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# Santos GLNG Offset Plan and Acquittal Summary: EPBC Act Approval 2012/6615 (Stage 5)

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## Abbreviations

| Acronym | Description |
|---|---|
| ALA | Atlas of Living Australia |
| CSG | Coal Seam Gas |
| DAWE | Department of Agriculture, Water and the Environment |
| DES | Department of Environment and Science |
| DNRME | Department of Natural Resources, Mines and Energy |
| DotE | Department of the Environment |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* |
| GLNG | Gladstone Liquefied Natural Gas |
| GFD | Gas Field Development |
| GTP | Gas Transmission Pipeline |
| GTDTHQ | *Guide to Determining Terrestrial Habitat Quality* |
| MNES | Matters of National Environmental Significance |
| OAMP | Offset Area Management Plan |
| RE | Regional Ecosystem |
| REDD | Regional Ecosystem Description Database |
| TEC | Threatened Ecological Community |
| SEVT | Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions |
| VM Act | *Vegetation Management Act 1999* |

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# 1.0 Introduction

## 1.1 Background

The Santos Gladstone Liquefied Natural Gas (GLNG) Project involves the development of Coal Seam Gas (CSG) resources in the Surat and Bowen Basins in Queensland, to supply gas via a 430 kilometre (km) gas transmission pipeline (GTP) to the LNG Facility located on Curtis Island.

Throughout the development of the Santos GLNG Project and in accordance with Santos GLNG Project approvals, potentially impacted environmental values are systematically identified and assessed and in order of preference are avoided, minimised or mitigated. For a project the size and scale of the Santos GLNG Project, not all potential impacts to identified values can be avoided and/or mitigated, resulting in significant residual adverse impacts to environmental values. Santos is committed to providing environmental offsets to compensate for significant residual impacts on matters of national environmental significance (MNES).

The Santos GLNG Project requires environmental offsets for significant residual impacts on MNES under five separate approvals under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth: EPBC Act):

- EPBC 2008/4057 which relates to the LNG facility and associated onshore facilities.
- EPBC 2008/4058 which relates to the marine facilities for the LNG facility.
- EPBC 2008/4059 which relates to the CSG fields.
- EPBC 2008/4096 which relates to the GTP.
- EPBC 2012/6615 which relates to the expansion of the CSG fields (the Santos GLNG Gas Field Development [GFD] Project).

## 1.2 Purpose

This document has been prepared to demonstrate how Santos will acquit MNES offset obligations associated with the Roma East development of the GFD Project under EPBC 2012/6615. Under EPBC 2012/6615, Santos may carry out the action in project stages and deliver environmental offsets for residual significant impacts to MNES over time. This offset plan has been prepared for Stage 5 of the GFD Project, to address conditions 11-19 under EPBC 2012/6615 (see Section 2.0).

## 1.3 Scope

This document includes:

- offset conditions of EPBC 2012/6615 and where each condition is addressed in this document (Section 2.0)
- details of the methods for assessing significant residual impacts and a summary of the impacts addressed as part of this document for Stage 5 of the GFD Project (Section 3.0)
- a reconciliation of impacts and offsets for Stages 1-4 of the GFD Project (Section 4.0)
- summary of how the proposed offset areas meet the requirements under the EPBC Act *Environmental Offsets Policy* (Section 5.0)

- brief overview of the offset properties selected to acquit the MNES offset requirements of Stage 5 of the GFD Project, namely, Cobbadah (Lots 35 SP140818 and 33 WT347) and Kentucky (Lot 1 WT37) (Section 6.0)
- demonstration of how each MNES offset requirement is acquit (Section 7.0)
- offset area management plans (OAMPs) for the Cobbadah and Kentucky offset areas (Appendix A and C, respectively).

## 2.0 Approval Conditions

Table 1 provides a summary of the conditions related to offsets under EPBC 2012/6615 for Stage 5 of the GFD Project and how they have been addressed within this document.

**Table 1: EPBC Act Approval Conditions and how they are met**

| Condition number | Condition | How the conditions are met |
|---|---|---|
| **EPBC Act approval 2012/6615** | | |
| 11 | The approval holder must ensure that environmental offsets comply with the principles of the EPBC Act Environmental Offsets Policy. | Offsets to compensate for significant residual impacts associated with Stage 5 of the GFD Project will be delivered in accordance with the principles of the EPBC Act *Environmental Offsets Policy*. Section 5.0 provides a summary of how the proposed offset areas meet the requirements for an offset under the EPBC Act *Environmental Offsets Policy* with additional detail provided in Section 2.8 of the Cobbadah OAMP (Appendix A) and Section 2.9 of the Kentucky OAMP (Appendix C). |
| 12 | The approval holder may carry out the action in project stages. The approval holder must deliver environmental offsets for residual significant impacts to matters of national environmental significance for each project stage. | The action will be carried out in stages. This offset plan has been prepared to address offset requirements for residual significant impacts on MNES associated with Stage 5 of the GFD Project, as described in Section 3.0. |
| 13 | The approval holder must submit an Offset Management Plan for the Minister's written approval. The Offset Management Plan may be prepared and submitted to the Minister for written approval in stages. If the approval holder submits the Offset Management Plan in stages, each version of the Offset Management Plan must address the known and predicted impacts of the completed, current, and next proposed project phases. | This offset plan has been submitted for the Minister's written approval. This offset plan has been prepared to address offset requirements for residual significant impacts on MNES associated with Stage 5 of the GFD Project, as described in Section 3.0.<br>A reconciliation of impacts for Stage 1-4 of the GFD Project is included in Section 4.0. |
| 14 | The Offset Management Plan must include:<br>a. a method for assessing residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities;<br>b. results from pre-disturbance surveys and/or an alternative approved methodology (if used) for the project phase as required under conditions 4 and 5;<br>c. details of the offset areas required to address predicted residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities for the project phase;<br>d. a survey and description of the current condition (prior to any management activities) of each offset area proposed, including existing vegetation (the baseline condition). This must include a shapefile of each offset property boundary;<br>e. information about how the offset areas provide connectivity with other relevant habitats and biodiversity corridors, including a map depicting the offset areas in relation to other habitats and biodiversity corridors;<br>f. performance and completion criteria for evaluating the management of the offset area, and criteria for triggering remedial action (if necessary);<br>g. a description of the management measures that will be implemented for the protection of EPBC threatened species, EPBC migratory species and EPBC communities, including a discussion of how measures outlined take into account relevant conservation advice and are consistent with the measures in relevant recovery plans and threat abatement plans;<br>h. a program to monitor and report on the effectiveness of these measures, and progress against the performance and completion criteria;<br>i. a description of potential risks to the successful implementation of the plan, and a description of the contingency measures that would be implemented to mitigate against these risks;<br>j. a timeline for when actions identified in the Offset Management Plan will be implemented for each offset area; and<br>k. the proposed legal mechanism for securing the offset. | The Cobbadah and Kentucky offset areas are proposed to be secured to acquit offset requirements for Stage 5 of the GFD Project. OAMPs for the Cobbadah and Kentucky offset areas have been developed in accordance with the requirements outlined in condition 14 (see Appendix A and C, respectively). A summary of how each requirement has been addressed is provided below and further detailed in each OAMP.<br>a. The method for assessing residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities is discussed in Section 3.2.<br>b. Details of the relevant field assessments are provided in Section 3.2 and a summary of the residual significant impacts on MNES for Stage 5 of the GFD Project is provided in Section 3.2.3.<br>c. A description of the proposed Cobbadah and Kentucky offset areas is provided in Section 6.0 and a summary of the offset area to be secured on each property to acquit the residual significant impacts for Stage 5 of the GFD Project is provided in Section 7.0.<br>d. Details of the baseline field surveys and ecological condition are provided in Section 2.4 and 2.5 of the Cobbadah OAMP (Appendix A) and Kentucky OAMP (Appendix C). Shapefiles of the offset areas will be submitted with this offset plan.<br>e. Details on the connectivity and the landscape context are provided in Section 2.2 of the Cobbadah OAMP (Appendix A) and the Kentucky OAMP (Appendix C).<br>f. Performance criteria, trigger levels and remedial actions for management activities are discussed in Section 6.0 of the Cobbadah OAMP (Appendix A) and the Kentucky OAMP (Appendix C).<br>g. Management measures implemented for the protection of MNES, including how measures outlined take into account relevant conservation advice and are consistent with the measures in relevant recovery plans and threat abatement plans are provided in Section 3.0 and 6.0 of the Cobbadah OAMP (Appendix A) and the Kentucky OAMP (Appendix C).<br>h. The monitoring program to measure the effectiveness of the management measures and progress against the performance and completion criteria is detailed in Section 7.0 of the Cobbadah OAMP (Appendix A) and the Kentucky OAMP (Appendix C).<br>i. Risks to the successful implementation of the OAMPs are outlined in Section 5.0 of the Cobbadah OAMP (Appendix A) and the Kentucky OAMP (Appendix C).<br>j. The timing for implementation of the management and monitoring program is provided in Section 9.0 of the Cobbadah OAMP (Appendix A) and the Kentucky OAMP (Appendix C).<br>k. Details on how each of the offset areas for Stage 5 of the GFD Project will be legally secured are provided in Section 2.7 of the Cobbadah OAMP (Appendix A) and Section 2.8 of the Kentucky OAMP (Appendix C). |

| Condition number | Condition | How the conditions are met |
|---|---|---|
| 15 | The currently approved Offset Management Plan must be implemented by the approval holder. | This offset plan complements previous offsets plans and proposals submitted for approval. Once approved, this offset plan will be implemented. |
| 16 | The approval holder must register and legally secure offsets for the first project phase identified in the Offset Management Plan within two years of commencement of the first project phase. | On 6 April 2018, the Springwater offset area was declared an area of high nature conservation value under section 19F of the *Vegetation Management Act 1999* (VM Act) and legally secured through a voluntary declaration. The Santos GLNG GFD Project Stage 1 Offset Plan was approved on 31 October 2016. |
| 17 | The approval holder must register and legally secure offsets for a project phase which are sufficient to acquit the residual significant impacts of that project phase. | Santos will apply to have the offset areas protected via a voluntary declaration under section 19E and 19F of the VM Act.<br>See Section 2.7 of the Cobbadah OAMP (Appendix A) and Section 2.8 of the Kentucky OAMP (Appendix C) for further detail. |
| 18 | If the approval holder submits the Offset Management Plan in stages, the approval holder must prepare and submit an updated Offset Management Plan for each subsequent project phase, for written approval by the Minister. The updated Offset Management Plan must:<br>a. include the information required for the Offset Management Plan at condition 14 for the next project phase;<br>b. include a reconciliation of actual and predicted but yet to be actualised residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities against offsets secured for the commenced project phases and may be subtracted from the obligations required for the subsequent project phases. Any shortfall in secured offsets relative to the requirements arising from actual and predicted but yet to be actualised impacts of any commenced project phases must be added to the obligations required for the next project phase; and<br>c. demonstrate how the offset builds on offsets already secured for previous project stages and will contribute to a larger strategic offset for cumulative project impacts. | The Cobbadah and Kentucky OAMPs (Appendix A and C, respectively) have been prepared to satisfy offset requirements for Stage 5 of the GFD Project.<br>a. OAMPs for the Cobbadah and Kentucky offset areas have been developed in accordance with the requirements outlined in condition 14 (see Appendix A and C, respectively). How each requirement has been addressed is further detailed in each OAMP.<br>b. A reconciliation of impacts for Stage 1-4 of the GFD Project is included in Section 4.0.<br>c. The Kentucky offset area has previously been used to compensate for impacts associated with the GLNG Project under EPBC Act approvals 2008/4059 and 2008/4096. Both the Cobbadah and Kentucky offset areas will have surplus area remaining after acquittal of Stage 5 offset requirements and Santos proposes to draw down on these to acquit future offset requirements. |
| 19 | The approval holder must not commence the project phase until the Offset Management Plan, updated for that project phase has been approved by the Minister in writing. | This offset plan and associated OAMPs are submitted for the approval of the Minister.<br>Stage 5 of the GFD Project is currently scheduled to commence in April 2022. However, Stage 5 will not commence until this OAMP for the project stage has been approved. |

# 3.0 Significant Residual Impacts

## 3.1 Staging Plan

Environmental offsets for the Santos GFD Project will be acquit in stages. For each offset stage of the GFD Project an environmental offset plan will be developed to:

- Report on the methodology and results of the environmental assessments completed over the proposed disturbance area (e.g. desktop and field ecological assessment results).
- Identify actual significant residual impacts on MNES for each stage.
- Reconcile the offsets obligations, post disturbance, against the advanced offsets provided.

An indicative flow diagram demonstrating the staging process is provided in Figure 1.

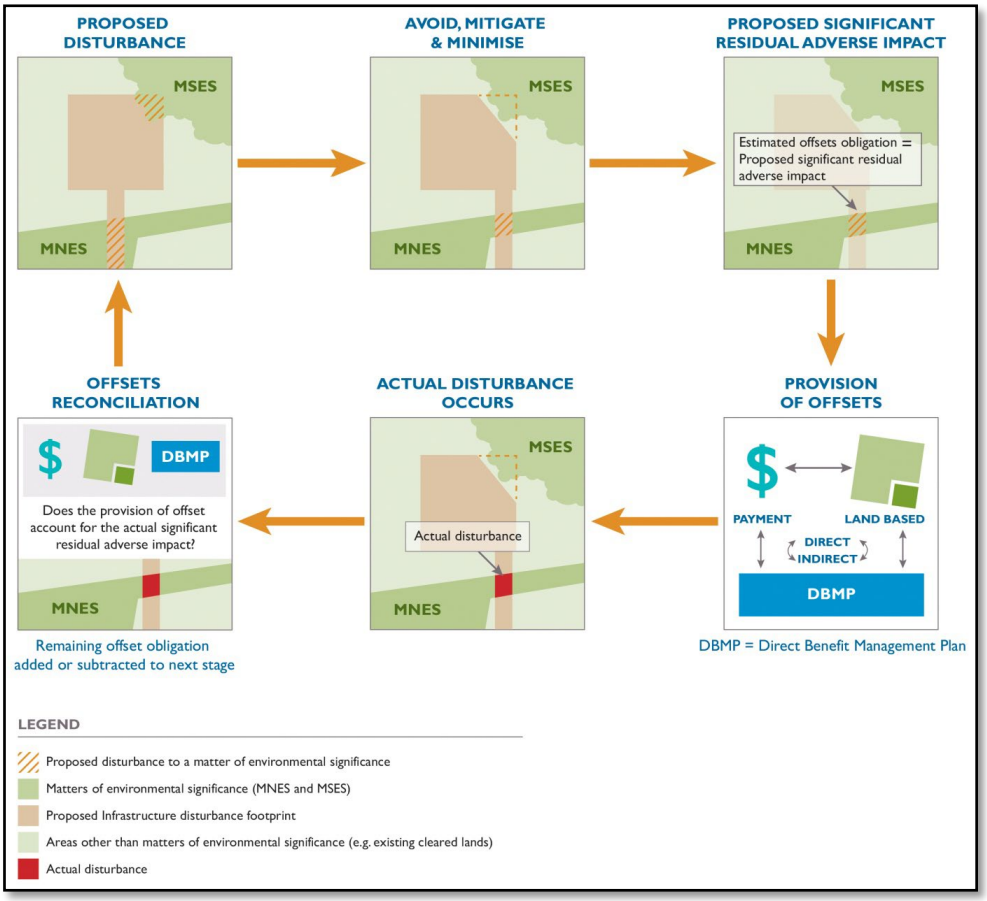


**Figure 1: The Santos GLNG Staging Process**

This offset plan has been prepared for Stage 5 of the GFD Project in accordance with condition 18 of EPBC 2012/6615.

## 3.2 Methods for Assessing Stage 5 Impacts

### 3.2.1 Stage 5 development area

The Stage 5 development area is located approximately 40 km east of Roma, in south central Queensland and extends from just east of Wallumbilla township to the west of the Yuelba Taroom Road and north to Anaby Creek. The project area is dissected north-south by Yuelba Creek and in a north-west to south-east direction by Kangaroo Creek. The project rea sits entirely within Subregion 26 (Southern Downs) of the Brigalow Belt Bioregion (Sattler and Williams 1999), and is wholly located within the Maranoa Regional Council area.

The development area has a long history as a pastoral settlement and is dominated by cleared cattle pastures with some patches of retained, native vegetation, including Yuelba State Forest in the east and Burnside Station in the west.

### 3.2.2 Ecological surveys and assessments

An ecological assessment of the Stage 5 development area was undertaken by Terrestria to provide baseline ecological data and to inform future offset obligations. The assessment included a desktop investigation followed by detailed field surveys between November 2020 and February 2021 to confirm the vegetation communities, flora/fauna species and habitat values present within the development area (Terrestria 2021).

Formal survey sites were established by Terrestria in a number of vegetation assessment units, based on identifiable vegetation characteristics. At each site quaternary vegetation structure and floristics, BioCondition and fauna habitat assessments were conducted. A description of the desktop and field survey assessments are summarised in the following sections.

In-field verification of desktop findings and additional findings of significance were undertaken in general accordancewith the following:

- *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al*. 2020).
- *Methodology for Conducting Ecological Assessments – GLNG Areas Rev 4.1* (Santos 2014).
- *Functional Thresholds for Assessing Regional Ecosystem Functionality* (Santos 2015).

