). In October 2023 the BOS (CO2 Australia 2023) was submitted to the DCCEEW outlining a strategy for how the Project's anticipated significant residual impacts on MNES will be compensated for and NLC's approach to delivering offsets in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act) *Environmental Offsets Policy*.

Comprehensive ecological field surveys and technical studies have been undertaken for the Project to inform an EA amendment and Referral under the Commonwealth EPBC Act (EPBC 2020/8778). Additional surveys were undertaken in March 2023 and an ecological impact assessment based on historical and recent field surveys was prepared (AARC 2024). These surveys and studies identified that the Project has the potential to impact on Matters of National Environmental Significance (MNES).

Significant residual impacts of the Project on MNES that cannot be avoided or minimised will be counterbalanced by the provision of biodiversity offsets. This OAMP has been prepared to address the acquittal of the Project's anticipated offset requirements. NLC's approach to delivering these offsets is in accordance with the EPBC Act *Environmental Offsets Policy*. Direct (land-based) offsets are proposed for all MNES requiring offsets:

- koala (*Phascolarctos cinereus*)
- squatter pigeon (southern) (*Geophaps scripta scripta*)
- greater glider (*Petauroides volans*)

- Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community (Poplar Box TEC).

The proponent has, through an existing landholder relationship, identified Kemmis Creek (Lot 12 SP303309) as a preferred option to deliver the required offsets for the Project. Kemmis Creek is a 27,800 ha cattle grazing property located in Kemmis, approximately 55 km northeast of Moranbah and 25 km east of the Project. Detailed ecological surveys of Kemmis Creek have been conducted, which indicates that there is appropriate habitat to provide offsets for the relevant MNES. Surveys undertaken by CO2 Australia also confirmed the presence of each MNES on the property. CO2 Australia conducted a preliminary survey of the property in July 2023 to ground-truth Regional Ecosystems (REs) present and determine the quantum of potential offset area available for relevant MNES.

In February 2024, CO2 Australia undertook detailed field assessments in a targeted area within the Kemmis Creek investigation area centred on areas of habitat consistent with Poplar Box TEC, as well as habitat for the other MNES species. The purpose of this fieldwork was to determine the baseline habitat condition of the MNES offset values across this broader area, finalise vegetation mapping and confirm management requirements to inform the preparation of this OAMP. The resulting Kemmis Creek offset area, presented in this OAMP can be used to acquit Project offset requirements for the following MNES:

- fully acquitted:
  - koala (*Phascolarctos cinereus*)
  - squatter pigeon (southern) (*Geophaps scripta scripta)*
  - greater glider (central and southern) (*Petauroides volans*)
  - Poplar Box TEC, with a reduction of around 6 ha in the impact area
- partially acquitted:
  - Poplar Box TEC, without a reduction in the impact area

If the impact area for Poplar Box TEC is not reduced, then offset acquittal for Poplar Box TEC still meets the minimum requirement of a 90% direct (land-based) offset. A 5.26% offset acquittal shortfall is proposed to be delivered as compensatory measures in the form of 58 ha of additional remnant vegetation on Kemmis Creek contiguous with Poplar Box TEC mapped within the offset area (the 'Buffer Area'). This compensatory measure will provide an important buffer (≥100 m) to the threatened ecosystem to maintain the extent and increase the integrity of the ecosystem under protection.

For each MNES, Table ES 1 outlines the impact of the Project, the offset area to be secured and managed on the ground, the baseline habitat quality score and the percent offset acquittal of impact.

Table ES 1: Summary of the offset areas to be secured on the Kemmis Creek property

MNES	EPBC Act status	Impact area (ha)	Impact area habitat quality score	Offset area on Kemmis Creek (ha)	Offset area start habitat quality score	Percent of impact acquitted on Kemmis Creek [a]
Koala (*Phascolarctos cinereus*)	Vulnerable [c]	327	5	2,213	7	107.54%
Squatter pigeon (southern) (*Geophaps scripta scripta*)	Vulnerable	192.3	6	2,213	7	152.62%
Greater glider (*Petauroides volans*)	Vulnerable [c]	293	6	2,213	7	100.01%
Poplar Box TEC (reduced impact area option, with impact area reduced by 5.91 ha)	Endangered	106.34	7	1,020	8	100.00%
Poplar Box TEC Buffer Area (only required if impact area remains unchanged at 112.25 ha)	-	-	-	58[b]	-	-

[a] Calculated using the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) *Offsets Assessment Guide*.
[b] Corresponds to the shortfall area required for Poplar Box TEC to acquit remaining 5.26% shortfall
[c] EPBC Act status for koala and greater glider reflects their status at the time of the Controlled Action decision on the New Lenton (2020/8778) Referral.

This Kemmis Creek OAMP has been prepared to guide management and monitoring of the offset area and to satisfy the requirements of the following approvals and commitments:

- Section 7 of the PER Guideline for the Project stating the PER must include a draft OAMP for any MNES for which a residual significant impact is likely.
- Section 6.4 of the NLC BOS (version 1) which states that an OAMP will be prepared for the Kemmis Creek area to guide the management and monitoring and ensure offset condition and associated timeframes are achieved.

The overall aim of this OAMP is to improve the habitats of MNES within the Kemmis Creek offset area in order to address offset requirements associated with the Project.

The interim performance targets and completion criteria defined in Table ES 2 indicate progress towards, and achievement of, the overall aim. The interim performance targets and completion

criteria must be achieved through the implementation of this OAMP. Following the commencement of this OAMP, the interim performance targets and completion criteria are expected to be achieved within 5, 10 and 20 years.

The management and monitoring measures outlined in this OAMP have been designed to support the achievement of the interim performance targets, completion criteria and the overall aim of this OAMP, and to minimise the risk of known threats to the MNES occurring.

Management actions outlined in this OAMP include restricting access to the offset area, control of pest animals and weeds, and management of fire, livestock and erosion. Monitoring activities include general offset area inspections, weed monitoring, pest animal monitoring, biomass monitoring, fuel hazard assessments, habitat quality assessments, photo monitoring and targeted fauna surveys.

Achieving legal security of the Kemmis Creek offset area is imperative for the successful implementation of this OAMP. Measures to legally secure the offset area are outlined in the OAMP and are linked to an approved/declared management intent.

Annual reports will be provided to the relevant administering authority each year following approval of this OAMP. The annual report will detail progress towards achieving the interim performance targets and/or completion criteria specified in this OAMP.

Following the completion of surveys in year 1 of OAMP implementation, this OAMP will be updated based on the survey results to specify control measures, timing for control activities, detailed location of existing (and required) infrastructure and to confirm the location of monitoring sites. Subsequently, in accordance with the principles of adaptive management, this OAMP will be reviewed and amended every three years (where required) to incorporate changes identified through management activities, regular site visits and monitoring activities.

Table ES 2: Interim performance targets and completion criteria for MNES

MNES	Start habitat quality score	Interim performance target – to be achieved by year 5 of management	Interim performance target – to be achieved by year 10 of management	Completion criteria – to be achieved by year 20 of management
Greater glider	7	• Improve the quality of greater glider habitat to achieve a habitat quality score greater than 7.	• Improve the quality of greater glider habitat to achieve a habitat quality score of 8 or greater.	• Improve the quality of greater glider habitat to attain and maintain a habitat quality score of 8 or greater.
Koala	7	• Improve the quality of koala habitat to achieve a habitat quality score greater than 7.	• Improve the quality of koala habitat to achieve a habitat quality score of 8 or greater.	• Improve the quality of koala habitat to attain and maintain a habitat quality score of 8 or greater.
Squatter pigeon (southern)	7	• Improve the quality of squatter pigeon (southern) habitat to achieve a habitat quality score greater than 7.	• Improve the quality of squatter pigeon (southern) habitat to achieve a habitat quality score of 8 or greater.	• Improve the quality of squatter pigeon (southern) habitat to attain and maintain a habitat quality score of 8 or greater.
Poplar Box TEC	8	• Improve the quality of Poplar Box TEC habitat to attain and maintain a habitat quality score of 8 or greater.	• Improve the quality of Poplar Box TEC habitat to attain and maintain a habitat quality score of 8 or greater.	• Improve the quality of Poplar Box TEC habitat to attain and maintain a habitat quality score of 8 or greater.

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FIGURES

TABLES

GLOSSARY

Adaptive management trigger: represented by:

- a completion criterion that has not been attained and/or maintained, or
- an identified, measurable event or parameter that if (or once) confirmed, is likely to prejudice attainment and/or maintenance of the completion criteria. This includes those incidentally detected and confirmed outside of monitoring activities (e.g. unplanned fire in offset area), as well as events or parameters with the potential to directly or indirectly impact on an offset value (e.g. a damaged fence likely to permit cattle to enter).

Approval holder: the person to whom the approval is granted, or any person acting on their behalf, or to whom the approval is transferred under section 145B of the EPBC Act.

Baseline monitoring: the measurement of environmental parameters prior to implementation of offsets for the purpose of establishing reference points against which changes can be measured.

Completion criteria: time-bound values, specified for measurable parameters that, if attained and maintained, ensure the plan's environmental outcomes have been achieved.

Corrective action: a feasible and effective action that is undertaken where an adaptive management trigger is identified, a completion criteria is not attained or once attained, is not maintained. In concert with implementing corrective actions, ongoing reviews of the efficacy of management actions will be undertaken to ensure adaptive management triggers can be avoided, and completion criteria can be attained and maintained. In accordance with adaptive management principles, this may include additional management actions to that prescribed in this OAMP.

Environmental outcomes: the overall outcome sought by the plan. It is achieved by an environmental offset for a prescribed activity for a prescribed environmental matter if the offset is selected, designed and managed to maintain the viability of the matter.

EPBC Act Offsets Policy: the document *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Department of Sustainability, Environment, Water, Population and Communities, October 2012 (or any later revised version).

EPBC Act: the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

Interim performance targets: time-bound short/medium term targets, used to monitor, evaluate, review and improve the effectiveness of management actions to achieve the completion criteria.

Legally binding mechanism: a covenant or similar legal agreement in relation to a site, to provide enduring protection for the site against developments incompatible with conservation.

Management actions: management aimed at addressing management objectives, achieved by meeting interim performance targets and ultimately, attaining and maintaining completion criteria.

Management objectives: statements identifying achievable objectives contributing to achieving the environmental outcome/s of the plan. Management objectives are achieved by implementation of management actions.

Minister: the Australian Government Minister administering the EPBC Act and includes a delegate of the Minister.

Monitoring: qualitative and quantitative methodologies that produce measurable parameters to confirm whether or not management actions are meeting interim performance targets and/or attaining and maintaining completion criteria.

New or increased impact: a new or increased impact on any matter protected by the controlling provisions for the action, when compared to the plan that has been approved by the Minister.

Offset values: environmental values considered whole of environment and listed threatened species and ecological communities under the EPBC Act in which significant residual impacts were identified to occur.

Performance criteria: short term management targets that if attained and maintained ensure the success of the management actions in achieving the management objectives.

Site condition: means the condition of a site in relation to the ecological requirements of a threatened species or ecological community. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features.

Suitably qualified person: a person who has professional qualifications, training, skills and/or experience related to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods and/or literature.

1 INTRODUCTION

1.1 BACKGROUND

New Lenton Coal Pty Ltd (NLC) is a wholly owned subsidiary of Bowen Coking Coal Ltd (BCC). The Lenton Joint Venture (LJV) is an unincorporated joint venture between NLC and MPC Lenton Pty Ltd (MPC). NLC and MPC own the LJV assets as tenants in common in the participating interests of 90% and 10% respectively. The New Lenton Coal Project (the Project) is proposed to be developed across mining leases (ML) 70337, ML 700053 and ML 700054 (referred to as the New Lenton MLs), held by LJV (Figure 1). The New Lenton MLs are subject to an existing State approved environmental authority (EA; EPML0047551), granted on 20 January 2021.

The Project was referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act; EPBC 2020/8778) to the Minister for the Environment on 23 September 2020 and as a result the Project is to be assessed by Public Environment Report (PER) including an assessment of significant residual impacts on Matters of National Environmental Significance (MNES).

In October 2023 the Biodiversity Offset Strategy (BOS) for the New Lenton Coal Project (CO2 Australia 2023; BOS) was submitted to the Department of Climate Change, Energy, the Environment and Water (DCCEEW), as part of the PER for the Project. The BOS outlined a strategy for how the Project's anticipated significant residual impacts on MNES will be compensated for and NLC's approach to delivering offsets in accordance with the EPBC Act Environmental Offsets Policy (Table 1). The BOS has been superseded by this OAMP.

Table 1: Impacts on MNES for which offsets will be delivered in accordance with the EPBC Act Environmental Offsets Policy

MNES	EPBC Act status	Impact area (ha)
Listed threatened species		
Koala (*Phascolarctos cinereus*)	Vulnerable [a]	327
Squatter pigeon (southern) (*Geophaps scripta scripta*)	Vulnerable	192.3
Greater glider (*Petauroides volans*)	Vulnerable [a]	293
Listed threatened ecological communities		
Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community (TEC)	Endangered	• 112.25 ha prior to any reduction in impact area

MNES	EPBC Act status	Impact area (ha)
		• 106.34 ha with a reduction in impact area

[a] EPBC Act status for koala and greater glider reflects their status at the time of the Controlled Action decision on New Lenton (2020/8778) Referral (2020).

As part of the BOS, the Kemmis Creek property (Lot 12 SP303309) was identified as NLC's preferred option to deliver the required offsets for the Project. This OAMP includes the results of preliminary field surveys at Kemmis Creek undertaken from 18th-20th July 2023 that were originally undertaken for the BOS, including ground-truthed REs within the proposed offset investigation area.

In February 2024, CO2 Australia subsequently undertook detailed field assessments of the Kemmis Creek investigation area (hereafter 'investigation area') for the purpose of collating information sufficient to prepare an offset area management plan (OAMP). As part of this fieldwork, baseline habitat condition of the investigation area was assessed for relevant MNES offset values, vegetation mapping was finalised and management requirements to inform the preparation of an OAMP was collated. This survey confirmed the presence of koala and squatter pigeon within the investigation area.

In June 2024, CO2 Australia undertook additional targeted surveys of greater glider (southern and central) within the investigation area. These additional surveys resulted in the positive identification of 11 individual greater gliders.

1.2 PURPOSE AND SCOPE

The land-based offsets required to acquit the Project's anticipated significant residual impacts on MNES will be delivered on Kemmis Creek as summarised below. This Kemmis Creek OAMP has been prepared to guide the ongoing management and monitoring of an offset area, to satisfy obligations under the EPBC Act Environmental Offsets Policy (DSEWPC 2012) for the following MNES offset values:

- koala (*Phascolarctos cinereus*)
- squatter pigeon (southern) (*Geophaps scripta scripta*)
- greater glider (*Petauroides volans*)
- Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community (TEC) (Poplar Box TEC).

This OAMP includes:

- summary information including:
  - departmental reference details

- the offset requirements acquitted through the implementation of this OAMP
- a description of the offset property
- details of surveys undertaken to date
- the proposed legally binding mechanism for the offset
- an outline of the compliance of the offset with the EPBC Act Environmental Offsets Policy.

- descriptions of the offset values including species ecology, the offset management area and identified threats for each MNES (Section 4)
- details on the legal security of the offset area (Section 5)
- a description of the adaptive management framework and process including the identification of threats, management objectives, performance criteria, adaptive management triggers and corrective actions for each MNES (Section 6)
- the management program to be implemented to achieve the interim performance targets and completion criteria (Section 7)
- the environmental outcomes to be achieved by this OAMP including interim performance targets and completion criteria for each MNES (Section 7.1)
- the monitoring requirements to be undertaken to assess progress towards achieving the interim performance targets and completion criteria (Section 8)
- details of reporting requirements to the administering authority (Section 9)
- a management, monitoring and reporting schedule to guide the implementation of this OAMP (Section 10).

1.2.1 Public Environmental Report Guidelines

Table 2 demonstrates how the scope of this OAMP meets the minimum requirements for a OAMP in accordance with the '*Guidelines for the content of a draft Public Environmental Report: New Lenton Coal Project, north of Moranbah, Queensland*' (DCCEEW 2023).

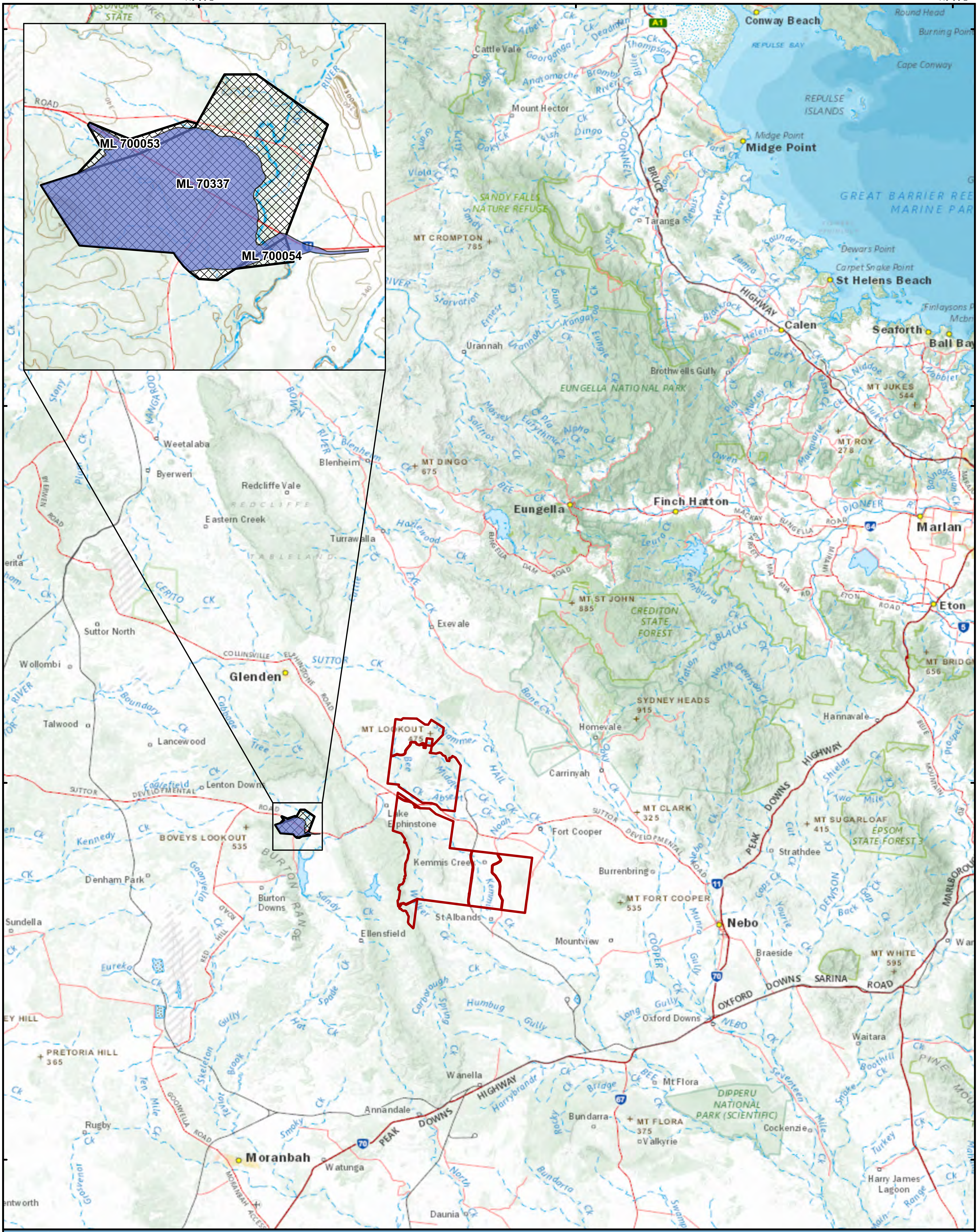
Table 2: Summary of how minimum requirements for an OAMP in the PER guidelines are addressed in this document

PER guideline requirement	Reference to location addressed in OAMP
A description of the offset area/s, including location, size, condition, environmental values present and surrounding land uses.	Section 2 Offset summary
Baseline data and other supporting evidence, including the ecological field data, that documents the presence of the relevant MNES, and the quality of their habitat within the offset area/s.	Section 3 Vegetation description and condition Appendix A Appendix C

PER guideline requirement	Reference to location addressed in OAMP
An assessment of the site habitat quality for the offset area/s using an appropriate methodology, with justification and supporting evidence, (e.g. using the Queensland Guide to determining terrestrial habitat quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy.	Section 2.3 Surveys to date Section 3 Vegetation description and condition Appendix A Appendix C
Details of how the offset area/s will provide connectivity with other habitats and biodiversity corridors and/or will contribute to a larger strategic offset for the relevant listed threatened species and communities.	Section 2.2.2 Connectivity
Maps and shapefiles to clearly define the location and boundaries of the offset area/s, accompanied by the offset attributes (e.g. physical address of the offset area/s, coordinates of the boundary points in decimal degrees, the listed threatened species and communities that the environmental offset/s compensates for, and the size of the environmental offset/s in hectares).	Figure 6: Offset area MNES habitat and confirmed Appendix F: Offset area coordinates
Specific offset completion criteria derived from the site's habitat quality to demonstrate the improvement in the quality of habitat in the offset area/s over a 20-year period.	Section 7.1 Environmental outcomes to be achieved
Details of the management actions, and timeframes for implementation, to be carried out to meet the offset completion criteria.	Section 7 Management program
Interim milestones that set targets at 5-yearly intervals for progress towards achieving the offset completion criteria.	Table 13: Interim performance targets and completion criteria for MNES
Details of the nature, timing and frequency of monitoring to inform progress against achieving the 5-yearly interim milestones (the frequency of monitoring must be sufficient to track progress towards each set of milestones, and sufficient to determine whether the offset area/s are likely to achieve those milestones in adequate time to implement all necessary corrective actions).	Section 8 Monitoring program
Proposed timing for the submission of monitoring reports which provide evidence demonstrating whether the interim milestones have been achieved.	Section 9 Reporting

PER guideline requirement	Reference to location addressed in OAMP
Timing for the implementation of corrective actions if monitoring activities indicate the interim milestones have not been achieved.	Table 12: Management objectives, performance criteria, adaptive management triggers, corrective actions
Risk analysis and a risk management and mitigation strategy for all risks to the successful implementation of this OAMP and timely achievement of the offset completion criteria, including a rating of all initial and post-mitigation residual risks in accordance with a risk assessment matrix.	Section 6.2 OAMP adaptive management framework
If proposed for listed threatened species and communities, evidence of how the management actions and corrective actions take into account relevant approved conservation advices and are consistent with the objectives of relevant recovery plans and threat abatement plans.	Section 4 Description of the offset values
Details of the legal mechanism for legally securing the proposed offset area/s, such that legal security remains in force over the offset area/s for a minimum of 20 years to provide enduring protection for the offset area/s against development incompatible with conservation.	Section 5 Legally securing the offset area
The draft OAMP must be prepared by a suitably qualified person and in accordance with the department's Environmental Management Plan Guidelines (2014), available at: https://www.awe.gov.au/environment/epbc/publications/environmental-management-plan-guidelines.	This draft OAMP has been prepared by the following suitably qualified personnel at CO2 Australia: • Tara D'Arcy-Evans (Head of Ecosystem Markets • Dr Jarrad Cousin (Head of Ecology) • Dr Catherine Bowler (Senior Ecologist) • Anai Fien (Ecologist) • Briana Clifton (Ecologist)
Please note, the department expects that an EPBC Act protected matter is present in the proposed offset area/s if it is present in the project site to align with the EPBC Act Environmental Offsets Policy.	Section 2.1
Supporting evidence must be included in the draft OAMP to justify how proposed management action/s are additional to the existing requirements of the landholder in managing their land (e.g. weed and pest management requirements under the Biosecurity Act 2014 (Qld), existing grazing	Results of site condition surveys (particularly BioCondition values presented in Table A-1 to Table A-3) indicate that weed load, especially *Lantana camara* was substantial, with little evidence of management in the

PER guideline requirement	Reference to location addressed in OAMP
regimes, etc.) as required by the EPBC Act Environmental Offsets Policy.	offset area. Additionally, results of motion sensor cameras and incidental observation indicate that pest animal species, especially chital deer, are prevalent within the offset area with little evidence of current landholder management causing a reduction in number across surveying events
The draft OAMP must include robust scientific evidence (e.g. published research, pilot studies, previously successful projects/programs, etc.) to demonstrate how the proposed measures will successfully create, revegetate, regenerate and/or improve habitat (e.g. tree planting, nest boxes, artificial hollows, etc.) in the proposed offset area/s for a listed threatened species or ecological community.	Table 12 lists the threats (identified in conservation advices) to each MNES and identifies which management actions will target a reduction in those threats to each MNES
Where the proposed offset area/s supports an environmental offset for multiple MNES, proposed management action/s for one protected matter must not be detrimental (i.e. have an impact) to other protected matters.	No management actions (Section 7) are proposed that are detrimental to the offset MNES
Where an offset is proposed, with a completed Offsets assessment guide calculation, all inputs must be supported by robust scientific evidence and/or supporting evidence (e.g. historical grazing regimes, satellite imagery, statements from landholders, etc.).	Appendix E



Bowen Coking Coal

Figure 1:
Project context

Kemmis Creek property
Project footprint
Mining lease

Location diagram

0 5 10 20 30
Kilometres

Date: 14/04/2025 Coordinate System: GDA2020 Scale: 1:500,000@A3

AUTHOR: J. Cousin
DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Mining leases

2 OFFSET SUMMARY

2.1 OFFSET REQUIREMENTS

The offset area will encompass 2,213 ha in the south-west of the Kemmis Creek property (lot 12 SP303309), centred along Walker Creek (Figure 2). The offset area comprises 2,213 ha for the koala, squatter pigeon, greater glider and Poplar Box TEC (all co-located), and 58 ha as Poplar Box TEC Buffer Area (if the impact area is not reduced).

Whilst a preferred offset area is presented in this OAMP, the final location of the offset area will be subject to landholder agreement and preferences, but within the offset investigation area. The final offset area location will be materially similar to the preferred option, given the same regional ecosystems, with the habitat quality scores and OAG calculations likely to remain the same.

The results of the detailed field surveys, described in Section 2.3, were used to inform application of the EPBC Act *Offsets Assessment Guide* (OAG) to calculate the percentage of the Project impacts to be offset for each MNES within the Kemmis Creek offset area. A detailed summary of the OAG inputs and supporting justifications are presented in Appendix E.

Table 3 presents a summary of the Project's MNES offset requirements and the offset area to be secured on Kemmis Creek to acquit the Project's impacts. Based on the OAG inputs and extent of suitable MNES habitat present, the Kemmis Creek offset area is able to fully acquit offset requirements for koala, squatter pigeon and greater glider, and Poplar Box TEC (if Poplar Box TEC impact area is reduced by 5.91 ha to 106.34 ha). If the Poplar Box TEC impact area is not reduced, then a compensatory measure (the Buffer Area) is proposed to deliver the remaining offset acquittal shortfall of 5.26%.

If the Poplar Box TEC impact area is not reduced, remnant vegetation areas contiguous with Poplar Box TEC vegetation will be added to the statutory required offset area to act as a buffer for edge effects around the TEC. A 58 ha Poplar Box TEC Buffer Area (Figure 2) has been identified[1], representing at least a 100 m buffer to Poplar Box TEC offset habitat areas. This buffer is larger than the recommended minimum buffer zone of 30 m as defined in the Conservation Advice (Department of Energy and Environment [DEE] 2019).

A buffer zone, as defined in the *Conservation Advice for the Poplar Box Grassy Woodland on Alluvial Plains* (DEE 2019) is a 'contiguous area immediately adjacent to a patch of the Poplar Box Grassy Woodland that is important for protecting its integrity'. The purpose of the buffer zone is to minimise any risk of damage from actions close to the patch of TEC. Known threats to the TEC that can be minimised with a buffer zone include weed invasion, inappropriate fire and grazing regimes by livestock or invasive fauna, chemical drift, hydrological changes, and changes to soil structure such as erosion. The buffer zone identified as the Poplar Box TEC Buffer Area will be managed and

[1] The 58 ha represents the area required to meet the 5.26% offset acquittal shortfall for Poplar Box TEC, calculated in an OAG using the same OAG inputs as for the Poplar Box TEC OAG

monitored as part of the greater Kemmis Creek offset area to ensure threats to the Poplar Box TEC are minimised.

The habitat required for koala, squatter pigeon (southern) and greater glider is co-located within the offset area, namely REs 11.9.7, 11.3.2, 11.3.4 and 11.3.25. Koala habitat is typically characterised by eucalypt forests and woodlands comprising areas suitable for foraging and breeding, particularly within remnant riparian vegetation. Preferred koala feed trees on the property include *E. populnea, E. crebra* and *E. tereticornis* (DAWE 2022). Critical habitat for greater glider is defined by large contiguous areas of eucalypt forest which contain mature hollow-bearing trees (DCCEEW 2022) and in general, squatter pigeon (southern) habitat is characterised as any remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species (Squatter Pigeon Workshop 2011). All four REs present within the offset area are eucalypt dominated woodlands.

Table 3: Offset requirements for the Project MNES

MNES matter	EPBC Act Status	Impact area (ha)	Offset area on Kemmis Creek (ha)	Offset starting habitat quality	Offset requirement acquitted on Kemmis Creek?	Percent of impact acquitted on Kemmis Creek[A]	Area required for 100% acquittal (ha)
Threatened fauna species							
Koala (*Phascolarctos cinereus*)	Vulnerable [c]	327	2,213	7	Yes	107.54%	2,059
Squatter pigeon (southern) (*Geophaps scripta scripta*)	Vulnerable	192.3	2,213	7	Yes	152.62%	1,452
Greater glider (*Petauroides volans*)	Vulnerable [c]	293	2,213	7	Yes	100.01%	2,213
Threatened ecological community							
Poplar Box TEC (with a reduction in impact area)	Endangered	106.34	1,020	8	Yes	100.00%	1,020
Poplar Box TEC Buffer Area (only required if no reduction in impact area from 112.25 ha to 106.34 ha)	-	-	58 [b]	-	-	-	-

[a] Calculated using the EPBC Act OAG.
[b] Represents the area required to meet the 5.26% offset acquittal shortfall for Poplar Box TEC, calculated in an OAG using the same OAG inputs as for the Poplar Box TEC OAG
[c] EPBC Act status for koala and greater glider reflects their status at the time of the Controlled Action decision on the New Lenton (2020/8778) Referral (2020).

148°20'0"E

148°30'0"E

21°20'0"S

21°30'0"S

21°40'0"S

Crediton State Forest

Homevale Resources Reserve

Homevale National Park

Crediton Forest Reserve

Homevale Conservation Park

HOMEVALE NATIONAL PARK

CREDITON STATE FOREST

MT HILLALONG 475

MT LOOKOUT 475

MT HESS 565

MT WICKAWAW 465

MT ROBERT 885

MT BRYDEN 925

SYDNEY HEADS 915

MT BRITTON 715

DINGO MTN 775

MTS TJOHN 885

RANGE

Exevale

Exe CK

SUTTOR CK

TURRAWULLA ROAD

Brumby Ck

Four Mile Ck

ELPHINSTONE

Anna Ck

Schommer Ck

Middle Ck

Absent Ck

Bee Ck

HAIL CREEK

Carrinyah

Doby Ck

Nure Ck

MT CLARK 325

SUTTOR DEVELOPMENTAL ROAD

Fort Cooper

Kemmis Creek

KEMMIS

MT FORT COOPER 535

St Albands

Mountview

Ellensfield

Strathfield

Burrenbring

Plumtree Ck

Kemmis Ck

Bowen Coking Coal

Figure 2:
Offset area context

- Kemmis Creek property
- Offset area
- Poplar Box TEC Buffer Area
- Investigation area
- Fence

Protected areas

- National Park
- State Forest
- Conservation Park
- Forest Reserve
- Resources Reserve

Statewide Corridors v1.6

- Regional
- State

Location diagram

Queensland

Brisbane

N

0 2.5 5 10

Kilometres

Date: 14/04/2025 Coordinate System: GDA2020 MGA zone 55 Scale: 1:150,000@A3

AUTHOR: J. Cousin
DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Protected areas
- Statewide corridors

Path: P:\GISData\Projects\Bowen Coking Coal\Kemmis Creek\20250409_KemmisCrk_OAMP_update\OAMP_Mapping_20250414.aprx

2.2 PROPERTY CONTEXT

2.2.1 Property details

The offset area is located on Kemmis Creek (Lot 12 SP 303309), a 27,800 ha property in the locality of Kemmis, within the Isaac Regional Council Local Government Area. The offset area is approximately 55 km northeast of Moranbah and 25 km east of the Project (Figure 1). The property is leasehold and currently managed for cattle grazing.

The proposed investigation area is overlayed by one Exploration Permit for Coal (EPC), one Exploration Permit for Minerals (EPM), one Mineral Development Licences (MDL) and one Authority to Prospect (ATP) detailed in Table 4 and illustrated in Figure 3. The proposed offset area is located outside of any areas encumbered by MLs or other granted production tenements. Although the offset area is overlayed by exploration tenements, these types of authorities are not considered to restrict or prevent the legal security of a potential future offset area.

Landholder and specific property details for the proposed offset are outlined in Table 4.

Table 4: Landholder and property details

Landholder Details		
Landholder:	Craigie Ross	
Postal Address:	458 Kemmis Creek Rd, Kemmis QLD 4742	
Property Details		
Lot on plan:	12 SP303309	
Local Government Area:	Isaac Regional Council	
Tenure:	Leasehold	
Property area:	27,800 ha	
Offset Area:	2,213 ha	
Exploration permits (minerals) – granted		
EPM 26984	HB Base Metals Pty Ltd (expires 10/02/2029)	Intersects a small portion in the north of the investigation area, but does not overlap the proposed offset
Exploration permits (coal) – granted		

EPC 1860	Coking Coal One Pty Ltd (expires 19/8/2027)	Intersects a small portion in the north of the investigation area, but does not overlap the proposed offset
Exploration permits (petroleum and gas) – granted		
ATP 1103	CH4 Pty Ltd (expires 31/12/2025)	Intersects the proposed offset area
Mineral development licence		
MDL 3033	Peabody West Walker Pty Ltd (expired 31/7/2024 – renewal lodged)	Intersects the proposed offset area
Mining Leases - active		
ML 4750	Stanmore SMC Pty Ltd (expired 31 July 2020 – renewal lodged)	Not within the offset area, located to the east of the offset area.

148°16'0"E

148°20'0"E

21°32'0"S

21°36'0"S

21°40'0"S

EPC 1860
COKING COAL
ONE PTY LTD

EPM 26984
HB BASE METALS
PTY LTD

ATP 1103
CH4 PTY LTD

MDL 3033
PEABODY WEST
WALKER PTY LTD

ML 4750
STANMORE SMC
PTY LTD

Lake Elphinstone

ANNA CK

Kemmis Ck

Bowen Coking Coal

Location diagram

Figure 3:
Resource authorities

- Kemmis Creek property
- Investigation area
- Poplar Box TEC Buffer Area
- Offset area
- Fence
- Mining lease
- Exploration permits - coal
- Exploration permits - mineral
- Mineral development licence
- Exploration permits - petroleum and gas

CO2 AUSTRALIA

N

0 0.5 1 2
Kilometres

Date: 14/04/2025 Coordinate System: GDA2020 MGA zone 55 Scale: 1:45,000@A3

Queensland

Brisbane

AUTHOR: J. Cousin
DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Resource authorities

Path: P:\GISData\Projects\Bowen Coking Coal\Kemmis Creek\20250409_KemmisCrk_OAMP_update\OAMP_Mapping_20250414.aprx

2.2.2 Connectivity

The Kemmis Creek property is within the Northern Bowen Basin Subregion of the Brigalow Belt Bioregion. State and Regional Significant Corridors overlap the property, representing areas of biodiversity significance of land in a bioregion mapped as part of the Queensland Government's Biodiversity Planning Assessments for Queensland's bioregions (Figure 2). The mapping of such corridors within the Brigalow Belt Bioregion has focussed on those corridors that link adjacent bioregions or are considered to connect wildlife refugia. The location of the Kemmis Creek offset area in the west of the property partially overlaps with a State Significant Corridor along the higher elevational range country that traverses the property from north to south (Figure 2).

Within the wider landscape, the Kemmis Creek offset area is well connected to large tracts of remnant vegetation immediately to the west of the property, which remains largely free of active mining tenure. The Kemmis Creek offset area provides an important link connecting an intact remnant patch to the west of the property with remnant vegetation extending to the Homevale National Park east of the property (Figure 2).

The Kemmis Creek property is located in the very north of the Isaac River drainage sub-basin of the Fitzroy drainage basin, within the Great Barrier Reef Catchment boundary. Drainage features and watercourses of stream order 1 and 2 flow through the offset area, including Walker Creek which drains through from north to south, joining other creeklines on the property, including Kemmis Creek, Absent Creek, Middle Creek, Brumby Creek and Bee Creek.

2.2.3 Climate

Kemmis Creek straddles a boundary between a subtropical climate warm oceanic climate/humid subtropical climate and hot semi-arid climate (in accordance with Köppen Climate Classification system; Bureau of Meteorology [BoM] 2014). Weather records from the Moranbah Airport (station ID 34035) (Figure 4), located approximately 51 km south-south-west of Kemmis Creek, show that mean monthly rainfall (2012-2024) ranges from approximately 12.2 mm (August) to 103 mm (January). Monthly mean maximum temperatures (2012-2024) range from approximately 24.3°C in July to 34.9°C in December, while monthly mean minimum temperatures range from 8.8°C in July to 20.6°C in December. For the purposes of this OAMP, November to March is considered a representative 'wet season' and April to October the 'dry season'.

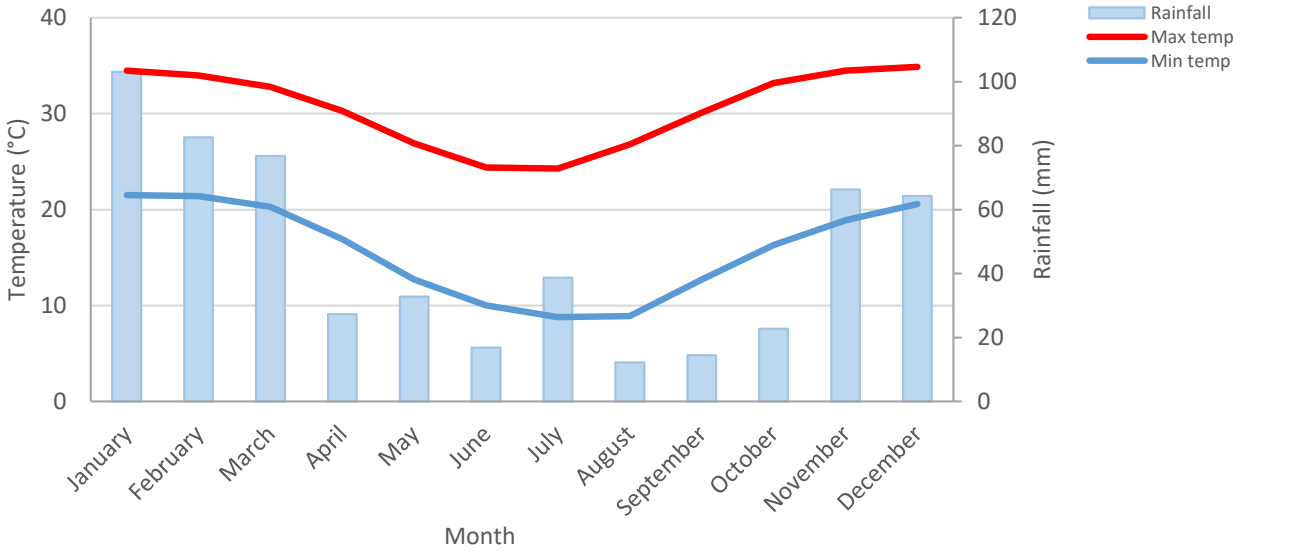


Figure 4: Mean monthly temperature and rainfall records from Moranbah Airport weather station (ID: 34035) 2012-2024 (BoM 2024)

2.3 SURVEYS TO DATE

Preliminary surveys were undertaken in July 2023 to ground-truth the vegetation on Kemmis Creek and refine the Queensland v12 Regional Ecosystem (RE) mapping (Department of Environment and Science [DES] 2021). This included mapping of any remnant and regrowth areas generally in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland Version 6.0* (Neldner et al. 2022).

Detailed field surveys were then undertaken generally in accordance with the Guide to Determining Terrestrial Habitat Quality version 1.3 (GTDTHQ), developed by the Queensland Government (DEHP 2020) within the Kemmis Creek offset investigation area in February 2024. The GTDTHQ represents a repeatable metric for measuring habitat quality of land based on three key indicators: site condition, site context and species habitat index. The GTDTHQ was developed to align with the Commonwealth Government's *EPBC Act Environmental Offsets Policy* measure of habitat quality. An overview of the GTDTHQ methodology, including relevant scoring considerations for the MNES offsets is provided in Table 5. BioCondition assessments were undertaken within RE 11.3.2, 11.3.4, 11.3.25 and 11.9.7 in the offset investigation area as they are the regional ecosystems identified to support the Project's MNES offset requirements.

The detailed field surveys were undertaken to:

- refine the area required to acquit the Project's MNES offset requirement
- confirm the ground-truthed vegetation mapping from previous preliminary assessments
- determine the baseline habitat quality scores for the MNES values generally in accordance with the GTDTHQ version 1.3 (DES 2020)
- targeted surveys and habitat assessments for koala, squatter pigeon and greater glider

- assess management, access, fencing and monitoring requirements to inform preparation of this OAMP.

Weather leading up to the detailed field surveys in February 2024 was wetter than average, with rainfall in the two months immediately prior (80.8 mm in December 2023 and 145.4 mm in January 2024) representing ~126% and 141% of those respective months' average rainfall (BOM 2024). While little rain fell in the two weeks prior to the detailed field surveys in early February 2024 (~20mm), ~60 mm fell during four of the survey days. Consequently, conditions were considered ideal for the purposes of assessing site condition, with representative forbs and grasses identifiable as part of the vegetation assessment.

As agreed with NLC and the landowner, the area of interest surveyed as part of the detailed field assessments, was confined to a 4,142 ha investigation area west of ML 4750 (Stanmore SMC Pty Ltd) and includes all areas of Poplar Box TEC identified on the property during preliminary field surveys (see Figure 5). Based on a preliminary assessment of the OAG for each MNES and consultation with NLC and the landowner, this was considered a suitable area to satisfy the Project's MNES offset requirements presented as part of this OAMP and support habitat for each MNES as part of one consolidated area.

The proposed offset area encloses several small 'islands' of vegetation mapped to contain RE 11.3.1 which does not support habitat for the Project's MNES offset values, and therefore these areas are not currently considered to be part of the offset area (see Figure 5). Subject to negotiations with the landholder and the proposed fencing arrangement for the offset area, it is anticipated that some of these areas will be managed as part of the larger consolidated offset area.

Targeted pest surveys and incidental records of relevant MNES fauna species were undertaken generally in accordance with recommended Commonwealth and Queensland government survey guidelines where available, including:

- deployment of remote camera traps
- incidental diurnal fauna observations
- active nocturnal habitat searches
    - Identification of management requirements, risks and threatening processes to ensure compatibility with environmental offsets, facilitate ongoing landholder negotiations and to inform preparation of an OAMP.

Targeted greater glider surveys were undertaken in June 2024, in order to confirm the presence of the species in or adjacent to the offset area. The two other target species (koala and squatter pigeon [southern]) were confirmed in February 2024 surveys, however due to unfavourable weather, nocturnal surveying was limited. Surveys were undertaken generally in accordance with recommended Commonwealth and Queensland government survey guidelines, namely active nocturnal spotlighting searches.

Detailed baseline surveys for weeds were not undertaken as part of the detailed field survey in February 2024. They will, however, be undertaken in year 1 of the implementation of this OAMP.

Table 5: Summary of indicators of habitat quality

Indicator	Summary of approach
Site condition	Determined through a field-based assessment of 13 ecological attributes to describe the structure and function of the vegetation community, compared to the expected range for a relatively undisturbed version of the community (i.e. RE benchmark).
Site context	Determined through a combination of: • field-based results; and • GIS assessment of landscape attributes including patch size, connectedness and cover of remnant and regrowth vegetation relevant to the assessment sites in question
Species habitat index	Calculated based on a combination of: • field-based assessments • known or likely threats • land-use patterns • knowledge of the potential or likely utilisation and importance of the site for the species or ecological community in question. As part of targeted fauna surveys proposed in this OAMP, data on abundance and distribution of the koala, squatter pigeon (southern) and greater glider within the offset area will be collected and contribute to the species habitat index contributing to future habitat quality assessments.

3 VEGETATION DESCRIPTION AND CONDITION

Detailed field assessments were undertaken within a 4,200 ha investigation area, located within the south-west of the Kemmis Creek property, centred along Walker Creek. The area comprises eucalypt woodlands on early Triassic sandstone, with dissecting Quaternary-age alluvial channels (associated with Walker Creek) and flood plains to the west of Walker Creek.

A summary of the ground-truthed REs within the Kemmis Creek offset area preferred option (including RE 11.9.9 and a small portion of RE 11.9.7 within the Poplar Box TEC Buffer Area), including a description of those communities, is presented in Table 6 and their location shown in Figure 5.

Table 6: Ground-truthed Regional Ecosystems observed in the offset area on Kemmis Creek

RE	Status[a]	Description	Area (ha)
11.9.7	OC	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	708.04 (+1.95[b])
11.9.9	LC	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	56.07[b]
11.3.2	OC	*Eucalyptus populnea* woodland on alluvial plains	1,019.97
11.3.4	OC	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	197.16
11.3.25	LC	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	287.51
		Total	**2,270.68**

[a] Vegetation Class under the *Vegetation Management Act 1999* (Qld; VM Act): OC = Of Concern, LC = Least Concern.
[b] Area comprising the Poplar Box TEC Buffer Area

3.1.1 Poplar box woodlands on sandstone

The broad landscape in the offset area to the east of Walker Creek comprises paddocks on early Triassic sandstone primarily dominated by RE 11.9.7, supporting a sparse overstory of *Eucalyptus populnea* and *Eucalyptus crebra* with a scattered midstory containing species such as *Alectryon oleifolius*, *Eremophila mitchellii* and *Petalostigma pubescens*. The average understorey exotic plant cover within these vegetation communities ranged from 4% to 75%, dominated by the exotic pasture grasses *Cenchrus ciliaris* (buffel) and *Bothriochloa pertusa* (Indian bluegrass). Grazing pressure was evident throughout parts of this RE during the baseline surveys conducted in February 2024, and exotic pasture grasses (*Cenchrus ciliaris* and *Bothriochloa pertusa*) were observed as the dominant groundcover across much of this RE.

3.1.2 Alluvial watercourses and plains

The Kemmis Creek property is dissected by several alluvial channels corresponding to Kemmis Creek in the east and Walker Creek in the west of the property; the latter traversing the offset area from north to south.

Vegetation along Walker Creek is characterized by a diversity of alluvial vegetation communities, including *E. tereticornis* woodland on alluvial plains (consistent with RE 11.3.25). This RE is characterised by *E. tereticornis* and/or *E. camaldulensis*, and *Melaleuca quinquenervia* along with *Casuarina cunninghamiana* and *Acacia salicina*. Along Walker Creek a high level of weed infestations were observed, with interruptive thickets of *Lantana camara* (lantana) prevalent at several sections within the bed and banks of the main channel. Native grasses including *Themeda triandra* and *Aristida* spp. were sporadically present throughout the riparian vegetation within offset area.

Alluvial plains and terraces adjacent to Walker Creek extending out along minor drainage contours (stream orders 1 and 2) were characterized by *E. tereticornis* woodland consistent with RE 11.3.4. *Corymbia tessellaris* and *Corymbia dallachiana were* often present in these areas with *E. crebra* sporadically dominant along the minor drainage tributaries off Walker Creek. High levels of weed infestations were also observed within these alluvial systems, predominantly *Parthenium hysterophorus* (parthenium) and *Malvastrum americanum* (malvastrum) often forming monocultures dominating this RE, particularly in the west of the offset area.

Extensive alluvial plains at the base of the ridgeline in the west of the property support *E. populnea* woodland consistent with RE 11.3.2 (Plate 1). Further open woodland areas supporting RE 11.3.2 were also prevalent on Quaternary alluvial plains to the east of Walker Creek. Areas of RE 11.3.2 were consistent with the key diagnostic characteristics of Poplar Box Woodland TEC, further described in Section 4 below.

Dense stands of *A. harpophylla* sporadically present throughout the alluvial poplar box woodlands were consistent with RE 11.3.2 and considered to meet the criteria and condition thresholds for the Brigalow TEC, though the condition of these areas was not assessed as part of the current report.

Plate 1: Example of popular box on alluvial plain RE 11.3.2

3.1.3 Eucalypt woodland on sandstone

Vegetation comprising the Poplar Box TEC Buffer Zone in the south-west of the offset area supports Eucalyptus grassy woodland, dominated by *Eucalyptus crebra* (RE 11.9.9). This community grades upslope to the west into *E. crebra* woodland on medium to course grained sediments (RE 11.10.4a) forming a north-south range at the western extent of the Kemmis Creek property.

148°16'0"E

148°20'0"E

21°32'0"S

21°36'0"S

21°40'0"S

Suttor Developmental Road

Suttor Developmental Road

Bee Creek

Walker Creek

Kemmis Creek

14
22
16
05
06
20
03
09
17
10
04
08
18
13
19
12
23
01
11
07
21
15
02
24
25

Bowen Coking Coal

Location diagram

Figure 5:
Observed Regional Ecosystems

Kemmis Creek property
Offset area
Poplar Box TEC Buffer Area
Investigation area
Access tracks
Fence
Survey locations

Watercourses
Drainage contour
Minor drainage line
Creekline

Ground-truthed REs
11.3.1
11.3.2
11.3.4
11.3.25
11.3.27
11.9.2
11.9.5
11.9.7
11.9.9
11.10.4a
11.10.7
non-rem

CO2 AUSTRALIA

N

0 0.5 1 2
Kilometres

Queensland

Brisbane

AUTHOR: J. Cousin
DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Watercourses

Date: 14/04/2025 Coordinate System: GDA2020 MGA zone 55 Scale: 1:45,000@A3

Path: P:\GISData\Projects\Bowen Coking Coal\Kemmis Creek\20250409_KemmisCrk_OAMP_update\OAMP_Mapping_20250414.aprx

4 DESCRIPTION OF THE OFFSET VALUES

The following sections outline the species ecology or community description, the location and condition of the offset management areas for each MNES, and the key threats to these offset values.

The locations of the Kemmis Creek offset management areas were determined based on the results of detailed field surveys undertaken by ecologists in February 2024. Offset management areas represent the extent of habitat for the relevant offset values that are to be legally secured and will be managed within the Kemmis Creek offset area.

For each MNES, Table 3 summarises the Project impact area, offset management area, the start habitat quality score and the percent of impact acquitted using the Kemmis Creek offset area. Appendix A presents a detailed summary of the results of the baseline habitat quality assessments for each MNES within the offset area. The habitat quality scores presented in Table 3 were determined based on the data collected during baseline field surveys.

Table 7 provides a summary of the composition of suitable habitat to support the Project's MNES offset requirements based on the ground-truthed REs within the offset area. Table 7 excludes the 58 ha within the Poplar Box TEC Buffer Area. Detailed descriptions of the habitat for each MNES offset value within their offset area is provided below.

Table 7: Availability of habitat for each MNES present in the Kemmis Creek offset area

RE	BVG	Total RE area (ha)	Area of suitable habitat (ha)			
			Koala	Squatter pigeon	Greater glider	Poplar box TEC
11.3.2	17a	1,019.97	1,019.97	1,019.97	1,019.97	1,019.97
11.3.4	16c	197.16	197.16	197.16	197.16	-
11.3.25	16a	287.51	287.51	287.51	287.51	-
11.9.7	17a	708.04	708.04	708.04	708.04	-
Total		**2,212.67**	**2,212.67**	**2,212.67**	**2,212.67**	**1,019.97**

4.1 KOALA

4.1.1 Species ecology

In Queensland, the koala's distribution extends inland from the east coast: from the Wet Tropics Bioregion, into the Einasleigh Uplands Bioregion in the north of the state; from the Central Mackay Coast Bioregion, through the Brigalow Belt North Bioregion to the Desert Uplands and Mitchell Grass Downs Bioregions, and from the Southeast Queensland Bioregion, through the Brigalow Belt

to the Mulga Lands and Channel Country Bioregions in the south-west of the state (Patterson 1996; DAWE 2022). Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by *Eucalyptus* species (Martin and Handasyde 1999).

Koala habitat can be broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees. The distribution of this habitat is largely influenced by land elevation, annual temperature and rainfall patterns, soil types and the resultant soil moisture availability and fertility. Preferred food and shelter trees are naturally abundant on fertile clay soils.

The koala is a (mainly) arboreal, medium-sized marsupial with a stocky body; large, rounded ears; sharp claws and predominantly grey-coloured fur. The species displays sexual dimorphism (males generally are larger than females). There is also a general gradient in body weight from north to south across the biological range, with larger individuals occurring in the south and smaller individuals occurring in the north (the average weight of males is 6.5 kilograms (kg) in Queensland, compared with 12 kg in Victoria). In the north of the biological species' range, the koala tends to have shorter, silver-grey fur, whereas in the south it has longer, thicker, brown-grey fur (Martin and Handasyde 1999).

The koala is a leaf-eating specialist that feeds primarily during dawn, dusk or night (Crowther et al. 2013). Its diet is restricted mainly to foliage of *Eucalyptus* spp.; however, it may also consume foliage of related genera, including *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp.

4.1.2 Offset management area

Koala habitat within the proposed offset area comprises 2,213 ha of ground-truthed remnant RE 11.9.7, 11.3.2, 11.3.4, and 11.3.25. The offset area comprises suitable foraging and breeding habitat for koala, particularly within remnant riparian vegetation adjacent Walker Creek. Important koala habitat trees found to be dominant in areas across the offset area included *E. populnea*, *E. crebra*, and *E. tereticornis* (dominant canopy species through RE 11.3.25 and prevalent within RE 11.3.4). Each of these REs are considered suitable habitat, with a high level of connectivity facilitating dispersal of koalas across the landscape.

An individual koala was observed during a spotlighting event on the 18 February 2024 within the offset area along Walker Creek in an *E. crebra* tree in vegetation mapped as RE 11.3.25 (Plate 2 and Figure 6). In addition, the landholder noted that koalas had been observed at the property previously.

Plate 2: Koala observed in RE 11.3.25 along Walker Creek in offset area during baseline surveys

4.1.3 Threats

The following key threats to koala will be addressed through the implementation of this OAMP (DAWE 2022):

- habitat loss and fragmentation through land clearing
- mortality due vehicle strikes
- predation by wild dogs.

4.2 SQUATTER PIGEON (SOUTHERN)

4.2.1 Species ecology

The squatter pigeon (southern) is a ground-dwelling pigeon that forages predominantly on seeds which have fallen to the ground from low vegetation such as grasses, herbs and shrubs. Foraging habitat for the squatter pigeon (southern) consists of remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species, on sandy or gravelly soils, within 3 km of a suitable, permanent or seasonal waterbody (Squatter Pigeon Workshop 2011). Foraging habitat is generally associated with well-draining, gravelly, sandy or loamy soils containing patchy, tussock-grassy understory.

Breeding habitat occurs on stony rises occurring on sandy or gravelly soils, within 1 km of a suitable, permanent waterbody (Squatter Pigeon Workshop 2011). Well-draining soil is also an important

attribute supporting breeding habitat which typically comprises a depression scraped into the ground beneath a tussock of grass, bush, fallen tree or log (DCCEEW 2024a).

Ground cover in areas of foraging and breeding habitat for the squatter pigeon (southern) consists of native, perennial tussock grasses or a mix of perennial tussock grasses and low shrubs or forbs. Ground cover is often patchy and rarely exceeds 33% of the ground area in areas of suitable habitat (DCCEEW 2024a).

The squatter pigeon (southern) requires access to suitable waterbodies to drink daily. Permanent or seasonal rivers, creeks, lakes, ponds and waterholes, and artificial dams all provide suitable watering points. The squatter pigeon (southern) prefers to drink where there is gently sloping, bare ground on which to approach and stand at the water's edge. While patchy to moderate ground covering vegetation may occur along the banks of suitable waterbodies, a small patch (less than a square metre [m]) of bare ground at the water's edge is all that the bird requires (Squatter Pigeon Workshop 2011).

The squatter pigeon (southern) uses areas of forest and woodland to move between patches of foraging or breeding habitat and suitable waterbodies. They are unlikely to move far from woodland trees which provide protection from predatory birds, however where scattered trees still occur, they may be found foraging in or moving across modified or degraded environments such as pastures, sides of roads and stockyards (Squatter Pigeon Workshop 2011).

4.2.2 Offset management area

Squatter pigeon (southern) habitat within the proposed offset area comprises 2,213 ha of ground-truthed remnant RE 11.9.7, 11.3.2, 11.3.4, and 11.3.25. The offset area comprises suitable foraging and breeding habitat for squatter pigeon (southern), in the vicinity of Walker Creek, as well as upslope areas with appropriate grassy woodland habitat. These RE are considered appropriate habitat for squatter pigeon (southern), represented by eucalypt grassy woodland on fine-grained sedimentary rocks (RE 11.9.7), and along alluvial channels and plains (RE 11.3.2, 11.3.4, and 11.3.25). All areas of squatter pigeon (southern) offset habitat support eucalypt and acacia-dominated remnant open-forest to open-woodland with a patchy, open grassy understorey. The entire offset area is within 3 km of permanent (artificial) or seasonal waterbodies, with much of the offset area within 1 km.

During ground-truthing surveys, the presence of squatter pigeon (southern) was confirmed in the offset area (Plate 3), with over 10 individuals recorded in various groups within the north and south of the offset area (in RE 11.3.2 and 11.9.7) as well as at other locations within the Kemmis Creek property (Plate 3; Figure 6).

Plate 3: Squatter pigeons (southern) observed in poplar box woodland (RE 11.3.2) within the Kemmis Creek offset area during baseline surveys

4.2.3 Threats

The following key threats to squatter pigeon (southern) (TSSC 2015) will be addressed through the implementation of this OAMP:

- ongoing vegetation clearance and fragmentation
- degradation of habitat by overgrazing livestock
- trampling of nests by livestock
- weed invasion
- habitat degradation by rabbits
- predation by feral cats and foxes
- inappropriate fire regimes
- thickening of understorey vegetation.

4.3 GREATER GLIDER

4.3.1 Species ecology

The greater glider is generally restricted to eucalypt forests and woodlands, typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (DCCEEW 2022). During the day, the species shelters in tree hollows, with a particular selection for large hollows in large, old trees (DCCEEW 2022). In southern Queensland, greater gliders require at least 2–4 live den trees for every 2 ha of suitable forest habitat (DCCEEW 2022). The diet of the greater glider mainly comprises eucalypt leaves and occasionally flowers, with the species favouring forests with a diversity of eucalypt species due to seasonal variation. Home ranges are typically relatively small (1–4 ha) but are larger in lower productivity forests and more open woodlands (up to 16 ha; DCCEEW 2022).

4.3.2 Offset management area

Greater glider habitat within the proposed offset area comprises 2,213 ha of ground-truthed remnant RE 11.9.7, 11.3.2, 11.3.4, and 11.3.25. This habitat is located throughout the Kemmis Creek offset area, including lowland areas in the vicinity of Walker Creek as well as upland areas supporting eucalypt woodland for foraging. RE 11.3.25 and 11.3.4 provide potential denning and foraging habitat for greater glider, with large, hollow-bearing and hollow-forming trees (an important habitat feature for the species) identified throughout alluvial REs. Several locations along Walker Creek supported large *Eucalyptus tereticornis* trees, which are known to be a preferred denning tree for the species (DES 2022) and hollow-bearing *E. populnea* were abundant on adjacent alluvial plains.

During targeted greater glider surveys undertaken in June 2024, 11 individuals were identified within the offset area (Plate 4). All individuals were observed along or adjacent to Walker Creek, primarily in RE 11.3.25, although four individuals were also found in RE 11.3.4 and the boundary of RE 11.3.2, in large eucalypts (Figure 6).

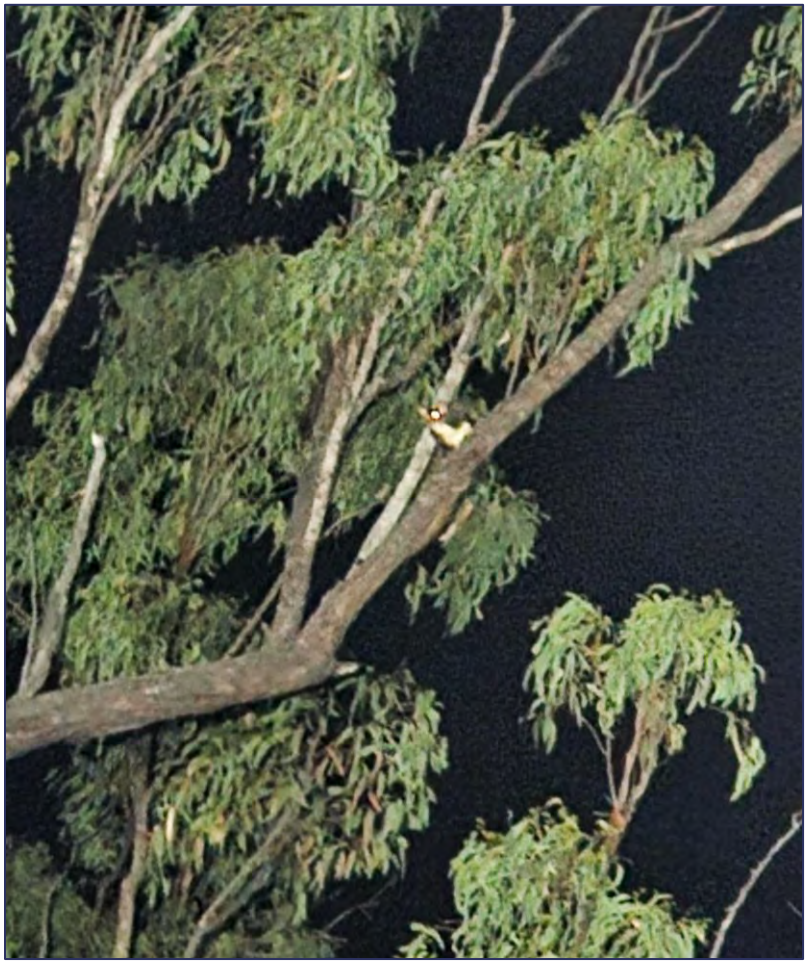


Plate 4: Greater glider observed in RE 11.3.4 within the Kemmis Creek offset area during targeted surveying

4.3.3 Threats

The following key threats to greater glider (DCCEEW 2022) will be addressed through implementation of this OAMP:

- habitat loss (through clearing, clearfell logging and the destruction of senescent trees due to prescribed burning) and fragmentation
- too intense or frequent fires.

4.4 POPLAR BOX TEC

4.4.1 Community ecology

Poplar Box TEC is typically characterised as a grassy woodland with canopy dominated by *Eucalyptus populnea* and an understory mostly of grasses and other herbs. Structure of the community varies from grassy woodland to grassy open woodland, and occasionally exhibits as an open forest. Poplar Box TEC is associated with a wide range of soil types of alluvial and depositional origin, often on gently undulating to flat landscapes and occasionally gentle slopes.

In Queensland, the TEC can be represented by four REs within the Brigalow Belt Bioregion including RE 11.3.2, 11.3.17, 11.4.7 and 11.4.12 (DCCEEW 2024b).

4.4.2 Offset management area

Poplar Box TEC within the offset area comprises 1,020.02 ha of ground-truthed remnant RE 11.3.2 on Quaternary age clay, silt and sandy alluvium and alluvial fans. Vegetation ground-truthed as RE 11.3.2 was assessed against the key diagnostic characteristics (DEE 2019) for Poplar Box TEC, being the following:

- a tree crown cover of 10% or more at the patch scale
- a tree canopy dominated by *E. populnea* and capable of reaching 10m or more in height
- a mid-layer (1-10m) crown cover of shrubs to small trees 30% or less
- a ground layer mostly dominated across a patch by native grasses, other herbs and occasionally chenopods

The canopy layer across areas of RE 11.3.2 was dominated by *E. populnea*, with other tree species occasionally present including *E. crebra, Acacia salicina, Atalaya hemiglauca* and *Alphitonia excelsa*. Canopy cover ranged from 22-48%, and canopy height from 16-19m across the five sites surveyed within RE 11.3.2. A native shrubby midstory was dominated by *Eremophila mitchellii, Atalaya hemiglauca*, and *Acacia salicina* and forming a shrub to sub-canopy layer and *Carissa ovata* the dominant shrub cover. The combined sub-canopy and shrub cover ranged from 1-30%.

The understorey was dominated by native grasses and forbs, characterised by *Aristida* spp., *Eragrostis* spp., *Panicum* spp., *Themeda triandra, Alloteropsis semialata, Cymbopogon refractus* and *Cyanthillium cinereum, Sida hackettiana, Achryanthes aspera, Indigofera* spp., *Fimbristylis dichotoma*, among others. Native grass cover accounted for 20-43% across the five sites surveyed for this RE, and non-native weed cover was recorded at <1 to 29% across sites. Prevalent non-native species included *Malvastrum americanum*, *Cenchrus ciliaris, Bothriochloa pertusa*, and *Parthenium hysterophus*.

Accordingly, areas of RE 11.3.2 across the offset area were considered to generally satisfy the key diagnostic characteristics of the Poplar Box TEC.

Plate 5: Representative photo in the Kemmis Creek offset area of poplar box grassy woodland on alluvial soils consistent with RE 11.3.2

4.4.3 Threats

The following key threats to Poplar Box TEC (DEE 2019) will be addressed through the implementation of this OAMP:

- clearance and fragmentation
- weed invasion
- inappropriate fire and grazing
- dieback
- chemical impact and spraydrift
- hydrological changes
- salinisation
- nutrient enrichment
- invasive fauna.

Should the impact area of Poplar Box TEC not be reduced, then to assist in the management of threats to Poplar Box TEC, a Buffer Area (at least 100m wide) will be managed and monitored as part of the offset (Figure 6).

148°16'0"E

148°20'0"E

21°32'0"S

21°36'0"S

Suttor Developmental Road

Suttor Developmental Road

Bee Creek

Walker Creek

Kemmis Creek

Bowen Coking Coal

Location diagram

Figure 6:
Offset area MNES habitat and confirmed species records

- Kemmis Creek property
- Offset area
- Poplar Box TEC Buffer Area
- Investigation area
- Access tracks
- Fence

Watercourse

- Drainage contour
- Minor drainage line
- Creekline

MNES offset habitat

- Koala, greater glider, squatter pigeon and Poplar Box TEC
- Koala, greater glider and squatter pigeon

Confirmed MNES species

- Squatter pigeon
- Greater glider
- Koala

CO2 AUSTRALIA

N

0 0.5 1 2

Kilometres

Queensland

Brisbane

AUTHOR: J. Cousin
DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Watercourses

Date: 14/04/2025 Coordinate System: GDA2020 MGA zone 55 Scale: 1:45,000@A3

Path: P:\GISData\Projects\Bowen Coking Coal\Kemmis Creek\20250409_KemmisCrk_OAMP_update\OAMP_Mapping_20250414.aprx

4.5 SUMMARY

Table 8 presents descriptions of each RE in the Kemmis Creek offset area and general habitat for each relevant MNES as a summary of the information provided in Sections 4.1 to 4.4.

Table 8: Descriptions and associations of REs and MNES habitat located on Kemmis Creek

REs	General description[1]	Associated MNES
11.3.2	*Eucalyptus populnea* woodland to open woodland. Occasionally, *E. melanophloia* or *E. crebra* may be present. A secondary tree layer may occur and include species such as *Geijera parviflora*, *Eremophila mitchellii, Acacia salicina, Cassia brewsteri*, and *Acacia excelsa*. The ground layer is dominated by a range of tussock grasses, including *Chloris* spp., *Enteropogon* spp., and *Aristida* spp. Occurs on Cainozoic alluvial plains with variable soil types including texture contrast, deep uniform clays, massive earths and sometimes cracking clays.	Koala, squatter pigeon (southern), greater glider, Poplar Box TEC
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus spp.* woodland to open forest on alluvial plains. A shrub layer is usually absent and a grassy ground layer is prominent. Occurs on deep cracking clays, medium to fine textured soils and deep texture-contrast soils.	Koala, squatter pigeon (southern), greater glider
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland to open forest on alluvial plains fringing drainage lines and banks of major rivers. Low shrubs are present and ground layer is open to sparse and dominated by perennial grasses, sedges or forbs. Soils are very deep, alluvial, grey and brown cracking clays with or without some texture contrast.	Koala, squatter pigeon (southern), greater glider

REs	General description[1]	Associated MNES
11.9.7	*Eucalyptus populnea* predominates forming a distinct but discontinuous canopy (10-20 m tall). Occasionally *E. melanophloia* is present in the canopy. Lower trees are absent or infrequent. An open to dense, tall shrub layer is always present, with *Eremophila mitchellii* often dominant. A patchy low shrub layer of varying density may be formed, where the tall shrub layer is more than 6 m tall. The ground layer is dominated by perennial grasses and varies from sparse to dense, depending on the shrub and tree density. *Bothriochloa decipiens, Enteropogon acicularis, Aristida ramosa* and *Aristida jerichoensis* are the most common dominants in the east with *Aristida calycina var. praealta, Aristida jerichoensis, Eragrostis* spp. and *Chloris pectinata* dominant further west. Forbs are seasonally abundant. Occurs on the lower and middle slopes of gently undulating lowlands and plains formed from Cainozoic to Proterozoic consolidated, fine-grained sediments. Associated soils are predominantly deep loamy red earths with sparse superficial ferruginous gravel, or deep texture contrast soils with thin sandy or loamy surfaces over strongly alkaline subsoils.	Koala, squatter pigeon (southern), greater glider

MNES - Threatened fauna species	General habitat description[2,3]	Associated REs
Koala (*Phascolarctos cinereus*)	Coastal and inland areas that are typically characterised by *Eucalyptus* forests and woodlands, with a limited variety of *Eucalyptus*, *Corymbia* and *Angophora* species.	11.3.2, 11.3.4, 11.3.25, 11.9.7
Squatter pigeon (southern) (*Geophaps scripta scripta*)	Open forests to sparse, open woodlands and scrub that are: • Mostly dominated in the overstory by *Eucalyptus, Corymbia, Acacia* or *Callitris* species; • Remnant, regrowth or partly modified vegetation communities; and • Within 3 km of waterbodies.	11.3.2, 11.3.4, 11.3.25, 11.9.7

REs	General description[1]	Associated MNES
Greater glider (*Petauroides Volans*)	*Eucalyptus* dominated woodlands and forests with relatively old trees and abundant hollows.	11.3.2, 11.3.4, 11.3.25, 11.9.7
MNES – Threatened Ecological Communities	**General description[3]**	**Associated REs**
Poplar Box TEC	Presence of *Eucalyptus populnea* as the dominant canopy species, on soil types of alluvial and depositional origin of grassy woodland to grassy open woodland., and occasionally open forest. Associated with the following four REs in Queensland: 11.3.2, 11.3.17, 11.4.7 and 11.4.12.	11.3.2

[1] REDD (Queensland Herbarium 2024), [2] Approved conservation advice (DAWE 2022, DEE2019, DCCEEW 2022), [3] SPRAT Profiles (DCCEEW 2024)

5 LEGALLY SECURING THE OFFSET AREA

The offset for the Project will be secured via a legally binding mechanism that is considered appropriate for protecting the MNES values in the offset areas on the offset property.

Such mechanisms include:

- Voluntary Declaration under the *Vegetation Management Act 1999* (Qld; VM Act)
- Statutory covenant under the *Land Title Act 1994* (Qld) or the *Land Act 1994* (Qld)
- Nature Refuge under the *Nature Conservation Act 1992* (Qld; NC Act).

An overview and comparison of each of these legally binding mechanisms is provided in Table 9.

The mechanisms to legally secure offset areas are linked to an approved management approach (e.g. an application for a Voluntary Declaration must be accompanied by an approved OAMP). Therefore, the appropriate legally binding mechanism process for the offset area will commence post approval of the OAMP by the Commonwealth (and State where relevant).

The offset area on Kemmis Creek is proposed to be legally secured through a Voluntary Declaration under the VM Act, subject to necessary further discussions between NLC, the regulators and the landholders.

Table 9: Legally binding mechanisms to secure offset areas

Mechanism	Summary
Voluntary Declaration VM Act Division 4, Subdivision 2 - Declarations by the Chief Executive, sections 19E to 19L	• Voluntary mechanism for protecting areas of native vegetation on land of high conservation value. • Registered on property title so its associated restrictions and obligations are binding on any subsequent landowner. • Requires implementation of an approved management plan [i.e. OAMP; s.19E(2)-(4)]. • Remains in place until the objectives of that plan are achieved, the declaration ends (s.19J and 19L), or when the authorised activities have ended, or in some cases, permanently. • Offset area is mapped on a Property Map of Assessable Vegetation and given at least the same level of protection as a remnant endangered RE under the VM Act. • Simple application process and less costly than other forms of protection such as a statutory covenant. • Enforcement is more certain than a statutory covenant. • Some activities can be exempt from the protection. • Can be removed by the Chief Executive if it is found to be not in the interest of the State, having regard to the public interest. • Timeframe: 3 to 12 months.

Mechanism	Summary

Statutory Covenant
 	
Freehold land – *Land Title Act 1994* (Qld), Part 6 Div. 4A
 	
Non-freehold land - *Land Act 1994* (Qld), Chapter 6 Part 4 Div. 8A
	• Voluntary written agreement between two or more parties that restricts or requires certain activities be carried out upon the land.
	• Registered on the land title, so the obligations they impose also bind any subsequent purchaser of the land.
	• For statutory covenants related to environmental offsets, the parties are typically:
	  o The State of Queensland or another entity representing the State or a local government (covenantee) who ensures that the conditions of the statutory covenant are observed, and
	  o The landowner (covenantor) who is subject to the obligations outlined by the covenant which, for an offset, includes complying with restrictions outlined in this OAMP.
	• To be capable of registration under Queensland legislation a statutory covenant must:
	  o relate to the use of a lot or part of a lot; or a proposed or existing building on the lot; or
	  o be aimed directly at preserving a native animal or plant; or a natural or physical feature of cultural or scientific significance; or
	  o ensure that the subject lots are transferred to single ownership only.
	• A plan of survey is required if covenant affects part of the lot.
	• Can be expensive due to survey costs as per the Registrar of Titles Directions for the Preparation of Plans. May not be suitable for land with multiple owners.
	• Can be terminated or amended by agreement of the Government covenantee.
	• Timeframe: 6 to 12 months.

Nature Refuge
 	
NC Act
 	
Part 4, Division 4
	• Voluntary nature refuge agreement between a landholder and the Government that acknowledges a commitment to manage and preserve land with significant conservation values while allowing compatible and sustainable land uses to continue.
	• High level, long-term protection.
	• Nature Refuges are managed to:
	  o conserve the area's significant cultural and natural resources;
	  o provide for controlled use of the area's cultural and natural resources; and
	  o provide for the interests of landholders to be considered.
	  o can allow for the continuation of other land uses including grazing, forestry and mining.
	• Some landholders may not wish to enter such a long-term agreement.
	• The Queensland Government no longer directly handles the establishment of privately-owned nature refuges. The Queensland Trust for Nature has been appointed by the Queensland Government to facilitate the application process for privately owned nature refuges.

Mechanism	Summary
	• The referral process with the Queensland Government can encounter bottlenecks, which can cause time delays. • Timeframe: 12-24 months.

5.1 EPBC ACT ENVIRONMENTAL OFFSETS POLICY PRINCIPLES

Table 10 demonstrates how the Kemmis Creek offset area meets the requirements of the EPBC Act *Environmental Offsets Policy*.

Table 10: EPBC Act *Environmental Offsets Policy* requirements and the Project's compliance

EPBC Act *Environmental Offsets Policy* requirement	Project offsets
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.	• Kemmis Creek offset area fully acquits the offset requirements for the three MNES species (koala, squatter pigeon [southern] and greater glider) and Poplar Box TEC (with a reduction of 5.91 ha in Poplar Box TEC impact area). • If there is no reduction in Poplar Box TEC impact area then a 58 ha Buffer Area comprising other eucalypt-dominated REs immediately adjacent to, and providing ≥100 m buffers to Poplar Box TEC vegetation will be established. It is noted, that a reduction of 5.95 ha in Poplar Box TEC impacts at the impact site, would result in there being sufficient Poplar Box TEC offset area at Kemmis Creek, and therefore remove the requirement for a 58 ha Buffer Area. • The Kemmis Creek offset area will be managed to improve the condition and viability of the species habitat and vegetation communities in accordance with EPBC Act offset obligations and OAG. The offset area will be managed and monitored from approval of this plan for 20 years. It is anticipated that the completion criteria will be achieved within a 20-year period.
Suitable offsets must be built around direct offsets but may include other compensatory measures.	• Kemmis Creek acquits the offset requirements through the delivery of suitable, direct land-based offsets in accordance with the EPBC Act *Environmental Offsets Policy* and OAG.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.	• The threatened status of the impacted protected matters is considered in the EPBC Act OAG in calculating the area of the offset to be provided.
Suitable offsets must be of a size and scale proportionate to the	• The size of the offset area to be secured has been calculated in accordance with the EPBC Act Environmental Offsets Policy and the OAG. The inputs and justifications are based on the

EPBC Act *Environmental Offsets Policy* requirement	Project offsets
residual impacts on the protected matter.	results of detailed field assessments as presented in Appendix A.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding.	• The suitability of the offset area to be secured has been calculated in accordance with the EPBC Act Environmental Offsets Policy and the OAG. The inputs and justifications are based on the results of detailed field assessments as presented in Appendix A. Implementation of this OAMP includes specific management actions to reduce the risk of threatening processes.
Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs.	• The Kemmis Creek property on which the offset area is located is zoned rural under the Isaac Regional Council Planning Scheme. The current primary land use on Kemmis Creek is cattle grazing. The proposed offsets are subject to potential threats, including spread of weeds such as parthenium (*Parthenium hysterophorus*), lantana (*Lantana camara*) and malvastrum (*Malvastrum americanum*) and exotic pasture grasses (e.g. *Cenchrus ciliaris* and *Bothriochloa pertusa*), pest animals, inappropriate fire regimes, overgrazing, land clearing where authorised and potential future development.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.	• An offset area has been identified and deemed suitable using an evidence-based and scientifically robust approach. This OAMP supports an efficient, effective, timely, transparent, scientifically robust and reasonable approach to providing offsets.
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	• This OAMP outlines a clear governance framework and delivery pathway to legally secure the offset area on the title, which will be monitored and audited/enforced.

6 ADAPTIVE MANAGEMENT

6.1 WHAT IS ADAPTIVE MANAGEMENT?

This OAMP is based on an adaptive management approach which involves 'flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood' (National Research Council 2004).

Adaptive management includes two key phases. The first phase involves the establishment of the key components of a management framework including engaging stakeholders, developing clear and measurable objectives and performance targets, identification and selection of potential management actions and the development of monitoring protocols which enable the evaluation of progress towards achieving objectives, and which will effectively contribute to the adaptive decision-making process. The second phase is an iterative learning phase which involves utilisation of the management framework to learn about the natural resource system and iteratively adapt management strategies and approaches based on what is learned (Williams 2011).

The management of natural systems involves uncertainty which can affect the success of the management measures in achieving the objectives and performance criteria. Williams (2011) and Williams and Brown (2016) identify four kinds of uncertainty: environmental variation, partial observability, partial controllability and structural or process uncertainty. These uncertainties and how they have been managed through the development of this OAMP are summarised below.

6.1.1 Environmental variation

Environmental variation is caused by external factors that act upon natural systems, but which are not influenced by the resource conditions and dynamics, for example variation in rainfall or temperature. Environmental variation is largely outside of the control of the manager (Williams 2011), however, its influence is considered in the analysis of the effectiveness of the adaptive management approach, the analysis of the ability to achieve and maintain performance criteria and when considering the need for corrective actions.

6.1.2 Partial observability

Partial observability includes potential uncertainty that arises from variation in the collection of data during monitoring events, and from being unable to completely observe the natural system in its entirety (Williams and Brown 2016). Uncertainty arising from partial observability has been managed in this OAMP through the development of a monitoring program based on scientifically tested and repeatable methods, which will be implemented by people with appropriate skills and qualifications to minimise the potential for variation.

6.1.3 Partial controllability

Partial controllability relates to the difference between the intended effect of the management measures to be implemented as part of this OAMP and the actual effect of their implementation on the ground (Williams and Brown 2016). This uncertainty is dealt with through adherence to an

adaptive management approach including regular monitoring of compliance with performance criteria, assessment of adaptive management triggers, the implementation of corrective actions, review and amendments to this OAMP and reporting to ensure that management measures are being effectively implemented on the ground.

6.1.4 Structural or process uncertainty

Structural or process uncertainty concerns a lack of knowledge or understanding regarding biological and ecological processes and relationships, and differing views regarding how natural systems respond to management (Williams and Brown 2016). Structural or process uncertainty will be largely managed through the adaptive management approach. Following the results of management, monitoring and reporting this OAMP will be reviewed and updated as required to incorporate learnings from management activities as well as updated conservation advice and best practice management techniques.

6.2 OAMP ADAPTIVE MANAGEMENT FRAMEWORK

6.2.1 Risk assessment

The adaptive management process for this OAMP is supported by a risk assessment which evaluated the known and potential risks for each offset value (see Appendix D). The relevant risks were identified based on a review of current literature (i.e. Conservation Advices, Recovery Plans etc.) and identification of potential site-specific risks. The results of the risk assessment were used to develop the adaptive management process including the identification of threats to offset values, management objectives, interim performance targets and completion criteria, management actions, monitoring programs, adaptive management triggers and corrective actions. Implementation of the adaptive management process aims to reduce the risk of the identified threats occurring to ensure that the environmental outcomes sought by this OAMP are achieved.

6.2.2 Adaptive management process

In summary, the adaptive management process for this OAMP includes the following key components:

- **Identified threats to offset values** – known and potential threats to the offset values have been identified as part of the risk assessment process.
- **Relevant offset values** – MNES for which the identified threat is relevant have been indicated.
- **Management objectives** – management objectives have been developed to address each identified threat to the offset values, and to ensure that the interim performance targets and completion criteria are attained.
- **Performance criteria** – assessable criteria have been defined to measure adherence to the management objectives.

- **Management action** – specific management actions have been identified to ensure that the performance criteria and management objectives are satisfied, and which will ultimately result in attainment of the interim performance targets and completion criteria.
- **Monitoring** – a combination of qualitative and quantitative methodologies has been included in this OAMP to assess whether management actions are meeting the performance criteria and management objectives, and ultimately, whether this OAMP is able to attain the interim performance targets and completion criteria.
- **Adaptive management trigger** – measurable events or parameters have been identified which, when triggered, indicate that a performance criterion has not been satisfied, instigating the implementation of contingency plans and corrective actions.
- **Contingency response and corrective action** – a two-step process has been established to identify the likely cause of the non-compliance with the performance criteria and allow for identification of suitable corrective actions:
    - Contingency response – a process to be instigated by a proponent Environmental Supervisor (or a nominated representative) to investigate the cause of the non-compliance with the performance criteria and identify suitable corrective actions to be implemented.
    - Corrective actions – implementation of a feasible, appropriate and effective action to address the identified issue and ensure the performance criteria is satisfied.

Figure 7 illustrates how the key components of the adaptive management process are implemented through an ongoing cycle of implementation, learning and review, with the aim of achieving the interim performance targets and completion criteria.

Through the implementation of this adaptive management process, it is anticipated that the interim performance targets and completion criteria will be attained and maintained.

It is important to note that when an adaptive management trigger occurs, the first step in applying corrective actions is to investigate the cause of the trigger. The investigation will be initiated as soon as possible, but within two business days after the trigger is identified and will focus on the reasons and causes of the trigger and identify appropriate corrective actions in a timely way. The investigation will involve:

- assessing the actual or potential, short- and long-term impacts
- determining the root and contributing causes
- recording details on approved templates
- identifying appropriate corrective actions.

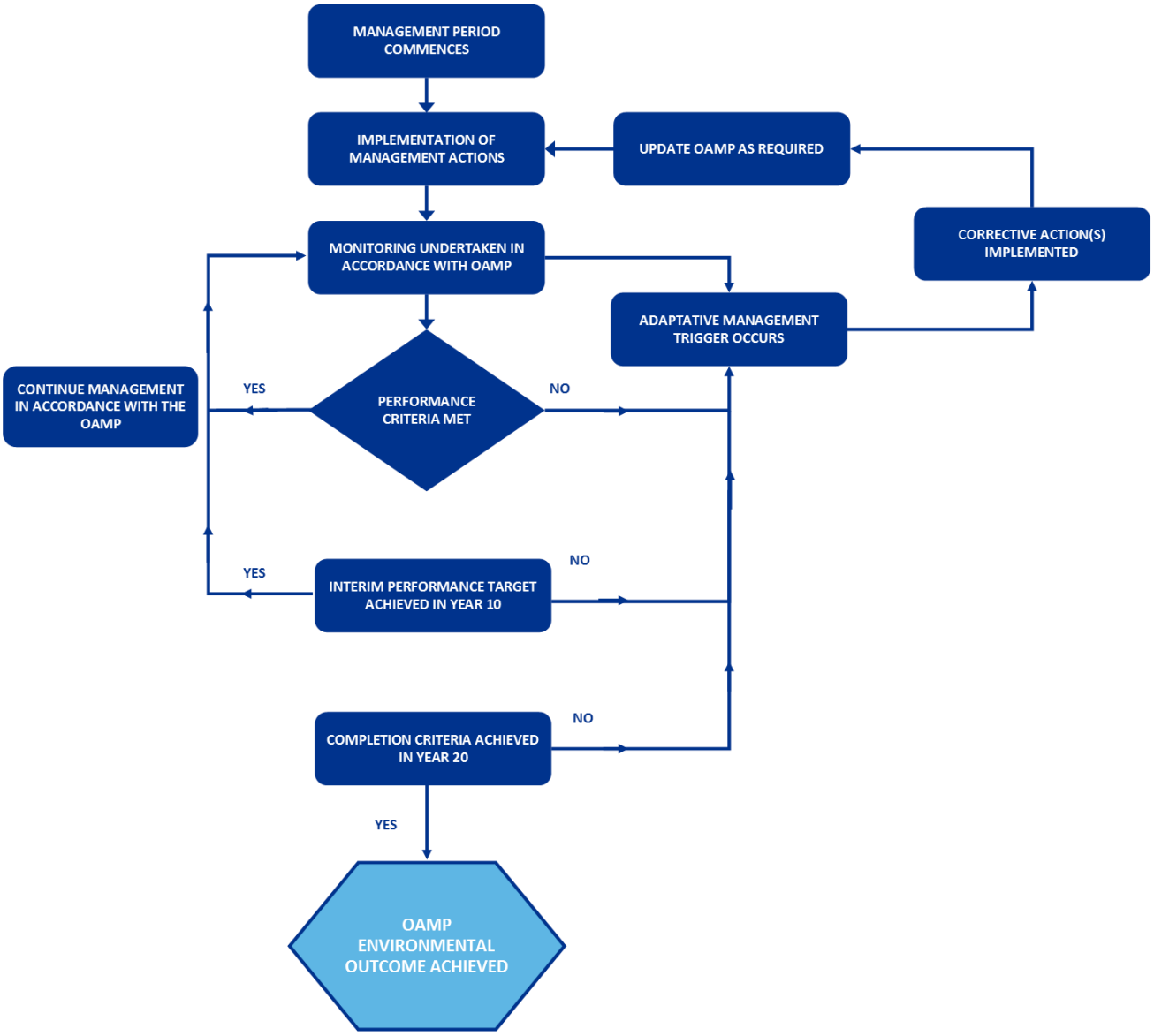


Figure 7: Process for implementation of this OAMP

6.2.3 Timing for implementation of this OAMP

The Kemmis Creek offset area will be managed and monitored until the interim performance targets and completion criteria are achieved. It is anticipated that through the adaptive management approach, interim performance targets and completion criteria will be achieved for all offset values within the proposed 20-year 'management period'. However, if the interim performance targets and/or completion criteria for all values have not been achieved within the anticipated timeframes, management and monitoring will continue beyond the 20-year period in accordance with this OAMP until the completion criteria have been achieved.