#### 3.2.2.1.1. Desktop assessment

A desktop assessment was conducted to inform the field survey. Sources of information utilised during the desktop assessment included the following:

- Queensland government remnant regional ecosystem (RE) and mature regrowth mapping (Department of Environment and Science [DES] 2021a; Department of Natural Resources, Mines and Energy [DNRME] 2021a).
- EPBC Act Protected Matters Search Tool (Department of Agriculture, Water and the Environment [DAWE] 2020a).
- Wildlife Online fauna and flora records (DES 2021b).
- Protected Plants Flora Survey Trigger Map (DES 2021c).
- Wetlands and waterways mapping (DES 2021d, 2021e; DNRME 2021a).
- Landscape terrestrial and aquatic values (DES 2021a, 2020d).
- Regulated vegetation and other Matters of State Conservation Significance (DES 2021d; DNRME 2021a, 2021b).
- Atlas of Living Australia (ALA) flora and fauna records within 10 km of the approximate centre of the Site (ALA 2021).

### 3.2.2.2 Regional Ecosystem and Threatened Ecological Community Assessment

Desktop RE mapping was ground-truthed based on quaternary level of data collected across the disturbance area in accordance with Neldner *et al*. (2020). Vegetation community polygons were verified in accordance with Queensland RE description and biodiversity status as per the Regional Ecosystem Description Database (REDD) (DES 2021a) and classified as remnant RE, vegetation consistent with RE (regrowth) or non-remnant vegetation (Santos 2014). For identified regrowth (i.e. vegetation floristically equivalent to a RE but not meeting structural thresholds of remnant RE) an ecosystem functionality assessment was conducted. This assessed selected vegetation characteristics against the parameters described in Santos (2015).

For each area of potential threatened ecological community (TEC), an assessment of vegetation survey data was made against the Commonwealth Government's TEC threshold criteria (e.g. Threatened Species Scientific Committee 2013).

### 3.2.2.3 BioCondition assessment

BioCondition assessments were used to evaluate ecological functionality of each vegetation community. These assessments were completed at 42 sites, which were selected to include each mapped RE (remnant and regrowth status). BioCondition assessments were undertaken in accordance with the *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual* (BioCondition Assessment Manual) (Eyre *et al*. 2015). Scores for BioCondition sites were calculated in accordance with Eyre *et al*. (2015), which compares the values obtained at each survey site with values in the benchmark document for that particular RE (Queensland Herbarium 2019). Where published benchmarks were not available, these site scores were derived by comparison of site attributes against regional benchmarks and median scores for remnant vegetation sites of the relevant RE, with low levels of disturbance, obtained from previous surveys (Terrestria 2021).

#### 3.2.2.4 Threatened species habitat assessment and mapping

Microhabitat assessments were undertaken in conjunction with vegetation community surveys at each survey plot, or as required where significant variation in the type and abundance of habitat features occurred. The results of these assessments, combined with published information and ecologist knowledge of fauna distribution and habitat use, were used to predict habitat suitability for nominated EPBC Act listed threatened flora and fauna confirmed, likely or potentially present within the development area.

Incidental records of threatened fauna obtained during vegetation assessments and general property traverses to and between sites (on foot and driving) were fully documented including species name, location (with site co-ordinates or area of extent), habitat and number detected (Terrestria 2021).

Microhabitat assessments were conducted at representative sites within each ground-truthed assessment unit present within the development area. Though the presence and abundance of microhabitat features (e.g. hollow logs) likely varies within and between patches (mapping polygons) of a given RE, for the purposes of predictive fauna habitat mapping it is assumed that the results of microhabitat assessment for a RE are applicable throughout the area. That is to say, a conservative approach has been taken with regard to mapping of species habitat where ground-truthing of the entire RE patch is impractical. Where patches have not been ground-truthed, relevant fauna microhabitat features were assumed to be present and patches have been mapped as habitat until further assessments can be undertaken. Similarly, where predictive mapping of flora habitat is based on known RE associations it is assumed that suitable habitat exists in all patches of the RE at the Site.

#### 3.2.2.5 Targeted flora survey

Targeted surveys for threatened flora species were informed by the desktop search results and local experience. Searches for threatened flora species under the EPBC Act and/or *Nature Conservation Act 1992* (Qld) were carried out at vegetation assessment sites and in random meanders in targeted habitat types, including remnant and non-remnant vegetation. If detected, counts and extent of each population of threat-listed flora were made, as well as structural characteristics and representative photographs taken. Data were recorded using the Santos-specific Notable Species - Flora Point or Region data capture layer (Terrestria 2021).

### 3.2.3 Significant Residual Impact Assessment

The Commonwealth Minister for the Environment requires the approval holder to ensure that environmental offsets comply with the principles of the EPBC Act *Environmental Offsets Policy* and secure environmental offsets to compensate for residual impacts to MNES for each stage of the GFD Project.

The EPBC Act *Environmental Offsets Policy* states that environmental offsets are measures that compensate for the residual adverse impacts of an action on the environment and defines residual adverse impacts as those impacts that remain after avoidance and mitigation measures have been implemented. The EPBC Act *Environmental Offsets Policy* requires residual adverse impacts to be offset if the impact is considered to be 'significant' as defined by the *Matters of National Environmental Significance – Significant Impact Guidelines Version 1.1* (Department of the Environment [DotE] 2013).

Based on the results of the desktop assessment and detailed field surveys described in Section 3.2.2, a likelihood of occurrence assessment for EPBC Act listed threatened species, migratory species and ecological communities was undertaken within the Stage 5 development area to determine the known or potential presence of MNES (Terrestria 2021).

Potential residual impacts were identified for EPBC Act listed threatened species and ecological communities, identified in annex 1 to the EPBC 2012/6615 approval, that were confirmed, likely or potentially present within the Stage 5 of the GFD Project development area. The extent of the residual impact for each MNES was determined by assessing a conservative 'best guess' scenario, i.e. assuming the maximum linear infrastructure corridor widths and larger well layouts on the most likely development layout, within the extent of predictive habitat mapping (defined by potentially suitable RE) within the Stage 5 development area. This generally results in a significant over-estimate of impacts, as it is rare the maximum potential disturbance widths are utilised during all construction. Table 2 summarises the conservative 'best guess' scenario of impacts to EPBC Act listed threatened species and ecological communities based on the predictive habitat mapping for each MNES within the Stage 5 GFD development area.

For EPBC Act listed migratory and marine fauna species a likelihood of occurrence assessment was also undertaken, followed by a significant residual impact assessment in accordance with the *Matters of National Environmental Significance – Significant Impact Guidelines Version 1.1* (DotE 2013) for species identified as confirmed, likely or potentially present within the Stage 5 GFD Project development area. The results of this assessment are presented in Table 3 and indicate that there would be no significant residual impacts to EPBC Act listed migratory and marine fauna species.

Following the results of the significant residual impact assessment described above, Santos proposes to secure environmental offsets to compensate for the impacts to EPBC Act listed threatened species and ecological communities identified in Table 2.

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**Table 2: Proposed disturbance to EPBC Act listed threatened fauna and ecological communities within the Stage 5 development area**

| MNES | Status under EPBC Act[1] | Distribution and known habitat use | Potentially suitable RE | Disturbance area (ha) |
|---|---|---|---|---|
| **Threatened ecological communities** | | | | |
| Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC | E | All remnant RE 11.3.1 and 11.9.5 was mapped as Brigalow TEC, where *Acacia harpophylla* was dominant in the canopy and the vegetation otherwise met the condition criteria. | 11.3.1, 11.9.5 | 6.5 |
| **Threatened species** | | | | |
| Collared Delma (*Delma torquata)* | V | Habitat includes eucalypt woodland with potentially suitable shelter sites (e.g. small rocks, woody debris). All areas of remnant and functional regrowth of the nominated REs are considered potential habitat.<br>Based on an assessment of the Stage 5 development area, this species is **unlikely to be present** due to low quality foraging and shelter resources and limited connectivity to other areas of suitable habitat. | 11.3.2, 11.5.1, 11.5.5, 11.7.2, 11.7.7, 11.9.5, 11.9.6, 11.9.7, 11.9.10, 11.10.3, 11.10.7a, 11.10.11 | 143.6 |
| Dunmall's Snake (*Furina dunmalli)* | V | Habitat includes a diversity of vegetation communities such as eucalypt and *Acacia* woodland and open forest. All areas of remnant vegetation and regrowth of the nominated RE are considered potential habitat.<br>Based on an assessment of the Stage 5 development area, this species is **unlikely to be present** due to low quality foraging and shelter resources and limited connectivity to other areas of suitable habitat. | 11.3.1, 11.3.2, 11.5.1, 11.5.5, 11.7.2, 11.7.7, 11.9.5, 11.9.6, 11.9.7, 11.9.10, 11.10.3, 11.10.7a, 11.10.11 | 144.0 |
| Yakka Skink (*Egernia rugosa*) | V | Habitat includes eucalypt woodland and areas with potentially suitable shelter sites (e.g. large logs, log piles, rocky areas). All areas of remnant and regrowth of the nominated RE are considered potential habitat. This may include sub-optimal habitat.<br>Based on an assessment of the Stage 5 development area, this species is **potentially present** due to moderate quality foraging and shelter resources, moderate connectivity to other areas of suitable habitat and previous records in the area. | 11.3.2, 11.5.1, 11.5.5, 11.7.2, 11.9.5, 11.9.6, 11.9.7, 11.9.10, 11.10.3, 11.10.7a, 11.10.11 | 140.8 |

| MNES | Status under EPBC Act[1] | Distribution and known habitat use | Potentially suitable RE | Disturbance area (ha) |
|---|---|---|---|---|
| Koala (*Phascolarctos cinereus*) | E | Habitat includes eucalypt-dominated woodlands and open forests, preferably riparian and floodplain communities. All REs with these characteristics, as well as all remnant and regrowth of REs dominated by Myrtaceae species, are considered potential habitat.<br>Based on an assessment of the Stage 5 development area, this species is **likely to be present** due to evidence of one or more species records in the last 10 years within 5 km of the site, and the site contains suitable foraging and shelter resources. | 11.3.2, 11.5.1, 11.5.5, 11.7.7, 11.9.7, 11.9.10 | 116.3 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | Habitat includes a range of dry woodland and open forest communities. All areas of non-grassland remnant and regrowth of the nominated RE are considered potential habitat.<br>Based on an assessment of the Stage 5 development area, this species is **unlikely to be present** due to low quality foraging and shelter resources and limited connectivity to other areas of suitable habitat. | 11.3.1, 11.3.2, 11.5.1, 11.5.5, 11.7.2, 11.7.7, 11.9.5, 11.9.7, 11.9.10, 11.10.3, 11.10.7a, 11.10.11 | 144.0 |

[1] E = Endangered; V = Vulnerable.

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**Table 3: Assessment of potential significant impacts upon EPBC Act listed migratory and/or marine fauna species potentially present within the development area**

| Species | Significant Impact Criteria (DotE 2013; Department of Environmental Heritage and Protection 2014) | | | | | | | Significant Residual Impact |
|---|---|---|---|---|---|---|---|---|
| | Lead to a long- term decrease in the size of a population (including declines due to loss or modification of habitat). | Reduce the Area of Occupancy (AoO), or the Extent of Occurrence (EoO) of the species. | Fragment an existing population into two or more populations; or, result in genetically distinct populations. | Adversely affect habitat critical to the survival of a species (including disruption to breeding, feeding, nesting, migration or resting sites). | Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat. | Introduce disease that may cause the population to decline. | Interfere with the recovery of the species. | |
| Common Sandpiper (*Actitis hypoleucos*) | No: There is limited suitable habitat (stream margins) at the Site and the development will not disturb this habitat. | No: No loss of potential habitat will occur. | No: Disturbance within the Site is unlikely to permanently impact on movement of the species, hence no isolation or fragmentation of populations is predicted. | No: Very limited potential habitat within the Site will not be disturbed by the development. | None known | None known | No: Very limited potential habitat within the Site will not be disturbed by the development. | No |
| Cattle Egret (*Bubulcus ibis*) | No: There is limited suitable habitat (riverine pools and wetlands) at the Site and the development will not disturb this habitat. | No: No loss of potential habitat will occur. | No: Disturbance within the Site is unlikely to permanently impact on movement of these species, hence no isolation or fragmentation of populations is predicted. | No: Very limited potential habitat within the Site will not be disturbed by the development. | None known | None known | No: Very limited potential habitat within the Site will not be disturbed by the development. | No |
| Eastern Great Egret (*Ardea alba modesta*) | | | | | | | | |
| Fork-tailed Swift (*Apus pacificus*) | No: These species are aerial feeding insectivores that forage over a wide range of intact and disturbed landscapes. The species do not breed in Australia and only very rarely roost during their summer presence. | No: The proposed disturbance is not materially relevant to these species. | No: the proposed disturbance is not materially relevant to these species. | No: No significant impact on foraging resources is anticipated, no other critical locations are relevant to these species in Australia. | None known | No: These species are aerial feeding insectivores that forage over a wide range of intact and disturbed landscapes. The species do not breed in Australia and only very rarely roost during their summer presence. | No: The proposed disturbance is not materially relevant to these species. | No: The proposed disturbance is not materially relevant to these species. |
| White-throated Needletail (*Hirundapus caudacutus*) | | | | | | | | |
| White-bellied Sea-Eagle (*Haliaeetus leucogaster*) | No: Limited suitable habitat (riverine pools for foraging and riparian trees for roosting and nesting) at the Site and the development will not disturb this habitat. | No: No loss of potential habitat will occur. | No: Disturbance within the Site is unlikely to permanently impact on movement of the species, hence no isolation or fragmentation of populations is predicted. | No: Very limited potential habitat within the Site will not be disturbed by the development. | None known | None known | No: Very limited potential habitat within the Site will not be disturbed by the development. | No |
| Straw-necked Ibis (*Threskiornis spinicollis)* | No: These bird species are common and widely distributed in eastern Australia and the development is not expected to impact on their distributions. | No: The scale of the development will not significantly reduce AoO or EoO for these species. | No: The scale of the development will not isolate or fragment populations of these mobile species. | No: The scale of the development will not significantly reduce critical habitat for these widespread and mobile species. Three species are non-breeding visitors/passage migrants within the development area. | None known | None known | No: These species are common and widespread mobile fauna, not currently under threat. Species recovery criterion is not relevant to this group of species. | No |
| Brown Goshawk (*Accipiter fasciatus)* | | | | | | | | No |
| Fan-tailed Cuckoo (*Cacomantis flabelliformis)* | | | | | | | | No |
| Pallid Cuckoo (*Cacomantis pallidus)* | | | | | | | | No |
| Shining Bronze-Cuckoo (*Chalcites lucidus)* | | | | | | | | No |

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| Species | Significant Impact Criteria (DotE 2013; Department of Environmental Heritage and Protection 2014) | | | | | | | Significant Residual Impact |
|---|---|---|---|---|---|---|---|---|
| | Lead to a long- term decrease in the size of a population (including declines due to loss or modification of habitat). | Reduce the Area of Occupancy (AoO), or the Extent of Occurrence (EoO) of the species. | Fragment an existing population into two or more populations; or, result in genetically distinct populations. | Adversely affect habitat critical to the survival of a species (including disruption to breeding, feeding, nesting, migration or resting sites). | Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat. | Introduce disease that may cause the population to decline. | Interfere with the recovery of the species. | |
| Black-eared Cuckoo (*Chalcites osculans)* | | | | | | | | No |
| Oriental Cuckoo *(Cuculus optatus)* | | | | | | | | No |
| Eastern Koel (*Eudynamys orientalis)* | | | | | | | | No |
| Channel-billed Cuckoo (*Scythrops novaehollandiae)* | | | | | | | | No |
| Forest Kingfisher (*Todiramphus macleayii)* | | | | | | | | No |
| Rainbow Bee-eater (*Merops ornatus)* | | | | | | | | No |
| Australian Magpie-lark (*Grallina cyanoleuca)* | | | | | | | | No |
| Satin Flycatcher (*Myiagra cyanoleuca)* | | | | | | | | No |
| Rufous Fantail (*Rhipidura rufifrons)* | | | | | | | | No |
| Black-faced Cuckoo-shrike (*Coracina novaehollandiae)* | | | | | | | | No |
| White-bellied Cuckoo-shrike (*Coracina papuensis)* | | | | | | | | No |
| Australasian Pipit (*Anthus novaeseelandiae)* | | | | | | | | No |
| Welcome Swallow (*Hirundo neoxena)* | | | | | | | | No |

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# 4.0 Impact and Offset Reconciliation for Stage 1-4

In accordance with condition 18 (b) of EPBC 2012/6615, a reconciliation of actual and predicted but yet to be actualised residual significant impacts to MNES against offsets secured for the commenced project stages must be undertaken. Secured offsets in excess of requirements arising from actual and predicted but yet to be actualised impacts of any commenced project phases will be subtracted from the obligations required for subsequent project phases. Any shortfall in secured offsets relative to the requirements arising from actual and predicted but yet to be actualised impacts of any commenced project phases will be added to the obligations required for the next project phase.

Table 4 and Table 5 provide a summary of the proposed significant residual impacts on MNES required to be offset for Stages 2, 3 and 4 of the GFD Project including the offset area secured on the Santos owned Springwater property and Mt Tabor property to compensate for the proposed disturbance. The offset areas on Springwater and Mt Tabor have been approved in accordance with the following under EPBC 2012/6615:

- Santos GLNG Gas Fields Development Project Stage 1 Offset Plan 2016 – 2021 (Document Number: 0007-650-PLA-0008), approved on 31 October 2016 and prepared to support gas field developments in Scotia Gas Field (PL 176).
- Santos GLNG Gas Fields Development Project Stage 2 Offset Plan (Document Number: 0030-650-EMP-0001 [Rev 2]), approved on 29 June 2018 and prepared to support gas field developments in Maisey Gas Field (PL 176).
- Santos GLNG Gas Fields Development Stage 3 Offset Plan (Rev 1, 12 April 2021), approved on 17 May 2021 and prepared to support gas field developments in Scotia Gas Field (PL 176), and Arcadia Gas Field (PL 90, PL 234 and PL 421).
- Santos GLNG Gas Fields Development Stage 4 Offset Plan (Rev 0, 21 July 2021), approved on 23 September 2021 and prepared to support gas field developments in Fairview Gas Field (PL 90, PL 91, PL 92, PL 99, PL 100, PL 232).

Activities comprising Stage 1 of the GFD Project will not incur any significant residual impacts to MNES and therefore have not been included in the table below. Activities comprising Stages 2, 3 and 4 of the GFD Project are yet to be completed in full, so an assessment of actual impacts to date is yet to be finalised.

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**Table 4: Reconciliation of predicted significant residual impacts associated with Stage 1-4 of the GFD Project and offset area secured on the Springwater property**

| MNES | Status under EPBC Act[1] | Area of suitable habitat within the Springwater offset area (ha) | Stage 2 | | | Stage 3 | | | Stage 4 | | | Surplus remaining (ha) (after Stages 1 – 4) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Predicted Stage 2 impacts (ha) | Impacts offset as part of Stage 2 (ha) | Offset area secured (ha) | Residual Stage 2 impacts reconciled and included in Stage 3 (ha) | Predicted Stage 3 impacts including reconciled Stage 2 (ha) | Offset area secured (ha) | Residual Stage 3 impacts reconciled and included in Stage 4 (ha) | Predicted Stage 4 impacts including reconciled Stage 3 (ha) | Offset area secured (ha) | |
| **Threatened Ecological Communities** | | | | | | | | | | | | |
| Brigalow TEC (*Acacia harpophylla* dominant and co-dominant) | E | 369.3 | 6.8 | 6.2 | 53.0 | 0.6 | 24.8 | 198.0 | - | 5.5 | 65.6 | 4.1 |
| Semi-evergreen vine thicket TEC of the Brigalow Belt (North and South) and Nandewar Bioregions | E | 57.5 | - | - | - | - | - | - | - | 2.0 | 26.0 | 18.5 |
| **Threatened Species** | | | | | | | | | | | | |
| Northern Quoll (*Dasyurus hallucatus)* | E | 837.3 | - | - | - | - | - | 251.0 | - | 301.4 | - | 137.0 |
| Collared Delma (*Delma torquata)* | V | 768.4 | 55.9 | 49.0 | 284.0 | 6.9 | 48.3 | 339.5 | - | 492.2 | - | 87.6 |
| Dunmall's Snake (*Furina dunmalli)* | V | 768.4 | 55.9 | 49.0 | 284.0 | 6.9 | 48.3 | 351.5 | - | 496.2 | - | 87.6 |
| Yakka Skink (*Egernia rugosa*) | V | 768.4 | 54.8 | 48.2 | 279.0 | 6.6 | 48.0 | 350.5 | - | 496.6 | - | 87.6 |
| Large-eared Pied Bat (*Chalinolobus dwyeri)* | V | 837.3 | - | - | - | - | - | 251.0 | - | 377.4 | - | 137.0 |
| Red Goshawk (*Erythrotriorchis radiatus*) | V | 837.3 | - | - | - | - | 31.0 | 288.0 | - | 500.6 | - | 137.0 |
| Squatter Pigeon (southern) (*Geophaps scripta scripta*) | V | 429.6 | - | - | - | - | 10.8 | 75.0 | - | 495.6 | - | 42.6 |
| Koala (*Phascolarctos cinereus*) | E | 429.6 | 42.1 | 37.5 | 217.0 | 4.6 | 23.1 | 156.0 | - | 355.6 | - | 42.6 |
| Black-breasted Button-quail (*Turnix melanogaster*) | V | 57.5 | - | - | - | - | 0.6 | 5.7 | - | 2.3 | 19.0 | 25.5 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 837.3 | 55.9 | 49.0 | 340.0 | 6.9 | 50.2 | 371.0 | - | 500.6 | - | 137.0 |

[1] E = Endangered; V = Vulnerable.

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**Table 5: Reconciliation of predicted significant residual impacts associated with Stage 4 of the GFD Project and offset area secured on the Mt Tabor property**

| MNES | Status under EPBC Act[1] | Area of suitable habitat within the Mt Tabor offset area (ha) | Stage 4 | | | Surplus remaining (ha) (after Stage 4) |
|---|---|---|---|---|---|---|
| | | | Residual Stage 3 impacts reconciled and included in Stage 4 (ha) | Predicted Stage 4 impacts including reconciled Stage 3 (ha) | Offset area secured (ha) | |
| **Threatened Ecological Communities** | | | | | | |
| Brigalow TEC (*Acacia harpophylla* dominant and co-dominant) | E | 369.3 | - | 5.5 | - | - |
| Semi-evergreen vine thicket TEC of the Brigalow Belt (North and South) and Nandewar Bioregions | E | 57.5 | - | 2.0 | - | - |
| **Threatened Species** | | | | | | |
| Northern Quoll (*Dasyurus hallucatus)* | E | 837.3 | - | 301.4 | 2,870.0 | 1,004.9 |
| Collared Delma (*Delma torquata)* | V | 768.4 | - | 492.2 | 4,485.0 | 1,004.9 |
| Dunmall's Snake (*Furina dunmalli)* | V | 768.4 | - | 496.2 | 4,520.0 | 1,004.9 |
| Yakka Skink (*Egernia rugosa*) | V | 768.4 | - | 496.6 | 4.525.0 | - |
| Large-eared Pied Bat (*Chalinolobus dwyeri)* | V | 837.3 | - | 377.4 | 3,440.0 | 1,004.9 |
| Red Goshawk (*Erythrotriorchis radiatus*) | V | 837.3 | - | 500.6 | 3,910.0 | 1,004.9 |
| Squatter Pigeon (southern) (*Geophaps scripta scripta*) | V | 429.6 | - | 495.6 | 4,515.0 | 1,004.9 |
| Koala (*Phascolarctos cinereus*) | E | 429.6 | - | 355.6 | 3,240.0 | 1,004.9 |
| Black-breasted Button-quail (*Turnix melanogaster*) | V | 57.5 | - | 2.3 | - | - |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 837.3 | - | 500.6 | 4,560.0 | 1,004.9 |

[1] E = Endangered; V = Vulnerable.

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# 5.0 EPBC Act Offset Framework

Offsets for Stage 5 are proposed to be secured on the Cobbadah and Kentucky properties, as detailed in Section 6.0. Table 6 outlines how the proposed offset areas will be provided to compensate for significant residual impacts to MNES and meet the requirements of the EPBC Act *Environmental Offsets Policy*.

**Table 6: Assessment against Principles of the Offset Policy**

| Principle | How the principle is met in this offset proposal |
|---|---|
| 1. 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 | The Cobbadah and Kentucky offset areas acquit MNES offset requirements under EPBC 2012/6615 as outlined in Table 7 of this offset plan.<br>The offset areas will be managed and monitored to improve the quality of Brigalow TEC and viability of habitat for MNES fauna species.<br>The Cobbadah and Kentucky OAMPs (Appendix A and Appendix C) include specific management objectives with interim performance targets and completion criteria. Management actions are outlined with accompanying adaptive management triggers and corrective actions in the event that monitoring identifies that interim performance targets are not attained or completion criteria are not attained and/or maintained. The offset areas will be managed and monitored from approval of the OAMP for a minimum of 20 years. It is anticipated that the completion criteria will be achieved within a 20-year period. |
| 2. be built around direct offsets but may include other compensatory measures | MNES offset obligations under EPBC 2012/6615 will be acquit through the delivery of direct land-based offsets on the Cobbadah and Kentucky offset areas. |
| 3. 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 *Offsets assessment guide* in calculating the area of the offset to be provided. |
| 4. be of a size and scale proportionate to the residual impacts on the protected matter | The size of the offset area to be secured for offset obligations has been calculated in accordance with the *Offsets assessment guide* (Appendix B and Appendix D) and is presented as part of the Cobbadah and Kentucky OAMPs (Appendix A and Appendix C). |
| 5. effectively account for and manage the risks of the offset not succeeding | The Cobbadah and Kentucky OAMPs (Appendix A and Appendix C) have been developed in consideration of known and identified threats to the offset values to manage the risk of failing to achieve the completion criteria and overall environmental outcomes for the offset area.<br>Threats to the offset Site are managed by through the implementation of the management measures, including:<br>• Fire prevention and management<br>• Weed and pest animal monitoring and control<br>• Clearing protection<br>• Management of grazing<br>• Restricted access<br>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 based on the results of field surveys and discussions with the landholder. The results of the risk assessment, presented in the Cobbadah and Kentucky OAMPs (Appendix A and |

| Principle | How the principle is met in this offset proposal |
|---|---|
| | Appendix C), have informed the adaptive management process including the identification of threats to offset values, management objectives, performance criteria, management actions, monitoring programs, adaptive management triggers and corrective actions. If the offset cannot attain and maintain the completion criteria, then additional offsets will be provided to compensate for the impact and the failed offset. |
| 6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action) | The environmental outcomes proposed to be achieved through the implementation of the Cobbadah and Kentucky OAMPs (Appendix A and Appendix C) are based on additional management and monitoring measures conducted as part of business as usual on the properties. For example under the *Biosecurity Act 2014* (Qld) a person has a general biosecurity obligation to: take all reasonable and practical steps to prevent or minimise each biosecurity risk. The steps proposed in the OAMPs are above reasonable and practical steps required to control feral animals and weeds in central Queensland.<br>Once the Voluntary Declaration has been secured over the offset area, environmental laws prevent other land uses inconsistent with the OAMP being approved over these parts of the properties. |
| 7. be efficient, effective, timely, transparent, scientifically robust and reasonable | The Cobbadah and Kentucky offset areas have been identified to be suitable using an evidence based and scientifically robust approach, as detailed in the Cobbadah and Kentucky OAMPs (Appendix A and Appendix C).<br>The environmental outcomes to be achieved through the OAMPs will be delivered progressively over 20 years. The offset area will be legally secured through a Voluntary Declaration under the VM Act, therefore any vegetation clearing contravention of the OAMPs is not permissible without specific Queensland government approval.<br>The preparation and implementation of the OAMPs support the efficient, effective, timely, transparent and scientifically robust approach to providing offsets. |
| 8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced. | The OAMPs include a detailed monitoring program which will assess the effectiveness of the management actions undertaken and the progress of the offset area in achieving the environmental outcomes.<br>The results of all management and monitoring programs will be included in annual reports to be prepared for each management year. An implementation schedule for monitoring and management is provided in the OAMPs which will be reviewed at least annually to ensure the timely implementation of the OAMPs. |

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# 6.0 Offset Approach

Santos will acquit the offset obligations for Stage 5 of the GFD Project under EPBC 2012/6615 on the Cobbadah and Kentucky offset areas. The following sections provide an overview of each offset option and Figure 2 spatially presents the location of the proposed offset areas in relation to the GFD Project.

## 6.1 Cobbadah

Cobbadah is a 3,859 ha freehold property located approximately 30 km west of Injune, Queensland (Lots 35 SP140818 and 33 WT347). The property is currently used for cattle grazing.

Cobbadah is situated adjacent to the Great Dividing Range in the Brigalow Belt Bioregion (Southern Downs Subregion) (Sattler and Williams 1999), approximately 40 km southeast of Oakvale State Forest and 25 km southwest of Doonkuna State Forest. The property is located entirely within the Dawson River Catchment, part of the Fitzroy River Basin, with all drainage channels on the property flowing into Hutton Creek which dissects the property, flowing from west to east. The topography is varied across the property, comprising early Tertiary Olivine basalt in upland areas capping Late Jurassic sandstone (Westbourne Formation and Springbok Sandstone) with lowland areas characterised by depositional alluvium. Elevation ranges between 460 metres (m) above sea level in the low-lying valleys up to approximately 940 m in the south of the property, corresponding to Mount Hutton which is located in the very southeast corner of Cobbadah.

Detailed field surveys of the Cobbadah offset area were undertaken by CO2 Australia ecologists between January 2017 and August 2020, to determine the potential biodiversity offset values and the suitability of the area as an offset for the Santos GLNG Project. Specifically, RE and TEC assessments/ground-truthing and mapping, BioCondition surveys, threatened fauna habitat assessment and mapping and incidental threatened flora surveys were conducted.

An OAMP for the Cobbadah offset area is included in Appendix A and has been prepared to meet the requirements of conditions 11-19 of EPBC 2012/6615.

## 6.2 Kentucky

Kentucky (Lot 1 WT37) is a 4,368 ha property located approximately 50 km east north-northeast of Injune in south central Queensland. The property is owned by Santos and was acquired primarily for its potential environmental offset values for the Santos GLNG Project. Kentucky is situated within Subregion 20 (Arcadia) of the Brigalow Belt South Bioregion (Sattler and Williams 1999) within the jurisdiction of the Maranoa Regional Council. Access to the property is via the Beilba Road, east of the Carnarvon Developmental Road between Injune and Rolleston. Current land uses on the property include cattle grazing, activities associated with CSG exploration and production as well as areas dedicated to environmental offsets. The Santos GLNG pipeline also traverses the property in a roughly south-north direction; however, has been excluded from all assessment and offset areas.

The property lies within rugged terrain and contains large vegetation remnants that are contiguous with Expedition (Limited Depth) National Park to the east and Lonesome Holding (proposed National Park) to the north. The property is located entirely within the Dawson River Catchment, part of the Fitzroy River Basin, with the major watercourses being the Dawson River and Baffle Creek. The topography is varied and is comprised mainly of hills, ridges, plateaux and steep scarps, with sandstone of the Precipice and Evergreen Formations forming the underlying geology. Small alluvial flats occur beside the Dawson River. Baffle Creek and its associated tributaries have associated deep gorges.

Detailed field surveys of the Kentucky offset area were initially undertaken by Boobook in 2010, to determine the potential biodiversity offset values and the suitability of the area as an offset for the Santos GLNG Project. Specifically, BioCondition surveys, threatened flora survey and mapping, targeted fauna surveys, canopy cover analysis and RE and vegetation community assessments/ground-truthing and mapping were conducted.

An OAMP for the Kentucky offset area was approved by the Commonwealth Government on 23 March 2021 for Phase 1 of the GLNG Project under EPBC 2008/4059. A separate OAMP has been prepared to acquit offset requirements for Stage 5 of the GFD Project (EPBC 2012/6615), drawing down on surplus areas of suitable MNES habitat within the approved Kentucky offset area (Appendix C). The offset area will be legally secured through a Voluntary Declaration under the VM Act by 23 March 2022, thereby satisfying the legal security requirements under condition 16 of EPBC 2012/6615.

The Kentucky offset area will continue to be managed by Santos to enhance and improve the condition of environmental values on the property in accordance with previous and current OAMPs over the Kentucky property.

148°20'0"E 148°40'0"E 149°0'0"E 149°20'0"E 149°40'0"E

25°20'0"S 25°40'0"S 26°0'0"S 26°20'0"S 26°40'0"S

PL 450 PL 1062 Arcadia West PL 235 PL 440 PL 1059 Towrie PL 420 PL 1017 Arcadia Branch PL 421 PL 234 PL 233 PL 90 PL 91 PL 457 PL 232 PL 92 PL 1012 East Lynne PL 99 PL 100

**Kentucky - 1WT37**

**Cobbadah - 33WT347, 35SP140818**

PL 1019 PL 309 Replacement PL 322 PL 314 PL 1021 Maisey PL application PL 1020 PL 310 Replacement PL 282 PL 3 PL 315 PL 93 PL 313 PL 6 PL 316 PL 317 PL 318 PL 8 PL 319 PL 9 PL 320 PL 321 PL 11

Injune Roma Wallumbilla Yuleba Dulacca

CARNARVON HIGHWAY WARREGO HIGHWAY ROMA CONDAMINE ROAD

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**Figure 2**
**EPBC 2012/6615**
**Stage 5 offset properties**

Santos Petroleum Lease

Offset properties

Location diagram

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Petroleum leases

Date: 10/22/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:550,000@A3

0 5 10 15 20 Kilometres

N

CO2 Australia

Path: P:\GIS\Data\Projects\Santos\912_211020_Roma_East_maps\Acquittal document\Figure 2 - Offset properties.mxd

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# 7.0 Offset Acquittal

Table 7 presents a summary of the offset areas to be secured to acquit offset requirements for Stage 5 of the GFD Project under EPBC 2012/6615 on Cobbadah and Kentucky, as well the area of surplus offset values remaining within each of the offset areas. For MNES where a surplus is noted, Santos proposes to draw down on these to acquit future offset requirements.