6.2.4 Offset area maintenance

As the completion criteria are met for each offset value, this OAMP will transition to actions required to sustain the completion criteria for the life of the EPBC Act approval. Beyond the achievement of the completion criteria, this OAMP will include appropriate management and monitoring measures

to ensure that the completion criteria will be sustained. The amended plan will also be based on the adaptive management process and will be provided to relevant Government Agencies prior to the end of the anticipated 20-year management period.

6.2.5 Risk of offset failure

In the unlikely event that the interim performance targets are not achieved for one or more offset values, for those offset values, NLC will promptly establish specialist advice with the aim of identifying appropriate additional management interventions.

In the unlikely event that the completion criteria are not likely to be achieved for one or more offset values, the following approved processes will be followed:

- propose the provision of additional offset options with the Commonwealth government within 1 year of the year 20 completion criteria not being met
- deliver additional offset requirements, if required, in accordance with the Commonwealth Government offset policy and in accordance with timeframes agreed with the Minister
- incorporate the additional offset requirements in a revised version of the relevant Project OAMP and submit to the Minister for approval.

6.2.6 Management objectives

A summary of the management objectives and performance criteria is presented in Table 11, and the complete adaptive management process for this OAMP is encapsulated in Table 12. Management actions, monitoring events, adaptive management triggers and corrective actions have been assigned to each management objective and performance criteria, as presented in Table 12.

Table 11: Summary of the management objectives and performance criteria

Management objectives	Performance criteria
Achieve the completion criteria and habitat quality improvements for MNES, which include the habitat quality scores in this OAMP.	Increase the habitat quality scores for each MNES at each habitat quality assessment site based on the results of baseline and subsequent monitoring events to achieve the scores presented in Table 13.
Maintain the extent of MNES habitat/vegetation within the Kemmis Creek offset area.	No unapproved/intentional clearing of habitat within the Kemmis Creek offset area, with the exception of clearing that is required for fencing, access, firebreaks and public safety as outlined in Table 14. Minimise any clearing required within the offset area for the above purposes (i.e. for fencing, access, firebreaks and public safety).
Ensure that any livestock grazing for fire management and weed control maintains and enhances the ground cover attributes for MNES	Increase the richness and average % cover of native perennial grasses at each habitat quality assessment

Management objectives	Performance criteria
and does not result in the degradation of habitat and vegetation.	site based on the results of baseline and subsequent monitoring events. Biomass levels of at least 1,500 kg/ha are retained at each of the monitoring sites at the end of the dry season. Livestock are only observed in the offset management areas during strategic grazing events.
Minimise predation risk by feral cats to threatened fauna species.	Reduction in Catling* Index for feral cats from year 1.
Minimise predation risk by wild dogs to threatened fauna species.	Reduction in Catling* Index for wild dogs from year 1.
Minimise predation risk by foxes to threatened fauna species.	Reduction in Catling* Index for foxes from year 1.
Minimise grazing pressure and associated habitat degradation by chital deer.	Reduction in Catling* Index for chital deer from year 1.
Minimise degradation of MNES habitat by rabbits.	Maintain rabbit impact category as 'acceptable'.
Minimise degradation of MNES habitat by feral pigs.	Reduction in mean feral pig abundance score from year 1.
Manage invasive weed species to reduce degradation of MNES habitat.	Decrease in relative abundance of weed species at 80% of monitoring sites from year 1 and subsequent monitoring events. No new weed species are identified at any monitoring site (based on year 1 and subsequent monitoring events).
Reduce the risk of adverse impacts on MNES habitat associated with inappropriate fire regimes or unplanned fire.	Increase in habitat quality scores as a result of implementation of the fire management measures.
Achieve the interim performance targets and completion criteria for each MNES within 5, 10 and 20 years.	The interim performance targets presented in Table 13 are achieved for all offset values by year 5. The interim performance targets presented in Table 13 are achieved for all offset values by year 10. The completion criteria presented in Table 13 are achieved for all offset values by year 20.

Management objectives	Performance criteria
Once attained, the habitat quality is sustained for all offset values.	Once attained, the habitat quality score, specified as the completion criteria in Table 13, is sustained for all offset values.

* Catling index provides a measure of relative abundance for foxes, wild dogs and feral cats within the Kemmis Creek offset area. The Catling index will be measured as the percentage of camera nights in which the pest species was observed as part of fauna camera monitoring for the species as outlined in Section 8.3.

Table 12: Management objectives, performance criteria, adaptive management triggers, corrective actions

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
Degradation of habitat	• koala • squatter pigeon (southern) • greater glider • Poplar box TEC	Achieve the completion criteria and habitat quality improvements for MNES, which include the habitat quality scores in this OAMP.	Increase the habitat quality scores for each MNES at each habitat quality assessment site based on the results of baseline and subsequent monitoring events to achieve the scores presented in Table 13.	Implementation of the management actions and adaptive management framework as outlined in this OAMP (see Section 7).	Monitoring of the Kemmis Creek offset area and MNES habitat quality scores will be undertaken in accordance with Section 7.8, including: Offset area inspections (Section 8.1). Habitat quality assessments to determine habitat quality scores (Section 8.6.2). The results of monitoring events will be compared against the habitat quality scores in the interim performance targets and completion criteria to determine the progress of the Kemmis Creek offset area and recorded as part of the annual report (Section 9.1).	Habitat quality scores for interim performance targets are not achieved for one or more offset value by year 5 or 10. Habitat quality scores for completion criteria are not achieved for one or more offset value by year 20.	Step 1: Investigate cause of trigger • Investigate reasons why the interim performance targets or the completion criteria were not achieved within the specified timeframes. • Re-evaluate the suitability of the relevant management measures in this OAMP. • Identify appropriate corrective actions based on the outcome of the investigation into the cause. Step 2: Implementation of corrective action(s) • Increasing the frequency and intensity of pest animal and weed control measures or revising the type of measures to be implemented. • Modifying the strategic grazing regime, or fire management measures, to better support enhancement of offset values. • Establishing additional fencing to exclude livestock from offset management areas during wet periods. • Third party review of this OAMP to provide input on the effectiveness of the management actions. • For offset values that have not achieved interim performance targets, establish specialist scientific advice with the aim of identifying appropriate additional management interventions. • In the very unlikely event that it is considered that the completion criteria will not be achieved, the proponent will discuss the provision of additional offset options with the Commonwealth Government.
Habitat or vegetation loss through land clearing	• koala	Maintain the extent of MNES habitat/vegetation within the Kemmis Creek offset area.	No unapproved/ intentional clearing of habitat within the Kemmis Creek offset area, with	Preferred option for legal security is a Voluntary Declaration of the Kemmis	Legally secure the offset area within the timeframe nominated in the EPBC approval (Section 5).	Any activities in contravention of the	Step 1: Investigate cause of trigger • Identify appropriate corrective actions.

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
	• squatter pigeon (southern) • greater glider • Poplar box TEC		the exception of clearing that is required for fencing, access, firebreaks and public safety as outlined in Table 14. Minimise any clearing required within the offset area for the above purposes (e.g. for fencing, access, firebreaks and public safety).	Creek offset area under the VM Act as described in Section 5.		Voluntary Declaration and this OAMP.	Step 2: Implementation of corrective action/s • The appropriate corrective actions will be implemented and may include submission of application for alternative legal security mechanism to relevant authority.
				Comply with the restrictions outlined in Table 14. Construction and maintenance of access tracks and fencing will be undertaken in accordance with Sections 7.3 and 7.4. Utilise existing network of roads and access tracks as firebreaks rather than establishing new ones, as outlined in Section 7.7. In the event that vegetation clearing is required for fencing, access, firebreaks or public safety, all activities must be recorded and monitored by the onsite Environmental Supervisor, as outlined in Section 7.2.	Compliance with restrictions for vegetation clearing associated with maintenance and establishment of access tracks, fencing and firebreaks will also be assessed as part of offset area inspections (Section 8.1).	Clearing for fencing, access, firebreaks or public safety is not undertaken in accordance with the restrictions outlined in Table 14 and Sections 7.3, 7.4 and 7.7.	Step 1: Investigate cause of trigger • If restrictions for clearing associated with fencing, access, firebreaks or public safety are not adhered to, NLC will ensure that all clearing activities cease immediately. • Investigate the reason for unapproved or unintentional clearing. • Following clearing, the area is to be assessed by a suitably qualified ecologist/expert to determine the total clearing extent of offset value habitat. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • The appropriate corrective actions will be implemented and may include: • Reviewing and modifying protocols for the establishment of fences, access tracks, and firebreaks. • Prior to the establishment of fences, access tracks, and firebreaks, the area to be cleared will be clearly marked out with flagging tape and checked prior to clearing. • Rehabilitation of the impacted area.

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
Degradation of habitat by livestock overgrazing	• squatter pigeon (southern) • Poplar Box TEC	Ensure that any livestock grazing for fire management and weed control maintains and enhances the ground cover attributes for MNES and does not result in the degradation of habitat and vegetation.	Increase the richness and average % cover of native perennial grasses at each habitat quality assessment site based on the results of baseline and subsequent monitoring events.	Implementation of strategic grazing to reduce fuel loads and control exotic pasture grasses in accordance with Section 7.8.2 Implementation of strategic grazing to promote the establishment of preferred foraging grass species including modifying the frequency, intensity and/or duration of grazing events. Excluding livestock grazing during wet periods (approximately November to March), which is typically the peak growing and flowering season for native grasses. Construct additional fencing should the current fencing be considered insufficient to manage the strategic grazing regime.	Habitat quality assessments will be undertaken in accordance with Section 8.6.2. These will include assessment of % cover of native perennial grasses.	Decrease in the richness and average ground layer cover at one or more habitat quality assessment sites based on the results of baseline and subsequent monitoring events.	Step 1: Investigate cause of trigger • Investigate the reason for the decrease in richness and average % cover of native perennial grasses. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • The appropriate corrective actions will be implemented and may include: • Modifying the strategic grazing regime to maintain a suitable ground layer cover for the squatter pigeon (southern) including modifying the frequency, intensity and/or duration of grazing events. • Constructing additional fencing should the current fencing be considered insufficient to manage livestock in accordance with the grazing regime. • Installing additional watering points for livestock to manage livestock in accordance with the grazing regime.
			Biomass levels of at least 1,500 kg/ha are retained at each of the monitoring sites at the end of the dry season.	Implementation of the strategic grazing regime to protect and maintain environmental values in accordance with Section 7.8.2	Biomass monitoring will be undertaken in accordance with Section 8.4.	Biomass monitoring results indicate less than 1,500 kg/ha of biomass is present at any of the monitoring sites at the end of the dry season.	Step 1: Investigate cause of trigger • Investigate the reason for the decrease in biomass at the end of the dry season. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • Corrective actions will be implemented and may include the following: • Re-evaluating the strategic grazing regime to assess the suitability of grazing to ensure no less than 1,500 kg/ha of biomass is retained at the end of the dry season. • Removal of stock or spelling grazing from the offset management area in which less than 1,500kg/ha of biomass was identified.

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
							• Reviewing adherence to livestock grazing restrictions in Section 7.8.2 • Amending livestock management practices in this OAMP, including amending stocking rates, and/or duration and/or frequency of strategic grazing. • Evaluating the location of existing fencing to ensure it is enough to control livestock as part of strategic grazing and investigate if additional fencing is required to be constructed. • Constructing additional fencing to control livestock movements.
			Livestock are only observed to be in the offset management areas undertaking strategic grazing.	Existing fencing is maintained as outlined in Section 7.4. Construction of additional fencing as required, in accordance with Section 7.4.1.	Offset area inspections will be undertaken at least twice a year (Section 8.1) and will include monitoring to assess the: • condition of fencing to identify any necessary maintenance requirements. • presence of livestock within the offset management area.	Livestock are observed within an offset management area when not permitted within that area. Damaged fencing is observed.	Step 1: Investigate cause of trigger • Investigate the reason why livestock have entered the offset area. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • Corrective actions will be implemented and may include the following: o If livestock are identified in the offset management areas, notify the person responsible for stock management and remove stock immediately. o Repair fencing to ensure its condition is satisfactory to exclude livestock. o Construct additional fencing should the current fencing be considered insufficient to exclude livestock.
Predation by feral cats	• squatter pigeon (southern)	Minimise predation risk by feral cats to threatened fauna species.	Reduction in Catling* Index for feral cats from year 1.	Implement control actions for feral cats in accordance with Section 7.5.	Undertake monitoring for feral cats in accordance with Section 8.3.	An increase in Catling* Index for feral cats from year 1 and subsequent monitoring events.	Step 1: Investigate cause of trigger • Investigate the reason for the increase in Catling index (or relative abundance or change in rabbit impact category) from year 1/subsequent monitoring events.
Predation by wild dogs	• koala	Minimise predation risk by wild dogs to threatened fauna species.	Reduction in Catling* Index for wild dogs from year 1.	Implement control actions for wild dogs in accordance with Section 7.5.	Undertake monitoring for wild dogs in accordance with Section 8.3.	An increase in Catling* Index for wild dogs from	

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
						year 1 and subsequent monitoring events.	• Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • Corrective actions will be implemented and may include the following: o Reviewing adherence to pest management control measures as outlined in Section 7.5. o Increasing the frequency and intensity of pest animal control. o Revising methods of pest animal control in accordance with Queensland Department of Agriculture and Fisheries (DAF) guidelines and coordinate with neighbouring landowners to ensure a consistent approach. o Updating pest animal control methods in this OAMP and targeted pest animal control programs.
Predation by foxes	• squatter pigeon (southern)	Minimise predation risk by foxes to threatened fauna species.	Reduction in Catling* Index for foxes from year 1.	Implement control actions for foxes in accordance with Section 7.5.	Undertake monitoring for foxes in accordance with Section 8.3.	An increase in Catling* Index for foxes from year 1 and subsequent monitoring events.	
Degradation of habitat by rabbits	• squatter pigeon (southern) • Poplar Box TEC	Minimise degradation of MNES habitat by rabbits.	Maintain rabbit impact category as 'acceptable'.	Implement control actions for rabbits in accordance with Section 7.5.	Undertake monitoring for rabbits in accordance with Section 8.3.	Rabbit impact category measured as 'monitor closely', or 'unacceptable'.	
Degradation of habitat by feral pigs	• koala • squatter pigeon (southern) • Poplar Box TEC	Minimise degradation of MNES habitat by feral pigs.	Reduction in mean feral pig abundance score from year 1.	Implement control actions for feral pigs in accordance with Section 7.5.	Undertake monitoring for feral pigs in accordance with Section 8.3.	An increase in mean feral pig abundance score from year 1 and subsequent monitoring events.	
Degradation of habitat by deer	• koala • squatter pigeon (southern) • Poplar Box TEC	Minimise degradation of MNES habitat by deer.	Reduction in mean deer abundance score from year 1.	Implement control actions for deer in accordance with Section 7.5.	Undertake monitoring for deer in accordance with Section 8.3.	An increase in mean deer abundance score from year 1 and subsequent monitoring events.	

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
Invasion of habitat by weed species, including exotic grasses and rubber vine	• koala • squatter pigeon (southern) • greater glider • Poplar box TEC	Manage invasive weed species to reduce degradation of MNES habitat.	Decrease in relative abundance of weed species at 80% of monitoring sites from year 1 and subsequent monitoring events.	Implement weed control actions in accordance with Section 7.6. Adhere to weed hygiene restrictions in accordance with Section 7.2.	Undertake weed monitoring in accordance with Section 8.2.	An increase in relative abundance of weed species at more than 15% of monitoring sites from year 1 and subsequent monitoring events.	Step 1: Investigate cause of trigger • Investigate the increase in relative weed abundance. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • Corrective actions will be implemented and may include the following: o Reviewing adherence to weed management control measures as outlined in Section 7.6. o Amending weed hygiene restrictions. o Providing additional weed awareness training for all staff and contractors to ensure weed hygiene restrictions are adhered to. o Revising weed control methods. o Increasing the frequency and intensity of weed control. o Updating weed control methods in this OAMP and targeted weed control programs.
Inappropriate fire regimes	• koala • squatter pigeon (southern) • greater glider • Poplar box TEC	Reduce the risk of adverse impacts on MNES habitat associated with inappropriate fire regimes or unplanned fire.	Increase in habitat quality scores as a result of implementation of the fire management measures.	All fire management measures to be implemented in accordance with the program outlined in Section 7.7.	Habitat quality assessments to determine habitat quality scores will be undertaken in accordance with Section 8.6.2.	As a result of fire management measures there is a decrease in the habitat quality score for any MNES from baseline.	Step 1: Investigate cause of trigger • Investigate the reason for the decrease in habitat quality score. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • Corrective actions will be implemented and may include the following: o Review adherence to the fire management measures as outlined in Section 7.7. o Increasing the frequency of biomass monitoring. o Increasing the frequency of weed control measures.

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
							○ Amending the strategic grazing regime. ○ Reviewing effectiveness of firebreaks, and establishment of additional fire breaks. ○ Modifying the timing and/or intensity of controlled burns.
Offset fails to achieve the interim performance targets and completion criteria within the anticipated 5, 10- and 20-year timeframes.	• koala • squatter pigeon (southern) • greater glider • Poplar box TEC	Achieve the interim performance targets and completion criteria for each MNES within 5, 10 and 20 years.	The interim performance targets presented in Table 13 are achieved for all offset values by year 5. The interim performance targets presented in Table 13 are achieved for all offset values by year 10. The completion criteria presented in Table 13 are achieved for all offset values by year 20.	All management actions outlined in Section 7 will be implemented to ensure that the interim performance targets and completion criteria are achieved.	Monitoring of the Kemmis Creek offset area will be undertaken in accordance with Section 7.8, including: • Offset area inspections (Section 8.1). • Habitat quality assessments to determine habitat quality scores (Section 8.6.2). • The results of monitoring events will be compared against the interim performance targets and completion criteria (Table 13) to determine the progress of the Kemmis Creek offset area and recorded as part of the annual report (Section 9.1).	Interim performance targets are not achieved for one or more offset values by year 5 or 10. Completion criteria are not achieved for one or more offset values by year 20.	Step 1: Investigate cause of trigger • Investigate the reason for not achieving interim performance targets. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • Corrective actions will be implemented and may include the following: ○ Re-evaluating the suitability of the relevant management measures in this OAMP. ○ Increasing the frequency and intensity of pest animal and weed control measures or revising the type of measures to be implemented. ○ Modifying the strategic grazing regime, or fire management measures, to better support enhancement of offset values. ○ Preventing livestock access to the offset management areas during wet periods.
Once attained, the habitat quality is not sustained within the lifetime of the OAMP or approved activities.	• koala • squatter pigeon (southern) • greater glider • Poplar box TEC	Once attained, the habitat quality is sustained for all offset values.	Once attained, the habitat quality score, specified as the completion criteria in Table 13, is sustained for all offset values.	Develop and implement a plan for sustaining habitat quality in the Kemmis Creek offset area (Section 7).	Monitoring will be undertaken in accordance with the plan for sustaining habitat quality in the Kemmis Creek offset area.	Monitoring event determines a decrease below the habitat quality score specified as the completion criteria in Table 13.	Step 1: Investigate cause of trigger • Investigate the reason for the decrease in habitat quality score. • Identify appropriate corrective actions. Step 2: Implementation of corrective action(s) • Corrective actions will be implemented and may include the following: ○ Re-evaluating the suitability of the relevant management

Identified threat to offset values[1]	Relevant MNES	Management objectives	Performance criteria	Management action (see Section 7)	Monitoring (see Section 8)	Trigger for adaptive management and corrective action	Corrective action
							measures in the plan for sustaining habitat quality in the Kemmis Creek offset area. o Increasing the frequency and intensity of pest animal and weed control measures or revising the type of measures to be implemented. o Modifying the strategic grazing regime, or fire management measures, to better support enhancement of offset values. o Preventing livestock access to the offset management areas during wet periods. o Revising the plan for sustaining habitat quality in the Kemmis Creek offset area.

* Catling index provides a measure of relative abundance for foxes, wild dogs and feral cats within the Kemmis Creek offset area. The Catling index will be measured as the percentage of camera nights in which the pest species was observed as part of fauna camera monitoring for the species as outlined in Section 8.3.

[1] MNES conservation advice taken from Species Profile and Threats Database, Department of the Environment, Canberra. Available from: https://www.environment.gov.au/sprat.

7 MANAGEMENT PROGRAM

This section outlines the management actions that will be implemented within the offset management areas to achieve the management objectives, satisfy the performance criteria and ultimately achieve the interim performance targets and completion criteria.

7.1 ENVIRONMENTAL OUTCOMES TO BE ACHIEVED

The overall aim of this OAMP is to improve the habitats of MNES within the Kemmis Creek offset area in order to meet the offset requirements of the Project.

The interim performance targets and completion criteria defined in Table 13 indicate progress towards achievement of the overall aim. The interim performance targets and completion criteria must be achieved through the implementation of this OAMP. The management measures outlined in Section 5 have been designed to support the achievement of the performance targets, completion criteria and the overall aim of this OAMP, and to minimise the risk of known threats to the MNES occurring.

Following the commencement of this OAMP, the interim performance targets and completion criteria are expected to be achieved within 5, 10 and 20 years.

7.1.1 Habitat quality scores

The key interim performance targets and completion criteria to be achieved include increases in habitat quality, which is represented by habitat quality scores. Habitat quality scores are calculated by assessing a range of indicators and ecological attributes that measure the overall viability of the offset and its capacity to support the MNES.

Table 13 presents the start and future habitat quality scores for each MNES as presented in the EPBC Act OAGs in Appendix A. The start quality score for each MNES was determined as part of baseline surveys undertaken in February 2024 in accordance with the GTDTHQ (version 1.3; DEHP 2020) which follows the Queensland Herbarium's BioCondition Assessment Manual (version 2.2). All future habitat quality scores will also be determined in accordance with the GTDTHQ method (DEHP 2020). The detailed method for calculating habitat quality scores is outlined in Appendix C.

Table 13: Interim performance targets and completion criteria for MNES

MNES	Start habitat quality score	Interim performance target – to be achieved by year 5 of management	Interim performance target – to be achieved by year 10 of management	Completion criteria – to be achieved by year 20 of management
Koala	7	• Improve the quality of koala habitat to achieve a habitat quality score greater than 7.	• Improve the quality of koala habitat to achieve a habitat quality score of 8 or greater.	• Improve the quality of koala habitat to attain and maintain a habitat quality score of 8 or greater.
Squatter pigeon (southern)	7	• Improve the quality of squatter pigeon (southern) habitat to achieve a habitat quality score greater than 7.	• Improve the quality of squatter pigeon (southern) habitat to achieve a habitat quality score of 8 or greater.	• Improve the quality of squatter pigeon (southern) habitat to attain and maintain a habitat quality score of 8 or greater.
Greater glider	7	• Improve the quality of greater glider habitat to achieve a habitat quality score greater than 7.	• Improve the quality of greater glider habitat to achieve a habitat quality score of 8 or greater.	• Improve the quality of greater glider habitat to attain and maintain a habitat quality score of 8 or greater.
Poplar Box TEC	8	• Improve the quality of Poplar Box TEC habitat to attain and maintain a habitat quality score of 8 or greater.	• Improve the quality of Poplar Box TEC habitat to attain and maintain a habitat quality score of 8 or greater.	• Improve the quality of Poplar Box TEC habitat to attain and maintain a habitat quality score of 8 or greater.

7.2 GENERAL RESTRICTIONS

The general restrictions presented in Table 14 will be imposed across the offset area to ensure the management objectives and completion criteria are achieved.

Table 14: Kemmis Creek offset area general restrictions

Restriction	Details
Access	Access into the Kemmis Creek offset area will be restricted to authorised personnel only. Existing and new fences will be used to restrict access into the Kemmis Creek offset area, with gates installed where necessary. Signs will be installed in prominent locations (i.e. at access points into the Kemmis Creek offset area) which recognise that the areas are protected for conservation purposes. The signs will advise that access into these areas is restricted to authorised personnel only. The Kemmis Creek offset area and the individual offset management areas will be demarcated on site plans.
Vehicles	Vehicle movement will be limited to designated access tracks in the Kemmis Creek offset area and access will be restricted to authorised personnel only. Vehicles will travel to track conditions to minimise the risk of vehicle strike with the speed sign posted at all entry points.
Vegetation clearing	No unapproved/intentional clearing of native vegetation is permitted within the Kemmis Creek offset area as part of any management and monitoring activities associated with this OAMP, except for clearing that is required: • to realign, construct or maintain access tracks up to 5 m width (Section 7.3) • for fence construction and maintenance (up to 5 m width on each side of the fence) (Section 7.4) • to ensure public safety or as directed by emergency management response personnel in the event of uncontrolled bushfire or another emergency procedure. If vegetation clearing is required for fencing, access, firebreaks or public safety, all activities must be recorded and monitored. No machinery will be allowed on site after heavy or prolonged rainfall events until the site has dried to allow for safe movement of traffic.
Weed hygiene	Weed hygiene measures will be implemented to prevent the movement of weed material into the Kemmis Creek offset area. All persons entering the Kemmis Creek offset area are required to ensure all vehicles and equipment are weed free. Contractors seeking to enter the Kemmis Creek offset area are to ensure they hold a current weed hygiene certificate or equivalent for all vehicles and equipment. Evidence is to be provided on request that vehicles and any machinery implementing management actions are clean prior to entry to minimise potential weed spread.

7.3 ACCESS TRACKS

Existing access tracks will be utilised to facilitate necessary management, maintenance and monitoring activities as part of this OAMP. If existing access tracks become impassable (through erosion or vegetation regrowth), maintenance activities of these tracks (e.g. grading) will be prioritised over alternative track alignments. Gully crossings are likely to be subject to periodic, maintenance because of erosion following rain events.

Existing and new access tracks will be no wider than 5 m and vegetation disturbance will be minimised (in accordance with Section 7.2). Additional access tracks may be required for ongoing monitoring of the offset property and management activities.

7.4 FENCING

7.4.1 Review of fencing and confirmation of new fencing requirements

Within the first year of management all existing fences contributing to the management of Kemmis Creek offset area will be mapped. In addition, as part of the year 1 review of strategic grazing (see details in Section 7.8), the location of existing fencing will be assessed and, where required to assist with livestock control for weed and fuel load management, additional fencing will be installed.

In addition to the above, if monitoring indicates degradation of habitat for MNES is occurring due to strategic grazing for weed and fuel load management, then options for additional fencing will be investigated and installed as required.

Any vegetation disturbance associated with new fence construction will be minimised in accordance with Section 7.2.

7.4.2 Fencing inspections

Regular inspections of all fencing will be undertaken in accordance with Section 8.1, and repairs to the fences will be made as required.

7.5 PEST ANIMAL MANAGEMENT

The offset values are at risk from various threats from pest animals. Many of these pest animals are known to be present within or in the immediate vicinity of the Kemmis Creek offset management areas, with threats including:

- predation by foxes, feral cats and wild dogs
- erosion and degradation of habitat of all MNES offset values by feral pigs, rabbits and deer

Pest animal species confirmed within the offset area included deer (*Axis axis*), feral pig (*Sus scrofa*), feral cat (*Felis catus*), rabbits (*Oryctolagus cuniculus*) and wild dogs (*Canis lupus*) which were observed on site during field surveys in July 2023, June 2024 or were captured by fauna camera traps which were set throughout the offset area from November 2023 to February 2024.

Management of pest animals is generally most effective when undertaken as part of a broad scale coordinated approach involving all stakeholders in the area. Pest animal control activities will be conducted in accordance with the *Biosecurity Act 2014* (Qld). Table 15 provides examples of approved pest animal control measures recommended by the Queensland and Commonwealth Governments.

Assessments of pest animals will be undertaken in year 1 to determine the species present and assess their distribution and abundance across the Kemmis Creek offset area (see Section 8.3). The results of year 1 assessments of the Kemmis Creek offset area will be compiled to inform the most appropriate species-specific control measures, location and timing for management activities. These will be incorporated into this OAMP prior to commencement of year 2.

Species-specific control measures and timing for control activities will be reviewed every three years based on the following:

- results of pest animal monitoring in the Kemmis Creek offset area (Section 8.3)
- liaison with surrounding landholders regarding known pest animal presence within the local area and a strategic approach to pest animal management.

Table 15: Species-specific pest animal control methods

Species	Status*	Control method options
Feral cat (*Felis catus*)	Restricted matter – category 3,4,6	Successful feral cat control programs require the use of multiple control methods including night shooting, poisoning, trapping and fencing in conjunction with land management practices (DAF 2020a): • Night shooting undertaken with the use of a fox whistle to attract cats. • Poisoning of feral cats using fresh meat baits containing sodium fluoroacetate (1080). • Trapping using rubber-jawed and leg-hold traps work best for true feral cats. Ideal trapping sites include those where territorial markers such as faecal deposits and pole-clawing are present.
Fox (Vulpes vulpes)	Restricted matter – category 3,4,5,6	Control methods for the fox include shooting, trapping, fencing, baiting and livestock guardian dogs combined with land management. Baiting activities will be coordinated among adjoining properties to effectively reduce the impact of foxes (DAF 2020b): • Poison baits using 1080 and strychnine and fresh meat baits are the most economic, efficient and effective method of controlling foxes and can be laid quickly by hand, from vehicles or aircraft. Baits should be placed along track and fence lines 200–500 m apart, 8–10 cm underground and covered with loose soil. The optimum time to bait is in spring following June/July when food demand is highest. • Trapping and shooting are other forms of control methods for foxes; however, are generally ineffective for broad-scale or long-term reductions and should be done in conjunction with other control techniques.

Species	Status*	Control method options
Wild dog (Canis familiaris)	Restricted matter – Category 3,4,6	Control methods for wild dogs include (DAF 2020c): • Ground baiting. • Foot hold traps. • Shooting.
Rabbit (Oryctolagus cuniculus)	Restricted matter – category 3,4,5,6	An integrated control approach, incorporating different control methods in conjunction with land management will be implemented as appropriate. This form of control includes destroying rabbit warrens, baiting, rabbit-proof fencing, fumigation, trapping and shooting (DAF 2021): • While warren ripping is the most effective method for long-term control, this method is not to be used in the Kemmis Creek offset area. Instead, control of rabbits will be undertaken through methods such as trapping, shooting and baiting. • Poison baiting consisting of 1080 or Pindone. • Trapping should be used as a 'mop up method' as it is not effective for reducing large populations. Trapping methods include cage trap, barrel trap and foot hold traps (soft-jaw or padded), however these methods are extremely labour intensive.
Pig (Sus scrofa)	Restricted matter – category 3,4,6	Effective pig control will include an integrated and collaborative approach with surrounding land management. The following controls will be applied as appropriate (DAF 2020d): • Poisoning using 1080 baits is the most efficient and effective control method. To maximise effectiveness, free feeding with non-poisoned bait should be performed for several days prior to laying poisoned baits. • Trapping is most effective in populated areas on smaller areas (<500 ha) and is useful in control of remaining individuals from poisoning programs. • Fencing can successfully reduce pig damage to a specific area; however, is considered an expensive control option. The most effective pig-proof fences use fabricated sheep mesh held close to the ground by plain or barbed wire and supported on steel posts.
Chital deer (*Axis axis*)	Restricted matter – category 3,4,6	Effective feral chital deer control will include an integrated and collaborative approach, best done as a joint exercise, involving all land managers in the district. The following controls will be applied as appropriate (DAF 2023): • Shooting • Ground and helicopter shooting • Trapping • Exclusion fencing

* Status under the *Biosecurity Act 2014* (Qld).

7.6 WEED MANAGEMENT

The presence of *Cenchrus ciliaris* and other exotic pasture and weed species pose a threat to vegetation communities and habitat values of the Kemmis Creek offset area. An initial survey will be undertaken in year 1 at each monitoring site (Section 8.2) to calculate the species richness and

abundance of restricted, prohibited weeds and other weed species, including exotic grasses. The primary weed control methods to be informed by the results of the initial year 1 survey (which will be incorporated into this OAMP prior to commencement of year 2):

Weed management by spot-spraying is appropriate in high weed load areas (e.g. high traffic/disturbance areas, permanent watering points, riparian areas). Spraying will occur at the end of the wet season when there is active growth. Strategic spraying of small, isolated patches of non-native species will be undertaken, working from upslope to downslopes areas, eventually working towards core infestations. Follow-up inspection and treatment will be implemented two to four weeks later if regrowth is evident, including mechanical removal of woody weeds. Woody weeds are typically difficult to control and will be managed through a combination of herbicide and mechanical techniques.

Regular maintenance of firebreaks, roads and tracks will also help reduce the risk of weed incursion by preventing traffic into intact grasslands and other habitat for offset matters.

Species-specific control measures and timing for control activities will be reviewed every three years based on the results of weed monitoring in the Kemmis Creek offset area (see Section 8.2).

7.6.1 Buffel grass (*Cenchrus ciliaris*)

Research at other sites has found that areas supporting *Cenchrus ciliaris* can contribute to a ground cover biomass up to 20 times that of similar, intact vegetation communities (Walker et al. 1981). Elevated biomass increases the risk of uncontrolled, high intensity fires. Furthermore, these exotic pasture species detrimentally impact on the habitat and availability of microhabitat features such as native grasses (Franks 2002), including species of grasses known to be important to threatened fauna species (e.g. squatter pigeon [southern]).

As a high density of *Cenchrus ciliaris* is known to increase the frequency and intensity of bushfire in some woodland communities, management will incorporate a combination of a strategic grazing regime (see Section 7.8.2) and fire management regime (see Section 7.7) in the offset management areas.

7.6.2 Restricted, prohibited and other weeds

In addition to exotic pasture grasses, there are isolated occurrences of numerous restricted, prohibited and other weed species across the Kemmis Creek offset area, including:

- malvastrum (*Malvatrum americanum)*
- lantana (*Lantana camara*)
- harrisia cactus (*Harrisia martinii*)
- prickly pear (*Opuntia* sp.)
- parthenium weed (*Parthenium hysterophorus*)

Restricted weed species listed under the *Biosecurity Act 2014* (Qld) are targeted for control because they have, or could have, serious economic, environmental or social impacts. Monitoring in

accordance with Section 8.2 will be undertaken to monitor the species richness and abundance of weeds in the Kemmis Creek offset area. Weed infestations in the offset management areas will be controlled in accordance with the recommended control measures available from the Queensland Department of Agriculture and Fisheries[2].

Table 16 presents example weed control methods that may be used for species known to occur within the Kemmis Creek offset area.

[2] https://www.daf.qld.gov.au/business-priorities/biosecurity/invasive-plants-animals/plants-weeds

Table 16: Example weed control methods

Species	Status*	Control method	Link to website
Harrisia cactus (*Harrisia martinii*)	Restricted matter – category 3	• Mechanical control • Herbicide control • Biological control	• Queensland government website for Harrisia cactus (*Harrisia martinii*)
Prickly pear (*Opuntia* sp.)	Restricted matter – various species in categories 2-5	• Mechanical control • Herbicide control • Biological control	• Queensland government website for prickly pear (*Opuntia* sp.)
Parthenium weed (*Parthenium hysterophorus*)	Restricted matter – category 3	• Herbicide control	• Queensland government website for *Parthenium hysterophorus*

* Status under the *Biosecurity Act 2014* (Qld).
^ Not prohibited or restricted invasive plant under the *Biosecurity act 2014* (Qld), but by law everyone has a general biosecurity obligation to take reasonable and practical steps to minimise the risks associated with invasive plants and animals under their control.

7.7 FIRE MANAGEMENT

A planned and co-ordinated fire management regime will be implemented to:

- minimise the risk and impacts of unplanned fire, and
- improve habitat quality through controlling weeds and supporting development of structural components of offset values (e.g. recruitment of native plants, establishment of fire sensitive native herbs and ground cover, important microhabitat including fallen logs and leaf litter, and increased understorey).

7.7.1 Fire management regime and management zones

Fire management of the offset matters will be guided by conservation advice documentation (e.g. for MNES) and the Regional Ecosystem Description Database (REDD; Queensland Herbarium 2024), which provides recommendations for fire management for each of the component REs. The recommended fire management regime for each RE is outlined in Table 17. The offset area consists of both fire sensitive ecosystems and fire dependent ecosystems.

Fire risk will be managed by:

- a well-maintained network of firebreaks:
  - the location for additional firebreaks will be mapped and, if required, additional firebreaks will be constructed to assist with controlled burns

- regular maintenance (grading and spraying) of firebreaks, roads and tracks will also be used to manage risks associated with unplanned fire. Biomass monitoring will be undertaken annually as part of fire management activities to assess fuel loads, determine the risk of unplanned fire to the offset area and inform fire management strategies. Biomass monitoring will also inform strategic grazing activities for fuel load management

Given the uncertainty and complexity around the relationship between fire and habitat quality, fire management measures will be reviewed yearly or following controlled burns, and outcomes of the review reported, as part of the annual report (Section 9.1) to ensure that management objectives and performance criteria for the various offset values are being addressed.

Table 17: Fire management guidelines for each component RE within the offset area (REDD; Queensland Herbarium, 2024)

RE	Management measure	Season	Intensity	Timing	Considerations
11.3.2	Restrict to less than 30% in any year. Burn under conditions of good soil moisture and when plants are actively growing. Sometimes a small amount of wind may move the fire front quickly so that burn intensity is not too severe to destroy habitat trees.	Late wet to early dry season when there is good soil moisture. Early storm season or after good spring rains.	Low to moderate.	6-10 years	Burn interval for conservation purposes will differ from that for grazing purposes; the latter being much shorter. Management of this vegetation type should be based on maintaining vegetation composition, structural diversity, fauna habitats (in particular hollow-bearing trees and logs) and preventing extensive wildfire. Maintaining a fire mosaic will help ensure protection of habitat and mitigate against wildfires. Fire can control shrub invasives (e.g., *Eremophila* spp. and *Acacia stenophylla* in the red soil country in particular). Low to moderate intensity burns with good soil moisture are necessary to minimise loss of hollow trees. Avoid burning riparian communities as these can be critical habitat for some species. Culturally significant (scar) trees may need protection, such as rake removal of ground fuels. Planned burns have traditionally been carried out in the winter dry season; further research required.
11.3.4					
11.9.7					
11.9.9					
11.3.25	Protection relies on broad-scale management of surrounding country with numerous small fires throughout the year so that wildfires will be very limited in extent.	Primarily early dry season.	Low	3-5 years.	Fringing communities are critical habitat. In some situations it may be best not to burn. Intense and extensive fires degrade vegetation structure and destroy fauna habitats. Restrict the extent and intensity of fires. Hollow trees are critical habitat. Non-native grasses may be an issue and an intensive

RE	Management measure	Season	Intensity	Timing	Considerations
					grazing regime for very short periods, may be necessary to limit potential of wildfire. Fire is an option for control of weeds (possibly in ungrazed situations). If riparian areas need to be burnt to reduce fuel load then burning should occur when there is good soil moisture and active growth. Late wet to early dry season when there is good soil moisture. Early storm season or after good spring rains.

7.8 LIVESTOCK MANAGEMENT

Livestock should be generally excluded from or reduced within the offset area during the wet season (November-March).

- Restricting the frequency and intensity of grazing within the offset area is undertaken to reduce the level of damage to the vegetation (native grass and saplings), maximise native grass seed production and facilitate recovery of native perennial grasses and the herbaceous layer, reduce soil impaction and erosion in certain areas, specifically around waterways and reduce fuel loads by decreasing weedy cover.
- To minimise erosion and subsequent impacts on water quality, strategic grazing will be excluded where rainfall causes inundated or waterlogged soils.
- The location and extent of grazing exclusion areas will be reviewed annually based on the results of management and monitoring events.
- End of the wet season also coincides with most common breeding time for squatter pigeon, hence removing or reducing grazing pressure at this time will reduce risk of nest trampling

Livestock will be potentially permitted into the offset area during the wet season if the minimum 1,500 kg/ha of dry matter is exceeded at the end of dry season surveying in order to reduce fuel loads, and potentially to control weeds. An annual report will submitted to New Lenton Coal (NLC) at the end of the dry seasons survey period.

- This report will include results for biomass monitoring for both the wet and dry seasons. If biomass has exceeded minimum thresholds, then liaison will occur between NLC and the landholder to allow additional grazing to occur within the offset area at the start of the wet season.

The suitability of conditions for undertaking a grazing event will be informed by biomass monitoring events as described in Section 8.4. Regular inspections of all fencing will be undertaken in accordance with Section 8.1 and repairs to the fences will be made as required.

7.8.1 Year 1 review

At the beginning of year 1 of management, NLC will review the following factors in order to support the best practice strategic grazing management approach outlined below:

- Buffel grass load, having regard for the results of initial surveys and the weed surveys carried out in year 1 of management.
- The location of existing and new fence lines to enable strategic grazing for conservation outcomes, fuel load management and management of exotic grass infestations.
- The location of existing watering points and location of potential new additional watering points to be installed if required

- Teed management activities, specifically management of buffel grass and other exotic pasture grasses.
- Agistment arrangements.

7.8.2 Best practice strategic grazing management principles

Best practice management for strategic grazing within the Kemmis Creek offset area will involve the following:

- livestock will be permitted in the offset area during the wet season to:
  - reduce fuel loads based on the results of biomass monitoring (Section 8.4), and
  - to avoid weed seed set and reduce weed cover based on the results of weed monitoring (Section 8.2).
- livestock will be excluded from the offset area during the wet season (approximately November to March) to maximise native grass seed production and facilitate recovery of native perennial grasses and the herbaceous layer, unless grazing is required under exceptional circumstances (e.g. the grazing event may be required to be extended as a result of additional rainfall and resultant grass growth/extended flowering and seeding period). In the event strategic grazing is required to be undertaken during the wet season the minimum amount of grazing to reduce the identified risk will be implemented.
- livestock will be excluded from recently burnt areas (< 2 years) to allow native grasses to recover, including seed set, except in instances where biomass monitoring (see Section 8.4) indicates there is a high fire risk.

7.9 EROSION MANAGEMENT

Erosion of waterlogged areas and creek embankments is possible especially in the vicinity of watercourses, gullies and historic high traffic areas following wet season flood events.

Erosion will be managed by:

- promoting vegetation colonisation of eroded areas by limiting stock access to those parts of the offset area subject to erosion
- maintaining offset boundary fencing
- restriction of strategic grazing events within these offset management zones following wet season rainfall (Section 7.8).

Vegetation colonisation will be encouraged through management of strategic grazing events. Livestock will be excluded from offset areas for the 3-month wet season spell (typically between December and February of each year, which are on average the wettest three months of the year), which is when most of the grass growth and seedling recruitment occurs.

Offset boundary fencing will be maintained to ensure it is in good working order, with inspections carried out annually and prior to cattle entering a paddock that bounds an offset area. Where

necessary, off-stream watering points will be established to minimise the need for stock to access watercourses for water. These management actions will assist with stabilisation of creek embankments and other areas susceptible to erosion, minimising likelihood of future erosion events.

If watercourses are not stabilising through this management regime, and are continuing to degrade in offset areas, corrective actions (including extended livestock exclusion and/or additional fencing or remediation) will be implemented.

8 MONITORING PROGRAM

Monitoring is required to ensure this OAMP meets the performance criteria and management objectives, and ultimately attains the interim performance targets and completion criteria. The monitoring program includes:

- offset area inspections (Section 8.1)
- weed monitoring (Section 8.2)
- pest animal monitoring (Section 8.3)
- biomass monitoring for grazing and fire management (Section 8.4)
- habitat quality assessments (Section 8.6.2)
- photo monitoring (Section 8.6.3)

The results of monitoring events will be included in annual reports to be completed at the end of each management year as outlined in Section 9.1. The monitoring results will also be used to assess adherence to management objectives. interim performance targets and completion criteria, and to determine when corrective actions are required to be implemented. The results will also be compared to those from previous monitoring events in order to assess change over time and to inform the implementation of this OAMP.