The results of the detailed field assessments including the ground-truthed RE mapping and fauna habitat associations were used to inform the suitability and location of the offset area on each of the properties and are discussed in detail as part of the OAMPs (see Appendix A and C).

The minimum offset area required to be secured for each MNES was determined in accordance with the EPBC Act *Offsets assessment guide*. The *Offsets assessment guide* inputs and supporting justifications for the Cobbadah and Kentucky OAMPs are provided in Appendix B and D, respectively. A habitat quality score for each MNES for both the impact and offset area has been calculated to inform the *Offsets assessment guide*.

The habitat quality of the impact area for each MNES required to be offset (Table 2) was calculated based on the outcomes of the detailed field surveys (Section 3.0) in accordance with the habitat quality scoring method described in Appendix E. This method has been developed based on a combination of assessment methods outlined in the Queensland Herbarium's BioCondition Assessment Manual and the *Guide to Determining Terrestrial Habitat Quality* (GTDTHQ) (version 1.3; DES 2020) to be consistent with the requirements under the EPBC Act guideline for the *Offsets assessment guide*. A detailed summary of the impact area habitat quality score calculations is provided in Appendix F.

A baseline habitat quality score for each MNES offset value, determined based on the results of the detailed field assessments, was used to inform the *Offsets assessment guide* and will be used as a measure to assess the success of the OAMPs through the interim performance targets and completion criteria. A detailed summary of the field assessments, baseline habitat quality scores for each MNES and interim performance targets and completion criteria are provided in each of the OAMPs (see Appendix A and C).

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**Table 7: Offset acquittal for Stage 5 of the GFD under EPBC 2012/6615**

| MNES | Status under EPBC Act[1] | Impact area (ha) | Cobbadah offset area | | | Kentucky offset area | | | Total % acquittal |
|---|---|---|---|---|---|---|---|---|---|
| | | | Offset area to be secured under *Offsets assessment guide* (ha) | % acquittal | Surplus area available (ha) | Offset area to be secured under *Offsets assessment guide* (ha) | % acquittal | Surplus area available (ha) | |
| **Listed threatened ecological communities** | | | | | | | | | |
| Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC | E | 6.5 | 72.2 | 100.1% | 0 | - | - | - | 100.1% |
| **Listed threatened species** | | | | | | | | | |
| Collared Delma (*Delma torquata*) | V | 143.6 | 557.7 | 74.6% | 572.9 | 806.5 | 107.9% | 517.2 | 182.5% |
| Dunmall's Snake (*Furina dunmalli*) | V | 144.0 | 557.7 | 74.4% | 0 | 806.5 | 107.6% | 568.9 | 182.0% |
| Yakka Skink (*Egernia rugosa*) | V | 140.8 | 557.7 | 60.9% | 87.6 | 806.5 | 88.1% | 568.9 | 149.0% |
| Koala (*Phascolarctos cinereus*) | E | 116.3 | 485.5 | 37.6% | 0 | 806.5 | 62.4% | 517.2 | 100.0% |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 144.0 | 557.7 | 74.4% | 572.9 | 806.5 | 107.6% | 568.9 | 182.0% |

[1] E = Endangered; V = Vulnerable.

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# APPENDIX A

## Cobbadah Offset Area Management Plan

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# Santos GLNG

# Cobbadah Offset Area Management Plan

# (EPBC 2012/6615 Stage 5)

**Document Number: 0007-650-EMP-0027**

| Date | Rev | Reason For Issue | Reviewed | Endorsed | Approved |
|---|---|---|---|---|---|
| 16 November 2021 | 0 | For DAWE submission | MB | MB | JC/ED |
| 01 March 2022 | 1 | Updated based on DAWE review | MB | MB | JC/ED |
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## Abbreviations

| Acronym | Description |
|---|---|
| BPA | Biodiversity Planning Assessment |
| CSG | Coal Seam Gas |
| DAF | Department of Agriculture and Forestry (Qld) |
| DAWE | Department of Agriculture, Water and the Environment; formerly Department of the Environment and Energy (DEE) |
| DES | Department of Environment and Science; formerly Department of Environment and Heritage Protection (DEHP) |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Cth) |
| GIS | Geographical Information System |
| GLNG | Gladstone Liquefied Natural Gas |
| GTDTHQ | Guide to Determining Terrestrial Habitat Quality |
| GTP | Gas Transmission Pipeline |
| MNES | Matters of National Environmental Significance |
| OAMP | Offset Area Management Plan |
| PMAV | Property Map of Assessable Vegetation |
| RE | Regional Ecosystem |
| REDD | Reginal Ecosystem Description Database |
| SEVT | Semi-evergreen vine thicket |
| spp | species |
| TEC | Threatened Ecological Community |
| VM Act | *Vegetation Management Act 1999* (Qld) |

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# Executive Summary

This offset area management plan (OAMP) has been prepared to address the offset requirements for matters of national environmental significance (MNES) associated with Stage 5 of the Gas Fields Development (GFD) Project in accordance with the Santos Gladstone Liquefied Natural Gas (GLNG) Project *Environment Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act) approval EPBC 2012/6615.

Santos proposes to secure a 557.7 hectare (ha) offset area on the Cobbadah property (Lots 35 SP140818 and 33 WT347), to partially acquit MNES offset requirements for Stage 5 of the GFD Project under EPBC 2012/6615, as well as a surplus of offset values to be used by Santos to acquit future project offset requirements (Table ES 1). The remaining obligations under EPBC 2012/6615 will be satisfied elsewhere.

The Cobbadah property is located approximately 120 kilometres (km) north-west of the project and 30 km west of Injune. The property is adjacent to the Great Dividing Range in the Brigalow Belt bioregion (Southern Downs subregion) and approximately 40 km southeast of Oakvale State Forest and 25 km south-west of Doonkuna State Forest. Desktop and field surveys of the Cobbadah property have been completed to confirm the presence of offset values and suitability to satisfy the Project's offset obligations as follows:

- January 2017
    - Preliminary desktop assessment of regional ecosystem (RE) mapping and potential biodiversity offset values.
    - Preliminary site visit for initial vegetation ground-truthing undertaken generally in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (version 3.2; Neldner *et al*. 2012).
- May 2017
    - Detailed field ecological assessments including:
        - refinement of ground-truthing of RE mapping.
        - baseline habitat quality assessments in accordance with the *Guide to Determining Terrestrial Habitat Quality* (GTDTHQ) (version 1.2; Department of Environment and Heritage Protection [DEHP] 2017).
        - incidental observations of any significant fauna and/or fauna habitat features, including habitat for potential threatened species.
- August 2020
    - Additional detailed field ecological assessments:
        - ground-truthing of RE mapping in additional areas on Cobbadah generally in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (version 5.1; Neldner *et al*. 2020).
        - baseline habitat quality assessments in accordance with GTDTHQ (version 1.2; DEHP 2017).

The outcome of this OAMP is to partially acquit the offset obligations of Stage 5 under EPBC 2012/6615. The Cobbadah offset area will be managed and monitored, based on an adaptive management framework, to achieve the interim performance targets and completion criteria presented in Table ES 2 and ultimately achieve the requirements under EPBC approval 2012/6615.

The key management actions to be implemented include:

- restricting access to the offset area
- management and restoration of regrowth threatened ecological communities (TEC)
- maintenance and upgrades of existing access tracks, fencing and firebreaks
- fire management through strategic grazing and fuel hazard reduction burns
- weed management
- pest animal management.

Ongoing monitoring events will be undertaken to assess the effectiveness of the management actions and progress of the offset area in achieving the interim performance targets and completion criteria, including:

- biannual offset area inspections
- biomass monitoring
- fuel load monitoring
- weed monitoring
- pest animal monitoring
- rapid monitoring events
- habitat quality assessments
- photo monitoring.

Annual reports will be prepared to detail progress of the offset area in achieving the interim performance targets and completion criteria for each management year including the results of management and monitoring activities completed.

Following approval of this OAMP, Santos will apply to have the offset area protected via a Voluntary Declaration under section 19E and 19F of the *Queensland Vegetation Management Act 1999* (including surplus areas identified in Table ES 1). The Voluntary Declaration will remain in place for the life of EPBC 2012/6615.

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**Table ES 1: Summary of Stage 5 MNES offset requirements acquit on the Cobbadah offset area**

| MNES | Status under EPBC Act[1] | Impact area (ha) | Offset area to be secured under EPBC 2012/6615 in accordance with the *Offsets assessment guide* (ha) | % acquittal |
|---|---|---|---|---|
| **Listed threatened ecological communities** | | | | |
| Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community (Brigalow TEC) | E | 6.5 | 72.2 | 100.1 |
| **Listed threatened species** | | | | |
| Collared Delma (*Delma torquata*) | V | 143.6 | 557.7 | 74.6^ |
| Dunmall's Snake (*Furina dunmalli*) | V | 144.0 | 557.7 | 74.4^ |
| Yakka Skink (*Egernia rugosa*) | V | 140.8 | 557.7 | 60.9^ |
| Koala (*Phascolarctos cinereus*) | E | 116.3 | 485.5 | 37.6^ |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 144.0 | 557.7 | 74.4^ |

[1] E = Endangered; V = Vulnerable.

^ Balance of the offset requirement satisfied on another property.

**Table ES 2: Interim performance targets and completion criteria for the Cobbadah offset area**

| MNES | Baseline habitat quality score | Interim performance target | | | Completion criteria |
|---|---|---|---|---|---|
| | | Year 5 | Year 10 | Year 15 | Year 20 |
| Brigalow TEC | 9 | No decrease in overall habitat quality score from previous monitoring event | | | 9 |
| Collared Delma (*Delma torquata)* | 7 (7.2) | 7.4 | 7.6 | 7.8 | 8 |
| Dunmall's Snake (*Furina dunmalli)* | 7 (7.2) | 7.4 | 7.6 | 7.8 | 8 |
| Yakka Skink (*Egernia rugosa*) | 7 (6.9) | 7.1 | 7.4 | 7.7 | 8 |
| Koala (*Phascolarctos cinereus*) | 7 (7.1) | 7.3 | 7.6 | 7.8 | 8 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | 7 (7.3) | 7.5 | 7.7 | 7.9 | 8 |

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# 1.0 Introduction

The Santos Gladstone Liquefied Natural Gas (GLNG) Project involves the development of Coal Seam Gas (CSG) resources in the Surat and Bowen Basins in Queensland, to supply gas via a 430 kilometre (km) gas transmission pipeline (GTP) to the liquified natural gas (LNG) facility located on Curtis Island. Throughout the development of the Santos GLNG Project and in accordance with Santos GLNG Project approvals, potentially impacted environmental values are systematically identified and assessed and in order of preference are avoided, minimised or mitigated.

The Santos GLNG Project is required to provide environmental offsets for significant residual impacts on matters of national environmental significance (MNES) in accordance with approvals granted under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act).

This offset area management plan (OAMP) has been prepared to address the acquittal of the MNES significant residual impacts for Stage 5 of the Gas Fields Development (GFD) Project under the GLNG Project approval EPBC 2012/6615, outlined in Table 1, on the Cobbadah offset area (Figure 1).

**Table 1: Impacted MNES required to be offset for Stage 5 of the GFD Project under EPBC 2012/6615**

| MNES | Status under EPBC Act[1] | Impact area (ha) |
|---|---|---|
| **Listed threatened ecological communities (TEC)** | | |
| Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow TEC) | E | 6.5 |
| **Listed threatened species** | | |
| Collared Delma (*Delma torquata)* | V | 143.6 |
| Dunmall's Snake (*Furina dunmalli)* | V | 144.0 |
| Yakka Skink (*Egernia rugosa*) | V | 140.8 |
| Koala (*Phascolarctos cinereus*) | E | 116.3 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 144.0 |

[1] E = Endangered; V = Vulnerable

## 1.1 Purpose

This OAMP provides a detailed management and monitoring framework for the Cobbadah offset area in accordance with the requirements of EPBC 2012/6615 as presented in Table 2 below.

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**Table 2: Approval conditions satisfied through this OAMP**

| Condition number | Condition | How the conditions are met |
|---|---|---|
| **EPBC Act approval 2012/6615** | | |
| **11** | The approval holder must ensure that environmental offsets comply with the principles of the EPBC Act Environmental Offsets Policy. | Offsets to compensate for significant residual impacts associated with Stage 5 of the GFD Project will be delivered in accordance with the principles of the EPBC Act *Environmental Offsets Policy*.<br>An offset area will be secured on Cobbadah to partially acquit offset obligations for the MNES matters outlined in Table 1.<br>The Cobbadah offset area has been identified to comply with the requirements for an offset under the EPBC Act *Environmental Offsets Policy* as detailed in Section 2.8 of this OAMP. |
| **12** | The approval holder may carry out the action in project stages. The approval holder must deliver environmental offsets for residual significant impacts to matters of national environmental significance for each project stage. | The action will be carried out in stages. An offset plan has been prepared to address offset requirements for residual significant impacts on MNES associated with Stage 5 of the GFD Project. |
| **13** | The approval holder must submit an Offset Management Plan for the Minister's written approval. The Offset Management Plan may be prepared and submitted to the Minister for written approval in stages. If the approval holder submits the Offset Management Plan in stages, each version of the Offset Management Plan must address the known and predicted impacts of the completed, current, and next proposed project phases. | An offset plan has been prepared to address offset requirements for residual significant impacts on MNES associated with Stage 5 of the GFD Project. This OAMP for the Cobbadah offset area is submitted as part of the offset plan to address Stage 5 of the GFD Project.<br>A reconciliation of impacts for Stage 1-4 of the GFD Project is included in the offset plan. |
| **14** | The Offset Management Plan must include:<br>a. a method for assessing residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities;<br>b. results from pre-disturbance surveys and/or an alternative approved methodology (if used) for the project phase as required under conditions 4 and 5;<br>c. details of the offset areas required to address predicted residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities for the project phase;<br>d. a survey and description of the current condition (prior to any management activities) of each offset area proposed, including existing vegetation (the baseline condition). This must include a shapefile of each offset property boundary;<br>e. information about how the offset areas provide connectivity with other relevant habitats and biodiversity corridors, including a map depicting the offset areas in relation to other habitats and biodiversity corridors;<br>f. performance and completion criteria for evaluating the management of the offset area, and criteria for triggering remedial action (if necessary);<br>g. a description of the management measures that will be implemented for the protection of EPBC threatened species, EPBC migratory species and EPBC communities, including a discussion of how measures outlined take into account relevant conservation advice and are consistent with the measures in relevant recovery plans and threat abatement plans;<br>h. a program to monitor and report on the effectiveness of these measures, and progress against the performance and completion criteria;<br>i. a description of potential risks to the successful implementation of the plan, and a description of the contingency measures that would be implemented to mitigate against these risks;<br>j. a timeline for when actions identified in the Offset Management Plan will be implemented for each offset area; and<br>k. the proposed legal mechanism for securing the offset. | The Cobbadah offset area is proposed to be secured to partially acquit offset requirements for Stage 5 of the GFD Project. An OAMP for the Cobbadah offset area has been developed in accordance with the requirements outlined in condition 14. A summary of how each requirement has been addressed is provided below.<br>a. The method for assessing residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities is discussed in the offset plan, submitted in conjunction with this OAMP.<br>b. Details of the relevant field assessments within the Stage 5 GFD Project development area are provided in the offset plan, submitted in conjunction with this OAMP.<br>c. A summary of the significant residual impacts associated with Stage 5 of the GFD Project is provided in Table 1 of this OAMP and the offset plan. A summary of the offset area required to acquit the Stage 5 offset requirements is provided in the offset plan, with a summary of the proposed offset area on Cobbadah and how it partially acquits the Stage 5 offset requirements provided in Section 2.6 of this OAMP. In accordance with the EPBC Act *Environmental Offsets Policy* the proposed offset areas required to be secured for the MNES were determined using the *Offsets assessment guide* as described in Section 2.6.<br>d. A summary of the ecological field surveys undertaken on the Cobbadah offset area is described in Section 2.4. Details of the baseline ecological condition are provided in Section 2.5 and Appendix B of this OAMP.<br>e. Details on the connectivity and the landscape context are provided in Section 2.2.<br>f. Individual completion criteria have been developed for the MNES as part of the environmental outcomes to be achieved for the Cobbadah offset area (Section 4.0). In addition, specific management objectives and performance criteria have been developed which will provide the basis for achieving the MNES completion criteria. The complete adaptive management process for this OAMP is encapsulated in Table 10 and includes management actions, monitoring events, adaptive management triggers and corrective actions that have been assigned to each management objective and performance criteria.<br>g. Management measures to be implemented as part of this OAMP have been developed to address key threats known or with the potential to occur within the Cobbadah offset area identified as part of detailed field surveys and take into account relevant conservation advice and are consistent with the measures in relevant recovery plans and threat abatement plans. A summary of the known and potential threats is detailed in Section 3.0 and proposed management measures are detailed in Section 6.0.<br>h. The monitoring program to measure the effectiveness of the management measures and progress against the performance and completion criteria is detailed in Section 7.0.<br>i. Risks to the successful implementation of this plan are included in the risk assessment presented in Appendix D.<br>j. The timing for implementation of the management and monitoring program are provided in Section 9.0. |

| Condition number | Condition | How the conditions are met |
|---|---|---|
| | | k. Details on how the Cobbadah offset area for Stage 5 of the GFD Project will be legally secured are provided in Section 2.7 of this OAMP. |
| **15** | The currently approved Offset Management Plan must be implemented by the approval holder. | Once approved, this OAMP will be implemented. |
| **16** | The approval holder must register and legally secure offsets for the first project phase identified in the Offset Management Plan within two years of commencement of the first project phase. | Details on how the Cobbadah offset area for Stage 5 of the GFD Project will be legally secured are provided in Section 2.7. |
| **17** | The approval holder must register and legally secure offsets for a project phase which are sufficient to acquit the residual significant impacts of that project phase. | Details on how the Cobbadah offset area for Stage 5 of the GFD Project will be legally secured are provided in Section 2.7. |
| **18** | If the approval holder submits the Offset Management Plan in stages, the approval holder must prepare and submit an updated Offset Management Plan for each subsequent project phase, for written approval by the Minister. The updated Offset Management Plan must:<br>a. include the information required for the Offset Management Plan at condition 14 for the next project phase;<br>b. include a reconciliation of actual and predicted but yet to be actualised residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities against offsets secured for the commenced project phases and may be subtracted from the obligations required for the subsequent project phases. Any shortfall in secured offsets relative to the requirements arising from actual and predicted but yet to be actualised impacts of any commenced project phases must be added to the obligations required for the next project phase; and<br>c. demonstrate how the offset builds on offsets already secured for previous project stages and will contribute to a larger strategic offset for cumulative project impacts. | An updated version of this OAMP will be submitted for any subsequent stages of the GFD project. |
| **19** | The approval holder must not commence the project phase until the Offset Management Plan, updated for that project phase has been approved by the Minister in writing. | This OAMP is submitted for the approval of the Minister.<br>Stage 5 will not commence until this OAMP for the project stage has been approved. |