8.1 OFFSET AREA INSPECTIONS

The aim of offset area inspections is to provide a general assessment of the offset management areas to identify any potential issues that may require remedial action to be undertaken. Inspections will be undertaken at least twice a year, usually, at the end of the wet season and at the end of the dry season. In considering the most appropriate timing for the inspections, the following matters will be considered:

- most appropriate time to assess fuel loads i.e. at the end of the wet season (approximately March) and towards the end of the dry season (approximately October), as biomass is at its greatest at the end of the wet season with fire risk greatest towards the end of the dry season
- annual variation in timing of the wet season (typically November to March) and the dry season (typically April to October) based on current, previous and predicted weather conditions.

Offset area inspections will assess the following:

- condition of fencing, gates and signs
- condition of access tracks
- condition of firebreaks
- compliance with restrictions for vegetation clearing associated with maintenance and establishment of access tracks, fencing and firebreaks

- erosion within the Kemmis Creek offset area, particularly around permanent and semi-permanent waterbodies
- damage/degradation resulting from pest animal activity within the Kemmis Creek offset area
- signs of land degradation and over-grazing
- exclusion of livestock outside of strategic grazing events
- incidental fauna observations and any additional risks to offset values (i.e. evidence of vehicle strike).

The results of offset area inspections will be included in the annual report to be submitted every year (see Section 9.1). The annual report will identify any remedial actions required to be undertaken in the subsequent year of management.

8.2 WEED MONITORING

The offset management areas will be monitored for evidence of restricted, prohibited and other weed outbreaks, including:

- an initial survey at each monitoring site to be undertaken in year 1 to calculate the species richness and abundance of weeds, including exotic grasses
- subsequent weed surveys undertaken in year 2 then every two years thereafter (corresponding to habitat quality assessment monitoring – Section 8.6.2) at the end of the wet season (approximately March) to implement timely and effective management of emerging weed infestations (and opportunistically during management and offset area inspections).

Weed monitoring sites will be established in accordance with the following considerations:

- permanent sites representative of offset values and collocated at 12 permanent habitat monitoring sites incorporating natural variability such as aspect (e.g. a mix of north, east, south and west facing monitoring sites), and community type – (e.g. woodland and riparian)
- within 1.5 km of each existing watering point and any new watering points in the Kemmis Creek offset area (where possible and relevant) to ensure timely detection of new source infestations of weeds.

Permanent monitoring sites provide greater confidence in monitoring changes that have occurred over time, compared with random monitoring sites which are likely to just reflect natural variation at the site level (Auld 2009). Accordingly, the number and location of permanent weed monitoring sites will be established in year 1 based on the results of the year 1 surveys.

Monitoring events will be undertaken post wet season and will include a combination of the following methods:

- plot-based weed transects – an assessment of weed species richness and relative abundance based on plot-based cover estimates along transects within 1 ha weed monitoring sites

- photo monitoring of selected sites to assess visual changes in weed species and infestations over time
- incidental observations will be collated as part of offset area inspections, noting weed infestations away from permanent weed monitoring sites, including at heavily trafficked/disturbed areas (e.g. entry gates, creek crossings, stock watering points) to monitor potential introduction and/or outbreaks of prohibited and restricted weed species.

Details of the weed monitoring methodologies are presented in Table 18.

Table 18: Weed monitoring methodology

Weed monitoring method	Methodology
Plot-based weed transects	An assessment of weed species richness and relative abundance will be undertaken in accordance with the following method: • at randomly stratified, permanent 1 ha sites (100 m x 100 m) across the Kemmis Creek offset area collocated at permanent habitat monitoring sites • at each site, mark out three 100 m transects (traversing perpendicular to the contour), keeping them parallel to one another, 50 m apart • at every 10 m interval along each of the transects, centre a 2 m x 2 m plot frame and record the presence, species and cover of weeds. Weed cover at each 2 m x 2 m survey site will be recorded as a percentage and converted into one of five cover classes: 1 = 0%, 2 = 0-5%, 3 = 6-25%, 4 = 26-50% and 5 = 51-100% (Auld 2009) • an average cover score for each weed species for each 1 ha site will be calculated. The average cover score is calculated as the average percentage from the 30 plots surveyed from the three 100 m transects.
Photo monitoring	A time-series photographic analysis to visually assess changes in vegetation composition (namely, weeds), will be undertaken as follows: • at the start of the first and second plot-based weed transects (corresponding to the 0 m and 50 m point of the collocated habitat quality monitoring site), establish photo-monitoring points • at each of the photo monitoring points, take five photos from 1.5 m height above ground level, namely photos facing north, east, south, west and one facing the ground. The ground shot should be chosen to give a representative indication of cover and species composition for the general area.
Incidental observations	As part of offset area inspections, outside of plot-based weed transects, record details (including location, species and extent) of weeds, including species not previously encountered in the Kemmis Creek offset area, new weed outbreaks and areas of significant weed cover.

8.3 PEST ANIMAL MONITORING

The Kemmis Creek offset area will be monitored for evidence of pest animals including:

- an initial survey undertaken in year 1 to assess the distribution and abundance of pest animals
- pest animal monitoring surveys undertaken every two years post wet season (approximately April).

In addition to surveys at the permanent monitoring sites described below, evidence of pest animals will be opportunistically observed throughout the year as part of other monitoring events (i.e. offset area inspections [Section 8.1]).

Based on the results of year 1 surveys, pest animal monitoring sites will be established in year 1. Monitoring of foxes, feral cats, rabbits, feral pigs and chital deer will target areas of known impacts/movements (e.g. along topographic features, including creeks, pads, paths, ridge-tops and roads) to not only maximise the success of encountering pest animals, but target monitoring in environments that are more regularly impacted (e.g. drainage lines, moist gullies and around swamps favoured by feral pigs; Hone 1995).

The results of this pest animal monitoring will inform adaptive pest animal control, including targeting specific areas of pest animal outbreaks or impact.

Methods for determining the presence and relative abundance for foxes, feral cats, rabbits, feral pigs and chital deer are presented in Table 19.

Table 19: Pest animal monitoring methodology

Pest animal	Methodology to be implemented
Fox (*Vulpes vulpes*) Wild dog (*Canis familiaris, C. familiaris dingo, C. lupus familiaris, C. lupus dingo*) Feral cat (*Felis catus*) Feral pig (*Sus scrofa*) Chital deer (*Axis axis*)	To assess the relative abundance of foxes, feral cats, wild dogs, feral pigs and chital deer within the Kemmis Creek offset area, camera monitoring will be undertaken as follows to provide a measure of the Catling index for each species. The Catling index will be measured as the percentage of camera nights in which the pest species was observed. An increase or decrease in the Catling index value between subsequent monitoring events will represent an increase or a decrease in the relative abundance of pest species and a measure of the success of pest animal control. • fauna monitoring cameras will be placed throughout the Kemmis Creek offset area • cameras will be placed along tracks, more than 500 m apart (where possible) • cameras will be left in place for a minimum of three consecutive nights • an analysis of the camera footage will be undertaken to determine the percentage of camera nights with animal captures for each species observed. This percentage represents the Catling index (Mitchell and Balogh 2007b, c). It is important to account for and remove cameras that have failed when determining the Catling index.
Feral pig (*Sus scrofa*)	An assessment of the presence or absence of feral pig signs [a] as a measure of the relative abundance of feral pigs within the Kemmis Creek offset area in accordance with Mitchell and Balogh (2007a) and Hone (1988), will be undertaken as follows: • nominate randomly stratified, permanent 300 m x 300 m sites across the Kemmis Creek offset area in environments that are more regularly impacted (e.g. drainage lines, moist gullies, around swamps etc.) • at each site, three 300 m transects are assigned; two each along the boundary of the 300 m x 300 m site and one parallel to those through the middle of the site • traverse in an east-west direction, surveying for the presence of any feral pig signs 1 m either side of the transect in every 50 m section • calculate an abundance score for each transect as the percentage of 'present' feral pig signs from the 6 sections along the 300 m transect. The average frequency of occurrence across the Kemmis Creek offset area will be used as an index of abundance and compared between subsequent monitoring events to assess the effectiveness of feral pig control. Furthermore, changes to scores for individual sites/transects can point to areas to target control activities. [a] Feral pig signs can include rooting, wallows, dung, footprints, travel pads, plant damage and tree rubs, as well as the physical presence of feral pigs.
Rabbit (*Oryctolagus cuniculus*)	An assessment of rabbit impact in accordance with Cooke et al. (2008) will be undertaken as follows. Permanent monitoring sites, represented by a 2 ha patch of habitat collocated with permanent habitat monitoring sites is traversed over 15-20 minutes assessing: • Rabbit abundance – a measure of the presence and number of rabbit warrens and the abundance of any faecal pellets (including 'buck-heaps' or latrines) – measured on a scale of 0 – 5 • Seedling abundance – a measure of the presence and abundance of native vegetation seedlings encountered during the 15-20-minute traverse – measured on a scale of 0 – 5 • Rabbit damage – a measure of seedlings (< 0.5 m height) with evidence of rabbit damage, identified as 45° 'secateurs-like' cuts through smaller stems, defoliation and gnawing of bark – measured on a scale of 0 – 5. From this assessment, a 'corrected regeneration score' is calculated from the seedling abundance and rabbit damage score. This measure corrects for seedling regeneration as a function of observed rabbit damage and is subsequently used to calculate overall rabbit impact with the rabbit abundance score (refer to Cooke et al. [2008]). Overall rabbit impact is assigned as one of three categories – 'acceptable', 'monitor closely' or 'unacceptable', as determined from a combination of the score for rabbit abundance and the corrected regeneration score.

8.4 BIOMASS MONITORING

Biomass monitoring for fire management will be undertaken twice a year, at the end of the wet season and end of the dry season, to:

- determine the risk of fire to the offset site, and
- inform fire management strategies.

Biomass is at its greatest at the end of the wet season (around April) with fire risk greatest towards the end of the dry season (September/October). Biomass will be monitored within the offset areas using appropriate photo standards[3] which will be used to determine dry matter yields and subsequently fuel loads. Biomass monitoring will be undertaken at the same permanent weed monitoring sites established as part of the baseline surveying in year 1, collocated with permanent habitat monitoring sites.

The stocking rate of strategic grazing events will be determined through a feed budgeting assessment (see Section 8.4.1) undertaken prior to a grazing event in the offset area. A feed budgeting assessment is a recognised method of determining the stocking rate based on the amount of feed available and the amount of feed desired at the end of the grazing event (i.e. >1,500 kg/ha).

8.4.1 Feed budgeting assessment

The process for undertaking a feed budget assessment will include the following sequence of activities:

- determine the current amount of feed present (kg/ha) using appropriate photo standards available on the Future Beef website[3].
- determine the amount of feed desired (kg/ha) at the end of the grazing event.
- calculate the total useable feed (kg/ha) by subtracting the feed desired from the feed present.
- determine utilisation (i.e. the proportion of useable feed that livestock can use).
- determine the feed available for the grazing animal (kg/ha) by multiplying the total useable feed by the utilisation rate.
- calculate the safe stocking rate by:
    - determining the feed consumption per day (kg/day)
    - determining the number of days feed is required (days)
    - calculating the feed requirement per head (kg/hd) by multiplying the feed consumption per day by the number of days
    - calculating the stocking rate (ha/hd) by dividing the feed requirement per head by feed available

3 See https://futurebeef.com.au/knowledge-centre/pastures-forage-crops/pasture-photo-standards/

- calculating the number of stock (head) by dividing the area of the paddock by the stocking rate.

The amount of feed available prior to the grazing event will be estimated using the appropriate photo standards available on the Future Beef website[3]. The "Dry Season Feed Budget" worksheet will then be used to calculate the required stocking rate for the grazing event.

At the completion of the grazing event, photo standards will be used to assess ground cover and ecosystem biomass. Should the grazing event be required to be extended (e.g. as a result of additional rainfall and resultant grass growth and potential weed flowering), the feed budget assessment will be recalculated using the "Dry Season Feed Budget" worksheet.

8.5 FUEL HAZARD MONITORING

Fuel hazard monitoring will be undertaken in accordance with the Overall Fuel Hazard Assessment Guide (Hines et al. 2010 ;Appendix G). Fuel hazard monitoring will be undertaken at all permanent habitat monitoring sites and will include a baseline survey in year 1 (post wet season; April), with ongoing fuel hazard monitoring conducted every year at the same time and location as biomass monitoring post wet season. Monitoring will focus on assessing the key structural layers of the fine fuels that burn in bushfires, specifically bark, elevated fuels, near-surface fuels and surface fuels. This will allow for a rapid assessment of each fuel layer, which in in turn is given a hazard rating and are then combined to provide an overall fuel hazard rating of low, moderate, high, very high or extreme.

The fuel hazard rating will be monitored to compare any changes from previous assessments. In conjunction with results of habitat quality assessments, the results of the fuel hazard assessments will be used to determine if fuel hazard reduction burns may be required within the offset area. Weed management and strategic grazing within the offset area will also be undertaken to maintain fuel hazard rating below extreme.

8.6 MONITORING OF OFFSET MANAGEMENT AREAS

The offset management areas will be monitored for each MNES identified in this OAMP. Monitoring activities within each offset management area will consist of:

- habitat quality assessments in accordance with the GTDTHQ, including targeted fauna surveys
- photo monitoring.

Specific timing for each of the monitoring activities is outlined in the sections below and is shown in the implementation schedule in Section 10.2.

8.6.1 Monitoring locations

Fixed monitoring sites within the offset areas will be established as part of the habitat quality assessments in year 1. The number and location of habitat quality monitoring sites is determined in accordance with the GTDTHQ (version 1.3; DEHP 2020), to assess any variation in condition across the offset area and effectively assess key habitat features for each offset value. Some habitat quality

monitoring sites will be used to assess habitat for more than one offset value where relevant habitat overlaps. The number of habitat quality monitoring sites required, based on the area of REs contributing to the Kemmis Creek offset area, is presented in Table 20.

Table 20: Permanent habitat monitoring sites

RE	Description	Area (ha)	Minimum number monitoring sites (GTDTHQ)
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	1,019.97	6
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	197.16	4
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	287.51	4
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	708.04 (+1.95 Poplar Box TEC Buffer Area)	5
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	56.07 (Poplar Box TEC Buffer Area)	2

The location of habitat monitoring sites will be consistent with locations established as part of the February 2024 baseline assessments, with additional points proposed to be established to ensure there are the required number in accordance with the GTDTHQ (version 1.3; DEHP 2020). The locations of habitat monitoring sites assessed in February 2024 are shown in Table 21 and Figure 5, also identifying the proposed location of additional points to be established within the Kemmis Creek offset area in the first year.

As part of the habitat quality assessments undertaken in the first year of implementation of this OAMP, the habitat monitoring sites will be demarcated with a capped stake at the 0 m and 50 m points along the 100 m transect, and a GPS location will be recorded in GDA2020, Zone 55 projection. The final location of the monitoring sites will be presented in the first annual report following the first year of management, with subsequent monitoring events undertaken at the same locations.

Table 21: Offset management area permanent habitat monitoring sites (GDA2020, Zone 55 projection)

Monitoring site	Easting	Northing	RE	Koala	Squatter pigeon (southern)	Greater glider	Poplar Box TEC
1*	633468	7607603	11.3.2	•	•	•	•
2*	633463	7606716	11.3.2	•	•	•	•
3*	633753	7613335	11.3.2	•	•	•	•
4*	632995	7610546	11.3.2	•	•	•	•
5*	632235	7615353	11.3.2	•	•	•	•
6*	632519	7615377	11.3.25	•	•	•	
7*	634139	7606983	11.3.25	•	•	•	
8*	633363	7610622	11.3.25	•	•	•	
9*	634151	7613320	11.3.25	•	•	•	
10*	633548	7611757	11.3.4	•	•	•	
11*	633867	7607044	11.3.4	•	•	•	
12*	633281	7608210	11.3.4	•	•	•	
13*	633194	7608779	11.3.4	•	•	•	
14†	633841	7608504	11.9.7	•	•	•	
15†	635202	7606772	11.9.7	•	•	•	
16*	631864	7618709	11.9.7	•	•	•	
17†	635202	7606772	11.9.7	•	•	•	
18*	633078	7615738	11.9.7	•	•	•	
19*	634071	7612081	11.9.7	•	•	•	
20§	633632	7614447	11.3.2	•	•	•	•
21§	634368	7606866	11.9.7	•	•	•	
22§	631420	7617731	11.9.7	•	•	•	

Monitoring site	Easting	Northing	RE	Koala	Squatter pigeon (southern)	Greater glider	Poplar Box TEC
23§	634339	7608115	11.9.7	Buffer Area for Poplar Box TEC			
24§	632560	7605890	11.9.9				
25§	633050	7605474	11.9.9				

* Original habitat quality monitoring sites within the Kemmis Creek offset area.
† Original habitat quality monitoring sites outside of the Kemmis Creek offset area, but used to establish baseline score.
§ Additional (new) monitoring sites (indicative location) to be established within the offsets area in the first year of management as part of the habitat quality assessments, including sites in the Poplar Box TEC Buffer Area.

8.6.2 Habitat quality assessments

Habitat quality for each MNES will be assessed in accordance with the GTDTHQ (version 1.3; DES 2020) as outlined in the method presented in Appendix C. The guide was developed by the Queensland Government to measure the habitat quality of a land-based offset and draws in part on. the methodology set out in the *BioCondition Assessment Manual* (Eyre et al. 2015) comparing site condition to BioCondition benchmarks (as developed by the Queensland Herbarium) with an additional component for species offsets that is a species habitat index (see below).

Habitat quality assessments will be undertaken in year 1 and year 2, followed by assessments every 2 years thereafter. Habitat quality assessments will be undertaken at the permanent habitat monitoring sites described above in Section 8.6.1 at the end of the wet season (approximately March).

Data from habitat quality assessments will be included in monitoring reports. Reports prepared for year 2 and subsequent years will include summary data from all previous years, and these will be presented to allow trend analysis of each of the measured attributes and will be used to assess progress towards achieving the interim performance targets and completion criteria.

For koala, squatter pigeon (southern) and greater glider, a species habitat index assessment will be calculated based on results of targeted fauna surveys for those threatened species within their respective offset management areas. Targeted fauna surveys will be undertaken in accordance with the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al*. 2018), *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010) and other species-specific survey guidelines endorsed by Queensland and/or Commonwealth Governments. Guidance on the specific methodologies to use as part of this OAMP is deferred to the abovementioned guides, but may include area searches, transects-based searches or other contemporary methods outlined in current or updated guidelines were endorsed by Queensland and/or Commonwealth Governments.

In the absence of specific seasonally enhanced detectability of squatter pigeon (southern), surveying will be undertaken over a minimum of three days during the breeding season (between spring and summer). In accordance with the *Survey Guidelines for Australia's Threatened Birds*

(DEWHA 2010) and based on effective previous experience in the Brigalow Belt (J. Cousin, pers. comm. 2024), squatter pigeon (southern) will be passively surveyed by flushing them while traversing the offset by vehicle and by foot, recording the number (and abundance) of squatter pigeon (southern) encounters during any survey event.

All methodology documents noted throughout this OAMP are referenced in Section 11 (References) and include internet hyperlinks to PDFs of those documents (where available).

8.6.3 Photo monitoring

Photo monitoring is a qualitative analysis technique that provides the opportunity for visual time series analysis of changes in vegetation composition, structure and integrity. In areas where active management is being undertaken, photo monitoring offers a simple and effective visual means by which to capture the response of the vegetation to management actions.

Photo monitoring will be undertaken at the same time as habitat quality assessments at each of the permanent habitat monitoring sites. Permanent photo monitoring points will be established at the 0 m and the 50 m point of all transects at all permanent habitat monitoring sites. Five photos will be taken at each location (from 1.5 m height above ground level) in the direction down the transect, one to the right, backwards, left and an oblique view of the ground. The ground shot should be chosen to give a representative indication of cover and species composition for the general area, at an angle such that the horizon is visible at the top of the photo.

A record of the photographs will be maintained, including GPS co-ordinates, date and time of each photograph, the direction in which the photo was taken and the height above the ground at which the photo was taken.

8.6.4 Targeted fauna surveys

Targeted fauna surveys will be undertaken for koala, squatter pigeon (southern) and greater glider within their respective offset management areas. Targeted fauna surveys will correspond with those years where habitat quality assessments are undertaken (Section 8.6.2). Consequently, targeted fauna surveys will be undertaken in year 1 and year 2, followed by assessments every 2 years thereafter. Targeted fauna surveys will be undertaken in accordance with relevant species-specific survey guidelines endorsed by the Queensland and/or Commonwealth Government (Table 22). All flora and fauna surveys will be conducted by suitably qualified personnel.

Table 22: Summary of survey techniques for flora and fauna

Offset matter	Survey summary	Relevant guidelines
Koala	• Surveys for koalas will be undertaken using a modified version of the Regularised Grid Based Spot Assessment Technique (RGB-SAT) (Biolink Ecological Consultants 2008), applied at 500 m grid-cell sampling intersections. This method will use the Spot Assessment Technique (SAT) methodology (Phillips and Callaghan 2011),	• Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al. 2018) • EPBC Act referral guidelines for the

Offset matter	Survey summary	Relevant guidelines
	which uses a tree-based scat sampling methodology providing presence/absence data. • Up to 15 SAT sites will be sampled across the koala offset management area. For areas where tree spacing is very sparse (e.g. open grassy eucalypt woodland – RE 11.3.2), the nearest tree to the sampling intersection will be applied when selecting the centre tree of the site. Furthermore, in sparse wooded areas, the extent of surveying for the 30 trees for any SAT site will be constrained to that within 200 m of the centre tree. The location of any signs of scratches on trees or observed koalas will also be recorded and photographed as part of the koala surveys or incidentally (Eyre et al. 2018).	vulnerable koala (DotE 2014) • Regularised Grid Based Spot Assessment Technique (RGB-SAT) (Biolink Ecological Consultants 2008) • Spot Assessment Technique (SAT) methodology (Phillips and Callaghan 2011)
Squatter pigeon (southern)	• In the absence of specific seasonally enhanced detectability of squatter pigeon (southern), surveying will be undertaken over a minimum of 3 days during the breeding season (between Spring and Summer). In accordance with the *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010) and based on effective previous experience in the Brigalow Belt (J. Cousin, pers. comm. 2024), squatter pigeon (southern) will be passively surveyed by flushing them while traversing the offset by vehicle and by foot; recording the number (and abundance) of squatter pigeon (southern) encounters during any survey event.	• Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al. 2018) • Survey Guidelines for Australia's Threatened Birds (DEWHA 2010)
Greater glider	• Surveys for greater glider will be undertaken through spotlighting, by vehicle along tracks and on foot. • Ideal timing for greater glider, assuring optimal detectability is when temperatures are warm, with no rain, fog or bright moonlight. Surveying is optimised well after dark as greater gliders may not emerge from their hollows as early as other species.	• Victorian Department of Sustainability and Environment Approved Survey Standards for Greater Glider (DSE 2011)

9 REPORTING

9.1 ANNUAL REPORT

Annual reports will be provided to the relevant administering authority every year. The annual report will detail progress towards achieving the interim performance targets and/or completion criteria identified in this OAMP. The report will contain, but may not be limited to:

- name and contact details of the proponent, landowner, and any contractors or consultants who have worked on the offset area. If someone other than the contractor is undertaking management activities (i.e. landowners, lessees, a sub-contractor or consultant) their details will also be provided, including skills and expertise of the responsible entity/entities
- EPBC approval number
- lot on plan property description and postal address
- a general description of climatic conditions for the year of management
- an overview of the management activities undertaken within the year of management, including details of the period of strategic grazing, location of the grazing event, duration and number of livestock head
- inclusion of a map detailing the location of any additional access tracks, fencing and firebreaks established in the Kemmis Creek offset area
- results of monitoring events undertaken within the year of management, including the results associated with:
- offset area inspections (see Section 8.1)
- weed monitoring (see Section 8.2)
- pest animal monitoring (see Section 8.3)
- biomass monitoring (see Section 8.4)
- habitat condition assessments (see Section 8.6.2)
- photo monitoring (see Section 8.6.3)
- a comparison of the monitoring results for the current year of management with the monitoring results from the previous years of management
- an indication of any risks or potential threats that have become apparent through monitoring, and activities to be undertaken to manage these threats and risks including any corrective actions that need to be implemented in the subsequent year of management
- progress towards achieving the management objectives as well as interim performance targets and completion criteria as well as any adaptive management triggers and/or corrective actions that have been implemented

- any corrective or remedial actions undertaken in previous management years
- If required, recommendations to be incorporated into this OAMP including changes to management and monitoring methodology.

9.2 OAMP REVIEW

Following the completion of weed surveys, pest animal surveys, biomass monitoring and habitat quality assessments in year 1 of OAMP implementation, this OAMP will be reviewed based on the survey results to specify control measures, timing for control activities and the location of monitoring sites.

This OAMP will be reviewed and amended (where applicable) to incorporate changes identified through management activities, regular site visits and monitoring activities. This may include the revision of current management actions, identification of additional activities and responses to unexpected events or threats to the Kemmis Creek offset area. This OAMP will be updated to incorporate additional information obtained through research programs, as the results become available.

Where changes are proposed from a review of this OAMP, the updated OAMP will be submitted to the Commonwealth Government.

10 MANAGEMENT, MONITORING AND REPORTING SCHEDULE

10.1 ROLES AND RESPONSIBILITIES

NLC will engage suitably qualified and experienced professionals to ensure that persons implementing management and monitoring activities described in this management plan have appropriate skills and qualifications. For the purposes of this OAMP, suitably qualified and experienced professionals are as follows:

> *Persons who have professional qualifications, training, skills or experiences related to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relative protocols, standards, methods or literature.*

For threatened species habitat monitoring, the lead ecologist will have greater than two years of experience undertaking BioCondition assessments in the Brigalow Belt Bioregion and be able to demonstrate identification skills for each listed species.

Persons monitoring weeds will have weed monitoring experience and demonstrable identification skills for likely terrestrial, wetland and waterway weeds in the Kemmis Creek offset area.

10.2 IMPLEMENTATION SCHEDULE

Table 23 and Table 24 summarise the implementation schedule for the management, monitoring and reporting activities presented in this OAMP.

Table 23: Implementation of management actions

Activity		Management years ✓ activity required ■ activity to be completed as required																				Timing	Related monitoring
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
General restrictions (Section 7.2)	Access, vehicles, vegetation clearing, weed hygiene	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	• At all times	Offset area inspections (Section 8.1)
Access tracks (Section 7.3)	Maintenance/new tracks	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• As required	Offset area inspections (Section 8.1)
Fencing (Section 7.4)	Mapping of existing fences	✓																				• In year 1 existing fencing will be mapped to determine where additional fencing may be constructed to assist with livestock control.	Offset area inspections (Section 8.1) Habitat quality assessments (Section 8.6.2)
	Construction of additional fencing to minimise the impact of grazing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• As required	
	Maintenance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• As required	
Pest animal management (Section 7.5)	Wild dog (*Canis familiaris*); Feral cat (*Felis catus*); Fox (*Vulpes vulpes*); Rabbit (*Oryctolagus cuniculus*); Pig (*Sus scrofa*)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• As required following year 1 assessment	Pest animal monitoring (Section 8.3)
Weed management (Section 7.6)	*Cenchrus ciliaris* and other weeds	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• Activities in addition to fire management and livestock management to be undertaken as required following year 1 assessment	Weed monitoring (Section 8.2)
Fire management (Section 7.7)	Low intensity control burn	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• Fuel reduction burns to control fuel loads as required	Weed monitoring (Section 8.2) Biomass monitoring (Section 8.4) Fuel hazard monitoring (Section 8.5)

Activity		Management years ✓ activity required ■ activity to be completed as required																				Timing	Related monitoring
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
Livestock management (Section 7.8)	Strategic grazing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• As required based on the results of biomass monitoring to be undertaken in accordance with Section 8.4	Weed monitoring (Section 8.2) Biomass monitoring (Section 8.4) Fuel hazard monitoring (Section 8.5)
Erosion management (Section 7.9)	Minimise erosion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	• At all times • Erosion will be managed throughout the Kemmis Creek offset area by livestock management and general access restrictions	Offset area inspections (Section 8.1)
Reporting (Section 9)	Annual report	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	• Each management year	-
	Review and update OAMP	✓	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	• Following year 1 surveys • Thereafter, as required	-

Table 24: OAMP monitoring events

Survey or monitoring objective	Monitoring activity	Management years ✓ Activity required ■ Activity to be carried out as required																				Timing	Survey/monitoring guidelines	Reliability
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
Offset area inspections (Section 8.1)	Twice yearly inspections of to enable a general assessment of the offset area and identify any potential issues that may require remedial action. See Section 7.1 for the criteria to be assessed as part of each inspection.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Inspections will be undertaken at least twice a year. Usually at the end of the wet season and the end of the dry season, with one of the inspections occurring prior to the submission of the annual report.	See Section 8.1 for a list of potential issues to be inspected.	General assessment of the offset management areas to identify any potential issues that may require remedial action to be undertaken.
Weed monitoring (Section 8.2)	Ongoing weed surveys to assess the effectiveness of weed control.	✓	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	Year 1 and Year 2, followed by assessments every 2 years thereafter.	NSW Guidelines for Monitoring weed Control and recovery of native vegetation (Auld 2009). Photo monitoring of selected sites to assess visual changes in weed species and infestations over time.	Assessment will be undertaken generally in accordance with published, reputable guidelines.
Pest animal monitoring (Section 8.3)	Ongoing pest animal surveys to assess the effectiveness of pest animal control.	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		In Year 1, then every two years post wet season.	Monitoring method outlined in Section 8.3.	Assessment undertaken generally in accordance with published monitoring techniques developed by the NSW Government.
Biomass monitoring (Section 8.4)	Biomass monitoring for fire management and to inform strategic grazing regime.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Twice every year at the end of the wet season (April) and towards the end of the dry season (October).	Assessment against Future Beef photo standards (Section 8.4)	Methodology developed by the Queensland Government.

Survey or monitoring objective	Monitoring activity	Management years ✓ Activity required ■ Activity to be carried out as required	Timing	Survey/monitoring guidelines	Reliability
Fuel hazard monitoring (Section 8.5)	Assessment of the fuel hazard rating within the offset area to inform fire management strategies.	✓ ✓	Annually at the end of the wet season (April).	Overall Fuel Hazard Assessment Guide (Hines et al. 2010)	Method developed by the Victorian Government.
Offset value assessments	Assessment of vegetation condition and habitat quality (Section 8.6.2)	✓ ✓	Year 1 and Year 2, followed by assessments every 2 years thereafter.	Guide to Determining Terrestrial Habitat Quality version 1.3 (DEHP 2020) and the methods outlined in Appendix C.	Assessment undertaken in accordance with method developed by the Queensland Government and aligns with the EPBC Act *Environmental Offsets Policy* measure of 'habitat quality' and is intended to provide a consistent framework for environmental offsets in Queensland.
	Photo monitoring (Section 8.6.3)	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓		Photos at each photo monitoring point will be taken in a north, east, south and westerly direction. A record of the photographs will be maintained, including GPS co-ordinates, date and time of each photograph and the direction in which the photograph was taken.	Based on best practice photo monitoring techniques, see Appendix 4 of BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2. (Eyre et al. 2015).

Survey or monitoring objective	Monitoring activity	Management years ✓ Activity required ■ Activity to be carried out as required																		Timing	Survey/monitoring guidelines	Reliability
	Targeted fauna surveys (Section 8.6.4)	✓	✓		✓		✓		✓		✓		✓		✓		✓		✓			See methods outlined in Section 7.6.4.	Techniques for fauna surveys are based on recommended survey guidelines published by the Queensland and Commonwealth governments.

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APPENDIX A BASELINE HABITAT QUALITY ASSESSMENT – KEMMIS CREEK OFFSET AREA

The following tables provide a summary of the data used to calculate the baseline habitat quality score for MNES used in the EPBC Act OAG in accordance with the GTDTHQ (version 1.3; DES 2020). The data required to inform the site condition and the fauna species habitat index scores were collected as part of detailed field surveys in February 2024 and June 2024. The site context score was calculated based on a desktop assessment following the method prescribed in the GTDTHQ (version 1.3; DES 2020).

Table A-1: Site condition raw data and scores for each monitoring site within the Kemmis Creek investigation area (sites B01-B07)

Site	B01			B02			B03			B04			B05			B06			B07		
RE	11.3.2			11.3.2			11.3.2			11.3.2			11.3.2			11.3.25			11.3.25		
Ecological condition indicators	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.25)	Score
Native plant species richness - trees	5	2	5	5	2	5	3	2	5	7	2	5	5	2	5	8	4	5	12	4	5
Native plant species richness - shrubs	4	2	5	5	2	5	5	2	5	4	2	5	4	2	5	2	4	2.5	5	4	5
Native plant species richness - grasses	6	9	2.5	11	9	5	10	9	5	10	9	5	10	9	5	3	8	2.5	5	8	2.5
Native plant species richness - forbs	10	15	2.5	19	15	5	9	15	2.5	14	15	5	6	15	2.5	3	13	0	10	13	2.5
Tree canopy height	18.1	18	2.5	19.4	18	2.5	16.5	18	4	17.5	18	4	16.1	18	4	19	23	4	17.1	23	4
Tree sub canopy height	0	9	2.5	0	9	0	3.8	9	0	6.2	9	0	4.4	9	0	6.3	11	0	7.3	11	0
Tree canopy cover	48.5	37	2.5	36.5	37	2.5	25.7	37	4	22.3	37	3.5	43.5	37	5	33.3	34	3.5	16.7	34	3.5
Tree sub canopy cover	0	7	2.5	0	7	2.5	18.4	7	0	1.8	7	0	7	7	0	3	12	0	7.6	12	0
Shrub canopy cover	2	4	5	1.3	4	3	11.3	4	3	12.6	4	3	6.2	4	5	11.3	7	5	5.3	7	5
Recruitment of woody perennial species	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5
Native perennial grass cover	43	26	5	26	26	5	24.2	26	5	28	26	5	20.2	26	3	28.4	35	3	14.6	35	1

Site	B01			B02			B03			B04			B05			B06			B07		
RE	11.3.2			11.3.2			11.3.2			11.3.2			11.3.2			11.3.25			11.3.25		
Ecological condition indicators	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.25)	Score
Organic litter	29	35	5	29	35	5	28	35	5	42	35	5	29.6	35	5	9	21	3	14	21	5
Large eucalypt trees	2	18	5	14	18	10	0	18	0	10	18	10	8	18	5	8	19	5	4	19	5
Large non-eucalypt trees	0	na	5	0	na	10	0	na	0	0	na	0	0	na	0	0	13	0	0	13	0
Coarse woody debris	155	281	5	200	281	5	165	281	5	45	281	2	320	281	5	175	473	2	162	473	2
Non-native plant cover	17.4	0	5	29	0	3	0.6	0	10	1.4	0	10	11	0	5	35	0	3	48	0	3
Site condition score	-	-	**55**	-	-	**61**	-	-	**58.5**	-	-	**67.5**	-	-	**59.5**	-	-	**43.5**	-	-	**48.5**
Max site condition score	-	-	**80**	-	-	**80**	-	-	**80**	-	-	**80**	-	-	**80**	-	-	**80**	-	-	**80**
Site condition score (/10)	-	-	**6.88**	-	-	**7.63**	-	-	**7.31**	-	-	**8.44**	-	-	**7.44**	-	-	**5.44**	-	-	**6.06**

Table A-2: Site condition raw data and scores for each monitoring site within the Kemmis Creek investigation (sites B08-B14)

Site	B08			B09			B10			B11			B12			B13			B14		
RE	11.3.25			11.3.25			11.3.4			11.3.4			11.3.4			11.3.4			11.9.7		
Ecological condition indicators	Raw Data	Benchmark (11.3.25)	Score	Raw Data	Benchmark (11.3.25)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.9.7)	Score
Native plant species richness - trees	17	4	5	8	4	5	8	4	5	6	4	5	9	4	5	8	4	5	4	3	2.5
Native plant species richness - shrubs	7	4	5	5	4	5	3	2	5	0	2	0	5	2	5	4	2	5	5	5	2.5
Native plant species richness - grasses	3	8	2.5	3	8	2.5	4	7	2.5	2	7	2.5	2	7	2.5	8	7	5	2	9	2.5
Native plant species richness - forbs	15	13	5	6	13	2.5	6	10	2.5	3	10	2.5	16	10	5	13	10	5	5	28	2.5
Tree canopy height	21.4	23	5	19.6	23	2.5	18.7	22	4	17.1	22	4	19.4	22	5	16.7	22	4	0	na	4
Tree sub canopy height	15	11	0	0	11	0	5.8	12	0	6.4	12	0	10.2	12	0	4.4	12	0	11.9	17	0
Tree canopy cover	98	34	4	41	34	2.5	40	17	2.5	61.5	17	2.5	41.5	17	3	19	17	3.5	0	na	2
Tree sub canopy cover	17.7	12	0	0	12	0	0.6	5	0	2.1	5	0	12	5	0	1.9	5	0	9.1	27	0
Shrub canopy cover	49.9	7	3	27.6	7	3	2.3	1	3	0	1	0	21.1	1	3	4.7	1	3	2.8	1	3
Recruitment of woody perennial species	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5
Native perennial grass cover	0	35	0	17	35	1	0	43	0	15	43	1	18	43	1	41	43	5	30	26	5
Organic litter	37	21	5	14	21	5	8	20	3	35	20	5	28	20	5	24	20	5	15	15	5
Large eucalypt trees	4	19	5	0	19	0	10	26	5	4	26	5	2	26	5	6	26	5	8	14	10
Large non-eucalypt trees	0	13	0	0	13	0	4	9	0	0	9	0	0	9	0	0	9	0	2	2	0

Site	B08			B09			B10			B11			B12			B13			B14		
RE	11.3.25			11.3.25			11.3.4			11.3.4			11.3.4			11.3.4			11.9.7		
Ecological condition indicators	Raw Data	Benchmark (11.3.25)	Score	Raw Data	Benchmark (11.3.25)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.3.4)	Score	Raw Data	Benchmark (11.9.7)	Score
Coarse woody debris	108	473	2	18	473	0	315	384	5	335	384	5	750	384	5	145	384	2	270	287	5
Non-native plant cover	79.4	0	0	69	0	0	79	0	0	84	0	0	45	0	3	10.2	0	5	15	0	5
Site condition score	-	-	**46.5**	-	-	**34**	-	-	**42.5**	-	-	**37.5**	-	-	**52.5**	-	-	**57.5**			54
Max site condition score	-	-	**80**	-	-	**80**	-	-	**80**	-	-	**80**	-	-	**80**	-	-	**80**			80
Site condition score (/10)	-	-	**5.81**	-	-	**4.25**	-	-	**5.31**	-	-	**4.69**	-	-	**6.56**	-	-	**7.19**			**6.75**

Table A-3: Site condition raw data and scores for each monitoring site within the Kemmis Creek investigation area (sites B15 – B29)

Site	**B15**			**B16**			**B17**			**B18**			**B19**		
RE	11.9.7			11.9.7			11.9.7			11.9.7			11.9.7		
Ecological condition indicators	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score
Native plant species richness - trees	5	3	5	3	3	5	10	3	5	5	3	5	6	3	5
Native plant species richness - shrubs	2	5	2.5	6	5	5	5	5	5	4	5	2.5	7	5	5
Native plant species richness - grasses	11	9	5	11	9	5	6	9	5	4	9	2.5	11	9	5
Native plant species richness - forbs	21	28	2.5	14	28	2.5	10	28	2.5	9	28	2.5	22	28	2.5
Tree canopy height	0	na	5	0	na	3	18.5	na	3	0	na	2.5	0	na	4
Tree sub canopy height	16.6	17	0	10.5	17	0	9.9	17	0	15.5	17	0	17.5	17	0
Tree canopy cover	0	na	3.5	0	na	2.5	0	na	2.5	0	na	1	0	na	5
Tree sub canopy cover	38.1	27	0	23.1	27	0	35.8	27	0	11.1	27	0	20.8	27	0
Shrub canopy cover	4.9	1	3	0.55	1	5	2.7	1	5	1.6	1	5	6.2	1	3
Recruitment of woody perennial species	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5
Native perennial grass cover	17.6	26	3	35	26	5	12	26	5	3	26	1	30	26	5
Organic litter	22.4	15	5	26.4	15	5	49	15	5	10.4	15	5	20	15	5
Large eucalypt trees	2	14	5	4	14	5	2	14	5	10	14	10	16	14	10
Large non-eucalypt trees	0	2	0	0	2	0	10	2	0	0	2	0	0	2	0
Coarse woody debris	45	287	2	548	287	5	157	287	5	55	287	2	275	287	5
Non-native plant cover	27.6	0	3	5	0	5	20	0	5	75	0	0	3.8	0	10
Site condition score			**49.5**			**58**			**58**			**44**			**69.5**

Site	B15			B16			B17			B18			B19		
RE	11.9.7			11.9.7			11.9.7			11.9.7			11.9.7		
Ecological condition indicators	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score	Raw Data	Benchmark (11.9.7)	Score
Max site condition score			**80**			**80**			**80**			**80**			**80**
Site condition score (/10)			**6.19**			**7.25**			**7.25**			**5.5**			**8.69**

Table A-4: Site context, species habitat index and habitat quality scores for each MNES at each monitoring site surveyed at Kemmis Creek

Attribute	Ecological condition indicators	Maximum score	Weighting	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19
				11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.25	11.3.25	11.3.25	11.3.25	11.3.4	11.3.4	11.3.4	11.3.4	11.9.7	11.9.7	11.9.7	11.9.7	11.9.7	11.9.7
Koala																						
Site context	Size of patch (fragmented bioregions)	10	25%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Connectivity (fragmented bioregions)	5	13%	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Context (fragmented bioregions)	5	13%	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Threats to species (site context)	25	50%	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
	Site context score (weighted)	**45**	**100%**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**	**29.9**
Species habitat index	Quality and availability of food and habitat required for foraging	10	17%	5	10	5	10	5	5	5	5	5	5	5	5	5	5	5	5	10	5	10
	Quality and availability of habitat required for shelter and breeding	10	17%	5	10	5	10	5	5	5	5	5	5	5	5	5	5	5	5	10	5	10
	Quality and availability of habitat required for mobility	10	17%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Role of site location to species overall population in the state	10	50%	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	Total species habitat index score (weighted)	**40**	**100%**	**27.3**	**34.0**	**27.3**	**34.0**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**27.3**	**34.0**	**27.3**	**34.0**
Species habitat quality score	Site condition score	80	30%	55.0	61.0	58.5	67.5	59.5	43.5	48.5	46.5	34.0	42.5	37.5	52.5	57.5	54.0	49.5	58.0	51.0	44.0	69.5
	Site context score	45	30%	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9
	Species habitat index score	40	40%	27.3	34.0	27.3	34.0	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	34.0	27.3	34.0
	Total/10	**-**	**100%**	**6.79**	**7.68**	**6.92**	**7.93**	**6.96**	**6.36**	**6.55**	**6.47**	**6.00**	**6.32**	**6.13**	**6.70**	**6.88**	**6.75**	**6.58**	**6.90**	**5.86**	**6.38**	**8.00**
Squatter pigeon																						
Site context	Size of patch (fragmented bioregions)	10	25%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	1	10	10
	Connectivity (fragmented bioregions)	5	12.5%	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Attribute	Ecological condition indicators	Maximum score	Weighting	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19
				11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.25	11.3.25	11.3.25	11.3.25	11.3.4	11.3.4	11.3.4	11.3.4	11.9.7	11.9.7	11.9.7	11.9.7	11.9.7	11.9.7
	Context (fragmented bioregions)	5	12.5%	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Threats to species (site context)	25	50%	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
	Site context score (weighted)	**45**	**100%**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**30.1**	**19.9**	**30.1**	**30.1**
Species habitat index	Quality and availability of food and habitat required for foraging	10	17%	5	5	1	1	5	5	5	1	1	1	5	5	5	5	5	5	1	5	5
	Quality and availability of habitat required for shelter and breeding	10	17%	5	5	1	1	5	5	5	1	1	1	5	5	5	5	5	5	1	5	5
	Quality and availability of habitat required for mobility	10	17%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Role of site location to species overall population in the state	10	50%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Total species habitat index score (weighted)	**40**	**100%**	**33.3**	**33.3**	**28.0**	**28.0**	**33.3**	**33.3**	**33.3**	**28.0**	**28.0**	**28.0**	**33.3**	**33.3**	**33.3**	**33.3**	**33.3**	**33.3**	**28.0**	**33.3**	**33.3**
Species habitat quality score	Site condition score	80	30%	55.0	61.0	58.5	67.5	59.5	43.5	48.5	46.5	34.0	42.5	37.5	52.5	57.5	54.0	49.5	58.0	51.0	44.0	69.5
	Site context score	45	30%	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	19.9	30.1	30.1
	Species habitat index score	40	40%	33.3	33.3	28.0	28.0	33.3	33.3	33.3	28.0	28.0	28.0	33.3	33.3	33.3	33.3	33.3	33.3	28.0	33.3	33.3
	Total (/10)	**-**	**100%**	**7.40**	**7.62**	**7.00**	**7.34**	**7.57**	**6.97**	**7.16**	**6.55**	**6.08**	**6.40**	**6.74**	**7.31**	**7.49**	**7.36**	**7.19**	**7.51**	**6.04**	**6.99**	**7.94**
Greater glider																						
Site context	Size of patch (fragmented bioregions)	10	25%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Connectivity (fragmented bioregions)	5	13%	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Context (fragmented bioregions)	5	13%	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Threats to species (site context)	25	50%	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
	Site context score (weighted)	**45**	**100%**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**	**31.3**
	Quality and availability of food and habitat required for foraging	10	17%	1	1	1	5	5	10	10	10	10	5	5	5	5	5	1	1	5	5	1

Attribute	Ecological condition indicators	Maximum score	Weighting	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19
				11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.25	11.3.25	11.3.25	11.3.25	11.3.4	11.3.4	11.3.4	11.3.4	11.9.7	11.9.7	11.9.7	11.9.7	11.9.7	11.9.7
Species habitat index	Quality and availability of habitat required for shelter and breeding	10	17%	1	1	1	10	10	10	10	10	10	10	10	10	10	5	1	1	10	10	1
	Quality and availability of habitat required for mobility	10	17%	10	10	10	10	10	10	10	10	10	10	10	10	10	1	1	1	4	4	4
	Role of site location to species overall population in the state	10	50%	10	10	10	10	10	10	10	10	10	10	10	10	10	7	7	7	7	7	7
	Total species habitat index score (weighted)	**40**	**100%**	**28.0**	**28.0**	**28.0**	**36.7**	**36.7**	**40.0**	**40.0**	**40.0**	**40.0**	**36.7**	**36.7**	**36.7**	**36.7**	**21.3**	**16.0**	**16.0**	**26.7**	**26.7**	**18.0**
Species habitat quality score	Site condition score	80	30%	55.0	61.0	58.5	67.5	59.5	43.5	48.5	46.5	34.0	42.5	37.5	52.5	57.5	54.0	49.5	58.0	51.0	44.0	69.5
	Site context score	45	30%	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3
	Species habitat index score	40	40%	22.7	28.7	22.7	28.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	6.7	4.0	4.0	6.7	4.0	4.0
	Total/10	**-**	**100%**	**6.95**	**7.17**	**7.08**	**8.28**	**7.98**	**7.72**	**7.90**	**7.83**	**7.36**	**7.35**	**7.16**	**7.72**	**7.91**	**6.24**	**5.54**	**5.86**	**6.66**	**6.40**	**6.49**
Poplar box TEC																						
	Site condition score	80	90%	55	61	58.5	67.5	59.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Site context score	20[A]	10%	20	20	20	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total/10	**-**	**100%**	**7.19**	**7.86**	**7.58**	**8.59**	**7.69**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

[A] Site context score for Poplar Box TEC is out of 20 (and not out of 45) as it only considers combined scores for size of patch (/10), connectivity (/5) and context (/5) and excludes Threats to Species component.

Table A-5: Absence of threat scores for MNES within Kemmis Creek investigation area

MNES	Matter-specific threat	Scope	Severity	Score
Koala	Change in ground layer composition and trampling ground nests as a consequence of livestock grazing and feral horse browsing, especially in grassy, alluvial areas	2	3	6
	Change in ground layer composition, including thickening of understorey structure, as a consequence of unsuitable fire regime	3	2	6
	Alteration of habitat suitability through the presence and extent of non-native, invasive weeds	3	2	6
	Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat	5	4	20
	Predation by feral predators (e.g., cats, foxes)	2	2	4
			Total (/25)	**8.4**
Squatter pigeon (southern)	Mortality due to vehicle collision, barbed wire fencing, roads, railways	4	3	12
	Predation by feral predators, particularly wild or domesticated dogs	3	2	6
	Alteration of the structure of suitable habitat, including loss of primary feed trees, as well as direct mortality as a consequence of unsuitable fire regime	3	2	6
	Alteration of the structure of suitable habitat and ability for species to move freely within habitat as a consequence of *Lantana camara* infestation	3	3	9
			Total (/25)	**8.3**
Greater glider	Clearing of large hollow bearing trees which are critical for survival. Very little dispersal through cleared areas therefore restricted to pockets of subpopulations	5	2	10
	Their restricted diet and unique physiology makes this species vulnerable to higher temperatures and low water availability	3	3	9
	Alteration of the structure of suitable habitat and ability for species to move freely within habitat as a consequence of *Lantana camara* infestation	3	4	12
	Obstacles hindering mobility of species (e.g. barbed wire fencing, powerline easements, railways, etc)	2	4	8
			Total (/25)	**9.8**

Table A-6: Final area-weighted MNES habitat quality scores in the Kemmis Creek investigation

RE	Area (ha)	Koala	Squatter pigeon	Greater glider	Poplar box TEC
11.3.2	1,019.97	7.3	7.4	7.5	7.8
11.3.25	287.51	6.6	6.7	7.7	-
11.3.4	197.16	6.5	7.0	7.5	-
11.9.7	708.04	6.7	7.2	6.2	-
Area weighted HQ score		**6.9 (7)**	**7.2 (7)**	**7.1 (7)**	**7.8 (8)**

APPENDIX B HABITAT QUALITY ASSESSMENT – NEW LENTON COAL PROJECT SITE

The following tables provide a summary of the data used to calculate the impact habitat quality score for MNES used in the EPBC Act OAG in accordance with the GTDTHQ (version 1.3; DES 2020). The data required to inform the site condition, and the fauna species habitat index scores were collected as part of detailed field surveys in March 2023. The site context score was calculated based on a desktop assessment following the method prescribed in the GTDTHQ (version 1.3; DES 2020) and outlined in Appendix C.

Table B-1: Site condition score for each impact RE assessment unit across the Project (sites Site 1 – Site 17)

Site[1]	Site 1			Site 2			Site 7			Site 8			Site 9			Site 10			Site 12			Site 14			Site 15			Site 17		
RE	11.3.7			11.8.5			11.3.25			11.3.36			HVR* 11.3.7			HVR* 11.8.5			HVR* 11.3.25			11.3.2			11.9.7a			11.3.2		
Ecological condition indicators	Raw data	Benchmark (11.3.7)	Score	Raw data	Benchmark (11.8.5)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.36)	Score	Raw data	Benchmark (11.3.7)	Score	Raw data	Benchmark (11.8.5)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.9.7)	Score	Raw data	Benchmark (11.3.2)	Score
Native plant species richness - trees	6	5	5	12	3	5	9	4	5	9	5	5	8	5	5	2	3	2.5	7	4	5	7	2	5	6	3	5	6	2	5
Native plant species richness - shrubs	2	3	2.5	13	3	5	7	4	5	6	2	5	3	3	5	4	3	5	2	4	2.5	9	2	5	10	5	5	9	2	5
Native plant species richness - grasses	0	7	0	9	9	5	5	8	2.5	9	13	2.5	3	7	2.5	5	9	2.5	2	8	2.5	10	9	5	11	9	5	10	9	5
Native plant species richness - forbs	5	9	2.5	19	8	5	7	13	2.5	12	20	2.5	10	9	5	20	8	5	7	13	2.5	10	15	2.5	22	28	2.5	16	15	5
Emergent canopy height	na	na	5	na	na	5	na	na	5	na	na	5	na	na	3	na	na	5	na	na	3	na	na	4	na	na	2.5	na	na	5
Tree canopy height	20	16		20	15		20	23		15	18		8	16		16	15		16	23		14	18		15	17		20	18	
Tree sub canopy height	8	na		8	6		8	11		6	8		4	na		7	6		7	11		6	9		0	9		8	9	
Emergent canopy cover	na	na	3	na	na	1.5	na	na	4	na	na	5	na	na	5	na	na	4	na	na	2.5	na	na	2.5	na	na	3.5	na	na	4
Tree canopy cover	55.5	24		32	13		18	34		23.5	39		14.5	24		30.5	13		21	34		3.6	37		10.4	27		46	37	
Tree sub canopy cover	0	na		0	3		45.5	12		30.5	23		na	na		2.5	3		0	12		9.8	7		20.1	12		17	7	
Shrub canopy cover	0	2	0	21	3	3	3.5	7	5	2.5	1	3	0	2	0	3.7	3	5	0	7	0	15.7	4	3	1.5	1	5	11	4	3

Site[1]	Site 1			Site 2			Site 7			Site 8			Site 9			Site 10			Site 12			Site 14			Site 15			Site 17		
RE	11.3.7			11.8.5			11.3.25			11.3.36			HVR* 11.3.7			HVR* 11.8.5			HVR* 11.3.25			11.3.2			11.9.7a			11.3.2		
Ecological condition indicators	Raw data	Benchmark (11.3.7)	Score	Raw data	Benchmark (11.8.5)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.36)	Score	Raw data	Benchmark (11.3.7)	Score	Raw data	Benchmark (11.8.5)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.9.7)	Score	Raw data	Benchmark (11.3.2)	Score
Recruitment of woody perennial species	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5
Native perennial grass cover	0	14	0	4	59	0	0	35	0	42.6	39	5	1	14	0	2	59	0	18	35	3	16	26	3	28.4	26	5	33	26	5
Organic litter	2	17	3	14	15	5	26.6	21	5	8	24	3	0	17	0	1	15	0	1	21	0	14	35	3	6	15	3	33	35	5
Large eucalypt trees	7	6	10	5	9	10	8	19	5	1	14	5	1	6	5	3	9	5	3	19	5	5	18	5	0	14	0	8	18	5
Large non-eucalypt trees	2	4		0	na		0	13		0	2		0	4		na	na		0	13		na	na		0	2		na	na	
Coarse woody debris	208	164	5	60	175	2	355	473	5	95	415	2	0	164	0	15	175	0	0	473	0	75	281	2	231	287	5	290	281	5
Non-native plant cover	99	0	0	55	0	0	65	0	0	25	0	3	98	0	0	90	0	0	80	0	0	2	0	10	2	0	10	60	0	0
Site condition score			41.0			51.5			49.0			51.0			35.5			39.0			31.0			55.0			56.5			57.0
Max site condition score			80			80			80			80			80			80			80			80			80			80
Site condition score (/10)			5.13			6.44			6.13			6.38			4.44			4.88			3.88			6.88			7.06			7.13

[1] VT refers to the impact site.
* HVR = high-value regrowth

Table B-2: Site condition score for each impact RE assessment unit across the Project (sites Site 18 – Site 41)

Site[1]	Site 18			Site 19			Site 27			Site 28			Site 29			Site 30			Site 37			Site 38			Site 39			Site 41		
RE	11.3.2			11.3.25			11.3.4			11.3.4			11.3.25			11.9.7a			11.3.4			HVR* 11.9.7a			11.3.4			11.3.7		
Ecological condition indicators	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.9.7)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.9.7)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.3.7)	Score
Native plant species richness - trees	8	2	5	7	4	5	6	4	5	7	4	5	9	4	5	11	3	5	6	4	5	7	3	5	2	4	2.5	6	5	5
Native plant species richness - shrubs	3	2	5	7	4	5	3	2	5	1	2	2.5	4	4	5	12	5	5	0	2	0	11	5	5	1	2	2.5	6	3	5
Native plant species richness - grasses	10	9	5	2	8	2.5	6	7	2.5	3	7	2.5	0	8	0	13	9	5	3	7	2.5	11	9	5	4	7	2.5	7	7	5
Native plant species richness - forbs	22	15	5	20	13	5	16	10	5	11	10	5	5	13	2.5	13	28	2.5	11	10	5	20	28	2.5	10	10	5	20	9	5
Emergent canopy height	na	na	5	na	na	5	na	na	5	na	na	4	na	na	5	na	na	5	na	na	4	na	na	0	0	na	2.5	na	na	5
Tree canopy height	16	18		22	23		18	22		20	22		22	23		15	17		22	22		0	17		18	22		14	16	
Tree sub canopy height	8	9		8	11		9	12		8	12		10	11		7	9		8	12		0	9		0	12		6	na	
Emergent canopy cover	na	na	3.5	na	na	4	na	na	4	na	na	4	na	na	4	na	na	5	na	na	4	na	na	1	na	na	3.5	na	na	5
Tree canopy cover	27.4	37		64	34		40	17		68	17		66.5	34		20	27		37.5	17		2	27		20.5	17		24.5	24	
Tree sub canopy cover	2.3	7		29	12		5	5		8	5		40.5	12		9.5	12		3	5		4.6	12		2	5		49	na	
Shrub canopy cover	0	4	0	4	7	5	1	1	5	0	1	0	2	7	3	10.5	1	3	0	1	0	17.8	1	3	0	1	0	2.5	2	5

Site[1]	Site 18			Site 19			Site 27			Site 28			Site 29			Site 30			Site 37			Site 38			Site 39			Site 41		
RE	11.3.2			11.3.25			11.3.4			11.3.4			11.3.25			11.9.7a			11.3.4			HVR* 11.9.7a			11.3.4			11.3.7		
Ecological condition indicators	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.3.25)	Score	Raw data	Benchmark (11.9.7)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.9.7)	Score	Raw data	Benchmark (11.3.4)	Score	Raw data	Benchmark (11.3.7)	Score
Recruitment of woody perennial species	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5
Native perennial grass cover	2	26	0	0	35	0	24	43	3	0	43	0	0	35	0	5.4	26	1	0	43	0	0	26	0	5	43	1	37	14	5
Organic litter	14	35	3	42	21	5	13	20	5	38	20	5	10	21	3	15	15	5	4	20	3	7	15	3	6	20	3	37	17	3
Large eucalypt trees	8	18	5	3	19	5	5	26	5	2	26	5	3	19	5	6	14	15	8	26	5	0	14	0	0	26	0	2	6	5
Large non-eucalypt trees	na	na		3	13		0	9		4	9		4	13		12	2		1	9		0	2		0	9		0	4	
Coarse woody debris	171	281	5	477	473	5	125	384	2	430	384	5	710	473	5	302	287	5	50	384	2	346	287	5	0	384	0	135	164	5
Non-native plant cover	90	0	0	80	0	0	45	0	3	55	0	0	95	0	0	35	0	3	55	0	0	65	0	0	85	0	0	5	0	5
Site condition score			46.5			51.5			54.5			43.0			42.5			64.5			35.5			34.5			27.5			63.0
Max site condition score			80			80			80			80			80			80			80			80			80			80
Site condition score (/10)			5.81			6.44			6.81			5.38			5.31			8.06			4.44			4.31			3.44			7.88

[1]VT refers to the impact site.
* HVR = high-value regrowth

Table B-3: Site condition score for each impact RE assessment unit across the Project (sites Site 42 – Site 53)

Site[1]	Site 42			Site 43			Site 44			Site 45			Site 46			Site 47			Site 50			Site 52			Site 53		
RE	11.3.2			11.3.2			11.3.2			11.3.2			11.3.2			11.3.2			11.3.36			11.3.2			11.3.7		
Ecological condition indicators	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.36)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.7)	Score
Native plant species richness - trees	11	2	5	6	2	5	9	2	5	5	2	5	9	2	5	10	2	5	11	5	5	11	2	5	4	5	2.5
Native plant species richness - shrubs	8	2	5	7	2	5	10	2	5	6	2	5	7	2	5	13	2	5	7	2	5	6	2	5	5	3	5
Native plant species richness - grasses	21	9	5	11	9	5	13	9	5	15	9	5	14	9	5	17	9	5	12	13	5	11	9	5	18	7	5
Native plant species richness - forbs	19	15	5	19	15	5	18	15	5	17	15	5	16	15	5	12	15	2.5	19	20	5	24	15	5	23	9	5
Emergent canopy height	na	na	4	na	na	4.00	na	na	5	na	na	5	na	na	5	na	na	2.5	na	na	5	na	na	5	na	na	5
Tree canopy height	14	18		15	18		16	18		20	18		18	18		14	18		17	18		19	18		17	16	
Tree sub canopy height	6	9		6	9		7	9		8	9		8	9		0	9		7	8		8	9		7	na	
Emergent canopy cover	na	na	5	na	na	5	na	na	5	na	na	5	na	na	3.5	na	na	2.5	na	na	2.5	na	na	4	na	na	5
Tree canopy cover	31	37		43.5	37		41.5	37		62	37		8.5	37		15.5	37		47	39		53.5	37		28	24	
Tree sub canopy cover	7.5	7		6.5	7		14	7		6.5	7		5	7		32.9	7		2	23		17	7		47	na	
Shrub canopy cover	4	4	5	6.5	4	5	11.5	4	3	1.5	4	3	4	4	5	50.7	4	3	0.5	1	5	2	4	5	1	2	5
Recruitment of woody perennial species	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5	100	100	5

Site[1]	Site 42			Site 43			Site 44			Site 45			Site 46			Site 47			Site 50			Site 52			Site 53		
RE	11.3.2			11.3.2			11.3.2			11.3.2			11.3.2			11.3.2			11.3.36			11.3.2			11.3.7		
Ecological condition indicators	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.36)	Score	Raw data	Benchmark (11.3.2)	Score	Raw data	Benchmark (11.3.7)	Score
Native perennial grass cover	46	26	5	35	26	5	41	26	5	0	26	0	65.6	26	5	25.4	26	5	30	39	3	13	26	3	19	14	5
Organic litter	29	35	5	20	35	5	28	35	5	33	35	5	13	35	3	15.6	35	3	20	24	5	20	35	5	39	17	3
Large eucalypt trees	1	18	5	2	18	5	2	18	5	7	18	5	7	18	5	3	18	5	5	14	5	5	18	5	1	6	5
Large non-eucalypt trees	na	na		na	na		na	na		na	na		na	na		na	na		0	2		na	na		0	4	
Coarse woody debris	139	281	2	290	281	5	266	281	5	230	281	5	240	281	5	379	281	5	110	415	2	90	281	2	190	164	5
Non-native plant cover	30	0	3	1	0	10	5	0	5	55	0	0	5	0	5	5	0	5	70	0	0	60	0	0	10	0	5
Site condition score			59.0			69.0			63.0			53.0			61.5			53.5			52.5			54.0			60.5
Max site condition score			80			80			80			80			80			80			80			80			80
Site condition score (/10)			7.38			8.63			7.88			6.63			7.69			6.69			6.56			6.75			7.56

[1] VT refers to the impact site.

Table B-4: Site context, species habitat index and habitat quality scores for each MNES at each monitoring site surveyed at the New Lenton Coal Project site (sites 1 – 30)

Attribute	Ecological condition indicators	Maximum score	Weighting	Site 1	Site 2	Site 7	Site 8	Site 9	Site 10	Site 12	Site 14	Site 15	Site 17	Site 18	Site 19	Site 27	Site 28	Site 29	Site 30
				11.3.7	11.8.5	11.3.25	11.3.36	HVR* 11.3.7	HVR* 11.8.5	HVR* 11.3.25	11.3.2	11.9.7a	11.3.2	11.3.2	11.3.25	11.3.4	11.3.4	11.3.25	11.9.7a
Koala																			
Site context	Size of patch (fragmented bioregions)	10	25%	10	0	10	10	-	10	2	10	2	10	10	10	10	10	10	10
	Connectivity (fragmented bioregions)	5	12.5%	2	2	5	5	-	0	2	2	0	4	4	5	5	5	5	4
	Context (fragmented bioregions)	5	12.5%	4	4	5	4	-	4	4	4	2	4	4	4	4	4	4	4
	Threats to species (site context)	25	50%	3	3	3	3	-	3	3	3	3	3	3	3	3	3	3	3
	Site context score (weighted)	**45**	**100%**	**20.7**	**9.5**	**25.2**	**24.1**	**-**	**18.5**	**11.7**	**20.7**	**7.2**	**23.0**	**23.0**	**24.1**	**24.1**	**24.1**	**24.1**	**23.0**
Species habitat index	Quality and availability of food and habitat required for foraging	40	17%	20	20	40	40	-	20	20	20	40	40	20	20	0	0	40	40
	Quality and availability of habitat required for shelter and breeding	20	17%	2	2	2	2	-	2	10	2	10	10	20	20	10	10	20	10
	Quality and availability of habitat required for mobility	30	17%	30	8	30	30	-	8	30	30	30	30	30	30	30	30	30	30
	Role of site location to species overall population in the state	5	50%	2	2	2	2	-	2	2	2	3	3	2	2	1	1	3	3
	Total species habitat index score (weighted)	**95**	**100%**	**46.7**	**34.4**	**55.0**	**55.0**	**-**	**34.4**	**53.3**	**46.7**	**71.7**	**71.7**	**61.7**	**61.7**	**35.0**	**35.0**	**80.0**	**71.7**
Species habitat quality score	Site condition score	80	30%	41	52	49	51	-	39	31	55	57	57	47	52	55	43	43	65
	Site context score	45	30%	21	9	25	24	-	18	12	21	7	3	23	24	24	24	24	23
	Species habitat index score	100	40%	47	34	55	55	-	34	53	47	72	72	62	62	35	35	80	72

Attribute	Ecological condition indicators	Maximum score	Weighting	Site 1	Site 2	Site 7	Site 8	Site 9	Site 10	Site 12	Site 14	Site 15	Site 17	Site 18	Site 19	Site 27	Site 28	Site 29	Site 30
				11.3.7	11.8.5	11.3.25	11.3.36	HVR* 11.3.7	HVR* 11.8.5	HVR* 11.3.25	11.3.2	11.9.7a	11.3.2	11.3.2	11.3.25	11.3.4	11.3.4	11.3.25	11.9.7a
	Total (/10)	**-**	**100%**	**4.8**	**3.9**	**5.7**	**5.7**	**-**	**4.1**	**4.1**	**5.3**	**5.5**	**5.2**	**5.7**	**6.0**	**5.0**	**4.6**	**6.4**	**6.8**
Squatter pigeon																			
Site context	Size of patch (fragmented bioregions)	10	25%	-	0	-	10	-	-	-	10	2	10	10	-	-	-	-	10
	Connectivity (fragmented bioregions)	5	13%	-	2	-	5	-	-	-	2	0	4	4	-	-	-	-	4
	Context (fragmented bioregions)	5	13%	-	4	-	4	-	-	-	4	2	4	4	-	-	-	-	4
	Threats to species (site context)	25	50%	-	3	-	3	-	-	-	3	3	3	3	-	-	-	-	3
	Site context score (weighted)	**45**	**100%**	**-**	**9.5**	**-**	**24.1**	**-**	**-**	**-**	**20.7**	**7.2**	**23.0**	**23.0**	**-**	**-**	**-**	**-**	**23.0**
Species habitat index	Quality and availability of food and habitat required for foraging	40	17%	-	20	-	20	-	-	-	25	25	20	20	-	-	-	-	25.0
	Quality and availability of habitat required for shelter and breeding	20	17%	-	15	-	10	-	-	-	15	15	15	15	-	-	-	-	15.0
	Quality and availability of habitat required for mobility	30	17%	-	25	-	25	-	-	-	25	25	25	25	-	-	-	-	25.0
	Role of site location to species overall population in the state	5	50%	-	3	-	3	-	-	-	3	3	3	3	-	-	-	-	3
	Total species habitat index score (weighted)	**95**	**100%**	**-**	**56.0**	**-**	**53.3**	**-**	**-**	**-**	**58.7**	**58.7**	**56.0**	**56.0**	**-**	**-**	**-**	**-**	**58.7**
Species habitat quality score	Site condition score	80	30%	-	52	-	51	-	-	-	55	57	57	47	-	-	-	-	65
	Site context score	45	30%	-	9	-	24	-	-	-	21	7	23	23	-	-	-	-	23
	Species habitat index score	40	40%	-	56	-	53	-	-	-	59	59	56	56	-	-	-	-	59

Attribute	Ecological condition indicators	Maximum score	Weighting	Site 1	Site 2	Site 7	Site 8	Site 9	Site 10	Site 12	Site 14	Site 15	Site 17	Site 18	Site 19	Site 27	Site 28	Site 29	Site 30
				11.3.7	11.8.5	11.3.25	11.3.36	HVR* 11.3.7	HVR* 11.8.5	HVR* 11.3.25	11.3.2	11.9.7a	11.3.2	11.3.2	11.3.25	11.3.4	11.3.4	11.3.25	11.9.7a
	Total/10	**-**	**100%**	**-**	**5.4**	**-**	**6.2**	**-**	**-**	**-**	**6.4**	**5.5**	**6.5**	**6.1**	**-**	**-**	**-**	**-**	**6.9**
Greater glider																			
Site context	Size of patch (fragmented bioregions)	10	25%	10	0	10	10	2	-	2	-	-	10	10	10	10	10	10	10
	Connectivity (fragmented bioregions)	5	13%	2	2	5	5	0	-	2	-	-	4	4	5	5	5	5	4
	Context (fragmented bioregions)	5	13%	4	4	5	4	4	-	4	-	-	4	4	4	4	4	4	4
	Threats to species (site context)	25	50%	4	4	4	4	4	-	4	-	-	4	4	4	4	4	4	4
	Site context score (weighted)	**45**	**100%**	**21.6**	**10.4**	**26.1**	**25.0**	**10.4**	**-**	**12.6**	**-**	**-**	**23.9**	**23.9**	**25.0**	**25.0**	**25.0**	**25.0**	**23.9**
Species habitat index	Quality and availability of food and habitat required for foraging	40	17%	7	0	15	15	0	-	7	-	-	0	7	15	0	15	15	0
	Quality and availability of habitat required for shelter and breeding	20	17%	20	40	40	40	20	-	0	-	-	40	20	40	0	20	20	0
	Quality and availability of habitat required for mobility	30	17%	40	10	30	30	20	-	20	-	-	40	30	40	30	40	40	30
	Role of site location to species overall population in the state	5	50%	3	2	4	4	2	-	1	-	-	2	2	4	1	3	3	1
	Total species habitat index score (weighted)	**95**	**100%**	**62.8**	**40.8**	**85.8**	**85.8**	**36.7**	**-**	**26.1**	**-**	**-**	**53.3**	**48.6**	**90.0**	**22.5**	**71.7**	**71.7**	**22.5**
Species habitat quality score	Site condition score	80	30%	41	52	49	51	36	-	31	-	-	57	47	52	55	43	43	65
	Site context score	45	30%	22	10	26	25	10	-	13	-	-	24	24	25	25	25	25	24
	Species habitat index score	40	40%	63	41	86	86	37	-	26	-	-	53	49	90	23	72	72	23

Attribute	Ecological condition indicators	Maximum score	Weighting	Site 1	Site 2	Site 7	Site 8	Site 9	Site 10	Site 12	Site 14	Site 15	Site 17	Site 18	Site 19	Site 27	Site 28	Site 29	Site 30
				11.3.7	11.8.5	11.3.25	11.3.36	HVR* 11.3.7	HVR* 11.8.5	HVR* 11.3.25	11.3.2	11.9.7a	11.3.2	11.3.2	11.3.25	11.3.4	11.3.4	11.3.25	11.9.7a
	Total/10	**-**	**100%**	**5.5**	**4.3**	**7.0**	**7.0**	**3.5**	**-**	**3.0**	**-**	**-**	**5.9**	**5.3**	**7.2**	**4.6**	**6.1**	**6.1**	**4.9**
Poplar Box TEC																			
	Site condition score	80	90%	-	-	-	-	-	-	-	-	-	7.13	5.81	-	-	-	-	-
	Site context score	20[A]	10%	-	-	-	-	-	-	-	-	-	9	9	-	-	-	-	-
	Total/10	**-**	**100%**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**7.3**	**6.1**	**-**	**-**	**-**	**-**	**-**

[A] Site context score for Poplar Box TEC is out of 20 (and not out of 45) as it only considers combined scores for size of patch (/10), connectivity (/5) and context (/5) and excludes Threats to Species component.
* HVR = high value regrowth

Table B-5: Site context, species habitat index and habitat quality scores for each MNES at each monitoring site surveyed at the New Lenton Coal Project site (sites 37 – 53)

Attribute	Ecological condition indicators	Maximum score	Weighting	Site 37	Site 38	Site 39	Site 41	Site 42	Site 43	Site 44	Site 45	Site 46	Site 47	Site 50	Site 52	Site 53
				11.3.4	HVR* 11.9.7a	11.3.4	11.3.7	11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.36	11.3.2	11.3.7
Koala																
Site context	Size of patch (fragmented bioregions)	10	25%	10	2	10	10	10	10	10	10	10	10	10	10	10
	Connectivity (fragmented bioregions)	5	12.5%	5	0	5	5	5	4	4	4	4	4	5	2	5
	Context (fragmented bioregions)	5	12.5%	4	2	4	5	5	4	5	4	4	4	4	4	5
	Threats to species (site context)	25	50%	3	3	3	3	3	3	3	3	3	3	3	3	3
	Site context score (weighted)	**45**	**100%**	**24.1**	**7.2**	**24.1**	**25.2**	**25.2**	**23.0**	**24.1**	**23.0**	**23.0**	**23.0**	**24.1**	**20.7**	**25.2**
Species habitat index	Quality and availability of food and habitat required for foraging	10	17%	0	20	0	0	40	40	40	40	20	40	40	40	0
	Quality and availability of habitat required for shelter and breeding	10	17%	20	10	10	2	2	2	2	2	2	2	2	10	2
	Quality and availability of habitat required for mobility	10	17%	30	14	30	30	30	30	30	30	30	30	30	30	30
	Role of site location to species overall population in the state	10	50%	1	2	1	1	2	2	2	2	2	2	2	2	1
	Total species habitat index score (weighted)	**40**	**100%**	**43.3**	**44.4**	**35.0**	**28.3**	**55.0**	**55.0**	**55.0**	**55.0**	**46.7**	**55.0**	**55.0**	**61.7**	**28.3**
Species habitat quality score	Site condition score	80	30%	36	35	28	63	59	69	63	53	62	54	53	54	61
	Site context score	45	30%	24	7	24	25	25	23	24	23	23	23	24	21	25
	Species habitat index score	40	40%	43	44	35	28	55	55	55	55	47	55	55	62	28
	Total (/10)	**-**	**100%**	**4.7**	**3.6**	**4.0**	**5.2**	**6.1**	**6.3**	**6.2**	**5.7**	**5.7**	**5.7**	**5.8**	**5.9**	**5.1**
Squatter pigeon																
Site context	Size of patch (fragmented bioregions)	10	25%	-	-	-	-	10	10	10	10	10	10	10	10	-

Attribute	Ecological condition indicators	Maximum score	Weighting	Site 37	Site 38	Site 39	Site 41	Site 42	Site 43	Site 44	Site 45	Site 46	Site 47	Site 50	Site 52	Site 53
				11.3.4	HVR* 11.9.7a	11.3.4	11.3.7	11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.36	11.3.2	11.3.7
	Connectivity (fragmented bioregions)	5	13%	-	-	-	-	5	4	4	4	4	4	5	2	-
	Context (fragmented bioregions)	5	13%	-	-	-	-	5	4	5	4	4	4	4	4	-
	Threats to species (site context)	25	50%	-	-	-	-	3	3	3	3	3	3	3	3	-
	Site context score (weighted)	**45**	**100%**	**-**	**-**	**-**	**-**	**25.2**	**23.0**	**24.1**	**23.0**	**23.0**	**23.0**	**24.1**	**20.7**	**-**
Species habitat index	Quality and availability of food and habitat required for foraging	10	17%	-	-	-	-	20.0	25.0	25.0	20.0	20.0	25.0	20.0	20.0	-
	Quality and availability of habitat required for shelter and breeding	10	17%	-	-	-	-	15.0	15.0	5.0	15.0	15.0	15.0	15.0	5.0	-
	Quality and availability of habitat required for mobility	10	17%	-	-	-	-	25.0	25.0	15.0	25.0	25.0	25.0	25.0	15.0	-
	Role of site location to species overall population in the state	10	50%	-	-	-	-	3	3	2	3	3	3	3	2	-
	Total species habitat index score (weighted)	**40**	**100%**	**-**	**-**	**-**	**-**	**56.0**	**58.7**	**40.0**	**56.0**	**56.0**	**58.7**	**56.0**	**37.3**	**-**
Species habitat quality score	Site condition score	80	30%	-	-	-	-	59	69	63	53	62	54	53	54	-
	Site context score	45	30%	-	-	-	-	25	23	24	23	23	23	24	21	-
	Species habitat index score	40	40%	-	-	-	-	56	59	40	56	56	59	56	37	-
	Total/10	**-**	**100%**	**-**	**-**	**-**	**-**	**6.7**	**7.1**	**6.0**	**6.3**	**6.6**	**6.5**	**6.4**	**5.3**	**-**
Greater glider																
Site context	Size of patch (fragmented bioregions)	10	25%	10	-	10	10	10	10	10	10	10	10	10	10	10
	Connectivity (fragmented bioregions)	5	13%	5	-	5	5	5	4	4	4	4	4	5	2	5
	Context (fragmented bioregions)	5	13%	4	-	4	5	5	4	5	4	4	4	4	4	5
	Threats to species (site context)	25	50%	4	-	4	4	4	4	4	4	4	4	4	4	4

Attribute	Ecological condition indicators	Maximum score	Weighting	Site 37	Site 38	Site 39	Site 41	Site 42	Site 43	Site 44	Site 45	Site 46	Site 47	Site 50	Site 52	Site 53
				11.3.4	HVR* 11.9.7a	11.3.4	11.3.7	11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.2	11.3.36	11.3.2	11.3.7
	Site context score (weighted)	**45**	**100%**	**25.0**	**-**	**25.0**	**26.1**	**26.1**	**23.9**	**25.0**	**23.9**	**23.9**	**23.9**	**25.0**	**21.6**	**26.1**
Species habitat index	Quality and availability of food and habitat required for foraging	10	17%	7	-	15	7	15	0	0	0	0	0	15	15	15
	Quality and availability of habitat required for shelter and breeding	10	17%	20	-	0	20	20	20	20	20	20	20	20	20	40
	Quality and availability of habitat required for mobility	10	17%	30	-	30	30	30	40	40	40	20	30	40	40	30
	Role of site location to species overall population in the state	10	50%	3	-	1	2	2	2	2	2	2	2	3	3	4
	Total species habitat index score (weighted)	**40**	**100%**	**58.6**	**-**	**39.2**	**48.6**	**57.5**	**45.0**	**45.0**	**45.0**	**36.7**	**40.8**	**71.7**	**71.7**	**85.8**
Species habitat quality score	Site condition score	80	30%	36	-	28	63	59	69	63	53	62	54	53	54	61
	Site context score	45	30%	25	-	25	26	26	24	25	24	24	24	25	22	26
	Species habitat index score	40	40%	59	-	39	49	58	45	45	45	37	41	72	72	86
	Total/10	**-**	**100%**	**5.3**	**-**	**4.3**	**6.0**	**6.3**	**6.0**	**5.8**	**5.4**	**5.4**	**5.2**	**6.5**	**6.3**	**7.4**
Poplar Box TEC																
	Site condition score	80	90%	-	-	-	-	7.38	8.63	7.88	6.63	7.69	6.69	-	6.75	-
	Site context score	20[A]	10%	-	-	-	-	10	9	9.5	9	9	9	-	9	-
	Total/10	**-**	**100%**	**-**	**-**	**-**	**-**	**7.6**	**8.7**	**8.0**	**6.9**	**7.8**	**6.9**	**-**	**7.0**	**-**

[A] Site context score for Poplar Box TEC is out of 20 (and not out of 45) as it only considers combined scores for size of patch (/10), connectivity (/5) and context (/5) and excludes Threats to Species component.
* HVR = high value regrowth

Table B-6: Absence of threat scores for MNES within New Lenton Project site

MNES	Matter-specific threat	Scope	Severity	Score
Koala	Mortality due to vehicle collision - close to main roads	3	3	9
	Mortality due to vehicle collision - further from main roads	4	3	12

MNES	Matter-specific threat	Scope	Severity	Score
	Predation by feral predators, particularly wild or domesticated dogs	1	3	3
			Total (/25)[A]	**3**
Squatter pigeon (southern)	Change in ground layer composition and trampling ground nests as a consequence of livestock grazing and feral horse browsing, especially in grassy, alluvial areas (transect with moderate signs of overstocking)	2	4	8
	Change in ground layer composition and trampling ground nests as a consequence of livestock grazing and feral horse browsing, especially in grassy, alluvial areas (transect with low signs of overstocking)	2	5	10
	Alteration of habitat suitability through the presence and extent of non-native, invasive weeds (weeds present)	2	2	4
	Alteration of habitat suitability through the presence and extent of non-native, invasive weeds (weeds absent)	4	5	20
	Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat	2	4	8
	Predation by feral predators (e.g., cats, foxes)	1	3	3
			Total (/25)[A]	**3**
Greater glider	Presence of barbed wire	1	4	4
			Total (/25)[A]	**4**

[A] In accordance with the GTDTHQ, the lowest score is used to represent the 'Absence of threats' score

Table B-7: Final area-weighted MNES habitat quality scores in the New Lenton Project site

RE	Area (ha)	Koala	Squatter pigeon	Greater glider	Poplar box TEC
11.3.2	113.7 (112.2 of TEC)	5.8	6.3	5.7	7.4
11.3.4	14.6	4.6	-	5.1	-
11.3.7	61.9	5.0	-	6.3	-
11.3.7 HVR*	22	-	-	3.5	-
11.3.25	11.5	6.0	-	6.8	-
11.3.25 HVR*	9.8	4.1	-	3.1	-
11.3.36	50.4	5.8	6.3	6.8	-
11.8.5	1.1	3.9	5.4	4.3	-
11.8.5 HVR*	12.29	4.1	-	-	-
11.9.7a	27.2	6.1	6.2	4.9	-
11.9.7a HRV*	10.3	3.6	-	-	-
Area weighted HQ score		**5.4 (5)**	**6.3 (6)**	**5.7 (6)**	**7.4 (7)**

* HVR = high value regrowth

APPENDIX C HABITAT QUALITY SCORE METHOD – IMPACT AND OFFSET

SUMMARY

The habitat quality score for each MNES has been calculated generally in accordance with the GTDTHQ (version 1.3; DES 2020) and the methods outlined below in order to be consistent with the requirements under the EPBC Act OAG.

MNES HABITAT QUALITY SCORING METHOD

The habitat quality for each MNES for use in the EPBC Act OAG is required to consider three attributes:

- site condition
- site context
- species stocking rate.

The following sections provide an overview of the methodology used to calculate habitat quality. All three components have been assessed for threatened fauna; however, for threatened ecological communities (i.e. Poplar Box TEC) only site condition and site context components inform the habitat quality score.

SITE CONDITION

METHOD

The site condition score for each MNES will be calculated generally in accordance with the Site based attribute assessment methodology of the BioCondition Assessment Manual (Eyre et al. 2015), outlined in the GTDTHQ version 1.3 (DES 2020). Site condition is determined through a field-based assessment of 13 ecological attributes to describe the structure and function of the vegetation community, compared to the expected range for a relatively undisturbed (intact) community (i.e. RE benchmark).

The results of field-based assessment are scored based on the scoring guide provided in the BioCondition Assessment Manual to determine the site condition score for each MNES at each relevant monitoring site, out of 80.

***Offsets Assessment Guide* requirements**

In accordance with the EPBC Act OAG, the condition of a site is considered in relation to the ecological requirements of a threatened species or ecological community including:

- What is the structure and condition of the vegetation on the site?

- What is the diversity of relevant habitat species present (including both endemic and non-endemic)?
- What relevant habitat features are on the site?

Table C-1 summarises how each of the requirements of the EPBC Act OAG are considered as part of determining the site condition score for an offset value.

Table C-1: Assessment of site condition

Habitat quality component	Assessment process
What is the structure and condition of the vegetation on the site?	The structure and condition of the vegetation is assessed generally in accordance with the site-based attribute assessment methodology from the BioCondition Assessment Manual. This assessment measures a suite of ecological attributes to describe the structure, function and integrity of the vegetation community, compared to the same vegetation community in a relatively undisturbed (intact) state (i.e. a benchmark). The condition of the vegetation community has a direct influence on its ability to support and provide habitat for biodiversity values.
What is the diversity of relevant habitat species present (including endemic and non-endemic)?	The site condition component from the BioCondition Assessment Manual assesses different attributes of a vegetation community comparing the relevant species richness for particular attributes against a published benchmark, including native tree, shrub, grass and forb species richness. The results of these assessments can be used to confirm the presence and diversity of habitat species relevant to the offset value.
What relevant habitat features are on the site?	The offset area for each value was initially determined based on ground-truthed RE and the presence of known habitat features identified as part of field surveys of the area, in accordance with species conservation advice and other species-specific sources endorsed by Queensland and/or Commonwealth Governments. Ongoing site condition assessments for each offset value will continue to confirm the presence of relevant habitat features within previously shortlisted, suitable vegetation communities as well as assessing their condition against the published benchmark.

SITE CONTEXT

METHOD

The method to calculate site context for a site is based on a combination of the landscape context attributes assessment method outlined in Section 6 of the BioCondition Assessment Manual as well

as an assessment of threats that occur on or near the site to ensure the requirements for site context under the OAG are adequately assessed.

Subregion assessment

The first step is to determine whether the given site is located within a fragmented or intact subregion in Queensland. Fragmented subregions are defined in the BioCondition Assessment Manual as those subregions where the amount of remnant vegetation is less than 65%, with remaining subregions considered intact. Section 6 of the BioCondition Assessment Manual identifies the bioregions and subregions considered either fragmented or intact. All impact and offset monitoring sites were located within fragmented subregions.

The following components were assessed through a GIS desktop analysis at each relevant monitoring site for each MNES.

Patch size (fragmented subregion)

Patch size is the size of the patch/assessment unit being assessed and any directly connecting remnant and regrowth vegetation. To calculate the patch size score:

- The area of remnant and regrowth vegetation in which the monitoring site is located is measured, summing together with this all other directly connecting areas of remnant and regrowth vegetation.
- Determine the score for this attribute by matching with the class ranges in Table C-2.

Table C-2: Size of patch scoring criteria contributing to context score

Criteria	Score
<5 ha remnant and/or regrowth	0
≥5-25 ha remnant and/or regrowth	2
≥26-100 ha remnant OR ≥25-200 ha remnant and regrowth OR ≥25-200 ha regrowth	5
≥100-200 ha remnant OR >200 ha remnant and regrowth OR > 200 ha regrowth	7
≥200 ha remnant	10

Connectedness (fragmented subregion)

The proportion of the assessment unit's boundary which is connected to remnant and regrowth vegetation is measured. To calculate the connectedness score:

- The percentage of remnant and/or regrowth vegetation along the boundary of the assessment unit containing the monitoring site is measured.

- Determine the score for this attribute by matching with the class ranges in Table C-3.

Table C-3: Connectedness scoring criteria contributing to context score

Criteria	Score
LOW: The assessment unit is not connected using any of the following descriptions.	0
MEDIUM: The assessment unit is connected with adjacent remnant vegetation along >10% to <50% of its perimeter OR is connected with adjacent remnant vegetation along <10% of its perimeter AND is connected with adjacent regrowth native vegetation > 25% of its perimeter.	2
HIGH: The assessment unit is connected with adjacent remnant vegetation along 50% to 75% of its perimeter.	4
VERY HIGH: The assessment unit is connected with adjacent remnant vegetation along >75% of its perimeter OR includes > 500 ha remnant vegetation	5

Context (fragmented subregion)

Assessment of context involves measuring the percentage of remnant and regrowth vegetation within a one kilometre buffer around the monitoring site. To calculate the context score:

- Create a 1 km buffer around the monitoring site.
- Measure the percentage of remnant and regrowth vegetation within the 1 km buffer.
- Determine the score for this attribute by matching with the thresholds in Table C-4.