148°20'0"E 148°40'0"E 149°0'0"E 149°20'0"E 149°40'0"E

25°20'0"S 25°40'0"S 26°0'0"S 26°20'0"S 26°40'0"S

Carnarvon National Park
Eden State Forest
Boxvale State Forest
Howe State Forest
Forrest State Forest
Doonkuna State Forest
Presho State Forest
Mebir State Forest
Expedition (Limited Depth) National Park
Belington Hut State Forest
Gwambagwine State Forest
Lake Murphy Conservation Park
Beilba State Forest
Expedition Resources Reserve
Stephenton State Forest
Hallett State Forest
Carraba Conservation Park
Walhallow State Forest
Taboonbay State Forest
Gubberamunda State Forest 3
Gubberamunda State Forest 2
Gubberamunda State Forest 1
Woodduck State Forest
Emu State Forest
Combabula State Forest
Mount Organ State Forest
Hinchley State Forest
Dinoun State Forest
Juandah State Forest
Inglebogie State Forest
Yuleba State Forest
Wallabella State Forest 2
Wallabella State Forest 1
Tinowon State Forest
Trinidad State Forest 2
Trinidad State Forest 1
Brucedale State Forest
Yalebone State Forest 1
Yalebone State Forest 2

PL 450 PL 1062 Arcadia West PL 235 PL 440 PL 1059 Towrie PL 420 PL 1017 Arcadia Branch PL 421 PL 234 PL 233 PL 90 PL 91 PL 457 PL 232 PL 92 PL 1012 East Lynne PL 99 PL 100 PL 1019 PL 309 Replacement PL 322 PL 314 PL 1021 Maisey PL application PL 282 PL 1020 PL 310 Replacement PL 3 PL 315 PL 93 PL 313 PL 281 PL 6 PL 317 PL 318 PL 8 PL 316 PL 319 PL 9 PL 320 PL 321 PL 11

Injune Roma Wallumbilla Dulacca

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Location diagram

**Figure 1**
**Project context**

Cobbadah - 33WT347, 35SP140818
Santos Petroleum Lease

***Protected Area***
National Park
State Forest
Conservation Park
Resources Reserve
Nature Refuge

***Statewide Corridors v1.4***
State
Regional

0 5 10 15 20
Kilometres

N

CO2 Australia

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Petroleum leases
- Protected areas
- Statewide corridors

Date: 10/22/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:550,000@A3

Path: P:\GISData\Projects\Santos\912_211020_Roma_East_maps\Cobbadah\Figure 1 - Project context.mxd

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# 2.0 Cobbadah Property

## 2.1 Property overview

Cobbadah (Lots 35 SP140818 and 33 WT347) is a 3,859 hectare (ha) freehold property located approximately 120 km north-west of the project and 30 km west of Injune (Figure 3). The property is located adjacent to the Great Dividing Range in the Brigalow Belt Bioregion (Southern Downs Subregion), approximately 40 km southeast of Oakvale State Forest and 25 km southwest of Doonkuna State Forest. The current primary land use on the property is cattle grazing.

The property is located entirely within the Dawson River Catchment, part of the Fitzroy River Basin, with all drainage channels on the property flowing into Hutton Creek which dissects the property, flowing from west to east. The topography is varied across the property, comprising early Tertiary Olivine basalt in upland areas capping Late Jurassic sandstone (Westbourne Formation and Springbok Sandstone) with lowland areas characterised by depositional alluvium. Elevation ranges between 460 metres (m) above sea level in the low-lying valleys, up to approximately 940 m in the south of the property. The high elevation in the south of the property is associated with Mount Hutton, which is located in the very southeast corner of Cobbadah.

Table 3 summarises Cobbadah landholder and property details.

**Table 3: Cobbadah landholder and property details**

| **Landholder and Property Details** | |
|---|---|
| **Landholder Details** | |
| Registered Owner/s on Title: | David John Chandler |
| ABN/ACN: | - |
| Postal Address: | 1813 Ninderra Road, Hutton Creek, Queensland 4454 |
| Primary contact person: | David and Puddy Chandler |
| Phone: | 07 4626 1462 |
| Email: | dagandpud2@bigpond.com |
| **Property Description** | |
| Lot on plan(s): | 35 SP140818 and 33 WT347 |
| Address: | “Cobbadah”, Injune, Queensland 4454 |
| Tenure: | Freehold |
| Area: | 3,859 ha |
| Primary Local Government Area: | Maranoa Regional Council |
| **Permits** | |
| Petroleum and gas production permit | PL45, Denison Gas (Queensland) Pty Ltd. Expires 25/08/2026 |

## 2.2 Connectivity

The Cobbadah property is mapped within a state conservation corridor (Figure 3). Conservation corridors have been mapped as part of the Queensland Government's Biodiversity Planning Assessments (BPA) which assess the biodiversity significance of land in a bioregion. The mapping of corridors within the Brigalow Belt Bioregion, in which the Cobbadah property is located, has focussed on those corridors that link adjacent bioregions or connect wildlife refugia. Corridors identified as being of state significance are considered of the greatest importance at the bioregional scale. As illustrated in Figure 3, the state conservation corridor runs along the western side of Cobbadah that connects contiguous remnant vegetation to the south of Cobbadah (associated with Hutton Range) with state forest and Carnarvon National Park to the north.

## 2.3 Climate

The Cobbadah area is considered to have a humid subtropical climate (Cfa) in accordance with the Köppen-Geiger climate classification system (Bureau of Meteorology [BoM] 2014). This climate is characterised by hot and humid summers, and cold to mild winters (Figure 2). Weather records from the Injune Post Office weather station (ID: 43015), approximately 23 km east of Cobbadah, show mean monthly rainfall for the period 1961 – 1990 ranges from 24.9 millimetres (mm) (September) to 94.6 mm (January), with a mean annual rainfall of 624.9 mm (BoM 2021). Mean monthly maximum temperatures range from 19.6 degrees Celsius (°C) and 33.7°C (July and January, respectively) and mean monthly minimum temperatures range from 3.0°C to 19.2°C (July and January, respectively) (BoM 2021).

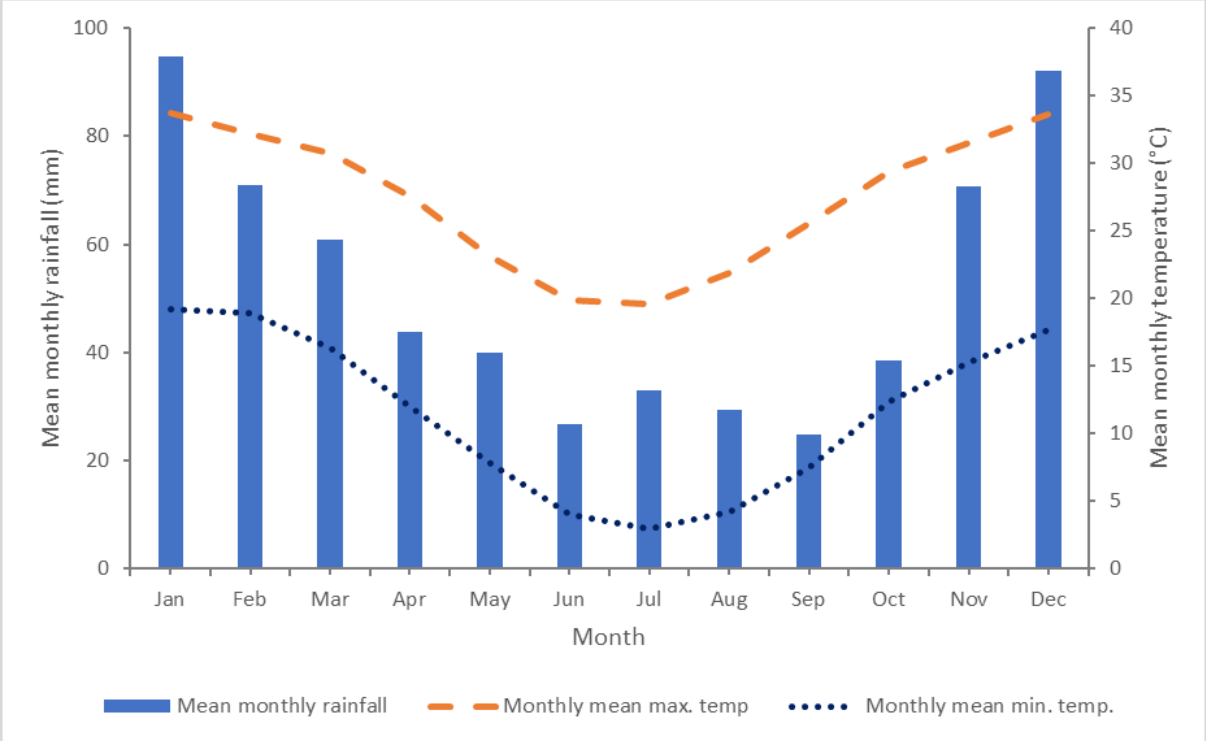


**Figure 2: Mean monthly temperature and rainfall records from Injune Post Office weather station (ID: 43015) 1961-1990 (BoM 2021)**

148°10'0"E
148°20'0"E
148°30'0"E
25°40'0"S
25°50'0"S
26°0'0"S

Oakvale State Forest
Forrest State Forest
Doonkuna State Forest
33WT347
35SP140818

SANTOS

**Figure 3**
**Property overview**

Cobbadah
DCDB
Cobbadah offset area

***Protected areas***
State Forest
Nature Refuge

***Statewide Corridors v1.5***
State
Regional

Location diagram
Queensland
Brisbane

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

Date: 10/21/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:150,000@A3

0 2 4 6 8
Kilometres

N

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## 2.4 On ground property assessments

Within the Cobbadah property, Santos has identified a 557.7 ha area for environmental offsets (herein referred to as the offset area). A combination of desktop and detailed field assessments of the Cobbadah property have been undertaken over numerous years to assess the potential for offsets at Cobbadah. This includes a more recent assessment to confirm the suitability of the property to satisfy the project's offset obligations. Desktop and field surveys of the Cobbadah property completed to date are summarised below:

- January 2017
    - Preliminary desktop assessment of regional ecosystem (RE) mapping and potential biodiversity offset values.
    - Preliminary site visit for initial vegetation ground-truthing undertaken generally in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (version 3.2; Neldner *et al*. 2012).
- May 2017
    - Detailed field ecological assessments including:
        - refinement of ground-truthing of RE mapping.
        - baseline habitat quality assessments in accordance with the *Guide to Determining Terrestrial Habitat Quality* (GTDTHQ) (version 1.2; Department of Environment and Heritage Protection [DEHP] 2017).
        - incidental observations of any significant fauna and/or fauna habitat features, including habitat for potential threatened species.
- August 2020
    - Additional detailed field ecological assessments:
        - ground-truthing of RE mapping in additional areas on Cobbadah generally in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (version 5.1; Neldner *et al*. 2020).
        - baseline habitat quality assessments in accordance with GTDTHQ (version 1.2; DEHP 2017).

## 2.5 Ground-truthed vegetation and habitat mapping

### 2.5.1 Vegetation description

Vegetation on Cobbadah varies from cleared paddocks dominated by pasture grasses (e.g. Buffel Grass [*Cenchrus ciliaris*]) in lowland areas subject to chemical and mechanical suppression of regrowth vegetation, to relatively intact remnant vegetation associated with ridge lines in the south and east, which have only been lightly impacted by cattle grazing. The structure of retained patches of lowland woodland remains relatively intact, even in the presence of intermittent cattle grazing (Figure 4).

**Figure 4: Lowland Poplar Box woodland on Cobbadah consistent with RE 11.9.7**

While the large area of Poplar Box and Ironbark woodland in the centre of the site is grazed, it retains much of the remnant vegetation structure, with a mix of pasture and native grasses throughout. Areas of steep terrain (including areas of Brigalow and vine thicket) are less impacted by grazing, although there is evidence of weed encroachment from adjacent grazed paddocks and remnant vegetation. Poplar Box woodland on alluvial plains (RE 11.3.2) fringes Hutton Creek and associated ephemeral draining lines in the centre of Cobbadah (Figure 5).

**Figure 5: Poplar Box woodland on alluvial plains (RE 11.3.2) fringing a waterway in the centre of Cobbadah**

Table 4 and Figure 6 summarise the area of remnant and regrowth ground-truthed REs on the offset area, including the relevant TEC associated with each RE, as appropriate.

**Table 4: Ground-truthed REs mapped within the Cobbadah offset area**

| RE | Description | Associated TEC | Area (ha) |
|---|---|---|---|
| 11.3.2 | *Eucalyptus populnea* woodland on alluvial plains | Poplar Box Grassy Woodland on Alluvial Plains TEC | 173.8 |
| 11.8.5 | *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks | - | 101.5 |
| 11.9.2 | *Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks | - | 107.2 |
| 11.9.5 | *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks | Brigalow TEC | 72.2 |
| 11.9.7 | *Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks | - | 103.0 |
| **Total** | | | **557.7** |

148°18'0"E
148°19'0"E
148°20'0"E
148°21'0"E
25°47'0"S
25°48'0"S
25°49'0"S
25°50'0"S
Hutton Creek (South Branch)
33WT347
35SP140818

SANTOS

**Figure 6**
**Ground-truthed vegetation**

Cobbadah
Cobbadah offset area
Access tracks

*Watercourse*
Drainage contour
Minor drainage line
Creekline
Major watercourse
Regional-scale

*Ground-truthed REs*
11.3.2
11.8.5
11.9.2
11.9.5
11.9.7

Location diagram
Queensland

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Watercourses

Date: 10/21/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:22,500@A3

0 0.25 0.5 0.75 1
Kilometres

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CO2 Australia

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### 2.5.2 Habitat description

Following the results of detailed field assessments, known habitat requirements for targeted fauna species were assessed against on-ground microhabitat observations within each habitat type to categorise suitable habitat.

Table 5 provides a summary of the extent of predicted suitable habitat mapped on the Cobbadah offset area for the Project's MNES offset requirements based on the results of detailed field assessments. Figure 7 spatially displays the extent of MNES habitat on Cobbadah. Additional information on the offset area for each MNES is provided in Section 3.0.

**Table 5: Extent of predicted suitable habitat mapped for MNES associated with disturbance under Stage 5 of EPBC 2012/6615 on the Cobbadah offset area**

| MNES | Habitat Description | Associated REs | Area (ha) |
|---|---|---|---|
| Brigalow TEC | Open forest to woodland where *Acacia harpophylla* is the dominant or co-dominant species. | 11.9.5 | 72.2 |
| Collared Delma (*Delma torquata*) | Eucalypt woodlands and open-forests with appropriate surface rocks and large woody debris. Typically associated with Land zones 3, 9 and 10. | 11.3.2, 11.8.5, 11.9.2, 11.9.5, 11.9.7 | 557.7 |
| Dunmall's Snake (*Furina dunmalli*) | Eucalypt and Brigalow woodland containing suitable large fallen woody debris. | 11.3.2, 11.8.5, 11.9.2, 11.9.5, 11.9.7 | 557.7 |
| Yakka Skink (*Egernia rugosa*) | Woodland and open forest containing soils suitable for burrowing or containing large woody debris. | 11.3.2, 11.8.5, 11.9.2, 11.9.5, 11.9.7 | 557.7 |
| Koala (*Phascolarctos cinereus*) | Eucalypt woodlands containing appropriate Koala food trees. | 11.3.2, 11.8.5, 11.9.2, 11.9.7 | 485.5 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | Forest and woodland with a distinct tree canopy. | 11.3.2, 11.8.5, 11.9.2, 11.9.5, 11.9.7 | 557.7 |

148°18'0"E
148°19'0"E
148°20'0"E
148°21'0"E
25°47'0"S
25°48'0"S
25°49'0"S
25°50'0"S

Hutton Creek (South Branch)

33WT347

35SP140818

SANTOS

Location diagram

Queensland

Brisbane

**Figure 7**
**MNES offset areas**

- Cobbadah
- Cobbadah offset area
- Access tracks

***Watercourse***

- Drainage contour
- Minor drainage line
- Creekline
- Major watercourse
- Regional-scale

***Threatened species records***

- Koala

***MNES offset areas***

- Offset area for all MNES except Brigalow TEC
- Offset area for all MNES except koala

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Watercourses

Date: 10/21/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:22,500@A3

0 0.25 0.5 0.75 1
Kilometres

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CO2 Australia

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## 2.6 Offset area

The total offset area to be secured on the Cobbadah property is 557.7 ha (Table 6: Summary of Stage 5 MNES offset requirements acquit on the Cobbadah offset area). This 557.7 ha area will partially acquit the offset obligation for Stage 5 of the GFD Project under conditions 11 to 19 of EPBC Approval 2012/6615.