Table C-4: Context scoring criteria contributing to context score

Criteria	Score
LOW: <10% remnant vegetation AND <30% native non-remnant vegetation (regrowth)	0
MEDIUM: ≥10% to 30% remnant vegetation AND <30% regrowth OR <10% remnant vegetation AND ≥30% regrowth	2
HIGH: ≥30% to 75% remnant vegetation OR ≥10% to 30% remnant vegetation AND ≥30% regrowth	4
VERY HIGH: >75% remnant vegetation	5

Threats

The measure of threat is calculated for each MNES that is a species (i.e. excluding TEC) and is undertaken generally in accordance with Section 2.4.4.4 (Absence of threats) of the GTDTHQ

(version 1.3; DES 2020). This attribute indicates the magnitude of all known or potential threats within, or within close proximity to, the offset matter that may negatively impact on the species' habitat and/or the species' ability to exist and persist in the offset area.

A list of known and potential threats are first collated from the literature, including relevant conservation advices and other matter-specific sources endorsed by Queensland and/or Commonwealth Governments. Through a combination of desktop assessments and field-based assessments, a refinement of identified threats for each offset matter is undertaken (whether involving the removal or addition of threats), resulting in a final list of threats considered to retain a level of scope or severity (refer to Table A-5 [offset area] and Table B-6 [Project site] for relevant matter-specific threats for each MNES species).

Scope refers to the proportion of the matter's habitat or local population within the matter area that can reasonably be expected to be affected by the threat within ten years given the continuation of current circumstances and trends. Scope is scored on a five-point rating scale:

Severity refers to the level of damage (given the identified scope) from the given threat to the matters' habitat/local population that can reasonably be expected given the continuation of current circumstances and trends. As with scope, severity is scored on a five-point rating scale:

1. Very High: Within the scope, the threat is likely to destroy or reduce the species' habitat/local population by 80-100% within ten years or three generations.
2. High: Within the scope, the threat is likely to seriously degrade or reduce the species' habitat/local population by 40-79% within ten years or three generations.
3. Medium: Within the scope, the threat is likely to moderately degrade or reduce the species' habitat/local population by 11-39% within ten years or three generations.
4. Low: Within the scope, the threat is likely to only slightly degrade or reduce the species' habitat/local population by 6-10% within ten years or three generations.
5. Very Low: Within the scope, the threat is likely to have a negligible damage or will only degrade or reduce the species' habitat/local population by 1-5% within ten years or three generations.

Using the rating scores for scope and severity, a score is assigned between 1 and 25 for each matters' threat factor in accordance with the threat matrix in Table C-5 below, whereby a score of 1 represents a very high threat and 25 poses very low threat.

Table C-5: Threat matrix for scoring each threat factor according to its scope and severity

Threat matrix			Severity				
			Very high	High	Medium	Low	Very low
			1	2	3	4	5
Scope	Very high	1	1	2	3	4	5
	High	2	2	4	6	8	10
	Medium	3	3	6	9	12	15
	Low	4	4	8	12	16	20
	Very low	5	5	10	15	20	25

The total site context score for each MNES that is a species at each relevant monitoring site is calculated based on the following:

1. Separately calculating the scores for patch size (out of 10), connectedness (out of 5) and context (out of 5).
2. Calculating the threats score, out of 25.
3. Calculating a final weighted score (out of 45) for site context as:
    a. 25% weighting of the patch size score,
    b. 12.5% weighting of the connectedness score,
    c. 12.5% weighting of the context score
    d. 50% weighting of the threats score.

The methodology prescribed in the GTDTHQ (version 1.3; DES 2020) calculates the final score for the 'absence of threats' attribute as that of the lowest scoring (i.e., most threatening) threat factor. This method was undertaken for the calculation of threat factor and the Project site (Table B-6). However, the method for calculating the threat factor for the offset area takes a more conservative approach by considering the average score for all threat factors, excluding all those with a score of 25 (i.e., excluding threat factors characterised as ones of very low severity and very low scope).

OFFSETS ASSESSMENT GUIDE REQUIREMENTS

In accordance with the EPBC Act OAG, site context is assessed based on the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a

threatened species or ecological community, as well as identifying known or potential threats including:

- What is the connectivity with other suitable/known habitat or remnants?
- What is the importance of the site in relation to the overall species population or the occurrence of the community?
- What threats occur on or near site?

Table C-6 summarises how each of the requirements above are considered as part of determining the site context score for an offset value.

Table C-6: Assessment of site context

Habitat quality component	Assessment process
What is the connectivity with other suitable/known habitat or remnants?	This component is assessed through: • Patch size – measuring the size of the patch of remnant vegetation being assessed and any directly connecting remnant vegetation. • Connectedness – measuring the proportion of the remnant patch that a given monitoring site is located within which is connected to remnant vegetation.
What is the importance of the site in relation to the overall species population or the occurrence of the community?	This component is assessed through the BioCondition Assessment Manual measure of context, representing the percentage of remnant vegetation within a 1 km buffer around a given monitoring site. The greater the proportion of suitable/known habitat and remnant vegetation within the buffer area the more likely the site and surrounding areas will support a viable, self-sustaining, source-meta-population of the species or community.
What threats occur on or near site?	This component is based on the assessment of the scope and severity of confirmed and potential threats occurring within, or within close proximity to the site for each MNES. A list of matter-specific threats is provided in Table A-5 (offset site) and Table B-6 (Project site).

SPECIES HABITAT INDEX

METHOD

Species habitat index was calculated generally in accordance with the species habitat attribute assessment methodology outlined in the GTDTHQ (version 1.3; DES 2020). Table C-7 summarises the method to be used to calculate the species habitat index score, out of 20. Species habitat attributes indicate a matter area's capacity to support a species for all or part of its life cycle, whether permanently or from time to time.

Each sub-component of species habitat index scoring method has been tailored for each MNES to take into account species-specific habitat requirements in accordance with conservation advice and other species-specific sources endorsed by Queensland and/or Commonwealth Governments, as well as an assessment of the role of the site population in regards to the overall species population. Table C-13 to Table C-12 provide additional detail on the method used to score habitat indices for the MNES (fauna) in the offset area, and Table C-9 to Table C-11 provide additional detail for those at the Project site.

Table C-7: Method to assess species habitat index

Component	Sub-component/scoring	Score
Quality and availability of food and habitat required for foraging	A species-specific assessment of the quality and availability of food and habitat required for foraging, assigned as a score between 1 and 10, where: • a score of 1 represents very limited species-specific foraging habitat (e.g., litter and stone cover for collared delma), conditions or food resources available • a score of 10 represents species-specific foraging habitat, conditions or food resources are present for all relevant stages of the life cycle.	1 – 10
Quality and availability of habitat required for shelter and breeding	A species-specific assessment of the quality and availability of habitat required for shelter and breeding. Habitat required for shelter may include habitat factors required to avoid predation or other threats, rest or seeking shelter from the elements. The result of the assessment assigns a score between 1 and 10, where: • a score of 1 represents very limited species-specific shelter and breeding habitat (e.g., presence of large coarse woody debris for yakka skink), conditions or resources available • a score of 10 represents presence of abundant, available species-specific shelter and breeding habitat, conditions and resources for all relevant stages of the life cycle	1 – 10
Quality and availability of habitat required for mobility	A species-specific assessment of quality and availability of habitat required for mobility. Habitat required for mobility relates to the species' ability to move within the matter and, if relevant, to and from adjacent patches of habitat. The result of the assessment assigns a score between 1 and 10, where: • a score of 1 represents an almost complete barrier to mobility between patches of suitable habitat for the given matter, either by natural barriers (e.g., steep mountain ranges, cliffs, unsuitable habitats) or artificial barriers (e.g., infrastructure (roads, rail, mines) or extensive areas of treeless, unsuitable habitat) • a score of 10 represents limited barriers to mobility, with contiguous remnant vegetation affording relatively unimpeded movement or functional connectivity between suitable habitat patches for the given matter.	1 – 10

Component	Sub-component/scoring	Score
Role of site location to species overall population	Site not or unlikely to be critical to species' survival – Site is unlikely to support a population of the species and the site is within the given species' geographical range. The site contains low quality food, foraging and shelter habitat, with limited mobility capacity to other areas of suitable habitat.	1
	Site likely to support habitat critical to species' survival – the site is likely to support a population of the species and the site is within the given species' geographical range. The site contains moderate quality food, foraging and shelter habitat, with moderate mobility capacity to other areas of suitable habitat.	4
	Site known to support habitat critical to species' survival – there is evidence of one or more species records within the last 10 years within 5 km of the site and site contains greater than moderate quality food, foraging and shelter habitat, with greater than moderate mobility capacity to other areas of suitable habitat.	7
	Site is critical to the species' survival – there is evidence of multiple species records within the last 10 years and site contains high quality food, foraging and shelter habitat, with limited mobility to other areas of suitable habitat.	10

OFFSETS ASSESSMENT GUIDE REQUIREMENTS

In accordance with the EPBC Act OAG, species stocking rate is assessed based on the usage and/or density of a species at a site and the role of the site population with regards to the overall species population viability or community extent, including:

- What is the presence of the species on the site (i.e. confirmed / modelled)?
- What is the density of species known to utilise the site?
- What is the role of the site population with regards to the overall species population?

Table C-8 summarises how each of the requirements above are considered as part of determining the species habitat index score for an offset value.

Table C-8: Assessment of species stocking rate

Habitat quality component	Assessment process
What is the presence of the species on the site (i.e. confirmed/modelled)?	The presence and density of the species on the site is incorporated into the scoring for the species habitat index score of the role of site location to species overall population in the state.
What is the density of species known to utilise the site?	Additionally, the components assessed as part of the species habitat index metrics detailed in Table C-7 above also provide a measure with regards to additional components of the site in supporting or

Habitat quality component	Assessment process
	potentially supporting the MNES captured in the quality and availability of food, foraging, shelter and breeding habitat scores (e.g. presence and volume of large trees for greater glider).
What is the role of the site population with regards to the overall species population?	Corresponds to the species habitat indices score for role of site location to species overall population in the state, as well as the quality and availability of habitat required for mobility.

OFFSET AREA HABITAT QUALITY METRICS FOR MNES

Table C-9: Species habitat index scoring for koala at offset area

Component	Score	Description
Quality and availability of food and foraging habitat	1	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Angophora* and *Lophostemon*) that is known from the RE, with limited foraging potential for the species based on koala food trees known to support koalas within the region.
	5	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Angophora* and *Lophostemon*) that is known from the RE, and provides known foraging habitat for the species including koala food trees known to support koalas within the region, AND/OR >50% of the RE benchmark for number of large trees attribute.
	10	• Minimum of two eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Angophora* and *Lophostemon*) that is known from the RE, and provides known foraging habitat for the species including koala food trees known to support koalas within the region, AND • >70% of the RE benchmark for attributes number of large trees OR • 1 koala food tree species known to support koalas within the region that alone accounts for >50% of the canopy.
Quality and availability of shelter	1	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Angophora* and *Lophostemon*) that is known from the RE, with limited sheltering or dispersal habitat potential for the species.
	5	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Angophora* and *Lophostemon*) that is known from the RE, and provides known habitat for the species including emergent trees likely to support shelter and/or dispersal habitat for koalas AND • >50% of the RE benchmark for attributes number of larger trees and/or canopy cover and/or canopy height.
	10	• Minimum of two eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Angophora* and *Lophostemon*) that is known from the RE, and provides known habitat for the species including emergent trees known to support shelter and/or dispersal habitat for koalas AND • >70% of the RE benchmark for at least two of the three following attributes: - number of larger trees, - canopy cover and - canopy height
Species mobility capacity	1	• The site is functionally isolated from other appropriate habitat for the species, with much of the landscape considered a barrier to species mobility, including natural barriers (e.g. mountain ranges, unsuitable habitats, major rivers/waterbodies) and/or artificial barriers (e.g. such as roads, rail, mines), or developments that create treeless areas more than 2 km wide. • The site is small compared with the known habitat known or likely to support the species. • The site is generally representative of one likely to only support a relictual population, with little opportunity for dispersal from source metapopulations.
	4	• The site is likely isolated to regular movement of the species into or out of habitat contiguous to the site, resulting in the site only likely to support a relictual population or, at best, a sink population, with very irregular dispersal from nearby populations.
	7	• The site is representative of a stepping-stone in the landscape between other patches of appropriate habitat for the species, with potential regular movement of the species into or out of habitat contiguous to the site, OR • Given the presence of appropriate habitat, the site is large enough to likely support a self-sustaining population either representative of a source metapopulation, or a nearby satellite population.
	10	• The site is limited in its barrier to movement by the species, or the site is sufficiently large to support a known source population of a likely or known metapopulation in the landscape.
Role of site location to species overall population in the state	1	• Site unlikely to support a population of the species and site is within geographical range and site contains low quality food, foraging and shelter habitat
	4	• Site likely to support a population of the species and site is within geographical range and site contains moderate quality food, foraging and shelter habitat
	7	• Evidence of one or more species records within the last 10 years within 5 km of the site and site contains greater than moderate quality food, foraging and shelter habitat

Component	Score	Description
	10	• Evidence of one or more species records within the last 10 years and site contains high quality food, foraging and shelter habitat

Table C-10: Species habitat index scoring for squatter pigeon (southern) at offset area

Component	Score	Description
Quality and availability of food and foraging habitat	1	• Overall BioCondition score <5 AND/OR • <50% of the RE benchmark value for native grass species AND native perennial grass cover • Highly disturbed ground layer
	5	• Overall BioCondition score >5 - <8 AND/OR • >50% of the RE benchmark for native grass species AND/OR native perennial grass cover. • Evidence of some disturbance to ground layer resulting in reduced native perennial grass cover.
	10	• Overall BioCondition score >8 AND/OR • >70% of the RE benchmark for native grass species AND native perennial grass cover • < 10% non-native plant cover • Limited evidence of disturbance to ground layer resulting in near benchmark native perennial grass cover.
Quality and availability of shelter	1	• Overall BioCondition score <5 AND/OR <50% of the RE benchmark value for native grass species AND native perennial grass cover • Distance to watering point >3 km
	5	• Overall BioCondition score >5 - <8 AND/OR >50% of the RE benchmark for native grass species AND/OR native perennial grass cover • Distance to watering point <3 km.
	10	• Overall BioCondition score >8 AND/OR • >70% of the RE benchmark for native grass species AND native perennial grass cover • Distance to watering point <1 km
Species mobility capacity	1	• The site is functionally isolated from other appropriate habitat for the species, with much of the landscape considered a barrier to species mobility, including natural barriers (e.g. mountain ranges, unsuitable habitats, major rivers/waterbodies) and/or artificial barriers (e.g. such as roads, rail, mines), or developments that create treeless areas more than 2 km wide. • The site is small compared with the known habitat known or likely to support the species. • The site is generally representative of one likely to only support a relictual population, with little opportunity for dispersal from source metapopulations.
	4	• The site is likely isolated to regular movement of the species into or out of habitat contiguous to the site, resulting in the site only likely to support a relictual population or, at best, a sink population, with very irregular dispersal from nearby populations.
	7	• The site is representative of a stepping-stone in the landscape between other patches of appropriate habitat for the species, with potential regular movement of the species into or out of habitat contiguous to the site, OR • Given the presence of appropriate habitat, the site is large enough to likely support a self-sustaining population either representative of a source metapopulation, or a nearby satellite population.
	10	• The site is limited in its barrier to movement by the species, or the site is sufficiently large to support a known source population of a likely or known metapopulation in the landscape.
	1	• Site unlikely to support a population of the species and site is within geographical range and site contains low quality food, foraging and shelter habitat

Component	Score	Description
Role of site location to species overall population in the state	4	• Site likely to support a population of the species and site is within geographical range and site contains moderate quality food, foraging and shelter habitat
	7	• Evidence of one or more species records within the last 10 years within 5 km of the site and site contains greater than moderate quality food, foraging and shelter habitat
	10	• Evidence of one or more species records within the last 10 years and site contains high quality food, foraging and shelter habitat

Table C-11: Species habitat index scoring for greater glider at offset area

Component	Score	Description
Quality and availability of food and foraging habitat	1	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Lophostemon*, or *Angophera*) that is known from the RE, with limited foraging potential for the species.
	5	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Lophostemon*, or *Angophera*) that is known from the RE, and provides known foraging habitat for the species (*Corymbia citriodora, Eucalyptus moluccana, E. tereticornis, E. crebra, C. intermedia and E. portuensis* AND • >50% of the RE benchmark for number of large trees attribute OR 10-50% or >200% tree canopy cover
	10	• Minimum of two eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Lophostemon*, or *Angophera*) that is known from the RE, and provides known foraging habitat for the species (*Corymbia citriodora, Eucalyptus moluccana, E. tereticornis, E. crebra, C. intermedia* and *E. portuensis*) AND • >70% of the RE benchmark for attributes number of large trees OR • 1 greater glider food tree species known to support greater glider within the region that alone accounts for >50% of the canopy.
Quality and availability of shelter	1	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Lophostemon*, or *Angophera*) that is known from the RE, with limited foraging potential for the species.
	5	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Lophostemon*, or *Angophera*) that is known from the RE, and provides known habitat for the species (*Corymbia citriodora, Eucalyptus moluccana, E. tereticornis, E. crebra, C. intermedia* and E. *portuensis*) including emergent trees likely to support shelter and/or dispersal habitat for greater glider, AND • >50% of the RE benchmark for attributes number of large trees
	10	• Minimum of one eucalypt species present (including species from the genera *Eucalyptus*, *Corymbia*, *Lophostemon*, or *Angophera* that is known from the RE, and provides known habitat for the species (*Corymbia citriodora, Eucalyptus moluccana, E. tereticornis, E. crebra, C. intermedia* and *E. portuensis*) including emergent trees known to support shelter and/or dispersal habitat for greater glider, and >70% of the RE benchmark for large trees at least one of the two following attributes: - canopy cover and - canopy height
Species mobility capacity	1	• The site is functionally isolated from other appropriate habitat for the species, with much of the landscape considered a barrier to species mobility, including natural barriers (e.g. mountain ranges, unsuitable habitats, major rivers/water bodies) and/or artificial barriers (e.g. such as roads, rail, mines), or developments that create treeless areas more than 2 km wide. The site is small compared with the known habitat required for the home range of the species (generally 3 ha for greater glider). The site is generally representative of one likely to only support a relictual population, with little opportunity for dispersal from source metapopulations.
	4	• The site is likely isolated to regular movement of the species into or out of habitat contiguous to the site, resulting in the site only likely to support a relictual population or, at best, a sink population, with very irregular dispersal from nearby populations. Site at least adjacent to riparian zone (i.e. alluvial food plain)
	7	• The site is representative of a stepping-stone in the landscape between other patches of appropriate habitat for the species, with potential regular movement of the species into or out of habitat contiguous to the site, OR • Given the presence of appropriate habitat, the site is large enough to likely support a self-sustaining population (at least 3 ha of suitable habitat available) either representative of a source metapopulation, or a nearby satellite population. Site is within riparian habitat of minor or major watercourse with connection across landscape to nearby remnant vegetation of suitable habitat for greater glider (i.e. riparian zone is connected to a state mapped riparian corridor) AND with width of vegetation 15-25m

Component	Score	Description
	10	• The site is limited in its barrier to movement by the species, or the site is sufficiently large to support a known source population of a likely or known metapopulation in the landscape. Site is within riparian habitat of major watercourse with connection across landscape to nearby remnant vegetation of suitable habitat for greater glider (i.e. riparian zone is connected to a state mapped riparian corridor) AND with width of vegetation at least 25m
Role of site location to species overall population in the state	1	• Site likely to support a species population and site is within geographical range of the species although the site contains low quality food, foraging and shelter habitat; OR • The site is likely to support only a small or relictual population of the species (i.e. patch of vegetation is less than 3ha or part of/adjacent to extremely narrow riparian zone)
	4	• Site likely to support a population of the species and site is within geographical range of the species and site contains moderate quality food, foraging and shelter habitat; OR • The site is likely to support only a small or relictual population of the species.
	7	• Evidence of one or more species records within the last 10 years within 15 km of the site OR • The site contains habitat likely to support a relatively higher than average population density of the species, likely to represent a source metapopulation AND • Site is within riparian habitat of minor major watercourse with connection across landscape to recorded population of greater glider AND with width of vegetation at least 25m
	10	• Evidence of one or more species records within the last 10 years within 15 km of the site AND • The site contains habitat likely or known to support a relatively higher than average population density of the species, likely to represent a source metapopulation AND • Site is within riparian habitat of major watercourse with connection across landscape to recorded population of greater glider AND with width of vegetation at least 25m

PROJECT SITE HABITAT QUALITY METRICS FOR MNES

Table C-12: Species habitat index scoring for koala at Project site

Component	Description			
Quality and availability of food and foraging habitat	**Presence and abundance of forage trees (/ha)**	**/40**		
	<15	0		
	≥15 - 45	20		
	≥45	40		
Quality and availability of shelter	**Presence and abundance of refugial habitat (distance to riparian vegetation)**	**/20**		
	within riparian vegetation	20		
	≤1 km to riparian vegetation	10		
	>1 km to riparian vegetation	2		
Species mobility capacity	**Habitat patch size (ha)**	**/20**	**Connectivity to habitat (distance in metres)**	**/10**
	<10 ha	1	<100	10
	≥10-100	7	≥100 - 500	7
	≥100-500 ha	10	≥500 - 1,500	4
	≥500-1,000 ha	15	≥1,500	0

Component	Description		
	>1,000 ha	20	
Role of site location to species overall population in the state	**Qualitative assessment of the role of the site location to species overall state population**		**/5**
	Site is likely to support only a small or relictual population of the species AND low quality food, foraging and shelter habitat		1
	Site is likely to support only a small or relictual population of the species AND moderate quality food, foraging and shelter habitat		2
	Site is likely to support a population AND moderate quality food, foraging and shelter habitat		3
	Site contains habitat likely to support a population at or lower than average population density for the species (sink population) AND moderate to high quality food, foraging and shelter habitat		4
	Site contains habitat likely or known to support a relatively higher than average population density of the species (source population) AND moderate to high quality food, foraging and shelter habitat		5

Table C-13: Species habitat index scoring for squatter pigeon (southern) at Project site

Component	Description					
Quality and availability of food and foraging habitat	**Distance to water**	**/15**	**Grass species richness**	**/5**	**Bare ground (%)**	**/10**
	<3 km	15	< 3 species	0	<20%	0
	≥3 km	0	≥ 3 - 10 species	3	≥20%	5

Component	Description					
			>10 species	5		
Quality and availability of shelter	**Distance to water**	**/10**	**Underlying geology suitability**	**/10**	**Ground vegetation cover (%)**	**/5**
	<1 km	10	No	0	<10%	0
	≥1 km	0	Yes	10	≥10% - 75%	5
					>75%	0
Species mobility capacity	**Connectivity of assessment unit to suitable habitat**	**/25**				
	Low	1				
	Moderate	15				
	High	25				
Role of site location to species overall population in the state	**Qualitative assessment of the role of the site location to species overall state population**					**/5**
	Site is likely to support only a small or relictual population of the species AND low quality food, foraging and shelter habitat					1
	Site is likely to support only a small or relictual population of the species AND moderate quality food, foraging and shelter habitat					2
	Site is likely to support a population AND moderate quality food, foraging and shelter habitat					3

Component	Description	
	Site contains habitat likely to support a population at or lower than average population density for the species (sink population) AND moderate to high quality food, foraging and shelter habitat	4
	Site contains habitat likely or known to support a relatively higher than average population density of the species (source population) AND moderate to high quality food, foraging and shelter habitat	5

Table C-14: Species habitat index scoring for greater glider at Project site

Component	Description			
Quality and availability of food and foraging habitat	**Presence and abundance of forage trees (/ha)**	**/15**		
	<15	0		
	≥15 - 45	7		
	>45	15		
Quality and availability of shelter	**Presence of shelter trees (hollows >20 cm/ha)**	**/40**		
	<4	0		
	≥4 - 9	20		
	>9	40		
Species mobility capacity	**Habitat patch size (ha)**	**/20**	**Eucalypt canopy cover (%)**	**/20**
	<100 ha	0	≤15	0

Component	Description			
	≥100-500 ha	10	>15-40	10
	≥500-1,000 ha	15	>40	20
	>1,000 ha	20		
Role of site location to species overall population in the state	**Qualitative assessment of the role of the site location to species overall state population**			**/5**
	Site is likely to support only a small or relictual population of the species AND low quality food, foraging and shelter habitat			1
	Site is likely to support only a small or relictual population of the species AND moderate quality food, foraging and shelter habitat			2
	Site is likely to support a population AND moderate quality food, foraging and shelter habitat			3
	Site contains habitat likely to support a population at or lower than average population density for the species (sink population) AND moderate to high quality food, foraging and shelter habitat			4
	Site contains habitat likely or known to support a relatively higher than average population density of the species (source population) AND moderate to high quality food, foraging and shelter habitat			5

FINAL HABITAT QUALITY SCORE

The habitat quality score for each MNES that is a species is calculated as the average area-weighted habitat quality score across each of the assessment units (RE and condition state) contributing to habitat. The habitat quality score for each assessment unit (RE) for an MNES is calculated as the average habitat quality score from all monitoring sites within that assessment unit (RE).

Table C-15 provides a summary of the components used to score habitat quality for each MNES that is a species, and the maximum score and relevant weighting for each component. Table C-16 provides a summary of the components used to score habitat quality for each MNES that is a TEC, including its maximum score and relevant weighting for each component.

Table C-15: Attributes and their weightings contributing to MNES species scores

Site condition			Site context			Species habitat index		
Attribute	Score	Weighting	Attribute	Score	Weighting	Attribute	Score	Weighting
Recruitment of woody perennial species	5	6.25%	Size of patch	10	25%	Quality and availability of food and foraging habitat	10	16.7%
Native plant species richness – trees	5	6.25%	Connectivity	5	12.5%	Quality and availability of habitat required for shelter and breeding	10	16.7%
Native plant species richness – shrubs	5	6.25%	Context	5	12.5%	Quality and availability of habitat required for mobility	10	16.7%
Native plant species richness – grasses	5	6.25%	Threats	25	50%	Role of site location to species overall population in the state	10	50%
Native plant species richness – forbs	5	6.25%						
Tree canopy height	5	6.25%						
Tree canopy cover	5	6.25%						
Shrub canopy cover	5	6.25%						

Site condition			Site context			Species habitat index		
Attribute	Score	Weighting	Attribute	Score	Weighting	Attribute	Score	Weighting
Native perennial grass cover	5	6.25%						
Organic litter	5	6.25%						
Large trees	15	18.75%						
Coarse woody debris	5	6.25%						
Non-native plant cover	10	12.5%						
Total	/80	100%	Total	/45	100%	Total	/25	100%
Site condition weighting		30%	Site context weighting		30%	Species habitat index weighting		40%

Table C-16: Attributes and their weightings contributing to MNES TEC scores

Site condition			Site context		
Attribute	Score	Weighting	Attribute	Score	Weighting
Recruitment of woody perennial species	5	6.25%	Size of patch	10	50%

Site condition			Site context		
Attribute	Score	Weighting	Attribute	Score	Weighting
Native plant species richness – trees	5	6.25%	Connectivity	5	25%
Native plant species richness – shrubs	5	6.25%	Context	5	25%
Native plant species richness – grasses	5	6.25%			
Native plant species richness – forbs	5	6.25%			
Tree canopy height	5	6.25%			
Tree canopy cover	5	6.25%			
Shrub canopy cover	5	6.25%			
Native perennial grass cover	5	6.25%			
Organic litter	5	6.25%			
Large trees	15	18.75%			
Coarse woody debris	5	6.25%			

Site condition			Site context		
Attribute	Score	Weighting	Attribute	Score	Weighting
Non-native plant cover	10	12.5%			
Total	/80	100%	Total	/20	100%
Site condition weighting		90%	Site context weighting		10%

APPENDIX D RISK ASSESSMENT

Table D-1: Risk framework

		Consequence (score/5)				
		Minor (1)	Moderate (2)	High (3)	Major (4)	Critical (5)
Likelihood	Highly likely (5)	Medium	High	High	Severe	Severe
	Likely (4)	Low	Medium	High	High	Severe
	Possible (3)	Low	Medium	Medium	High	Severe
	Unlikely (2)	Low	Low	Medium	High	High
	Rare (1)	Low	Low	Low	Medium	High

Table D-2: Likelihood and consequence

Qualitative measure of likelihood (how likely is it that this event/circumstances will occur after management actions have been put in place/are being implemented)	
Rare (1)	May occur in exceptional circumstances
Unlikely (2)	Could occur but considered unlikely or doubtful
Possible (3)	Might occur during the life of the Project
Likely (4)	Will probably occur during the life of the Project
Highly likely (5)	Is expected to occur in most circumstances
Qualitative measure of consequences (what will be the consequence/result if the issue does occur)	
Minor (1)	Minor risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing low cost, well characterised corrective actions.
Moderate (2)	Moderate risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing well characterised, high cost/effort corrective actions.
High (3)	High risk of failure to achieve the plan's objectives. Results in medium-long term delays to achieving plan objectives, implementing uncertain, high cost/effort corrective actions.
Major (4)	The plan's objectives are unlikely to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies.
Critical (5)	The plan's objectives are unable to be achieved, with no evidenced mitigation strategies.

Table D-3: Risk assessment

Management objective	Risk	Initial risk rating			Control strategies	Residual risk rating		
		Likelihood	Consequence	Overall Risk Rating		Likelihood	Consequence	Overall Risk Rating
Achieve the completion criteria and habitat quality improvements for MNES, which include the habitat quality scores in this OAMP.	Completion criteria and habitat quality improvements are not achieved	3	4	H	▶ Implement the OAMP, including the monitoring programs and management actions outlined in Section 8 and Section 7, respectively. ▶ Implementation of the adaptive management process outlined in Section 6 ▶ Obtain advice from scientific advisory groups with the aim of identifying appropriate additional management interventions if interim performance targets are not achieved for one or more offset values by year 15.	1	4	M
Maintain the extent of MNES habitat/vegetation within the Kemmis Creek offset area.	Habitat or vegetation loss through land clearing.	2	3	M	▶ Declaration of Kemmis Creek offset area as a Voluntary Declaration under the *Vegetation Management Act 1999* (Qld) or other security mechanism. ▶ No clearing of native vegetation is permitted within the Kemmis Creek offset area as part of any management and monitoring activities associated with the OAMP, except for clearing that is required: - to realign, construct or maintain access tracks up to 6 m width - for fence construction and maintenance (up to 5 m width on each side of the fence) - ensure public safety or as directed by emergency management response personnel in the event of uncontrolled bushfire or other emergency procedure. ▶ Any clearing required for fencing, access, firebreaks or public safety is undertaken in accordance with the restrictions outlined in Sections 7.2, 7.3 and 7.4.	1	3	L
Ensure that any livestock grazing for fire management and weed control maintains and enhances the ground cover attributes for MNES and does not result in the degradation of habitat and vegetation.	Inappropriate grazing management and fire management reduces cover, diversity and integrity of the ground cover attributes contributing to MNES habitat	3	2	M	▶ Monitoring of the offset area will be undertaken in accordance with Section 8, including: - Offset area inspections (Section 8.1) - Biomass monitoring (Section 8.4) - Furl hazard monitoring (Section 8.5) - Habitat quality assessments to determine habitat quality scores (Section 8.6). ▶ Modifying fire management measures to better support enhancement of offset values ▶ Modifying strategic grazing management to ensure enhancement of offset values	2	2	L

Management objective	Risk	Initial risk rating			Control strategies	Residual risk rating		
		Likelihood	Consequence	Overall Risk Rating		Likelihood	Consequence	Overall Risk Rating
Minimise predation risk by feral cats to threatened fauna species.	Predation of threatened fauna by feral cats.	3	2	M	▸ Regular monitoring for pest animals will be undertaken in accordance with the methods detailed in Section 8.3 and pest animal control will be implemented following the results of monitoring in accordance with Section 7.5.	2	2	L
Minimise predation risk by wild dogs to threatened fauna species.	Predation of threatened fauna by wild dogs.	3	2	M				
Minimise predation risk by foxes to threatened fauna species.	Predation of threatened fauna by foxes.	3	2	M		2	2	L
Minimise degradation of MNES habitat by rabbits.	Degradation of habitat by rabbits.	3	2	M		2	2	L
Minimise degradation of MNES habitat by feral pigs.	Degradation of habitat by feral pigs.	3	2	M		2	2	L
Manage invasive weed species to reduce degradation of MNES habitat.	Invasion of habitat by weed species, including exotic grasses.	3	3	M	▸ Regular inspections in accordance with the methods in Section 8.2, will be undertaken to monitor the presence of weeds. ▸ Based on the results of monitoring events, weed control will be implemented in accordance with Section 8.2 and the recommended control measures available from the Queensland Department of Agriculture and Fisheries.	2	3	M
Reduce the risk of adverse impacts on MNES habitat associated with inappropriate fire regimes, or unplanned fire.	Decrease in the habitat quality score for any offset value from baseline and subsequent monitoring events as a result of fire management measures, or an unplanned fire.	4	3	H	▸ Fuel loads within the offset area will be managed through strategic grazing and/or fuel hazard reduction burns (see Section 7.7). ▸ Firebreaks will be maintained to be no wider than 6 m along all boundaries of the offset area, except along the road reserve (which will act as a firebreak) and where they correspond with waterways; all existing/proposed fence lines.	2	3	M
Achieve the interim performance targets and completion criteria for each MNES within 5, 10 and 20 years.	Offset fails to achieve the interim performance targets and completion criteria within the anticipated 10 and 20 year timeframes, respectively.	3	4	H	▸ Monitoring of the offset area will be undertaken in accordance with Section 8, including: - Offset area inspections (Section 8.1). - Habitat quality assessments to determine habitat quality scores (Section 8.6). ▸ The results of monitoring events will be compared against the interim performance targets and completion criteria to determine the progress of offset area and recorded as part of reporting (Section 9).	1	4	M

Management objective	Risk	Initial risk rating			Control strategies	Residual risk rating		
		Likelihood	Consequence	Overall Risk Rating		Likelihood	Consequence	Overall Risk Rating
					▶ Third party review of the OAMP to provide input on the effectiveness of the management actions. ▶ Increasing the frequency and intensity of pest animal and weed control measures or revising the type of measures to be implemented. ▶ Modifying fire management measures to better support enhancement of offset values.			
Once attained, the habitat quality is sustained for all offset values	If attaining the completion criteria prior to year 20, the habitat quality of MNES habitat declines	3	4	H	▶ Monitoring of the offset area will be undertaken in accordance with Section 8, including: - Offset area inspections (Section 8.1). - Habitat quality assessments to determine habitat quality scores (Section 8.6). ▶ Third party review of the OAMP to provide input on the effectiveness of the management actions. ▶ Increasing the frequency and intensity of pest animal and weed control measures or revising the type of measures to be implemented. ▶ Modifying fire management measures to better support enhancement of offset values.	1	4	M

APPENDIX E OFFSET ASSESSMENT GUIDES

The following tables present the OAG inputs and supporting justification for MNES in the Kemmis Creek offset area.

Table E-1 to Table E-4 present the Project impact habitat quality score data for each MNES and presents inputs and justifications for the OAG inputs for Kemmis Creek

Table E-1: Koala *Offsets Assessment Guide*

Input	Score	Justification
Quality of impact area	5	Koala habitat within the immediate vicinity of the Project site was assessed and defined by AARC (2024). Direct impacts of the Project on koala habitat totals 327 ha compromising primarily remnant RE 11.3.2, as well as remnant REs 11.3.7, 11.3.36, 11.9.7a, 11.3.4, 11.9.7a, 11.3.25, 11.8.5 and non-remnant REs 11.3.25 and 11.8.5. The quality of koala habitat within the Project impact area was calculated generally in accordance with the GTDTHQ (version 1.3; DES 2020). The scoring method is outlined in Appendix C. The impact habitat quality score is outlined in Appendix B and was determined to be 5/10.
Quality of offset area	7	The offset management area for koala on Kemmis Creek is 2,213 ha (107.54% of impact acquitted). Quality was assessed in accordance with the GTDTHQ (version 1.3; DEHP 2020) based on the results of preliminary field surveys in July 2023 and detailed field surveys in February 2024, which identified a habitat quality score of 7/10. The scoring method is outlined in Appendix C.
Future quality without offset management	7	The main threats to koala include habitat loss and fragmentation, vehicle strike and predation by dogs (DAWE 2022). Kemmis Creek is currently used for cattle grazing which has the potential to supress the regeneration of regrowth vegetation in areas that have been previously cleared. In addition, the potential presence of feral animals such as wild dogs have the potential to impact on koala populations in the offset area. Without offset management it has been conservatively calculated that the habitat quality of the offset area will remain over time at 7/10.
Future quality with offset management	8	The quality of habitat for koala will be improved and maintained through the establishment of an offset area on Kemmis Creek. Future quality of the offset represents the ecological gain that can be achieved over 20 years of active land management practices to improve the ecological condition of habitat for the species. This OAMP has been developed which details generic property specific management actions, and a suite of management actions that are specific to or targeted for koala. Specific management actions for the koala have been developed in accordance with approved conservation advice and recommended threat abatement and management advice for the species. Examples of these management actions include: • pest animal management to reduce mortality due to dog attacks – a pest animal control program will be undertaken to reduce the number pest animals, including dogs, that may predate on the koala. Methods may include shooting and/or baiting. • pest animal management to reduce numbers of chital deer (Axis axis) – a pest animal control program will be undertaken to reduce the number of

Input	Score	Justification
		pest animals, including deer to assist in the recruitment of native seedlings. Methods may include shooting. • weed management on the property to reduce the spread of lantana (Lantana camara) to aid in the recruitment of seedlings. • cattle grazing management to improve the condition of habitat by reducing the spread of weeds such as lantana and manage soil quality and erosion– cattle will be excluded from the offset area except during strategic grazing events. • restricted access to reduce mortality due to vehicle strikes – access to the offset area will be restricted to authorised personnel only, with any vehicle movement limited to designated access track, and ensuring driving speeds are limited to 40 km/hr. This will reduce the risk of vehicle strike. • fire management to minimise the risk and impacts of unplanned fire and improve habitat quality through controlling weeds and supporting development of structural components of offset values.
Confidence in result – future quality	80%	Through the implementation of this OAMP with specific management objectives and measurable outcomes aimed at improving the quality of koala habitat, there is a high degree of confidence that the future quality score can be achieved. This is reflected in the 80% confidence in result. Biodiversity monitoring will also be conducted as part of this OAMP to measure the progress of the offset area and ensure this OAMP achieves its required outcomes. However, there is inherent risk associated with ecological restoration. As recognised in the Society for Ecological Restoration primer which states that, 'restoration attempts to return an ecosystem to its historic trajectory. Historic conditions are therefore the ideal starting point for restoration design. The restored ecosystem will not necessarily recover its former state, since contemporary constraints and conditions may cause it to develop along an altered trajectory. The historic trajectory of a severely impacted ecosystem may be difficult or impossible to determine with accuracy.' This uncertainty is also reflected in the confidence in result – future quality score.
Risk of loss without offset	0.42%	The clearing of remnant vegetation in Queensland is regulated by the VM Act and the *Planning Act 2016* (Qld) and associated policies and codes. This framework identifies vegetation as one of four categories, varying in their degree of restriction on permissible clearing. Under the VM Act, an application must be made to the Queensland Government to clear remnant vegetation (Category B) unless an exemption applies. The VM Act prevents broad-scale clearing of remnant vegetation for agriculture or other development activities; however, clearing of some remnant vegetation for resource development purposes (e.g. mining) is allowed. The VM Act allows clearing of category X areas without requiring landholders to obtain approval. Areas mapped as category X are not subject to

Input	Score	Justification
		vegetation clearing codes and therefore have the potential to be cleared by the current or future landholders at any time. Pastoralists are motivated to clear vegetation for a variety of reasons; however, historically a combination of favourable conditions and higher commodity prices have coincided with increased rates of clearing (Evans 2016). Market conditions over the coming years look to continue to put pressure on pastoralists to increase production which inevitably leads to higher rates of clearing (M. Taylor pers comm). This is supported by clearing rates for regrowth vegetation increasing every year since 2012 (Steffen and Dean 2018). Historical clearing has disproportionately impacted vegetation on the most fertile soil, such as eucalypt woodlands on alluvial flats and Brigalow vegetation on clay plains. Expert estimates of the likelihood of clearing regrowth of alluvial ecosystems are as high as 90% (C. Hempel pers comm). Notwithstanding the property-specific decisions influencing any landholder's decision to clear, the risk that areas will be cleared resulting in the complete loss of habitat for MNES within the next 20 years, is considered to be 0.42%. This percentage reflects the average annual background rate of loss (2005 – 2014) within the Isaac Regional Council LGA as outlined in the Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act document prepared by Maseyk et al. (2017).
Risk of loss with offset	0%	The offset area is proposed to be secured through declaration as an area of high nature conservation value under section 19F of the VM Act.
Confidence in result – risk of loss	90%	The legally binding mechanism will preclude all development except where the Queensland Government authorises an activity and offsets for both the original offset and any protected matters present on site are provided. Consequently, the resultant difficulty and expense acts as a strong disincentive for development within a protected offset area.
Time over which loss is averted (years)	20	The offset area will be protected by a legally binding mechanism which will remain in effect as required by the applicable State and Commonwealth legislative requirements, therefore, the time over which loss is averted is afforded the maximum allowable time of 20 years.
Time until ecological benefit (years)	20	The implementation of site-specific land management actions through the development and application of an OAMP is expected to increase the quality of the offset area by improving vegetation condition and reducing potential threats to MNES habitat. An ecological benefit is expected to be realised in 20 years. It is estimated that it will take 20 years for koala habitat within the offset area to realise a habitat quality score improvement of 1 point. This increase in the habitat quality score will principally be achieved by:

Input	Score	Justification
		• reducing mortality through the implementation of a pest animal management plan. Should koalas be utilising the offset area, this will result in an ecological benefit to the species within a relatively short timeframe and will result in an increase in the habitat species index score. • improving the general condition of habitat through the implementation of a strategic grazing regime, fire regime and weed control program which will result in an improvement in the site condition score within the 20-year timeframe.

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Koala
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Habitat for koala	**Area**	327	Hectares	
			Quality	**5**	Scale 0-10	
			Total quantum of impact	163.50	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	163.50	Adjusted hectares	Kemmis Creek	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	2213	**Risk of loss (%) without offset**	0%	**Risk of loss (%) with offset**	0%	9.29	90%	8.37	8.04	175.82	107.54%	Yes	
									Future area without offset (adjusted hectares)	2203.7	**Future area with offset (adjusted hectares)**	2213.0								
					Time until ecological benefit	20	**Start quality (scale of 0-10)**	**7**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**8**	1.00	80%	0.80	0.77				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	163.5	175.82	107.54%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Table E-2: Squatter pigeon (southern) *Offsets Assessment Guide*

Input	Score	Justification
Quality of impact area	6	Squatter pigeon (southern) habitat within the immediate vicinity of the Project site was assessed and defined by AARC (2024) to comprise primarily alluvial vegetation communities on the impact site. Clearing associated with direct impacts of the Project on squatter pigeon (southern) habitat totals 192.3 ha supporting primarily RE 11.3.2 as well as REs 11.8.5, 11.3.36 and 11.9.7a. This comprises 150 ha of potential breeding habitat and 42 ha of potential foraging habitat, as determined by AARC. The quality of squatter pigeon (southern) habitat within the Project impact area was calculated generally in accordance with the GTDTHQ (version 1.3; DES 2020). The scoring method is outlined in Appendix C. The impact habitat quality score is outlined in Appendix B and was determined to be 6/10.
Quality of offset area	7	The offset management area identified for squatter pigeon (southern) is 2,213 ha (152.62% of impact acquitted). Quality was assessed in accordance with the GTDTHQ (version 1.3; DEHP 2020) based on the results of preliminary field surveys in July 2023 and detailed field surveys in February 2024, which identified a habitat quality score of 7/10. The scoring method is outlined in Appendix C.
Future quality without offset management	7	Grazing by livestock and the prevalence of exotic pasture grasses may decrease the quality of squatter pigeon (southern) habitat on Kemmis Creek. Overgrazing and the spread of invasive weeds are known threats to the squatter pigeon (southern) and its habitat (DCCEEW 2024a). In addition, inappropriate fire regimes may impact on the quality of habitat for squatter pigeon (southern) in the offset area. Without offset management habitat quality of the offset area is predicted to remain over time at 7/10.
Future quality with offset management	8	The quality of habitat for squatter pigeon (southern) will be improved and maintained through the establishment of an offset area on Kemmis Creek. Future quality of the offset represents the ecological gain that can be achieved over 20 years of active land management practices to improve the ecological condition of habitat for the species. This OAMP has been developed which details generic property specific management actions, and a suite of management actions that are specific to or targeted for squatter pigeon (southern). Specific management actions for squatter pigeon (southern) have been developed in accordance with approved conservation advice and recommended threat abatement and management advice for the species. Examples of these management actions include: • cattle grazing management to reduce habitat degradation – cattle will be excluded from the offset areas except during strategic grazing events.

Input	Score	Justification
		Strategic grazing events will be undertaken in the offset area in order to reduce fuel loads and control exotic pasture grasses including buffel grass. Periods of grazing will be followed by an extended period of rest and stocking rates will depend on seasonal conditions and pasture growth. • weed control to reduce habitat degradation –actions to control and prevent the spread of exotic grasses and other weed species in the offset area. • pest animal management to reduce predation – a pest animal control program will be undertaken to reduce the number of pest animals that may predate on the squatter pigeon (southern). Methods may include the baiting of feral cats and foxes.
Confidence in result – future quality	80%	Through the implementation of this OAMP, detailing specific management objectives and measurable outcomes aimed at improving the quality of squatter pigeon (southern) habitat, there is a high degree of confidence that the future quality score can be achieved. This is reflected in the 80% confidence in result. Biodiversity monitoring will also be conducted as part of this OAMP to measure the progress of the offset area and ensure this OAMP achieves its required outcomes. However, there is inherent risk associated with ecological restoration. As recognised in the Society for Ecological Restoration primer which states that, 'restoration attempts to return an ecosystem to its historic trajectory. Historic conditions are therefore the ideal starting point for restoration design. The restored ecosystem will not necessarily recover its former state, since contemporary constraints and conditions may cause it to develop along an altered trajectory. The historic trajectory of a severely impacted ecosystem may be difficult or impossible to determine with accuracy.' This uncertainty is also reflected in the confidence in result – future quality score.
Risk of loss without offset	0.42%	The clearing of remnant vegetation in Queensland is regulated by the VM Act and the *Planning Act 2016* (Qld) and associated policies and codes. This framework identifies vegetation as one of four categories, varying in their degree of restriction on permissible clearing. Under the VM Act, an application must be made to the Queensland Government to clear remnant vegetation (Category B) unless an exemption applies. The VM Act prevents broad-scale clearing of remnant vegetation for agriculture or other development activities; however, clearing of some remnant vegetation for resource development purposes (e.g. mining) is allowed. The VM Act allows clearing of category X areas without requiring landholders to obtain approval. Areas mapped as category X are not subject to vegetation clearing codes and therefore have the potential to be cleared by the current or future landholders at any time.

Input	Score	Justification
		Pastoralists are motivated to clear vegetation for a variety of reasons; however, historically a combination of favourable conditions and higher commodity prices have coincided with increased rates of clearing (Evans 2016). Market conditions over the coming years look to continue to put pressure on pastoralists to increase production which inevitably leads to higher rates of clearing (M. Taylor pers comm). This is supported by clearing rates for regrowth vegetation increasing every year since 2012 (Steffen and Dean 2018). Historical clearing has disproportionately impacted vegetation on the most fertile soil, such as eucalypt woodlands on alluvial flats and Brigalow vegetation on clay plains. Expert estimates of the likelihood of clearing regrowth of alluvial ecosystems are as high as 90% (C. Hempel pers comm). Notwithstanding the property-specific decisions influencing any landholder's decision to clear, the risk that areas will be cleared resulting in the complete loss of habitat for MNES within the next 20 years, is considered to be 0.42%. This percentage reflects the average annual background rate of loss (2005 – 2014) within the Isaac Regional Council LGA as outlined in the *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act* document prepared by Maseyk et al. (2017).
Risk of loss with offset	0%	The offset area is proposed to be secured through declaration as an area of high nature conservation value under section 19F of the VM Act.
Confidence in result – risk of loss	90%	The legally binding mechanism will preclude all development except where the Queensland Government authorises an activity and offsets for both the original offset and any protected matters present on site are provided. Consequently, the resultant difficulty and expense acts as a strong disincentive for development within a protected offset area.
Time over which loss is averted (years)	20	The offset area has been protected by a legally binding mechanism which will remain in effect as required by the applicable State and Commonwealth legislative requirements, therefore, the time over which loss is averted is afforded the maximum allowable time of 20 years.
Time until ecological benefit (years)	20	The squatter pigeon (southern) has been observed in the offset area. It is estimated that it will take 20 years for squatter pigeon (southern) habitat within the offset site to realise improvement in habitat quality from 7/10 to 8/10. This is in line with recommended recovery times for natural grassland habitat (Butler 2008) and demonstrated improvement in woodland bird habitat in grassy woodlands (Bowen et al. 2009). This increase in the habitat quality score will principally be achieved by:

Input	Score	Justification
		improving species habitat index score). This is in line with recommended recovery times for natural grassland habitat (Butler 2008) and demonstrated improvement in woodland bird habitat in grassy woodlands (Bowen et al. 2009).

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Squatter pigeon
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	192	Hectares	
			Quality	**6**	Scale 0-10	
			Total quantum of impact	115.20	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	115.20	Adjusted hectares	Kemmis Creek	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	2213	**Risk of loss (%) without offset**	0%	**Risk of loss (%) with offset**	0%	9.29	90%	8.37	8.04	175.82	152.62%	Yes	
									Future area without offset (adjusted hectares)	2203.7	**Future area with offset (adjusted hectares)**	2213.0								
					Time until ecological benefit	20	**Start quality (scale of 0-10)**	**7**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**8**	1.00	80%	0.80	0.77				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	115.2	175.82	152.62%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Table E-3: Greater glider *Offsets Assessment Guide*

Input	Score	Justification
Quality of impact area	6	Greater glider habitat within the immediate vicinity of the Project site was assessed and defined by AARC (2024). Clearing associated with direct impacts of the Project on greater glider habitat totals 293 ha and comprises primarily remnant RE 11.3.2, as well as remnant REs 11.3.7, 11.3.36, 11.9.7a, RE 11.3.4, 11.3.25, 11.8.5 and non-remnant RE 11.3.7 and non-remnant RE 11.3.25. The quality of greater glider habitat within the Project impact area was calculated generally in accordance with the GTDTHQ (version 1.3; DES 2020). The scoring method is outlined in Appendix C. The impact habitat quality score is outlined in Appendix B and was determined to be 6/10.
Quality of offset area	7	The offset management area for greater glider is 2,213 ha (100.01% impact acquitted). Quality was assessed in accordance with the GTDTHQ (version 1.3; DEHP 2017) based on the results of preliminary field surveys in July 2023, the detailed field surveys in February 2024 and the targeted surveys in June 2024, a habitat quality score of 7/10 was identified. The scoring method is outlined in Appendix C.
Future quality without offset management	7	Greater glider threats include inappropriate fire regimes and habitat clearing, degradation and fragmentation. Areas of cleared habitat limit dispersal ability of greater gliders due to the fragmentation of patches of habitat required for connectivity (DCCEEW 2022). Extensive land clearing for agriculture has led to an increasingly fragmented landscape. This is also exacerbated by inappropriate fire regimes. Greater gliders rely on old, large eucalypts for hollows large enough to support denning. Extensive clearing of suitable habitat results in less hollows available to support viable populations. By securing Kemmis Creek as an offset, existing suitable habitat will be protected from felling for the minimum time frame of 20 years the offset is in agreement. Without offset management it has been conservatively calculated that the habitat quality of the offset area will remain over time as 7/10.
Future quality with offset management	8	The quality of habitat for the greater glider will be improved and maintained through the establishment of an offset area on Kemmis Creek. Future quality of the offset represents the ecological gain that can be achieved over 20 years of active land management practices to improve the ecological condition of habitat for the species. This OAMP has been developed which details generic property specific management actions, and a suite of management actions that are specific to or targeted for the greater glider. Specific management actions for the greater glider have been developed in accordance with approved conservation advice

Input	Score	Justification
		and recommended threat abatement and management advice for the species. Examples of these management actions include: • cattle grazing management to improve the condition of habitat – cattle will be excluded from the offset area except during strategic grazing events. The exclusion of cattle will allow regrowth vegetation in the offset area to regenerate and mature. • pest animal management to reduce impact of predation by wild dogs, cats and foxes – a pest animal control program will be undertaken to reduce the number pest animals that may predate on or disturb the habitat of the greater glider. Methods may include the baiting of feral cats, pigs and dingoes.
Confidence in result – future quality	80%	Through the implementation of this OAMP, detailing specific management objectives and measurable outcomes aimed at improving the quality of greater glider habitat, there is a high degree of confidence that the future quality score can be achieved. This is reflected in the 80% confidence in result. Biodiversity monitoring will also be conducted as part of this OAMP to measure the progress of the offset area and ensure this OAMP achieves its required outcomes. However, there is inherent risk associated with ecological restoration. As recognised in the Society for Ecological Restoration primer which states that, 'restoration attempts to return an ecosystem to its historic trajectory. Historic conditions are therefore the ideal starting point for restoration design. The restored ecosystem will not necessarily recover its former state since contemporary constraints and conditions may cause it to develop along an altered trajectory. The historic trajectory of a severely impacted ecosystem may be difficult or impossible to determine with accuracy.' This uncertainty is also reflected in the confidence in result – future quality score.
Risk of loss without offset	0.42%	The clearing of remnant vegetation in Queensland is regulated by the VM Act and the *Planning Act 2016* (Qld) and associated policies and codes. This framework identifies vegetation as one of four categories, varying in their degree of restriction on permissible clearing. Under the VM Act, an application must be made to the Queensland Government to clear remnant vegetation (Category B) unless an exemption applies. The VM Act prevents broad-scale clearing of remnant vegetation for agriculture or other development activities; however, clearing of some remnant vegetation for resource development purposes (e.g. mining) is allowed. The VM Act allows clearing of category X areas without requiring landholders to obtain approval. Areas mapped as category X are not subject to vegetation clearing codes and therefore have the potential to be cleared by the current or future landholders at any time.

Input	Score	Justification
		Pastoralists are motivated to clear vegetation for a variety of reasons; however, historically a combination of favourable conditions and higher commodity prices have coincided with increased rates of clearing (Evans 2016). Market conditions over the coming years look to continue to put pressure on pastoralists to increase production which inevitably leads to higher rates of clearing (M. Taylor pers comm). This is supported by clearing rates for regrowth vegetation increasing every year since 2012 (Steffen and Dean 2018). Historical clearing has disproportionately impacted vegetation on the most fertile soil, such as eucalypt woodlands on alluvial flats and Brigalow vegetation on clay plains. Expert estimates of the likelihood of clearing regrowth of alluvial ecosystems are as high as 90% (C. Hempel pers comm). Notwithstanding the property-specific decisions influencing any landholder's decision to clear, the risk that areas will be cleared resulting in the complete loss of habitat for MNES within the next 20 years, is considered to be 0.42%. This percentage reflects the average annual background rate of loss (2005 – 2014) within the Isaac Regional Council LGA as outlined in the *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act* document prepared by Maseyk et al. (2017).
Risk of loss with offset	0%	The offset area is proposed to be secured through declaration as an area of high nature conservation value under section 19F of the VM Act.
Confidence in result – risk of loss	90%	The legally binding mechanism will preclude all development except where the Queensland Government authorises an activity and offsets for both the original offset and any protected matters present on site are provided. Consequently, the resultant difficulty and expense acts as a strong disincentive for development within a protected offset area.
Time over which loss is averted (years)	20	The offset area has been protected by a legally binding mechanism which will remain in effect as required by the applicable State and Commonwealth legislative requirements, therefore, the time over which loss is averted is afforded the maximum allowable time of 20 years.
Time until ecological benefit (years)	20	Greater glider has been observed 11 times throughout the offset area during targeted spotlight searches in June 2024. It is estimated that it will take 20 years for the greater glider habitat within the offset area to realise a habitat quality score improvement of 1 point. This increase in the habitat quality score will principally be achieved by: • reducing the degradation of habitat through the exclusion of grazing in areas of known greater glider habitat (i.e. improving site condition score).

Input	Score	Justification
		• improving the quality of habitat (structure and composition) through weed control. • reducing potential predators, such as wild dogs, cats and foxes, through the implementation of pest animal control strategies (i.e. improving species habitat index score). • planned and co-ordinated fire management regime to minimise the risk and impacts of unplanned fire and improve habitat quality through controlling weeds and supporting development of structural components of offset values.

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Greater glider
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Habitat for greater glider	**Area**	293	Hectares	
			Quality	**6**	Scale 0-10	
			Total quantum of impact	175.80	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	175.80	Adjusted hectares	Kemmis Creek	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	2213	**Risk of loss (%) without offset**	0%	**Risk of loss (%) with offset**	0%	9.29	90%	8.37	8.04	175.82	100.01%	Yes	
									Future area without offset (adjusted hectares)	2203.7	**Future area with offset (adjusted hectares)**	2213.0								
					Time until ecological benefit	20	**Start quality (scale of 0-10)**	**7**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**8**	1.00	80%	0.80	0.77				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	175.8	175.82	100.01%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Table E-4: Poplar Box TEC *Offsets Assessment Guide*

Input	Score	Justification
Quality of impact area	7	Poplar Box TEC was assessed and mapped by AARC (2024) to comprise 112.2 ha of remnant RE 11.3.2, split into 83 ha of high quality condition and 29 ha of moderate quality condition of the ecosystem. A reduction of 5.91 ha in the impact area to 106.34 ha would result in 100% acquittal of the offset requirements for Poplar Box TEC. A lack of large trees, coarse woody debris, native perennial grasses, and high level of weeds and shrub canopy cover were assessed as drawing the site condition score down for the TEC within the impact area. The quality of Poplar Box TEC within the Project impact area was calculated generally in accordance with the GTDTHQ (version 1.3; DES 2020). The scoring method is outlined in Appendix C. The impact habitat quality score is outlined in Appendix B and was determined to be 7/10.
Quality of offset area	8	The offset management area for Poplar Box is 1,020 ha (100.00% impact acquitted with a reduction of 5.91 ha in the impact area). Quality was assessed in accordance with the GTDTHQ (version 1.3; DEHP 2020) based on the results of preliminary field surveys in July 2023 and detailed field surveys in February 2024, which identified a habitat quality score of 8/10. The scoring method is outlined in Appendix C. A 90/10 weighting of site condition to site context was used to calculate habitat quality to take into account the significantly more important contribution of site condition to the integrity and characterisation of Poplar Box TEC than site context.
Future quality without offset management	7	The invasion of weed species such as large exotic grasses, pose a threat to Poplar Box (DCCEEW 2024b). Increased fuel loads and fire frequency associated with a grassy, weedy understorey may also be detrimental to the TEC particularly through hindered regeneration of popular box trees, but also native grasses and forbs that would otherwise be able to proliferate in the offset management area. With increased demand and prices for cattle, it is anticipated that with a heating and drying climate in the immediate future, additional stresses from greater density of livestock grazing would further impede the integrity of the species richness, diversity and cover of native canopy, shrub, grasses and forbs that represent the Poplar Box TEC. Without offset management, including grazing management reducing pressures on these MNES, it has been conservatively calculated that the habitat quality of the offset area will decrease over time from 8/10 to 7/10.
Future quality with offset management	8	The quality of habitat for the Poplar Box will be at least maintained through the establishment of an offset area on Kemmis Creek. Future quality of the offset represents the ecological gain that can be achieved over 20 years of active land management practices to improve the ecological condition of

Input	Score	Justification
		habitat for the TEC from a scenario of ongoing and additional cattle grazing pressure that would result in a condition loss over 20 years. This OAMP has been developed which details generic property-specific management actions and a suite of management actions that are specific to or targeted for Poplar Box TEC. Specific management actions for the Poplar Box TEC have been developed in accordance with approved conservation advice and recommended threat abatement and management advice for the matter. Examples of these management actions include: • Weed control, particularly for exotic grasses such as buffel grass (*Cenchrus ciliaris)* that increase fire frequency that can negatively affect healthy regeneration of species consistent with Poplar Box TEC, including recruitment of poplar box (*Eucalyptus populnea*) as well as other diagnostic species. Actions to control and prevent the spread of exotic grasses and other weed species in the offset area, and promote understorey regeneration, including species diagnostic of poplar box woodland. • Fire management to reduce the frequency of fires, as increased fire frequency affects the healthy regeneration of Poplar Box. Where required, controlled burns will be undertaken in the late wet season/early dry season in order to reduce fuel loads and prevent uncontrolled wildfires. Firebreaks and mosaic burning will be used to break up the offset area and maintain a range of fire ages. • Excluding cattle from the offset areas except during strategic grazing events.
Confidence in result – future quality	90%	Through the implementation of this OAMP, detailing specific management objectives and measurable outcomes aimed at halting the decline in quality of habitat for Poplar Box, there is a high degree of confidence that the future quality score can be maintained at 8/10; precluding a decline to an alternative habitat quality score of 7/10 in the absence of securing as an offset. This is reflected in the 90% confidence in result. Biodiversity monitoring will also be conducted as part of this OAMP to measure the progress of the offset area and ensure this OAMP achieves its required outcomes. However, there is inherent risk associated with ecological restoration. As recognised in the Society for Ecological Restoration primer which states that, 'restoration attempts to return an ecosystem to its historic trajectory. Historic conditions are therefore the ideal starting point for restoration design. The restored ecosystem will not necessarily recover its former state, since contemporary constraints and conditions may cause it to develop along an altered trajectory. The historic trajectory of a severely impacted ecosystem may be difficult or impossible to determine with accuracy.' This uncertainty is also reflected in the confidence in result – future quality score.

Input	Score	Justification
Risk of loss without offset	0.42%	The clearing of remnant vegetation in Queensland is regulated by the VM Act and the *Planning Act 2016* (Qld) and associated policies and codes. This framework identifies vegetation as one of four categories, varying in their degree of restriction on permissible clearing. Under the VM Act, an application must be made to the Queensland Government to clear remnant vegetation (Category B) unless an exemption applies. The VM Act prevents broad-scale clearing of remnant vegetation for agriculture or other development activities; however, clearing of some remnant vegetation for resource development purposes (e.g. mining) is allowed. The VM Act allows clearing of category X areas without requiring landholders to obtain approval. Areas mapped as category X are not subject to vegetation clearing codes and therefore have the potential to be cleared by the current or future landholders at any time. Pastoralists are motivated to clear vegetation for a variety of reasons; however, historically a combination of favourable conditions and higher commodity prices have coincided with increased rates of clearing (Evans 2016). Market conditions over the coming years look to continue to put pressure on pastoralists to increase production which inevitably leads to higher rates of clearing (M. Taylor pers comm). This is supported by clearing rates for regrowth vegetation increasing every year since 2012 (Steffen and Dean 2018). Historical clearing has disproportionately impacted vegetation on the most fertile soil, such as eucalypt woodlands on alluvial flats and Brigalow vegetation on clay plains. Expert estimates of the likelihood of clearing regrowth of alluvial ecosystems are as high as 90% (C. Hempel pers comm). Notwithstanding the property-specific decisions influencing any landholder's decision to clear, the risk that areas will be cleared resulting in the complete loss of habitat for MNES within the next 20 years, is considered to be 0.42%. This percentage reflects the average annual background rate of loss (2005 – 2014) within the Isaac Regional Council LGA as outlined in the *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act* document prepared by Maseyk et al. (2017).
Risk of loss with offset	0%	The offset area is proposed to be secured through declaration as an area of high nature conservation value under section 19F of the VM Act.
Confidence in result – risk of loss	90%	The legally binding mechanism will preclude all development except where the Queensland Government authorises an activity and offsets for both the original offset and any protected matters present on site are provided. Consequently, the resultant difficulty and expense acts as a strong disincentive for development within a protected offset area.

Input	Score	Justification
Time over which loss is averted (years)	20	The offset area will be protected by a legally binding mechanism which will remain in effect as required by the applicable State and Commonwealth legislative requirements, therefore, the time over which loss is averted is afforded the maximum allowable time of 20 years.
Time until ecological benefit (years)	20	Ecological benefits for the species can be realised through the implementation of a weed control program targeting weeds that are known threats to the species (i.e. exotic grasses). Exclusion of cattle grazing will also assist in natural regeneration of Poplar Box trees within the offset area in the short to medium term. The implementation of appropriate fire management will also increase the habitat quality score by aiding natural regeneration of the species.

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Poplar box
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes		**Area**	106.3	Hectares	
			Quality	**7**	Scale 0-10	
			Total quantum of impact	74.44	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

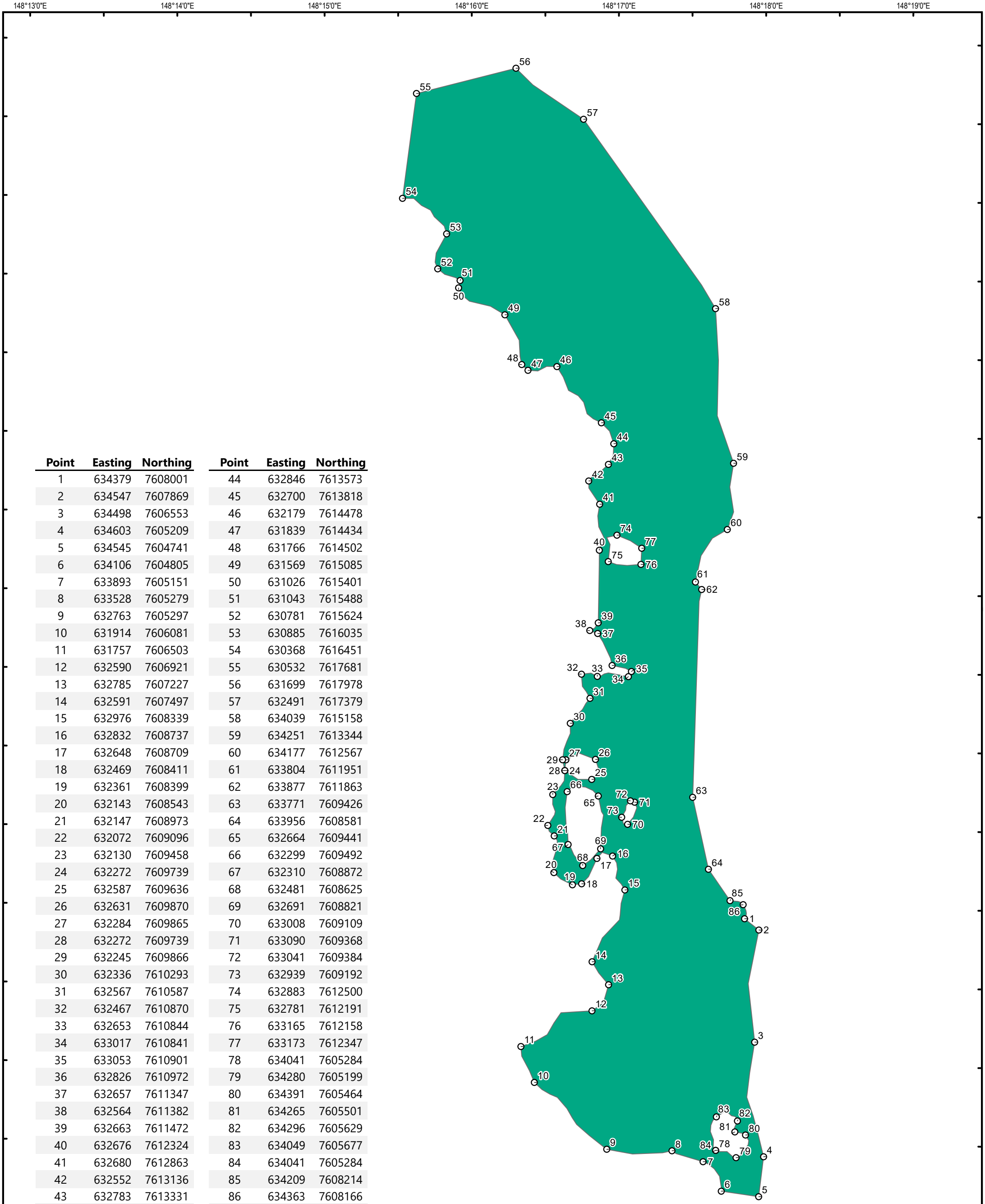
Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	Yes	74.44	Adjusted hectares	Kemmis Creek	**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	1019.97	**Risk of loss (%) without offset**	0%	**Risk of loss (%) with offset**	0%	4.28	90%	3.86	3.04	74.44	100.00%	Yes		
									Future area without offset (adjusted hectares)	1015.7	**Future area with offset (adjusted hectares)**	1020.0								
					Time until ecological benefit	20	**Start quality (scale of 0-10)**	**8**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**8**	1.00	90%	0.90	0.71				
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	74.438	74.44	100.00%	**Yes**	$0.00	N/A	$0.00
					$0.00	**$0.00**	**$0.00**

APPENDIX F OFFSET AREA COORDINATES



Point	Easting	Northing	Point	Easting	Northing
1	634379	7608001	44	632846	7613573
2	634547	7607869	45	632700	7613818
3	634498	7606553	46	632179	7614478
4	634603	7605209	47	631839	7614434
5	634545	7604741	48	631766	7614502
6	634106	7604805	49	631569	7615085
7	633893	7605151	50	631026	7615401
8	633528	7605279	51	631043	7615488
9	632763	7605297	52	630781	7615624
10	631914	7606081	53	630885	7616035
11	631757	7606503	54	630368	7616451
12	632590	7606921	55	630532	7617681
13	632785	7607227	56	631699	7617978
14	632591	7607497	57	632491	7617379
15	632976	7608339	58	634039	7615158
16	632832	7608737	59	634251	7613344
17	632648	7608709	60	634177	7612567
18	632469	7608411	61	633804	7611951
19	632361	7608399	62	633877	7611863
20	632143	7608543	63	633771	7609426
21	632147	7608973	64	633956	7608581
22	632072	7609096	65	632664	7609441
23	632130	7609458	66	632299	7609492
24	632272	7609739	67	632310	7608872
25	632587	7609636	68	632481	7608625
26	632631	7609870	69	632691	7608821
27	632284	7609865	70	633008	7609109
28	632272	7609739	71	633090	7609368
29	632245	7609866	72	633041	7609384
30	632336	7610293	73	632939	7609192
31	632567	7610587	74	632883	7612500
32	632467	7610870	75	632781	7612191
33	632653	7610844	76	633165	7612158
34	633017	7610841	77	633173	7612347
35	633053	7610901	78	634041	7605284
36	632826	7610972	79	634280	7605199
37	632657	7611347	80	634391	7605464
38	632564	7611382	81	634265	7605501
39	632663	7611472	82	634296	7605629
40	632676	7612324	83	634049	7605677
41	632680	7612863	84	634041	7605284
42	632552	7613136	85	634209	7608214
43	632783	7613331	86	634363	7608166

GDA2020 Zone 55 projection

Bowen Coking Coal

Location diagram

Figure F-1:
Offset area Coordinates

Offset area coordinate

Offset area

CO2 AUSTRALIA

N

0 0.5 1 2

Kilometres

Queensland

Brisbane

AUTHOR: J. Cousin

Date: 14/04/2025 Coordinate System: GDA2020 MGA Zone 55 Scale: 1:40,000@A3

Path: P:\GISData\Projects\Bowen Coking Coal\Kemmis Creek\20250409_KemmisCrk_OAMP_update\OAMP_Mapping_20250414.aprx

APPENDIX G OVERALL FUEL HAZARD ASSESSMENT GUIDE (HINES ET AL. 2010)

Department of Sustainability and Environment

Overall fuel hazard assessment guide

4th edition July 2010

Fire and adaptive management

report no. 82

A Victorian Government initiative

Victoria The Place To Be

Overall fuel hazard assessment guide

4th edition July 2010

Fire and adaptive management, report no. 82

By Francis Hines, Kevin G Tolhurst, Andrew AG Wilson and Gregory J McCarthy

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Images have been provided by Department of Sustainability and Environment – Victoria, Department of Environment and Heritage – South Australia, Country Fire Service – South Australia, Department of Conservation and Environment – Western Australia and Christian Pearson – Misheye. Katy Friend drew the illustrations.

Cover image: Elaine – Atchison Rd Fire, Victoria, January 2008. Bark Hazard – Extreme, Elevated Fuel Hazard – Moderate, Near-surface Fuel Hazard – Low, Surface Fuel Hazard – Very High. Overall Fuel Hazard – Extreme. Fire burning under FFDI 17 – High.

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Contents

1. About this guide

1.1 Purpose

The main purpose of this guide is to allow people to:

- make a rapid, visual assessment of fuel arrangement, and
- gain an understanding of how this will affect the chances of controlling a bushfire.

1.2 Audience

This guide has been principally designed to provide information on fuel arrangement to be used by:

- firefighters to assess the difficulty of controlling a bushfire.

Information on fuel arrangement may also be used by:

- asset owners and managers to assess potential bushfire risks to assets
- land and fire managers to provide a measurable objective and trigger for fuel management in fire management plans
- personnel to identify which key attributes and fuel layers are contributing the most to the hazard
- personnel to plan and conduct planned burns
- personnel to assess the effectiveness of planned burning or mechanical hazard reduction
- fire behaviour analysts to produce fire-spread predictions and community warnings.

Those who use the guide for these other purposes need to be mindful of its limitations and how the results are applied and interpreted.

1.3 What fuel is assessed

This guide is for assessing fine fuels that burn in bushfires. Fine fuels are the fuels that burn in the continuous flaming zone at the fire's edge. They contribute the most to the fire's rate of spread and flame height. Typically, they are dead plant material, such as leaves, grass, bark and twigs thinner than 6mm thick, and live plant material thinner than 3mm thick. Once ignited, these fine fuels generally burn out within two minutes.

This guide focuses on assessing the key structural layers of the fine fuel complex, in particular those of bark, elevated, near-surface and surface fuels.

1.4 How the fuel is assessed

Each fuel layer is assessed simply and visually. Assessing the fuel takes only a few minutes and is based on the premise that the eye is better able to integrate local variations in fuel than systematic measurement. Each fuel layer is assessed in turn and given a hazard rating. Particular emphasis is placed on how the fuel is arranged within each of these layers. The hazard ratings are then combined to produce an Overall Fuel Hazard Rating that ranges from Low to Extreme.

1.5 Why fuel arrangement is more important than fuel load

The image below highlights the effect that changing the arrangement of the fuel can have on fire behaviour. Both fires were ignited at the same time in the same way. Both fires are burning in the same fuel load, approximately two broadsheets of newspaper over a 20cm diameter area. The fuel on the right was laid flat and has little vertical orientation. The fuel on the left was crumpled up, which gave it more vertical orientation and exposed more of the surface to the air. As a result, the fire on the left shows significantly greater flame height and the fuel is consumed much faster.

The simple difference in the arrangement of the fuel significantly affects the resulting fire behaviour. The effect would not be discerned if the fuel assessment was based purely on fuel load. An assessment of fuel hazard takes into account the fuel arrangement. It gives a better indication of potential fire behaviour and suppression difficulty.

1.6 Suppression difficulty is not just about fire behaviour

This guide has been mainly developed to allow people to assess the impact of fuel arrangement on suppression difficulty. An assessment of suppression difficulty (how hard it is to control a bushfire) is not based solely on the anticipated fire behaviour. Many other factors affect the chances of a firefighting operation succeeding, including resources, fire size and terrain.

In order to consider the impact of fuels, the other factors need to be treated as if they are constant. The factors that have been held constant are referred to as the Reference Extended First Attack Conditions. Further detail on these conditions is contained in Appendix 1.

1.7 Basis of the Overall Fuel Hazard classification

A comprehensive explanation of this guide is contained in DSE's *Overall fuel hazard assessment guide: a rationale report – fire and adaptive management report no. 83* (in prep.).

This assessment guide updates and builds on work previously published by Wilson (1992a, 1992b, 1993), McCarthy *et al*. (1998a, 1998b, 1998c, 1999, 2001), the Department of Environment and Heritage (2006) and Gould *et al*. (2007a, 2007b).

Classifying Overall Fuel Hazard is complex, with few available measurements. Therefore, we have relied on the perceptions of experienced fire personnel (e.g. fire behaviour specialists, fire managers and firefighters). The collective experience of these personnel is vast, with a broad geographic base across Australia.

1.8 Need for continual learning and development

Although our knowledge about fuels has many gaps, this guide is based on the best available information and experience. The authors acknowledge that this guide will need to change and improve as more information is obtained.

Observers of firefighting operations can improve future editions of this guide by carefully recording what they see. Observations, comments and feedback can be emailed to fire.monitoring@dse.vic.gov.au.

2. How to use the guide

This guide has been kept concise and should not be considered as a standalone document. To produce reliable and consistent results requires extra knowledge which may be gained through local hands-on training in fuel assessment.

2.1 Application

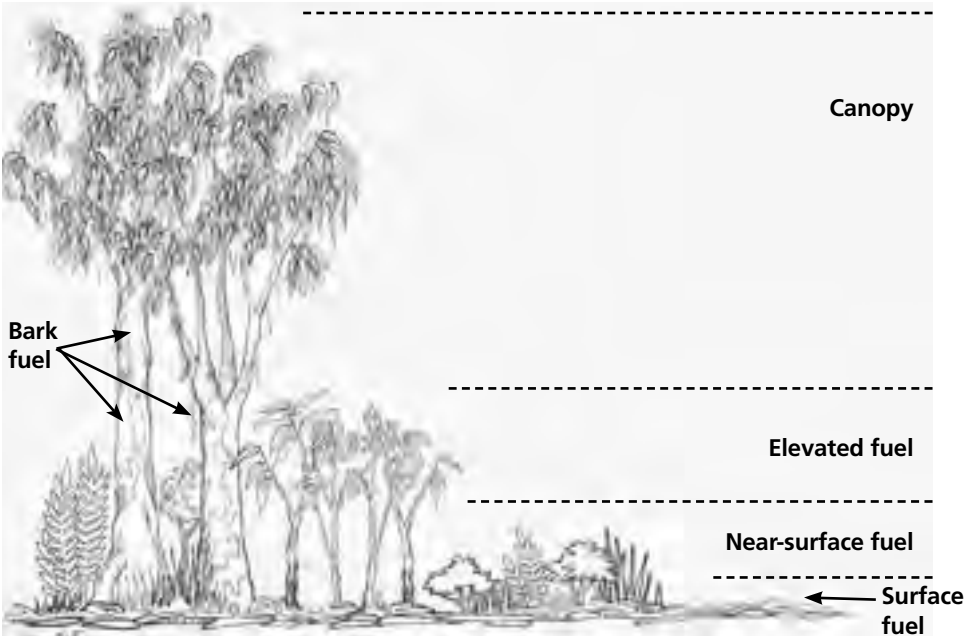
This guide is a tool for rapidly assessing fuel arrangement and its effect on the chances of controlling a bushfire. It may also be used for a range of other fire management purposes, as shown in the table below. Users of this guide should understand the underlying assumptions and limitations before applying it, particularly if applying it for purposes other than the assessment of suppression difficulty.

Application	Methodology
Assess suppression difficulty	Assess the fuels in which the fire may occur or is actually occurring.
Assess fuels for predicting potential risk to assets	Assess the fuels immediately adjacent to the asset as part of an assessment of possible radiant heat loads and defendable space. Assess the fuels further away from the asset; paying particular attention to areas that may generate spotting, such as ridges. Assessments should be focused, particularly in the direction of likely fire attack.
Assess the need for, or success of, fuel management activities	Assess the average fuels across the nominated area by sampling within major vegetation types, slopes and aspects.
Plan and conduct planned burns	Assess the variability in fuels across the nominated area by sampling within major vegetation types, slopes and aspects. Pay particular attention to areas where the burn may escape, such as the tops of gullies, ridge tops and areas adjacent to planned burn boundaries.
Assess fuels for predicting fire behaviour	Assess the fuel values needed as inputs for the appropriate fire behaviour model.

2.2 Fuel layers

Fuel in forests, woodlands and shrublands can be divided into four layers, each based on its position in the vegetation profile (Fig 2.1). This guide focuses on assessing the key structural layers of the fine fuel complex, those of bark, elevated, near-surface and surface fuels.

Figure 2.1 Fuel layers and bark



Use the following descriptions to determine how to separate vegetation into fuel layers.

Layer	Description	Contribution to suppression difficulty
Canopy	• Crowns of the tallest layer of trees. • Under some conditions canopy fuels can play a significant role in fire behaviour and suppression difficulty. Currently, however, these fuels are not assessed as part of Overall Fuel Hazard.	
Bark fuel	• Bark on tree trunks and branches, from ground level to canopy.	Spotting
Elevated fuel	• Fuels are mainly upright in orientation. • Generally most of the plant material is closer to the top of this fuel layer. • Sometimes contains suspended leaves, bark or twigs. • Fuels that have a clear gap between them and the surface fuels. • Can be highly variable in ground coverage. • Low-intensity fire (flame height of less than 0.5m) may pass beneath this layer without consuming much, if any, of it.	Influences the flame height and rate of spread of a fire.
Near-surface fuel	• Live and dead fuels, effectively in touch with the ground, but not lying on it. • Fuel has a mixture of vertical and horizontal orientation. • Bulk of the fuels are closer to the ground than to the top of this layer, or are distributed fairly evenly from the ground up. • Sometimes contains suspended leaves, bark or twigs. • Coverage may range from continuous to having gaps many times the size of the fuel patch. • Low-intensity fire (flame height of less than 0.5m) will consume most or all of this fuel. • Fuel in this layer will always burn when the surface fuel layer burns.	Influences the rate of spread and flame height of a fire.
Surface fuel (litter)	• Leaves, twigs, bark and other fine fuel lying on the ground. • Predominantly horizontal in orientation.	Influences the rate of spread of a fire.

This guide is for assessing fine fuels only. Coarse fuels including logs are not considered. See Section 1.3 for further details.

The descriptions of the fuel layers exclude references to species' names or common vegetation forms, such as shrubs. During a plant's life it may transition back and forth between different layers. For example, juvenile bracken fern can be classified as near-surface fuel before becoming elevated fuel as it matures. Once it dies and collapses it may become near-surface fuel again.

2.3 Assessment based on key attributes of fuel hazard

A fuel hazard rating of Low, Moderate, High, Very High or Extreme is assigned to each fuel layer by assessing it against the key attributes listed below.

Key attribute	
Horizontal continuity of the layer	Determines how readily a piece of burning fuel may ignite the fuel beside it. Identifies which of surface, near-surface or elevated fuels will determine the average flame height.
Vertical continuity of the layer	Determines how readily a piece of burning fuel may ignite the fuel above it.
Amount of dead material in the layer	Determines how much dead material is present to burn and thus help with igniting the live (green) fuels.
Thickness of the fuel pieces	Determines whether the fuel pieces will burn in the flaming front of the fire.
Total weight of fine fuel	Determines the weight of fine fuel contributing to the flaming front of the fire.

The descriptions in the hazard assessment tables do not cover all possible combinations of the key attributes. Users will need to exercise judgement and make an assessment using all key attributes when actual conditions fit between the descriptions.

2.4 Using the descriptions and photographs

This is **not** a photographic guide for assessing fuels. The **descriptions** for each of the key attributes should be used as the basis for determining the fuel hazard rating. Photographs cannot adequately show all of the key attributes that are important in determining fuel hazard. The photographs are provided to illustrate **some** of the key attributes for each fuel hazard rating. They do not represent all possible variations of that particular hazard rating.

2.5 Area of assessment

Within an area of interest fuels are assessed in small patches or plots. The size and number of plots depends on the reason for assessing the fuels. Some applications (such as for input into fire behaviour models) may require a more rigorous and systematic approach to sampling. Other applications (such as assessing fuel hazard during firefighting operations) will necessitate a more rapid informal approach. For whatever purpose the guide is being used it is recommended that the following principles be applied:

- Any assessment of fuels should try to assess the variability in fuels across an area by assessing the fuels at multiple plots.
- The size and number of plots should reflect the level of reliability required of the results.
- For surface, near-surface and elevated fuel layers the result of assessing the plot should reflect the average state of that fuel layer.
- For bark hazard the result of assessing the plot should be based on the trees with the highest rating.
- Always record with the result the name and the version of the guide used.

2.6 Tips for assessing fuel hazard

The process of assessing fuel hazard using this guide is largely subjective. Implementing the following techniques will help to improve accuracy and reliability:

- Identify and agree on examples of the highest rating of fuel hazard for each layer that occur locally. These examples should be used as benchmarks.
- Conduct assessments in pairs of observers and regularly change assessment pairs.
- Assessors should be no more than one hazard rating apart when assessing each layer (e.g. Low or Medium, not Low or High).
- Use different assessors to re-assess completed work and provide feedback.

2.7 Vesta fire behaviour predictions

In dry eucalypt forest with a litter and shrub understorey the *Field guide – fuel assessment and fire behaviour prediction in dry eucalypt forest* (Gould *et al.* 2007b) provides a systematic method for assessing fuel and predicting fire behaviour (rate of spread, flame height, and spotting). The Project Vesta fuel hazard scoring system is similar to the Victorian system developed by Wilson (1992a, 1992b, 1993) and revised by McCarthy *et al*. (1999). The scale that underlies the Vesta fuel hazard scores is directly related to fire behaviour. These scores, along with height measurements of various fuel layers, are needed as inputs into the fire behaviour prediction tables in Gould *et al*. (2007b). Section 9.3 contains a table for translating the fuel hazard rating for each fuel layer into Vesta fuel hazard scores.

2.8 Effect on fire behaviour

Each table for assessing fuel hazard contains information on the effect that the fuel arrangement is likely to have on fire behaviour. This effect is for weather conditions equivalent to a Forest Fire Danger Index (FFDI) of 25 (McArthur 1973). An FFDI of 25 can be achieved in many ways. For the purposes of this guide the specific conditions required to achieve this are:

Temperature: 33°C	Relative Humidity: 25%	Wind Speed: 20km/h
Drought Factor: 10	Slope: 0°	

If weather conditions vary from those listed above the effect on fire behaviour will also vary.

2.9 Fuel assessment data sheet

Appendix 2 contains a sample field data sheet that can be used when assessing fuels.

3. Bark fine fuel

3.1 Identification

Bark fuel is the bark on tree trunks and branches. Bark lying on or near the ground or draped over understorey plants is considered to be surface, near-surface or elevated fuel.

3.2 Identifying bark types

The key attributes for assessing the effect of bark on suppression difficulty are shown below:

Key attribute	Determines	How it is assessed
Ease of ignition	• How readily the bark will ignite. • Whether the fire will burn up the trunk and into the branches of the tree.	Thickness, size and shape of bark pieces.
How bark is attached	• How likely the bark is to break off the tree.	How easily the bark breaks off the tree.
Quantity of combustible bark	• Volume of potential embers that a fire may generate.	Relative quantity of combustible bark.
Size-to-weight ratio of the bark pieces	• How far the wind is likely to carry bark pieces once they break off the tree.	Thickness, size and shape of bark pieces.
Burn out time	• Length of time a piece of bark will stay ignited once it breaks off the tree.	Thickness, size and shape of bark pieces.

Descriptions of trees have been separated into three broad bark types using three of these key attributes – ease of ignition, burn out time and size-to-weight ratio:

1. Fine fibrous barks, including stringybarks
2. Ribbon or candle barks
3. Other bark types, including smooth, platy, papery and coarsely fibrous. The reason for describing these types in some detail is to help observers distinguish them from the above two types.