Table 6 provides a summary of the Cobbadah offset area to be secured under EPBC 2012/6615. Figure 6 spatially presents the Cobbadah offset area and the ground-truthed vegetation communities.

**Table 6: Summary of Stage 5 MNES offset requirements acquit on the Cobbadah offset area**

| MNES | Status under EPBC Act[1] | Impact area (ha) | Offset area to be secured under EPBC 2012/6615 in accordance with the *Offsets assessment guide* (ha) | % acquittal |
|---|---|---|---|---|
| **Listed threatened ecological communities** | | | | |
| Brigalow TEC | E | 6.5 | 72.2 | 100.1 |
| **Listed threatened species** | | | | |
| Collared Delma (*Delma torquata*) | V | 143.6 | 557.7 | 74.6^ |
| Dunmall's Snake (*Furina dunmalli*) | V | 144.0 | 557.7 | 74.4^ |
| Yakka Skink (*Egernia rugosa*) | V | 140.8 | 557.7 | 60.9^ |
| Koala (*Phascolarctos cinereus*) | E | 116.3 | 485.5 | 37.6^ |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 144.0 | 557.7 | 74.4^ |

[1] E = Endangered; V = Vulnerable.

^ Balance of the offset requirement satisfied on another property.

148°18'0"E
148°20'0"E
148°22'0"E
25°46'0"S
25°48'0"S
25°50'0"S

33WT347
35SP140818
Hutton Creek (South Branch)

SANTOS

**Figure 8**
**Infrastructure**

- Cobbadah
- Cobbadah offset area
- Cobbadah homestead

***Watercourse***
- Drainage contour
- Minor drainage line
- Creekline
- Major watercourse
- Regional-scale

***Infrastructure***
- Access tracks
- Existing fenceline
- Watering point

Location diagram
Queensland

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Watercourses

Date: 10/21/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:25,000@A3

0 0.25 0.5 0.75 1
Kilometres

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CO2 Australia

Path: P:\GISData\Projects\Santos\912_211020_Roma_East_maps\Cobbadah\Figure_8_Infrastructure.mxd

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## 2.7 Offset protection

The offset area will be protected via a Voluntary Declaration under section 19E and 19F of the VM Act and will be declared as an area of high nature conservation value. Once this OAMP is approved, Santos will register and legally secure the offsets by placing a Voluntary Declaration on the property within 12 months of approval. The Voluntary Declaration will be registered on the property title and will be binding on current and future landowners.

A Voluntary Declaration under the VM Act is an authorised legally binding mechanism and is considered appropriate to legally secure MNES values and protect the area from vegetation clearing. The offset area will be mapped as a Category A area on the Property Map of Assessable Vegetation (PMAV). A Category A area on a PMAV is described as an "Area subject to compliance notices, offsets and voluntary declarations".

The Voluntary Declaration will remain in place for the life of EPBC 2012/6615. The Voluntary Declaration may only be removed in accordance with the provisions of the VM Act or if the chief executive the Queensland Department of Natural Resources, Mines and Energy considers it necessary.

Offset area coordinates for the proposed declared area for the Voluntary Declaration are given in Appendix C.

## 2.8 EPBC Act Environmental Offset Policy

Table  outlines how the Stage 5 GFD Project offset obligations acquit on the Cobbadah offset area meet the requirements of the EPBC Act *Environmental Offsets Policy*.

**Table 7: Assessment against Principles of the Offset Policy**

| Principle | How the principle is met in this offset proposal |
|---|---|
| 1. 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 | The Cobbadah offset area partially acquits MNES offset requirements for Stage 5 of the GFD Project under EPBC 2012/6615 as outlined in Table 6: Summary of Stage 5 MNES offset requirements acquit on the Cobbadah offset area. The remaining will be acquit on another property.<br>The Cobbadah offset area will be managed and monitored to improve the quality of Brigalow TEC and viability of habitat for threatened fauna species. This will include the management of regrowth vegetation to become self-sustaining functional remnant vegetation communities.<br>This OAMP sets out specific management objectives with interim performance targets and completion criteria. Management actions are outlined with accompanying adaptive management triggers and corrective actions in the event that monitoring identifies that interim performance targets are not attained or completion criteria are not attained and/or maintained. The offset area will be managed and monitored from approval of this OAMP for a minimum of 20 years. It is anticipated that the completion criteria will be achieved within a 20-year period. |
| 2. be built around direct offsets but may include other compensatory measures | MNES offset obligations for Stage 5 of the GFD Project under EPBC 2012/6615 will be acquit through the delivery of direct land-based offsets on the Cobbadah offset area and additional land based offset areas to be secured by Santos. |
| 3. be in proportion to the level of statutory | The threatened status of the impacted protected matters is considered in the *Offsets assessment guide* in calculating the area of the offset to be provided. |

| Principle | How the principle is met in this offset proposal |
|---|---|
| protection that applies to the protected matter | |
| 4. be of a size and scale proportionate to the residual impacts on the protected matter | The size of the offset area to be secured for offset obligations has been calculated in accordance with the *Offsets assessment guide* (Santos 2021). |
| 5. effectively account for and manage the risks of the offset not succeeding | This OAMP has been developed in consideration of known and identified threats to the offset values to manage the risk of failing to achieve the completion criteria and overall environmental outcomes for the offset area.<br>Threats to the offset site are managed through the implementation of the management measures discussed in Section 6.0, including:<br>• Fire prevention and management<br>• Weed monitoring and control<br>• Clearing protection<br>• Management of grazing, and<br>• Restricted access.<br>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 based on the results of field surveys and discussions with the landholder. The results of the risk assessment, presented in Appendix D, have informed the adaptive management process including the identification of threats to offset values, management objectives, performance criteria, management actions, monitoring programs, adaptive management triggers and corrective actions. If the offset cannot attain and maintain the completion criteria, then additional offsets will be provided to compensate for the impact and the failed offset (see Section 5.2.4). |
| 6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action) | The environmental outcomes proposed to be achieved through the implementation of this OAMP are based on additional management and monitoring measures conducted as part of business as usual on the Cobbadah property. For example, under the *Biosecurity Act 2014* a person has a general biosecurity obligation to: take all reasonable and practical steps to prevent or minimise each biosecurity risk. The steps proposed in this OAMP are above reasonable and practical steps required to control feral animals and weeds in central Queensland.<br>Once the Voluntary Declaration has been secured over the offset area, environmental laws prevent other land uses inconsistent with this OAMP being approved over this part of the property. |
| 7. be efficient, effective, timely, transparent, scientifically robust and reasonable | The Cobbadah offset area has been identified to be suitable using an evidence based and scientifically robust approach.<br>The environmental outcomes to be achieved through this OAMP will be delivered progressively over 20 years. The offset area will be legally secured through a Voluntary Declaration under the VM Act, therefore any vegetation clearing contravention of this OAMP is not permissible without specific Queensland government approval.<br>The preparation and implementation of this OAMP supports the efficient, effective, timely, transparent and scientifically robust approach to providing offsets. |

| Principle | How the principle is met in this offset proposal |
|---|---|
| 8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced. | This OAMP includes a detailed monitoring program which will assess the effectiveness of the management actions undertaken and the progress of the offset area in achieving the environmental outcomes.<br>The results of all management and monitoring programs will be included in annual reports (Section 8.1). An implementation schedule for monitoring and management is provided in Section 9.0 which will be reviewed at least annually to ensure the timely implementation of this OAMP. |

# 3.0 Offset Values

The following sections provide a description of the offset area and potential threats that will be managed as part of this OAMP for each MNES offset value.

## 3.1 Brigalow TEC

### 3.1.1 Offset area

Remnant Brigalow TEC is located in two discrete patches in the southern section of Cobbadah. These patches are largely characterised by remnant *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks (RE 11.9.5;

Figure 9).

**Figure 9: Brigalow vegetation on Cobbadah consistent with RE 11.9.5 (Brigalow TEC)**

While the property is currently used for livestock grazing, most areas of remnant Brigalow TEC show low or moderate evidence of impact from livestock grazing. There is evidence of widespread weeds and exotic pasture grasses in the vicinity of the offset area, especially *Cenchrus ciliaris*, with scattered populations of Parthenium (*Parthenium hysterophorus*) and Prickly Pear (*Opuntia spp*.).

### 3.1.2 Threats

The following key threats to Brigalow TEC identified on the property will addressed through the implementation of this OAMP (Department of Agriculture, Water and the Environment [DAWE] 2021a):

- clearing of regrowth vegetation
- inappropriate fire regimes and management
- pest plant infestation

- potential knowledge gaps
- increased grazing by livestock.

## 3.2 Collared Delma

### 3.2.1 Offset area

Habitat for the Collared Delma within the offset area comprises areas of RE 11.3.2, 11.8.5, 11.9.2, 11.9.5 and 11.9.7.

The Collared Delma is known to occur in REs on land zones 3, 9 and 10 (DoE 2021b). The species occupies a range of eucalypt woodlands and open forests; and requires rocks, timber bark and other large woody debris for shelter (Wilson 2015; DAWE 2021b).

### 3.2.2 Threats

The following known and potential threats to the Collared Delma will be addressed through the implementation of this OAMP (DAWE 2021b):

- Loss of suitable habitat through land clearing and habitat fragmentation
- Predation by feral predators (e.g., cats and foxes)
- Removal of foraging and shelter habitat (e.g., rocks, coarse woody debris, ground litter)
- Change in ground layer composition as a consequence of overgrazing
- Weed invasion.

## 3.3 Dunmall's Snake

### 3.3.1 Offset area

Habitat for Dunmall's Snake within the offset area comprises areas of RE 11.3.2, 11.8.5, 11.9.2, 11.9.5 and 11.9.7.

The Dunmall's Snake occurs in a variety of habitats including forests and woodlands (including those dominated by Brigalow, Bull Oak and other *Acacia, Eucalyptus* and *Callitris* species) on clay loam, cracking clay soils and sandstone derived soil (DAWE 2021c). Rare observations have been made on the edge of dry vine scrub and in hard ironstone country (DAWE 2021c).

### 3.3.2 Threats

The following known and potential threats to Dunmall's Snake will be addressed through the implementation of this OAMP (DAWE 2021c):

- Loss of suitable habitat through land clearing and fragmentation
- Predation by feral predators
- Change in ground layer composition as a consequence of overgrazing
- Alteration of habitat suitability through the presence and extent of invasive weeds
- Alteration of ground cover as a consequence of unsuitable fire regime.

## 3.4 Yakka Skink

### 3.4.1 Offset area

Habitat for the Yakka Skink within the offset area comprises areas of RE 11.3.2, 11.8.5, 11.9.2, 11.9.5 and 11.9.7.

The Yakka Skink is known to occur in open dry sclerophyll forest, woodland and scrub and a within a wide variety of vegetation types within land zones 3, 4, 5, 7, 9 and 10 (DAWE 2021d). The species is commonly found under partly buried rocks, logs, root cavities or in abandoned animal burrows (DAWE 2021d).

### 3.4.2 Threats

The following key threats to the Yakka Skink will be addressed through the implementation of this OAMP (DAWE 2021d):

- Loss of suitable habitat through land clearing and fragmentation
- Predation by feral predators (e.g., cats and foxes)
- Removal of foraging and shelter habitat (e.g., rocks, coarse woody debris, ground litter)
- Destruction of potential shelter habitat associated with rabbit warren ripping
- Alteration of habitat suitability through the presence and extent of invasive weeds
- Alteration of ground cover as a consequence of unsuitable fire regime.

## 3.5 Koala

### 3.5.1 Offset area

Habitat for the Koala within the offset area comprises areas of RE 11.3.2, 11.8.5, 11.9.2 and 11.9.7.

Koala habitat can be broadly defined as any forest or woodland containing known Koala food trees, which are naturally abundant on fertile clay soils (DAWE 2021e). Koalas predominantly feed on *Eucalyptus* spp.; however, they are also known to consume other Myrtaceae species (DAWE 2021e).

There are anecdotal records of Koala within the offset area, with the landowner having previously spotted the species along Hutton Creek in RE 11.3.2 habitat.

### 3.5.2 Threats

The following key threats to the Koala will be addressed through the implementation of this OAMP (DAWE 2021e):

- Loss of suitable habitat through land clearing, habitat fragmentation and inappropriate fire regimes
- Mortality due to vehicle collision
- Predation by feral predators, particularly wild or domesticated dogs
- Evidence for the presence of disease within the population (i.e. *Chlamydia pecorum*).

## 3.6 South-eastern Long-eared Bat

### 3.6.1 Offset area

Habitat in the offset area for South-eastern Long-eared Bat comprises areas of RE 11.3.2, 11.8.5, 11.9.2, 11.9.5 and 11.9.7.

The species is known to occur in a variety of dry forest habitats including those dominated by River Red Gum, open woodland, mallee, Brigalow and other arid and semi-arid habitats, although the preferred habitat is mallee and *Callitris* woodlands (Pennay *et al*. 2011), and habitats that have a distinct canopy with a dense, cluttered understorey (Turbill and Ellis 2006). The species roosts in tree hollows, crevices or under loose bark (DAWE 2021f). Surveys suggest the species requires large tracts of forest to occur (Turbill *et al*. 2008).

### 3.6.2 Threats

The following key threats to the South-eastern Long-eared Bat will be addressed through the implementation of this OAMP (Threatened Species Scientific Committee [TSSC] 2015):

- Loss of suitable habitat through land clearing and fragmentation
- Alteration of the structure of suitable habitat (e.g. mix of shrubby and open structure habitat) as a consequence of unsuitable fire regime
- Impacts on understorey habitat as a consequence of livestock grazing, impacting habitat for understorey invertebrate prey
- Competition for hollows from native fauna species (e.g., parrots and cockatoos) and non-native fauna species (e.g., European honeybees, Common Myna), especially where hollows are limited.

# 4.0 Environmental Outcomes to be Achieved

The outcome of this OAMP will partially acquit the Stage 5 offset obligations for the GFD Project under EPBC Approval 2012/6615 in accordance with the EPBC Act *Environmental Offset Policy*.

The specific environmental outcomes to be achieved for the offset on Cobbadah are defined as interim performance targets and completion criteria, detailed in Table 8, based on the proposed habitat quality score to be achieved for each MNES in the *Offsets assessment guides* (Santos 2021).

**Table 8: Interim performance targets and completion criteria**

| MNES | Baseline habitat quality score | Interim performance target | | | Completion criteria |
|---|---|---|---|---|---|
| | | Year 5 | Year 10 | Year 15 | Year 20 |
| Brigalow TEC | 9 | No decrease in overall habitat quality score from previous monitoring event | | | 9 |
| Collared Delma (*Delma torquata)* | 7 (7.2) | 7.4 | 7.6 | 7.8 | 8 |
| Dunmall's Snake (*Furina dunmalli)* | 7 (7.2) | 7.4 | 7.6 | 7.8 | 8 |
| Yakka Skink (*Egernia rugosa*) | 7 (6.9) | 7.1 | 7.4 | 7.7 | 8 |
| Koala (*Phascolarctos cinereus*) | 7 (7.1) | 7.3 | 7.6 | 7.8 | 8 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | 7 (7.3) | 7.5 | 7.7 | 7.9 | 8 |

Santos

# 5.0 Adaptive Management

## 5.1 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:

- establishment of the key components of a management framework including engaging stakeholders, developing clear and measurable objectives and performance criteria, 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 management decision making process
- 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, outlined as follows, with how they have been addressed through the development of this OAMP:

- environmental variation:
    - 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
    - largely outside of the control of the manager (Williams 2011)
    - 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.
- partial observability:
    - includes potential uncertainty arising 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)
    - addressed in this OAMP through the development of a monitoring program based on scientifically tested and repeatable methods.
- partial controllability:
    - relates to the difference between the intended effect of the management measures to be implemented through this OAMP and the actual effect of their implementation on the ground (Williams and Brown 2016)
    - address through adherence to an adaptive management approach including regular monitoring of conformance with performance criteria, assessment of adaptive management triggers, the implementation of corrective actions, review and amendments to the OAMP, and reporting to ensure that management measures are being effectively implemented on the ground.

- structural and 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)
  - addressed through the adaptive management approach. Following the results of ongoing management, monitoring and reporting, the OAMP will be reviewed and updated as required to incorporate learnings, updated conservation advice and best practice management techniques.

## 5.2 OAMP adaptive management framework

### 5.2.1 Risk assessment

The adaptive management process for this OAMP is supported by a risk assessment through which the known and potential risks for each offset value have been evaluated. 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. As presented in Appendix D, the risk assessment included an assessment of the likelihood and consequence for each identified risk, both with and without the implementation of control strategies. The results of the risk assessment have informed the adaptive management process including the identification of threats to offset values, management objectives, performance 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 overall outcome sought by this OAMP are achieved.

### 5.2.2 Adaptive management process

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 or other offset matter 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 actio**n – 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 to assess whether management actions are meeting the performance criteria and management objectives, and ultimately, whether the OAMP is supporting the delivery of 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

**corrective actions** – 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. Corrective actions include the implementation of a feasible, appropriate and effective action to address the identified issue and ensure the performance criteria is satisfied.

Figure 10 illustrates the ongoing adaptive management cycle of implementation, learning and review, with the aim of achieving the interim performance targets and completion criteria.

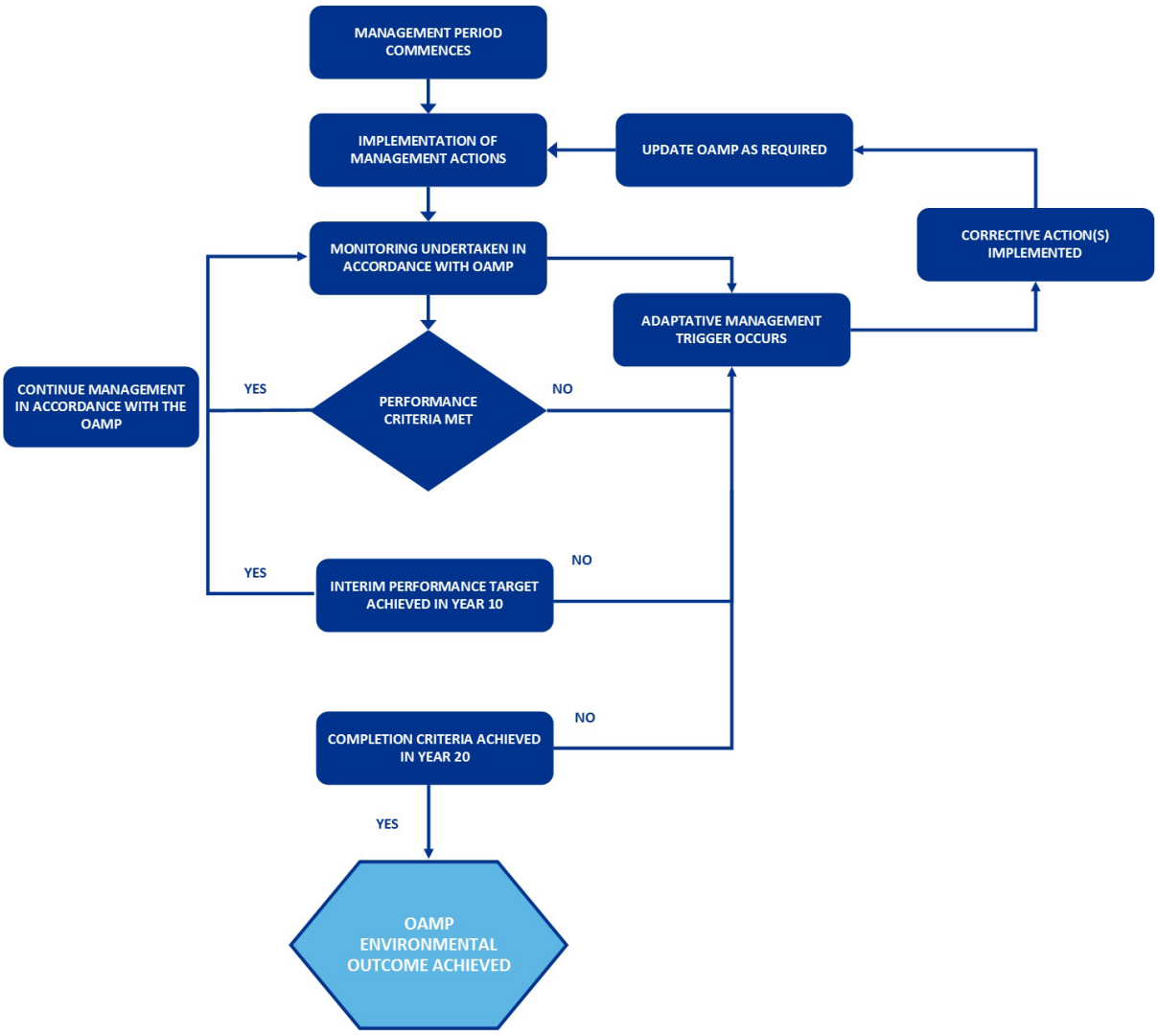


**Figure 10: Process for implementation of the OAMP**

### 5.2.3 Timing for implementation of the OAMP

The 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 within the proposed 20-year management period. However, if the interim performance targets and/or completion criteria for offset values have not been achieved within the anticipated timeframes, management and monitoring will continue beyond the 20-year management period in accordance with this OAMP until the completion criteria have been achieved. Once attained, completion criteria will be maintained for at least the life of the EPBC Act approval relevant to this OAMP.

### 5.2.4 Risk of offset failure

Based on the adaptive approach to management and the proposed management and monitoring program, it is considered that the management objectives, interim performance targets and completion criteria will be successfully achieved.

In the unlikely event that the interim performance targets are not achieved for one or more offset values by year 5, 10 or 15 for those offset values, Santos will obtain advice from suitably qualified people/groups with the aim of identifying appropriate additional management interventions.

It should be noted that unavoidable temporary perturbations such as severe drought, or insect/fungal pest invasion that may cause a temporary decrease in metrics such as canopy or shrub cover from which the community still may recover within the next 5-year period should not preclude assessment of a satisfactory increase in ecological condition by the completion date.

If it is considered that the completion criteria cannot be achieved, Santos will update this OAMP proposing alternative offset areas in order to acquit the required offset requirements. The revised OAMP will be submitted to the Commonwealth Government.

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# 6.0 Management program

## 6.1 Management objectives

A summary of the management objectives and performance criteria for the offset area is presented in Table 9 and the complete adaptive management process for this OAMP is encapsulated in Table 10. The management measures provided in this section (Section 6.0) take into account the information in the relevant conservation advices for each MNES. For the MNES being offset in this OAMP, none have a recovery plan or relevant threat abatement plan. Management actions, monitoring events, adaptive management triggers and corrective actions have been assigned to each management objective and performance criteria.

**Table 9: Summary of the management objectives and performance criteria**

| Management objectives | Performance criteria |
|---|---|
| Achieve the completion criteria and habitat quality improvements for offset values, which include the habitat quality scores in this OAMP. | Increase the habitat quality scores for each offset value at each habitat quality assessment site based on the results of baseline and subsequent monitoring events to achieve the scores in the completion criteria |
| Maintain the extent of offset value habitat within the offset area. | No unapproved/intentional clearing of habitat within the offset area, except for clearing that is required for fencing, access, firebreaks and public safety as outlined in Table 11. |
| Ensure that the livestock grazing restrictions outlined in Section 6.2.4.1 for fire management and weed control assist in the enhancement of ground cover attributes for offset values and does not result in the degradation of habitat. | 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.<br>Biomass levels of 2,500 kg/ha are retained at each of the monitoring sites at the end of the dry season.<br>Livestock are only observed to be grazing in the offset area during strategic grazing event/s |
| Minimise predation risk by wild dogs to threatened fauna species. | Reduction in Catling* Index for wild dogs from year 1 and subsequent monitoring events. |
| Minimise predation risk by foxes to threatened fauna species. | Reduction in Catling* Index for foxes from year 1 and subsequent monitoring events. |
| Minimise predation risk by feral cats to threatened fauna species. | Reduction in Catling* Index for feral cats from year 1 and subsequent monitoring events. |
| Minimise degradation of offset value habitat by feral pigs. | Reduction in mean feral pig abundance score from year 1 and subsequent monitoring events. |
| Minimise degradation of offset value habitat by rabbits. | Maintain rabbit impact category as ‘acceptable’. |

| Management objectives | Performance criteria |
|---|---|
| Manage invasive weed species to reduce degradation of offset value habitat. | A decrease in species richness and relative abundance of weed species at 80% of monitoring sites from year 1 and subsequent monitoring events.<br>No new weed species are identified at any monitoring site (based on year 1 and subsequent monitoring data). |
| Reduce the risk of adverse impacts to offset value habitat by inappropriate fire regimes or unplanned fire. | No unplanned fire within the offset area<br>Increase in habitat quality scores as a result of implementation of any fire management measures. |
| Achieve the interim performance targets and completion criteria for each offset value within 5, 10, 15 and 20 years, respectively. | The interim performance targets are achieved for all offset values by years 5, 10 and 15.<br>The completion criteria are achieved for all offset values by year 20. |

* Catling index provides a measure of relative abundance of wild dogs, foxes and feral cats within the 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 7.5.

**Table 10: Management objectives, performance criteria, adaptive management triggers and corrective actions**

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| Degradation of habitat | Achieve the completion criteria and habitat quality improvements for offset values, which include the habitat quality scores in this OAMP. | Increase the habitat quality scores for each offset value at each habitat quality assessment site based on the results of baseline and subsequent monitoring events so as to achieve the scores in the completion criteria. | Implementation of the management actions and adaptive management framework as outlined in this OAMP. | Monitoring of offset value habitat quality scores and condition of habitat will be undertaken in accordance with Section 7.0 including:<br>Offset area inspections (Section 7.1).<br>Rapid monitoring events (Section 7.6.1).<br>Habitat quality assessments to determine habitat quality scores (Section 7.6.2).<br>The results of monitoring events will be compared against the interim performance targets and completion criteria to determine the progress of the offset area and recorded as part of reporting (Section 8.1). | Interim performance targets are not achieved for one or more offset values by year 5 or 10.<br>Completion criteria are not achieved for one or more offset values by year 20. | Step 1: Investigate cause of trigger<br>• Investigate reasons why the interim performance targets or the completion criteria were not achieved within the specified timeframes.<br>• Re-evaluate the suitability of the relevant management measures in the OAMP.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Third party review of the OAMP to provide input on the effectiveness of the management actions.<br>○ Increasing the frequency and intensity of pest animal and weed control measures, or revising the type of measures to be implemented.<br>○ Modifying the strategic grazing regime to better support enhancement of offset values.<br>○ For offset values that have not achieved interim performance targets by year 5 or 10 for those offset values, Santos will obtain advice from suitably qualified people/groups with the aim of identifying appropriate additional management interventions.<br>○ If it is considered that the completion criteria cannot be achieved, Santos will update this OAMP proposing alternative offset areas in order to acquit the required offset requirements. The revised OAMP will be submitted to the Commonwealth Government. |
| Habitat loss through vegetation clearing | Maintain the extent of offset value habitat within the offset area. | No unapproved and/or intentional clearing of habitat within the offset area, with the exception of clearing that is required for fencing, access, firebreaks and public safety as outlined in Table 11. | Protection of the offset area via a Voluntary Declaration under section 19E and 19F of the VMA, as described in Section 2.7. | Reporting to the Commonwealth Government consistent with EPBC approval. | Any activities in contravention of the Voluntary Declaration and this OAMP. | Step 1: Investigate cause of trigger<br>• Investigate reasons why unapproved clearing occurred e.g. unauthorised access.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Additional fencing, signage and/or security for the offset area.<br>○ Restoration of the impacted area. |
| | | | Comply with the restrictions outlined in Table 11.<br>Construction and maintenance of access | Compliance with restrictions for vegetation clearing associated with maintenance and establishment of access | Clearing for access, fencing, firebreaks or public safety is not undertaken in accordance with the | Step 1: Investigate cause of trigger<br>• If restrictions for clearing associated with fencing, access, firebreaks or public safety are not adhered to, Santos will ensure that all clearing activities cease immediately. |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| | | | tracks, fencing and firebreaks will be undertaken in accordance with Sections 6.2.2, 6.2.3 and 6.2.4.<br><br>In the event that vegetation clearing is required for fencing, access, firebreaks or public safety, all activities will be planned, recorded and monitored. | tracks, fencing and firebreaks will also be assessed as part of offset area inspections (Section 7.1). | restrictions outlined in Sections 6.2.2, 6.2.3 and 6.2.4. | • Investigate the reason for unapproved or unintentional clearing.<br>• Following clearing, the area is to be assessed by a suitably qualified ecologist/expert to determine the total clearing extent of offset value habitat.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>o Reviewing and modifying protocols for the establishment of fences, access tracks, and firebreaks.<br>o 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.<br>o Rehabilitation of the impacted area. |
| Degradation of habitat by livestock overgrazing | Ensure that the livestock grazing restrictions outlined in Section 6.2.4.1 for fire management and weed control assist in the enhancement of ground cover attributes for offset values and does not result in the degradation of habitat. | 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 and promote the establishment of native perennial grass species in accordance with Section 6.2.4.1. | Rapid monitoring events and habitat quality assessments will be undertaken in accordance with Section 7.6.1 and 7.6.2. These will include assessment of % cover of native perennial grasses and incidental flora surveys. | Decrease in the richness and average % cover of native perennial grasses at one or more habitat quality assessment sites based on the results of baseline and subsequent monitoring events. | Step 1: Investigate cause of trigger<br>• Investigate the reason for the decrease in richness and average % cover of native perennial grasses.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>o Modifying the strategic grazing regime including modifying the frequency, intensity and/or duration of grazing events.<br>o Constructing additional fencing should the current fencing be considered insufficient to manage livestock in accordance with the grazing regime.<br>o Installing additional watering points for livestock to manage livestock in accordance with the grazing regime. |
| | | Biomass levels of 2,500 kg/ha are retained at each of the monitoring sites at the end of the dry season. | Implementation of a strategic grazing regime to protect and maintain environmental values in accordance with Section 6.2.4.1. | Biomass monitoring will be undertaken in accordance with Section 7.2 | Biomass monitoring results indicate less than 2,500 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<br>• Investigate the reason for biomass being less than 2,500 kg/ha.<br>• Re-evaluate the strategic grazing regime to assess the suitability of grazing to ensure no less than an average of 2,500 kg/ha of biomass is retained at the end of the dry season.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| | | | | | | • The appropriate corrective actions will be implemented and may include:<br>  ○ Removal of stock or spelling grazing from the area of the offset in which less than 2,500 kg/ha of biomass was identified.<br>  ○ Review adherence to livestock grazing restrictions in Section 6.2.4.1.<br>  ○ Where relevant, amending livestock management practices in the OAMP, including amending stocking rates, and/or duration and/or frequency of strategic grazing events. |
| | | Livestock are only observed to be grazing in the offset area during strategic grazing event/s. | Existing fencing is maintained at all times as outlined in Section 6.2.3. | Offset area inspections to be undertaken at least annually (Section 7.1) and will include monitoring to assess the:<br>• condition of fencing to identify any necessary maintenance requirements.<br>• presence of livestock within the offset area. | Livestock are observed within the offset area when not permitted within that area.<br>Damaged fencing is observed. | Step 1: Investigate cause of trigger<br>• If livestock are identified in the offset area, remove stock immediately.<br>• Inspect and evaluate fencing and identify the cause of livestock within the offset area.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>  ○ Repairing fencing where required to ensure its condition is satisfactory to exclude livestock.<br>  ○ Constructing additional fencing should the current fencing be considered insufficient to exclude livestock. |
| Predation by wild dogs | Minimise predation risk by wild dogs to threatened fauna species. | Reduction in Catling* Index for wild dogs from year 1 and subsequent monitoring events. | Implement control actions for wild dogs in accordance with Section 6.2.6. | Undertake monitoring for wild dogs in accordance with Section 7.5. | An increase in Catling* Index for wild dogs from year 1 and subsequent monitoring events. | Step 1: Investigate cause of trigger<br>• Investigate potential sources or reasons that may have attributed to an increase in the:<br>  ○ Catling* index for wild dogs, feral cats and/or foxes.<br>  ○ relative abundance of feral pigs and horses.<br>• Review adherence to pest management control measures as outlined in Section 6.2.6.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>  ○ The appropriate corrective actions will be implemented and may include:<br>  ○ Increasing the frequency and intensity of pest animal control.<br>  ○ Revising methods of pest animal control in accordance with Queensland Department of |
| Predation by foxes | Minimise predation risk by foxes to threatened fauna species. | Reduction in Catling* Index for foxes from year 1 and subsequent monitoring events. | Implement control actions for foxes in accordance with Section 6.2.6. | Undertake monitoring for foxes in accordance with Section 7.5. | An increase in Catling* Index for foxes from year 1 and subsequent monitoring events. | |
| Predation by feral cats | Minimise predation risk by feral cats to threatened fauna species. | Reduction in Catling* Index for feral cats from year 1 and subsequent monitoring events. | Implement control actions for feral cats in accordance with Section 6.2.6. | Undertake monitoring for feral cats in accordance with Section 7.5. | An increase in Catling* Index for feral cats from year 1 and subsequent monitoring events. | |
| Degradation of habitat by feral pigs | Minimise degradation of offset value habitat by feral pigs. | Reduction in mean feral pig abundance score from year 1 and subsequent monitoring events. | Implement control actions for feral pigs in accordance with Section 6.2.6. | Undertake monitoring for feral pigs in accordance with Section 7.5. | An increase in mean feral pig abundance score from year 1 and subsequent monitoring events. | |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| Degradation of habitat by rabbits | Minimise degradation of offset value habitat by rabbits. | Maintain rabbit impact category as 'acceptable'. | Implement control actions for rabbits in accordance with Section 6.2.6. | Undertake monitoring for rabbits in accordance with Section 7.5. | Rabbit impact category measured as 'monitor closely', or 'unacceptable'. | Agriculture and Fisheries (DAF) guidelines, and coordinate with neighbouring landowners to ensure a consistent approach.<br>○ Updating pest animal control methods in the OAMP and targeted pest animal control programs. |
| Invasion of habitat by weed species, including exotic grasses | Manage invasive weed species to reduce degradation of offset value habitat. | A decrease in species richness and relative abundance of weed species at 80% of monitoring sites from year 1 and subsequent monitoring events.<br>No new weed species are identified at any monitoring site (based on year 1 and subsequent monitoring data). | Implement weed control actions in accordance with Section 6.2.5.<br>Adhere to weed hygiene restrictions in accordance with Section 6.2.1. | Undertake weed monitoring in accordance with Section 7.3. | An increase in species richness and relative abundance of weed species at more than 20% of monitoring sites from year 1 and subsequent monitoring events.<br>A new weed species is identified at one or more monitoring sites. | Step 1: Investigate cause of trigger<br>• Investigate potential sources or reasons that may have attributed to an increase in species richness and/or relative abundance of weeds.<br>• Investigate potential sources or reasons for the occurrence of the new weed species.<br>• Review adherence to weed management control measures as outlined in Section 6.2.5.<br>• Review adherence to weed hygiene restrictions as outlined in Section 6.2.1.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Amending weed hygiene restrictions.<br>○ Providing additional educational awareness training for all staff and contractors to ensure weed hygiene restrictions are adhered to.<br>○ Revising weed control methods in accordance with the *Biosecurity Act 2014* (Qld).<br>○ Increasing the frequency and intensity of weed control.<br>○ Updating weed control methods in the OAMP and targeted weed control programs. |
| Inappropriate fire regimes | Reduce the risk of adverse impacts to offset value habitat by inappropriate fire regimes or unplanned fire. | No unplanned fire within the offset area.<br>Increase in habitat quality scores as a result of implementation of any fire management measures. | All fire management measures to be implemented in accordance with the program outlined in Section 6.2.4. | Habitat quality assessments to determine habitat quality scores will be undertaken in accordance with Section 7.6.2.<br>Rapid monitoring events will be undertaken to assess the general condition of vegetation in accordance with Section 7.6.1.<br>Fuel load monitoring in accordance with Section 7.3. | As a result of fire management measures, or an unplanned fire, there is a decrease in the habitat quality score for any offset value from baseline and subsequent monitoring events. | Step 1: Investigate cause of trigger<br>• Investigate reasons why the fire management measures have resulted in a decrease in habitat quality scores.<br>• Review adherence to the fire management measures as outlined in Section 6.2.4.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Increasing the frequency of biomass and fuel load monitoring.<br>○ Increasing the frequency of weed control measures. |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| | | | | | | ○ Amending the strategic grazing regime.<br>○ Reviewing effectiveness of firebreaks, and establishment of additional fire breaks.<br>○ Review timing and intensity of fuel hazard reduction burns in accordance with the Regional Ecosystem Description Database (REDD) fire management guidelines and conservation advice for the particular offset value. |
| Offset fails to achieve the interim performance targets and completion criteria within the anticipated 5, 10, 15- and 20-year timeframes, respectively. | Achieve the interim performance targets and completion criteria for each offset value within 5, 10, 15 and 20 years, respectively. | The interim performance targets are achieved for all offset values by years 5, 10 and 15.<br>The completion criteria are achieved for all offset values by year 20. | All management actions outlined in Section 6.0 will be implemented to ensure that the interim performance targets and completion criteria are achieved. | Monitoring of the offset area will be undertaken in accordance with Section 7.0 including:<br>Offset area inspections (Section 7.1).<br>Offset value assessments (Section 7.6).<br>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 8.0). | Interim performance targets are not achieved for one or more offset values by years 5, 10 or 15.<br>Completion criteria are not achieved for one or more offset values by year 20. | Step 1: Investigate cause of trigger<br>• Investigate reasons why the interim performance targets or the completion criteria were not achieved within the specified timeframes.<br>• Re-evaluate the suitability of the relevant management measures in the OAMP.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Third party review of the OAMP to provide input on the effectiveness of the management actions.<br>○ Increasing the frequency and intensity of pest animal and weed control measures, or revising the type of measures to be implemented.<br>○ Modifying the strategic grazing regime, or fire management measures, to better support enhancement of offset values. |