3.3 Identifying Stringybark and other fine fibrous bark types

Contribution to suppression difficulty	• Bark types that can produce massive quantities of embers and short distance spotting.
Physical description	• Bark is fine fibrous material with easily visible fibres less than 1mm thick covering the whole trunk. • Bark fibres resemble the fine fibres that are twisted together to form natural string. • Old bark is retained on the trunk of the tree for decades, forming a relatively spongy fibrous mass with deep vertical fissures. • Outer bark may weather to a greyish colour, while underlying bark retains its original colour. • Bark may form large strands when peeled off. • Fine, hairlike pieces also break off from the tree when it is rubbed.
Ease of ignition	• Bark is very flammable (can be easily lit with a match when dry). • Fires will readily climb the tree and branches.
How bark is attached	• Young or new bark is held tightly to the trunk. • As bark ages it becomes less tightly held. • Old, long-unburnt bark is held very loosely.
Quantity of combustible bark	• Bark on old, long-unburnt stringybarks can be more than 10cm in depth. During fires it can produce massive quantities of embers.
Size-to-weight ratio	Burning pieces of bark tend to be either: • Very fine lightweight fibres that will be carried for less than 100m. • Small lightweight wads (about the size of a thumb) that will be carried for less than 300m. • Very large wads (bigger than a fist) that fall close to the tree.
Burn out time	• Very fine fibres of bark that will burn out within one minute. • Small wads of bark that will burn out within 2–3 minutes. • Very large wads of bark that will burn for up to 10 minutes.
Hazard accumulation	• Bark hazard can reach Extreme. • Bark hazard increases over time as the thickness and looseness of the old bark increases. • Repeated low intensity fires (<0.5m flame height) may produce a 'black sock' effect on the base of the trunk, but this may have limited effect in reducing the overall quantity of bark and the hazard.

Examples

Table 3.1 Assessing the hazard of fine fibrous bark types including stringybarks

Only use this table if at least 10% of the trees in a forest have fine fibrous bark. To achieve a given hazard rating a best fit of both key attributes should be sought. Choices for the hazard rating of fuels that fit across several descriptions may be informed by the effect that different levels of key attributes have on fire behaviour.

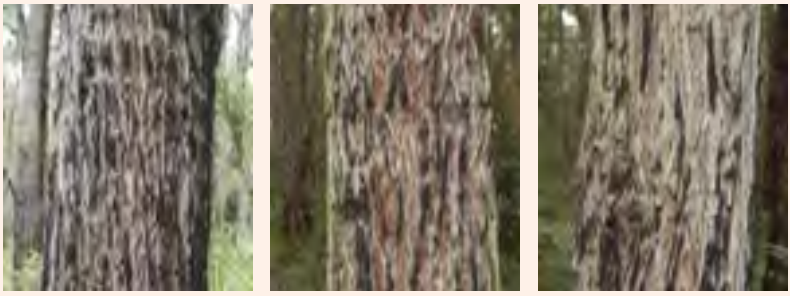
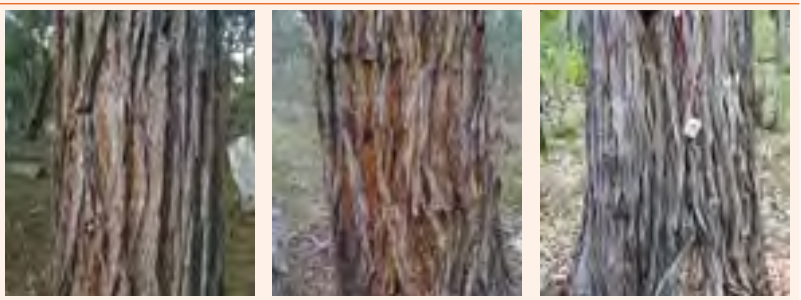
Key attributes		Hazard rating	Effect on fire behaviour (at FFDI 25)[1]
How bark is attached	**Quantity of combustible bark**		
This hazard rating cannot occur when only this bark type is present.		Low	
Bark tightly held. Requires substantial effort to break off bark by hand.	Very little combustible bark. Entire trunk almost completely black or charred.	Moderate	Spotting generally does not hinder fire control. Fires will not climb these trees.
Bark is mostly tightly held with a few pieces loosely attached.	Limited amount of combustible bark. 50–90% of trunk charred. Most of the bark is charred, especially on the lower part of the trunk.	High	Infrequent spotting. Fires will climb some of these trees.
Many pieces of bark loosely held. Deep fissures present in bark.	Large amounts of combustible bark. 10–50% of trunk charred. Upper parts of the tree may not be charred at all.	Very High	Substantial spotting. Fires will climb most of these trees.
Outer bark on trees is weakly attached. Light hand pressure will break off large wads of bark. Deep fissures present in bark.	Huge amounts of combustible bark. <10% of trunk charred. Minimal evidence of charring.	Extreme	Quantity of spotting generated makes fire control very difficult or impossible. Fires will climb virtually all these trees.

Assess bark hazard over a plot 20m in radius. Assessing multiple plots will give better results. Trunk is defined as being the part of the tree between the ground and the branches.

See Section 9.3 for application of bark hazard ratings for the Vesta fire behaviour tables.

1 FFDI 25 is a Forest Fire Danger Index of 25 (McArthur 1973). Refer to Section 2.8 for the specific weather conditions used to achieve this FFDI.

Table 3.2 Examples of Stringybarks and other fine fibrous bark hazard

Low	This hazard rating cannot occur when only this bark type is present.
Moderate	
High	
Very High	
Extreme	

The photos above show some of the variation possible within each bark hazard rating.

3.4 Identifying ribbon or candle bark types

Effect on suppression difficulty	• Bark types that can produce substantial quantities of spotting at distances greater than 2km. Will also produce short distance spotting.
Physical description	• Trees characterised by the annual shedding of old bark layers, exposing the smooth new bark underneath. • Bark is shed in the form of long strips or ribbons of bark. • Long strips of bark curl tightly inwards to form a candle-like shape (see image lower right). • Bark strips 50cm or more in length fall off and often drape around the trunk and over branches and surrounding shrubs. • Strips of bark are usually less than 2mm thick. • Bark is shed at various times of the year so that the trunk may have a mottled appearance.
Ease of ignition	• Bark is moderately flammable (can be lit with a cigarette lighter when dry). • Fires will climb up ribbons of bark.
How bark is attached	• Bark strips may drape over, or be weakly attached to, the trunk and branches.
Quantity of combustible bark	• Large quantities of bark can be retained in upper trunk and head of the tree.
Size-to-weight ratio	• Bark pieces are relatively light for their large size. • Easily transported by strong updrafts – may travel up to 30km downwind.
Burn out time	• Bark can burn and smoulder within the curled up ribbons for longer than 10 minutes.
Hazard accumulation	• Bark hazard never exceeds Very High. • Bark hazard tends to increase over the long term as ribbons accumulate on the tree. • A low intensity fire (flame height of less than 0.5m) may not reduce the hazard in this bark type.

Example

Note: Loose ribbon or candle-like bark that is retained on the trunk near ground level is not included in the assessment of ribbon or candle bark types. It is usually:

- firmly attached to the trunk of the tree
- consumed in place by a surface fire.

This bark is considered in 'Other bark types' and can also be considered as near-surface fuel.

Smooth-bark trees also shed bark as slabs or flakes. These bark types are considered in 'Other bark types'.

Table 3.3 Assessing the hazard of ribbon or candle bark types

If more than 10% of the trees in a forest are fine fibrous bark trees use Table 3.1 (Assessing the hazard of fine fibrous bark types) to determine the bark hazard for a site.

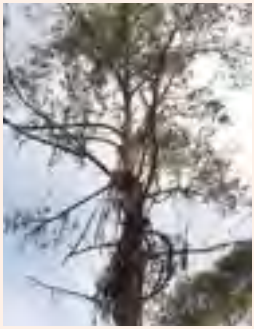
Key attribute Amount of combustible bark	Hazard rating	Effect on fire behaviour (at FFDI 25)[2]
This hazard rating cannot occur when only this bark type is present.	Low	
No long ribbons of bark present. Trunk and branches of trees almost entirely smooth.	Moderate	Spotting generally does not hinder fire control. Fires will not climb these trees.
Long ribbons of bark present on upper trunk (>4m above ground) and in head of trees. Lower trunk mainly smooth.	High	Infrequent spotting. Fires will climb some of these trees.
Long ribbons of bark in the head and upper trunk with: • ribbons hanging down to ground level or, • flammable bark covers trunk.	Very High	Substantial spotting. Fires will climb most of these trees.
This hazard rating cannot occur when only this bark type is present.	Extreme	

Assess bark hazard over a plot 20m in radius. Assessing multiple plots will give better results. Trunk is defined as the part of the tree between the ground and the branches.

See Section 9.3 for application of bark hazard ratings for the Vesta fire behaviour tables.

2 Refer to Section 2.8 for the specific weather conditions used to achieve this FFDI.

Table 3.4 Examples of ribbon or candle bark hazard

Low	This hazard rating cannot occur when only this bark type is present.		
Moderate			
High			
Very High			
Extreme	This hazard rating cannot occur when only this bark type is present.		

3.5 Identifying other bark types

This bark type includes all other bark types not included in the previous two types. As a result, many different tree species are grouped together. This grouping is based on the ease of ignition, burn out time and size-to-weight ratio of the bark, rather than on botanical values. These other bark types can produce limited quantities of short distance spotting.

This bark type group has been divided into several subgroups. These subgroups are described in some detail to help observers distinguish them from the other two main bark types.

3.5.1 Ironbarks and Platy barks

Physical description	• Trees characterised by layers of old, coarse bark retained on the trunk and branches. • Bark becomes rough, compacted and furrowed with age • Bark feels very abrasive when rubbed by hand. • Bark pieces tend to be more than 2mm thick when they break off. • There may be little or no evidence of charring on the bark following planned burns.
Hazard accumulation	• Bark hazard never exceeds Moderate.

Example

3.5.2 Coarsely fibrous barks

Physical description	• Trees characterised by short strand fibrous bark. • Layers of old dead bark are retained on the trunk and branches. • Unlike stringybark trees, the bark on these trees forms only short strands or chunks when peeled off. • Evidence of charring on the bark may last for up to 10 years.
Hazard accumulation	• Bark hazard never exceeds High. • Bark hazard increases over the long term as the thickness and looseness of the old bark increases.

3.5.3 Papery barks

Physical description

- Shrubs and trees growing from 2m to 30m tall, often with flaky shedding bark.
- Old bark is retained on the trunk and branches and builds up into a thick spongy mass.
- Bark layers tend to split allowing sheets of bark to become loose and eventually peel off.
- Evidence of charring on the bark may last for up to 10 years.

Hazard accumulation

- Bark hazard never exceeds High.
- Bark hazard increases over the long term as the thickness and looseness of the old bark increases.

Example

3.5.4 Slab bark, smooth bark and small flakes

Physical description

- Trees characterised by the annual shedding of old bark layers, exposing the smooth living bark underneath.
- Bark shed is often seasonal and often annual.
- Species where the old bark tends to peel into large slabs (<50cm in length) or small flakes when shed.
- Most of the bark falls off the tree soon after it is shed.
- Some small amounts of bark may be retained on the stem or branches for several months before falling off, leading to a mottled effect.
- The mottled effect leads to discontinuous bark fuel up the tree.

Hazard accumulation

- Bark hazard never exceeds Moderate.
- Bark hazard tends to be seasonal.

Example

Table 3.5 Assessing the hazard of other bark types

If more than 10% of the trees in a forest are fine fibrous bark trees use Table 3.1 (Assessing the hazard of fine fibrous bark types) to determine the bark hazard for a site. To achieve a given hazard rating a best fit of both key attributes should be sought. Choices for the hazard rating of fuels that fit across several descriptions may be informed by the effect that different levels of key attributes have on fire behaviour.

Key attributes		Hazard rating	Effect on fire behaviour (at FFDI 25)[3]
How bark is attached	**Quantity of combustible bark**		
No trees present. or Trunk and branches of tree entirely smooth or free from loose bark.		Low	No bark present that could contribute to fire behaviour.
Bark rubs off by hand with firm pressure.	Limited amount of combustible bark.	Moderate	Spotting generally does not hinder fire control. Fires will climb some of these trees.
Light hand pressure will break bark off.	Large amounts of combustible bark.	High	Infrequent spotting. Fires will climb most of these trees.
This hazard rating cannot occur when only this bark type is present.		Very High	
This hazard rating cannot occur when only this bark type is present.		Extreme	

Assess bark hazard over a plot 20m in radius. Assessing multiple plots will give better results. Trunk is defined as the part of the tree between the ground and the branches.

See Section 9.3 for application of bark hazard ratings for the Vesta fire behaviour tables.

3 Refer to Section 2.8 for the specific weather conditions used to achieve this FFDI.

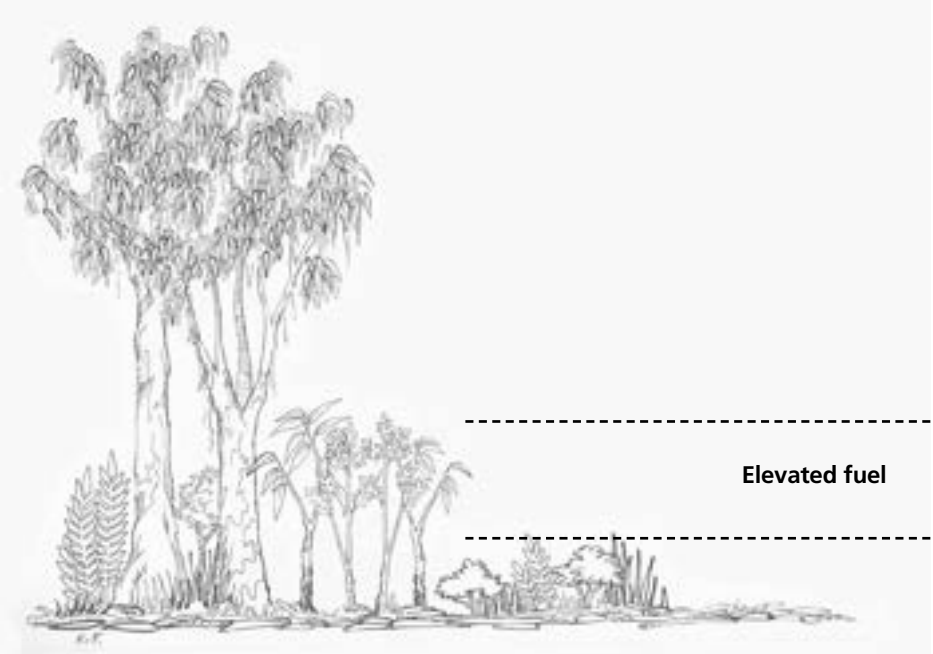
Table 3.6 Examples of other bark types

Low	No trees present. or Trunk and branches of tree entirely smooth or free from loose bark.	
Moderate	  	
High	  	
Very High	Does not occur when this is the only bark type present on a site.	
Extreme	Does not occur when this is the only bark type present on a site.	

4. Elevated fine fuel

4.1 Identification

- Fuels are mainly upright in orientation
- Generally most of the plant material is closer to the top of this layer
- Sometimes contains suspended leaves, bark or twigs
- Fuels that have a clear gap between them and the surface fuels
- Elevated fuel can be highly variable in ground coverage
- A low intensity fire (flame height of less than 0.5m) may pass beneath this layer without consuming much, if any, of it.



4.2 Assessment

The elevated fuel hazard is highest when the:

- foliage, twigs and other fuel particles are very fine (maximum thickness 1–2mm)
- proportion of dead material is high
- fuels are arranged with a high level of density and/or horizontal and vertical continuity that promotes the spread of flames
- live foliage has low fuel moisture content.

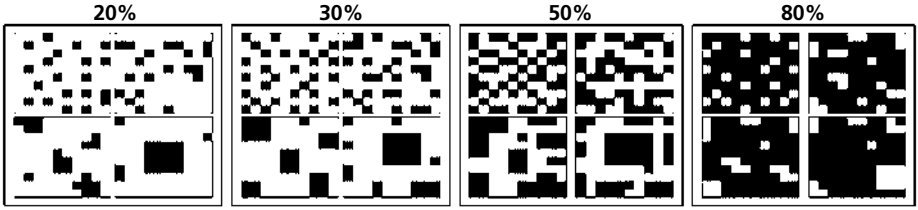
Table 4.1 Assessing elevated fine fuel hazard

To achieve a given hazard rating a best fit of all key attributes should be sought. Choices for the hazard rating of fuels that fit across several descriptions may be informed by the effect that different levels of key attributes have on fire behaviour.

Key attributes					Fuel hazard rating	Effect on fire behaviour (at FFDI 25)[4]
Plant Cover	% dead	Vertical continuity	Vegetation density	Thickness of fuel pieces		
<20% or low flammability species	<20%		Easy to walk in any direction without needing to choose a path between shrubs.		Low	Little or no effect.
20–30%	<20%	Most of the fine fuel is at the top of the layer.	Easy to choose a path through but brush against vegetation occasionally.		Moderate	Does not sustain flames readily.
30–50%	<20%	Most of the fine fuel is at the top of the layer.	Moderately easy to choose a path through, but brush against vegetation most of the time.		High	Causes some patchy increases in the flame height and/or rate of spread of a fire.
50–80%	20–30%	Continuous fine fuel from the bottom to the top of the layer.	Need to carefully select path through.	Mostly less than 1–2mm thick.	Very High	Elevated fuels mostly dictate flame height and rate of spread of a fire.
>70%	>30%	Continuous fine fuel from the bottom to the top of the layer.	Very difficult to select a path through. Need to push through vegetation.	Large amounts of fuel <2mm thick.	Extreme	Elevated fuels almost entirely determine the flame height and rate of spread of a fire.

Assessing plant cover

For the purpose of this guide, plant cover is defined as the amount of ground blocked out by that fuel layer if viewed while looking straight down from above. Each plant is considered opaque – any ground within the perimeter of the plant cannot be seen. The following visual guide can be used to assist in assessing plant cover. Each quarter of any one square has the same percent cover.



4 Refer to Section 2.8 for the specific weather conditions used to achieve this FFDI.

Table 4.2 Examples of elevated fine fuel hazard

Low	Elevated fuel absent or virtually absent	
Moderate		
High		
Very High		
Extreme		

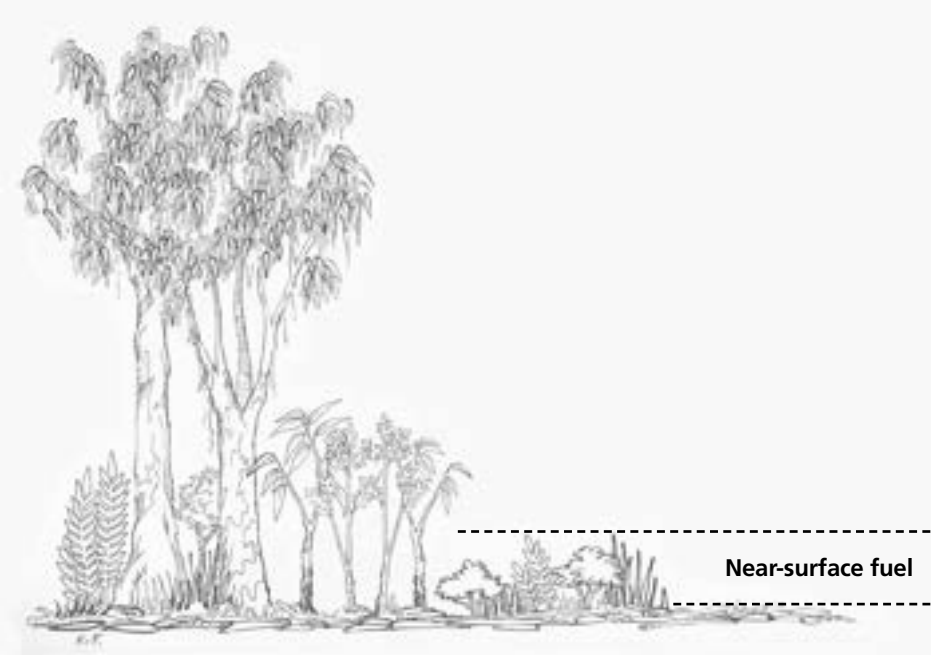
Assess elevated hazard over a plot 10m in radius. Assessing multiple plots will give better results.

See Section 9.3 for application of elevated fuel hazard ratings for the Vesta fire behaviour tables. For the Vesta fire behaviour tables the elevated fuel height (m) should be the average of 10 measurements taken along a 300m walk-through. Measure the typical height from ground level.

5. Near-surface fine fuel

5.1 Identification

- Live and dead fuels effectively in touch with the ground but not lying on it
- Fuel has a mixture of vertical and horizontal orientation
- Either the bulk of the fuels is closer to the ground than the top of this layer, or is distributed fairly evenly from the ground up
- Sometimes contains suspended leaves, bark or twigs
- Coverage may range from continuous to having gaps many times the size of the fuel patch
- A low intensity fire (flame height of less than 0.5m) will consume most or all of this fuel
- Fuel in this layer will always burn when the surface fuel layer burns.



5.2 Assessment

The near-surface fuel hazard is highest when the:

- foliage, twigs and other fine fuel particles are very fine (maximum thickness 1–2mm)
- proportion of dead material is high
- fuels are arranged with a high level of density and /or horizontal and vertical continuity, that promotes the spread of flames
- live foliage has low fuel-moisture content.

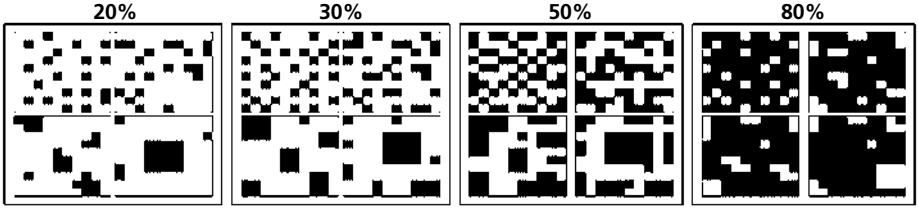
Table 5.1 Assessing near-surface fine fuel hazard

To achieve a given hazard rating a best fit of all key attributes should be sought. Choices for the hazard rating of fuels that fit across several descriptions may be informed by the effect that different levels of key attributes have on fire behaviour.

Key attributes			Fuel hazard rating	Effect on fire behaviour (at FFDI 25)[5]
Plant cover	% dead	Horizontal connectivity		
<10%	<10%	Near-surface fuel is absent or virtually absent.	Low	Little or no effect.
10–20%	<20%	Gaps many times the size of fuel patches.	Moderate	Occasionally increases flame height.
20–40%	>20%	Gaps between fuel patches are greater than the size of fuel patches. Starting to obscure logs and rocks.	High	Contributes to surface fire spread and causes patchy increase to flame height.
40–60%	>30%	Fuel patches are equal to or larger than the gaps between the fuel patches.	Very High	Contributes significantly to fire spread and flame height. A fire will spread readily in this layer without having to consume the surface layer.
>60%	>50%	Very small gaps between fuel patches. Logs and rocks obscured.	Extreme	Contributes significantly to fire spread and flame height. A fire will spread readily in this layer without having to consume the surface layer.

Assessing plant cover

For the purpose of this guide, plant cover is defined as the amount of ground blocked out by that fuel layer if viewed while looking straight down from above. Each plant is considered opaque – any ground within the perimeter of the plant cannot be seen. The following visual guide can be used to assist in assessing plant cover. Each quarter of any one square has the same percent cover.



5 Refer to Section 2.8 for the specific weather conditions used to achieve this FFDI.

Table 5.2 Examples of near-surface fine fuel hazard

Low	Near-surface fuel is absent or virtually absent	
Moderate		
High		
Very High		
Extreme		

Assess near-surface hazard over a plot 10m in radius. Assessing multiple plots will give better results.

See Section 9.3 for application of near-surface fuel hazard ratings for the Vesta fire behaviour tables. For the Vesta fire behaviour tables the near-surface fuel height (cm) should be the average of 10 measurements taken over a 300m walk through. Measure the typical height from ground level.

6. Surface fine fuel

6.1 Identification

- Leaves, twigs, bark and other fine fuel lying on the ground
- Predominantly horizontal in orientation
- Usually contributes the most to fuel load or quantity
- Includes the partly decomposed fuel (duff) on the soil surface.

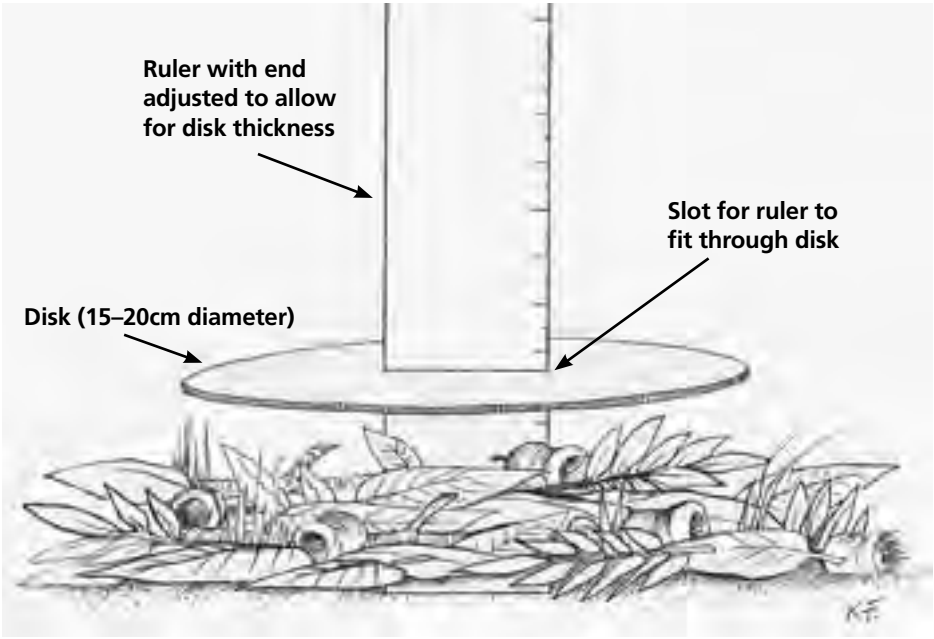
6.2 Assessment

The surface fine fuel hazard is highest when the:

- litter pieces are well connected
- surface litter cover is high, with minimal interruption from rocks, logs or patches of bare soil
- surface litter has substantial depth (greater than 30mm).

6.3 Measurement

Surface litter-bed depth should be measured using a simple depth gauge, as pictured below. This follows the methodology described in McCarthy (2004) and McCarthy *et al*. (1999).



Litter depth should be measured in areas where near-surface fuels do not obscure the litter. Fuel depth is measured using a 15cm circular disk with a ruler through a slot in its centre. To use this gauge, a small gap is made in the litter bed down to mineral soil, then the end of the ruler is placed resting on the mineral soil surface. The disk is pushed down with light pressure until its whole perimeter is in contact with the fuel. Light pressure can be described as 'enough pressure to hold a tennis ball under water'. The ruler is read off level with the top of the disk. Note that the end of the ruler needs to be adjusted to match the thickness of the disk.

Five measurements of litter bed depth should be made at each site. The average of these measurements is one of the attributes that can be used to determine the surface fine fuel hazard.

Table 6.1 Assessing surface fine fuel hazard

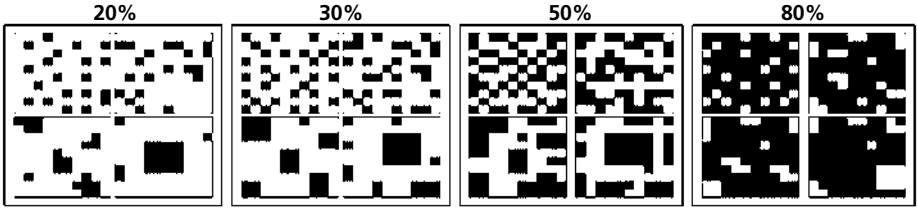
To achieve a given hazard rating a best fit of all key attributes should be sought. Choices for the hazard rating of fuels that fit across several descriptions may be informed by the effect that different levels of key attributes have on fire behaviour.

Key attributes			Fuel hazard rating	Effect on fire behaviour (at FFDI 25)[6]
Horizontal connectivity	Surface litter cover	Litter-bed depth		
Litter poorly interconnected. Large areas of bare soil or rock. More soil than litter. Soil surface readily visible through litter bed.	<60%	Very thin litter layer <10mm	Low	Surface fires will not spread.
Litter well connected. Some areas of bare soil or rock. Soil surface occasionally visible through litter bed.	60–80%	Thin litter layer 10–25mm	Moderate	Litter connected well enough to allow fire spread to overcome bare patches.
Litter well connected. Little bare soil.	80–90%	Established litter with layers of leaves ranging from freshly fallen to decomposing. 20–30mm	High	Surface fires spread easily with a continuous fire edge.
Litter completely connected.	>90%	Thick litter layer 25–45mm	Very High	Surface fires spread easily. Increasing flame depth and residence time.
Litter completely connected.	>95%	Very thick layer of litter >35mm	Extreme	Surface fires spread easily. Increasing flame depth and residence time.

Assess surface hazard over a plot 10m in radius. Assessing multiple plots will give better results. For each plot litter bed depth should be an average of five measurements (McCarthy 2004) or more.

See Section 9.3 for application of surface fuel hazard ratings for the Vesta fire behaviour tables.

The following visual guide can be used to assist in assessing surface litter cover. Each quarter of any one square has the same percent cover.



6 Refer to Section 2.8 for the specific weather conditions used to achieve this FFDI.

Table 6.2 Examples of surface fine fuel hazard

Low		
Moderate		
High		
Very High		
Extreme		

7. Determining the combined surface and near-surface fine fuel hazard rating

Assessments of surface and near-surface fuels must be combined together before an Overall Fuel Hazard rating can be determined. The near-surface fuel rating is used to adjust the surface fine fuel hazard rating, according to Table 7.1.

To determine the effect of near-surface fine fuel hazard:

1. Select the **surface fuel hazard rating** from column 1
2. Select the **near-surface fuel hazard rating** from column 2
3. Select the resulting **combined rating** value 3
4. Use this value to determine the Overall Fuel Hazard rating using the Table 8.1.

Table 7.1 Determining the combined surface and near-surface fine fuel hazard rating

1 Surface fine fuel hazard rating	2 Near-surface fine fuel hazard rating				
	Low	Moderate	High	Very High	Extreme
	3 Combined surface and near-surface fine fuel hazard rating				
Low	L	L	M	H	VH
Moderate	M	M	H	VH	E
High	H	VH	VH	VH	E
Very High	VH	VH	E	E	E
Extreme	E	E	E	E	E

8. Determining Overall Fuel Hazard

Overall Fuel Hazard = (sum of the influences of) Bark Hazard + Elevated Fine Fuel Hazard + Combined Surface and Near-surface Fine Fuel Hazard.

The following table is used to combine the assessed levels of Bark, Elevated and Combined Surface and Near-surface Fuel Hazard to give an Overall Fuel Hazard rating.

To determine the Overall Fuel Hazard rating:

1. Select the row that corresponds to the **Bark Hazard** ❶
2. Select the row that corresponds to the **Elevated Fine Fuel Hazard** ❷
3. Select the column that corresponds to the assessed level of **Combined Surface and Near-surface Fine Fuel Hazard** ❸
4. Identify where these two intersect and this will provide you with the corresponding Overall Fuel Hazard rating.

Table 8.1 Determining the Overall Fuel Hazard rating

❶ Bark Hazard	❷ Elevated Fine Fuel Hazard	❸ Combined Surface and Near-surface Fine Fuel Hazard *				
		L	M	H	VH	E
Low or Moderate	L	L	M	M	H	H
	M	L	M	M	H	H
	H	L	M	H	VH	VH
	VH	VH	VH	VH	VH	VH
	E	E	E	E	E	E
High	L	L	M	H	H	H
	M	L	M	H	H	H
	H	L	H	H	VH	VH
	VH	VH	VH	VH	VH	E
	E	E	E	E	E	E
Very High or Extreme	L	L	VH	VH	VH	E
	M	M	VH	VH	E	E
	H	M	VH	E	E	E
	VH	E	E	E	E	E
	E	E	E	E	E	E

* Combined Surface and Near-surface Fine Fuel Hazard is a measure of the Surface Fine Fuel Hazard adjusted to account for the level of near-surface fine fuel (see Table 7.1).

9. Interpreting and applying Overall Fuel Hazard

9.1 Chances of extended first attack success

The chances of extended first attack being successful[1] for a fire ignited in these fuels under the reference extended first attack conditions (Appendix 1) is approximately as follows:

Table 9.1 Chances of extended first attack success

GFDI[2]	FFDI[3]	Overall Fuel Hazard rating[4]				
		Low	Moderate	High	Very High	Extreme
0–2	0–5					
3–7	6–11					
8–20	12–24					
20–49	25–49					
50–74	50–74					
75–99	75–99					
100+	100+					

Chance of extended first attack success is greater than 95% (almost always succeeds)

Chance of extended first attack success is between 95% and 50% (succeeds most of the time)

Chance of extended first attack success is between 49% and 10% (fails most of the time)

Chance of extended first attack success is less than 10% (almost always fails)

Notes:

1. Extended first attack is deemed successful when a fire is controlled by 0800hrs the day after ignition and at less than 400 hectares.
2. GFDI is the Grass Fire Danger Index at the time of ignition and is assumed to be the highest GFDI expected before 0800hrs the next day.
3. FFDI is the Forest Fire Danger Index at the time of ignition and is assumed to be the highest FFDI expected before 0800hrs the next day.
4. Chance of success is for a fire ignited in fuels with this Overall Fuel Hazard rating.
5. Predicted outcomes will differ if the conditions vary from those listed in the reference extended first attack conditions.
6. Predicted outcomes based on expert opinion and informed by work carried out by Wilson (1992b, 1993), McCarthy *et al*. (1998a, 2001) and Plucinski *et al*. (2007).

9.2 Indicative fuel loads (t/ha)

In the absence of local data obtained by sampling fuel loads destructively the following table of indicative fuel load data from Project Vesta and Victorian studies may be useful. These tonnes per hectare figures may be applied to the Forest Fire Danger Meter Mark V (McArthur 1973) for predicting forward rate of spread and flame height for forest fires.

Table 9.2 Indicative fuel loads (t/ha)

Fuel	Fuel hazard rating				
	Low	Moderate	High	Very High	Extreme
Bark	0	1	2	5	7
Elevated	0–1	1–2	2–3	3–5	5–8
Near-surface	1–2	2–3	3–4	4–6	6–8
Surface	2–4	4–10	8–14	12–20	16–20+

9.3 Determining Vesta fuel hazard scores

The following table translates fuel hazard ratings for each fuel layer into Project Vesta fuel hazard scores. These scores can be used with the fire behaviour prediction tables in publications such as Gould *et al*. (2007b).

To determine the Vesta fuel hazard score:

1. Select the row that corresponds to the fuel hazard rating for required fuel layer (1)
2. Select the Vesta fuel hazard score column that corresponds to the same layer (2)
3. Identify where these two intersect and this will provide you with the corresponding Vesta fuel hazard score.

Table 9.3 Determining Vesta fuel hazard scores

	Vesta fuel hazard score (2)			
Fuel hazard rating (1)	**Surface**	**Near-surface**	**Elevated**	**Bark**
Low	1	1	1	0
Moderate	2	2	2	1
High	3	3	3	2
Very High	3.5	3.5	3.5	3
Extreme	4	4	4	4

Notes:

- Surface and near-surface hazard score and near-surface height (cm) is required for fire spread prediction.
- Rate of spread and elevated fuel height (m) is required for flame height prediction.
- Rate of spread, surface and bark fuel hazard scores are required for prediction of spotting distance.

Acknowledgements

This Fuel Hazard Assessment Guide updates and continues to develop work previously conducted by a number of authors. Andrew Wilson laid the foundations for this guide, with the conceptual framework presented in Research Report No. 31; and the visual guides for assessing the influence of bark and elevated fuels on suppression difficulty in the *Eucalypt Bark Hazard Guide and Elevated Fuel Guide* (Reports 32 and 35, respectively). Greg McCarthy (2004) detailed a method for rapidly assessing surface fine fuels in Research Report No. 44.

These three techniques were brought together in the first three editions of the *Overall Fuel Hazard Guide* (McCarthy, Tolhurst and Chatto, 1998b, 1998c, 1999). A subsequent unpublished edition of the guide, produced by Kevin Tolhurst (2005), provided greater detail on the assessment of near-surface fuels. In 2006, Mike Wouters adapted the guide for South Australian conditions, and incorporated the preliminary results from Project Vesta (CSIRO and Department of Conservation and Environment, Western Australia). Further information and results from the final Project Vesta report (Gould *et al.* 2007a) have also been incorporated.

Thanks to Lachie McCaw (Department of Environment and Conservation, Western Australia), Mike Wouters (Department of Environment and Heritage, South Australia), Jim Gould and Miguel Cruz (CSIRO) for their advice and comments during the production of this guide. Thanks must also go to the many other people across Australia who have provided comments and feedback during the production of the guide.

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Appendix 1. Reference extended first attack conditions

This guide assesses the impact of fuels in suppressing a fire during extended first attack, using local resources. Several factors affect the success of an extended first attack. Therefore, to consider the impact of fuels alone, the other factors must be treated as if they were constant. Table A1 below adapted from Wilson (1993) summarises reference extended first attack conditions for four fuel types.

Table A1. Revised reference extended first attack conditions

Fuel type	Forest fuels	Grass fuels	Mallee and scrub fuels	Heath fuels
Examples of typical resources (on scene within the designated arrival time)	Small dozer (D4) 1 to 2 small 4WD tankers (400l) 6 firefighters	5 x 4WD heavy tankers (4000l) each with 5 firefighters	Small dozer (D4) or tractor with scrub roller 1 to 2 small 4WD tankers (400l) 6 firefighters	Small dozer (D4) 1 to 2 small 4WD tankers (400l) 6 firefighters
Extended attack resources	Potential additional resources deployed to the fire during extended first attack may include heavy tankers, large plant (dozers, graders or tractors) and fire bombing aircraft.			
Arrival time	Within 60 minutes of detection			
Suppression workload	A single fire			
Topography and terrain	Burning on level ground with good access			
Fuel availability[1]	MDF is 10 or AFF is 1.0	100% grass curing	MDF is 10 or AFF is 1.0	
Wind speed[2]	20km/h	30km/h		20km/h
Fire danger rating system[3]	McArthur FFDI	McArthur GFDI	McArthur FFDI	

Notes:

1. MDF (McArthur Drought Factor) is calculated using the Forest Fire Danger Meter (McArthur 1973) and is a measure of the short-term availability of forest fuels. AFF (Available Fuel Factor) is used in Western Australia to define the proportion of litter fuel available for burning (Sneeuwjagt & Peet 1998).
2. Wind speed is measured at 10m height in the open above ground level.
3. FFDI is the McArthur Forest Fire Danger Index, GFDI is the McArthur Grass Fire Danger Index.

The rationale for the reference first attack conditions is documented in DSE's *Overall fuel hazard assessment guide: a rationale report – fire and adaptive management report no. 83* (in prep).

Appendix 2. Sample fuel assessment field work form

Date Assessed:	Assessors:
Sampling Location:	Veg Type:

Plot Information			
Plot No.			
Zone:			
Easting (GDA94 MGA UTM):			
Northing (GDA94 MGA UTM):			

Canopy (20m radius)			
Canopy Ave Height to Top:	m	m	m
Canopy Ave Height to Base:	m	m	m

Bark fuel (20m radius)															
Stringybark Fuel Hazard:	NP	M	H	VH	E	NP	M	H	VH	E	NP	M	H	VH	E
Ribbon Bark Fuel Hazard:	NP	M	H	VH		NP	M	H	VH		NP	M	H	VH	
Other Bark Fuel Hazard:	L	M	H			L	M	H			L	M	H		

Note: NP is bark type not present. Use the highest bark hazard rating to determine Overall Fuel Hazard.

Elevated fuel layer (10m radius)															
Elevated % Cover:	%					%					%				
Elevated % Dead	%					%					%				
Elevated Fuel Ave Height (m)	m					m					m				
Elevated Fuel Hazard:	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Near-surface fuel layer (10m radius)															
Near-surface % Cover:	%					%					%				
Near-surface % Dead	%					%					%				
NS Ave Height (cm):	cm					cm					cm				
NS Fuel Hazard:	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

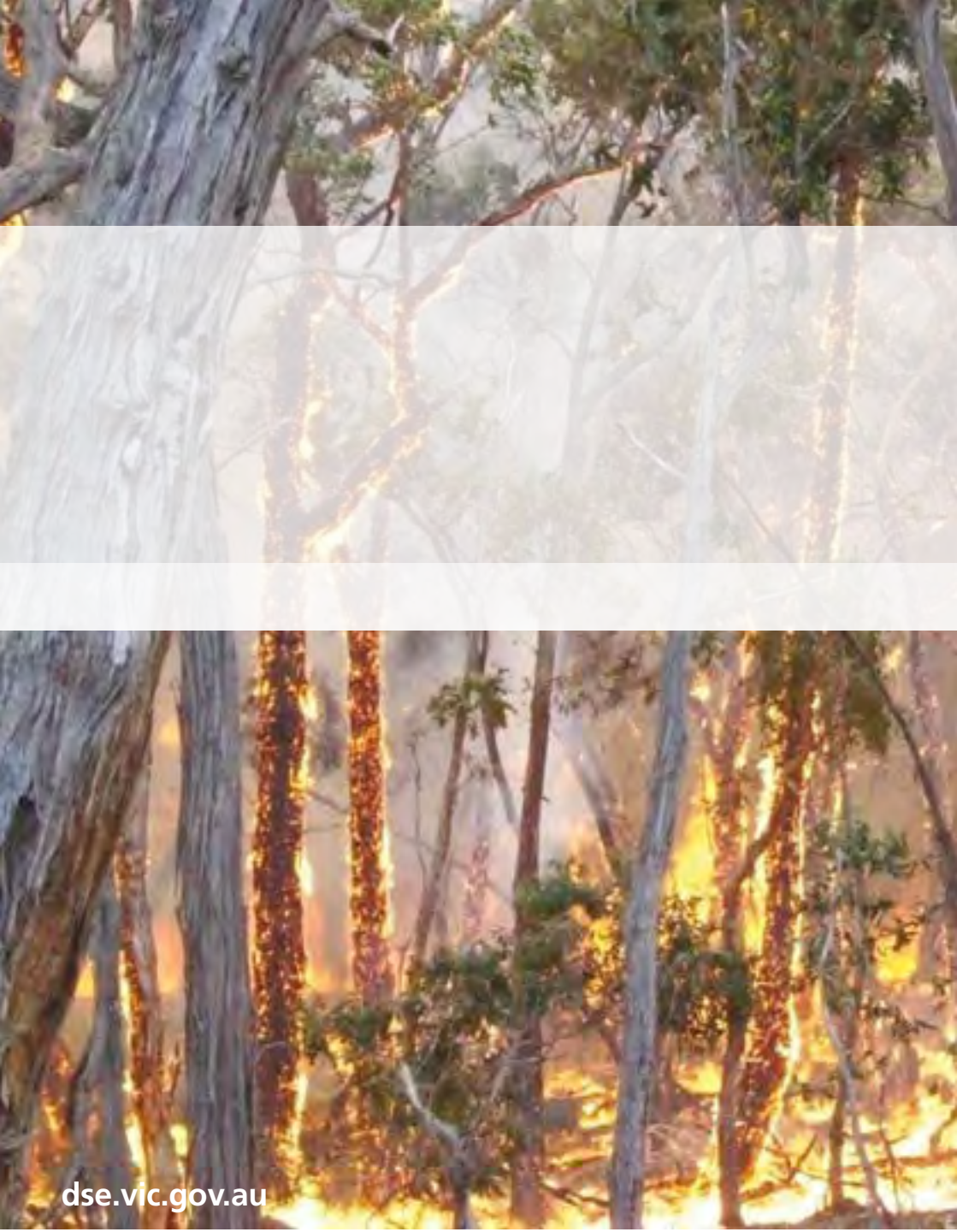
Surface fuel layer (10m radius)															
Surface Litter % Cover:	%					%					%				
Ave Litter Depth (mm):	mm					mm					mm				
Surface Fuel Hazard	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Combined Surface and Near-surface Fine Fuel Hazard calculation (refer Section 7)															
Combined Hazard	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Overall Fuel Hazard calculation (refer Section 8)															
Overall Fuel Hazard	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Are the plots representative of the average fuels across the sampling location?	Yes	No

If no, explain any significant difference between plots. For example, wet gully runs through the sampling area, no plots were located in this gully.



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