## 6.2 Management actions

### 6.2.1 General restrictions

Table 11 details the restrictions to be implemented for the offset area to ensure the completion criteria and management objectives are met.

**Table 11: Offset area restrictions**

| Restrictions | Details |
|---|---|
| Weed hygiene | • Weed hygiene measures will be implemented to prevent the movement of weed material into the offset area.<br>• All persons entering the property and offset area will be required to ensure vehicles and equipment are weed free.<br>• All contractors entering the property and offset area must hold a current weed hygiene certificate or equivalent for all vehicles and equipment.<br>• Evidence is to be provided on request to the landowner and Santos environmental advisors that vehicles, slashers or any machinery implementing management actions are clean prior to entry to minimise potential weed spread. |
| Vehicles | • Vehicle movement will be limited to designated access tracks in the offset area and access will be restricted to authorised personnel only.<br>• Vehicles will travel to track conditions to minimise the risk of vehicle strike to fauna. |
| Vegetation clearing | • Clearing will be excluded from the offset area through demarcation and protection by means of Voluntary Declaration under the VM Act. Clearing for timber gathering and development will also be excluded.<br>• Clearing of native vegetation will not be permitted within the offset area as part of any management and monitoring activities associated with this OAMP, except for clearing that is required for:<br>  ○ maintenance of access tracks and/or fire breaks<br>  ○ fence construction and maintenance, and<br>  ○ ensuring public safety or as directed by emergency management response personnel in the event of unplanned fire or other emergency or associated procedure.<br>• If vegetation clearing is required for fencing, access, firebreaks or public safety, all activities will be appropriately planned, recorded and monitored.<br>• Machinery will not be allowed on site after heavy or prolonged rainfall events until after the site has dried to allow for safe movement of traffic. |
| Unauthorised access or use | • Access into the offset area will be restricted to authorised personnel only.<br>• Signs will be installed in prominent locations (i.e. at access points into the offset area) which recognise that the areas are protected for conservation purposes. The signs will advise that access into the offset area is restricted to authorised personnel only.<br>• Property fencing will be maintained to restrict access by unauthorised persons.<br>• At no time can persons access the site without first approaching the Santos Land Advisor of the Cobbadah property and informing them of their intent.<br>• When entering and leaving the property, the Santos Land Advisor must be advised.<br>• Contractors will only be permitted to access the property following the direct engagement by Santos. |

### 6.2.2 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.

Existing and new access tracks will be no wider than 5 m and vegetation disturbance will be minimised.

Low-lying areas and gully crossings are likely to be subject to periodic, ongoing maintenance and restriction of strategic grazing events should occur because of erosion following rain events. Some access tracks are steep and easily erodible, and will require ongoing maintenance, such as grading.

The property owners of Cobbadah will maintain access rights to the offset area and the access tracks within it.

### 6.2.3 Fencing

Current fencing on Cobbadah is in relatively good order and will be used to manage strategic grazing and access to the offset area. Existing fencing bounds the majority of the offset area as illustrated in Figure 8. The steep and rugged parts of the offset area are bordered by the Great Dividing Range (elevations upwards of 850 m above sea level) which provides a natural boundary between Cobbadah and adjoining properties and will not be fenced.

Where installation of additional fencing is required, it will be constructed to be fit for purpose and fauna friendly. Any vegetation disturbance associated with new fence construction will be minimised in accordance with Table 11.

Regular inspections of all fencing will be undertaken in accordance with Section 7.1, and repairs to the fences will be made as required.

### 6.2.4 Fire management

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

- minimise the risk and impacts of unplanned fire, especially to fire sensitive Brigalow TEC but also to other areas on Cobbadah (e.g. Semi-evergreen vine thickets of the Brigalow Belt [North and South] and Nandewar Bioregions TEC) as well as adjoining land.
- improve habitat quality through:
    - controlling weeds and biomass levels
    - supporting development of structural components of habitat for offset values (e.g. recruitment of native plants, establishment of fire sensitive native herbs and groundcover, important microhabitat including fallen logs and leaf litter, and increased understorey), and
    - promoting germination and recruitment of eucalypt species and other species characteristic of the specific RE.

Unplanned fire risk will be managed through:

- establishment and regular maintenance of firebreaks
- monitoring and managing fuel loads primarily through the implementation of a strategic grazing regime (Section 6.2.4.1), and
- fuel hazard reduction burns (if required; Section 6.2.4.2).

Firebreaks are currently established along fence lines across the Cobbadah property, and narrower fire management access tracks are currently established on rugged steep slopes. Firebreaks will be maintained at least annually in mid / late autumn and, or early spring. Firebreak maintenance will be undertaken with a blade and/or shallow cultivation and/or slashing (green break) to a width of up to 10 m.

A comprehensive monitoring program will be undertaken as part of fire management activities to assess fuel loads (Section 7.3) and biomass levels (Section 7.2) to determine the risk of unplanned fire to the offset area and inform fire management strategies including strategic grazing and fuel hazard reduction burns.

Fire management within the Cobbadah property but outside of the offset area will remain the responsibility of the owner of Cobbadah.

#### 6.2.4.1 Strategic grazing

Strategic grazing within the offset area will be used to manage fuel loads and control exotic weeds and pasture grasses such as *Cenchrus ciliaris*. As increasing grazing intensity is correlated with an increase in weedy cover (Franks 2002), and a decrease in native grass species richness, grazing will be permitted in the offset area on a managed and limited basis to control weeds and reduce fuel loads.

Best practice management for strategic livestock grazing within the offset area will be undertaken as follows:

- livestock will only be permitted in the offset area to reduce fuel loads, avoid weed seed set and reduce weed cover, and
- within the offset area a minimum of 2,500 kg/ha of biomass will be retained at the end of the dry season.

The suitability of conditions for undertaking a grazing event will be informed by biomass monitoring events as described in Section 7.2. Following a wet season spell and prior to a strategic grazing event, a feed budgeting assessment will be undertaken. The feed budgeting assessment will determine the stocking rate based on the amount of feed available within pasture areas and the amount of feed desired in these areas at the end of the grazing event.

Further details of the method for undertaking biomass monitoring are provided in Section 7.2.

#### 6.2.4.2 Fuel hazard reduction burns

The aim of fuel hazard reduction burns is to manage excess fuel loads, to initiate regeneration of eucalypt communities and to create habitat with a mosaic of different fire frequencies and times since fire.

Fire management, through fuel hazard reductions burns will be guided by conservation advice documentation (e.g. for MNES) and the REDD (Queensland Herbarium 2019), which provides recommendations for fire management for each of the component RE (Table 12), guidelines published in the Fire and Biodiversity Monitoring Manual published by the South East Queensland Fire and Biodiversity Consortium (SEQFBC 2002), local regional fire plans, regional fire authorities and local knowledge of fire behaviour.

Based on this advice, fire is to be excluded from areas of Brigalow TEC in the offset area. To reduce the risk of fire occurring within Brigalow TEC in the offset area, very cool fuel hazard reduction burns (trickle burns) in a rotational mosaic pattern may be conducted in adjacent areas, particularly in RE 11.8.5.

Hazard reduction burns will be considered if fuel hazard ratings within the offset area are unable to be maintained below extreme in accordance with the *Overall Fuel Hazard Assessment Guide* (Hines *et al*. 2010; Appendix E) through the implementation of strategic grazing and weed control. However, the location and timing for fuel hazard reduction burns will be informed by the results of biomass monitoring (Section 7.2) and fuel load monitoring (Section 7.3) in conjunction with the results of habitat quality assessments and considering the REDD fire management guidelines (Queensland Herbarium 2014) for the vegetation community and MNES conservation advices.

In general, where applicable, fire management will be undertaken in a mosaic pattern at the appropriate time of year when:

- soil and fuel moisture levels are high, ideally following minimum of 40 mm of rainfall
- ambient temperature and wind speed are low
- atmospheric humidity is high
- the risk of long-term impacts/high intensity fire is low, and/or
- when plants approach a more active growing phase.

**Table 12: Fire management guidelines for each component RE**

| RE | Associated MNES | Fire Exclusion? | Fire Management |
|---|---|---|---|
| 11.9.5 | • Brigalow TEC<br>• Collared Delma<br>• Dunmall's Snake<br>• Yakka Skink<br>• Koala<br>• South-eastern Long-eared Bat | Yes | • Protection from fire is necessary.<br>• High intensity fires will cause damage to overstorey.<br>• Maintain fire management of surrounding country so that any fires will be very limited in extent. Frequent fire at the edge of this community keeps fuel loads low.<br>• The invasion of exotic grasses such as *Cenchrus ciliaris* increases the risk from fire. Grazing may be an option for reducing fuel loads in Brigalow TEC. |
| 11.3.2<br>11.8.5<br>11.9.2<br>11.9.7 | • Collared Delma<br>• Dunmall's Snake<br>• Yakka Skink<br>• Koala<br>• South-eastern Long-eared Bat | No | • Undertake low to moderate intensity controlled burns every six to ten years.<br>• Burn under conditions of good soil moisture and when plants are actively growing, generally in the late wet to early dry season or early storm season or after good spring rains.<br>• Maintaining a fire mosaic will help ensure protection of habitat and mitigate against wildfires. As such restrict controlled burns to less than 30% of the community in any one year. |

### 6.2.5 Weed management

Offset area weed management will minimise the introduction, establishment and spread of restricted and prohibited pest plants under the *Biosecurity Act 2014* (Qld) and other invasive species that present a threat to vegetation communities and species habitat in the offset area. Weed management within the offset area will focus on reducing the extent of the following existing weeds as well as minimising the risk of introduction of additional weed species to the offset areas:

- *Cenchrus ciliaris*
- *Parthenium hysterophorus* and
- *Opuntia spp*.

Field surveys completed to date confirmed evidence of widespread weeds and exotic pasture grasses, especially *Cenchrus ciliaris* within areas of remnant eucalypt woodland, with scattered populations of *Parthenium hysterophorus* and *Opuntia spp.* throughout the offset area.

Reductions in the extent of *Cenchrus ciliaris* and *Parthenium hysterophorus* are most effectively achieved by maximising the competitive advantage of native ground cover species. This requires native species richness and abundance to be maximised. In historically grazed environments the most effective way to ensure high species richness is through conservatively managed cattle grazing (Fensham 1998); to maintain enough biomass to maximise grass growth and appropriate spelling to allow for native species to set seed.

Accordingly, a strategic grazing regime will be implemented to reduce the presence and biomass of exotic pasture grasses in the offset areas (refer to Section 6.2.4.1). To supplement this, weeds will be managed using biological, chemical and/or mechanical control in accordance with the control measures outlined in the Biosecurity Queensland Fact Sheets, for the relevant weed species.

A weed survey will be conducted in year one of the implementation of this OAMP to calculate the species richness and abundance of restricted, prohibited and other weed species, including exotic pasture grasses, at each monitoring site in accordance with Section 7.4. The results of the year one surveys will inform the species-specific weed control measures, timing and location for ongoing weed management.

Species-specific control measures and timing for control activities will be reviewed based on the results of ongoing weed monitoring in the offset area.

Weed declaration certificates will completed for all offset monitoring and maintenance vehicles prior to entering the Cobbadah property.

### 6.2.6 Pest animal management

The following pest animals are present or have the potential to occur on or within the immediate vicinity of the Cobbadah property and pose the following threats:

- Predation of native fauna by foxes, cats and wild dogs.
- Erosion and degradation of habitat and competition by pigs and rabbits.

Pest animal control activities will be undertaken to minimise the introduction of pest animals and control existing pest animal populations in accordance with the *Biosecurity Act 2014* (Qld). Table  provides examples of approved species-specific pest animal control measures recommended by the Queensland and Commonwealth governments. Results of pest animal monitoring (Section 7.5) will be reviewed following each management year to inform the need for, location and timing of species-specific control measures in subsequent years.

**Table 13: Examples of species-specific control methods for pest animal species**

| Species | Status under *Biosecurity Act 2014* | Example control method | Reference |
|---|---|---|---|
| Wild dog (*Canis familiaris*) | Category 3,4,6 | • Ground baiting<br>• Shooting | (DAF 2020a) |
| Fox (*Vulpes vulpes*) | Category 3,4,5,6 | • Ground baiting<br>• Trapping<br>• Shooting | (DAF 2020b) |
| Feral cat (*Felis catus*) | Category 3,4,6 | • Night shooting<br>• Poisoning<br>• Trapping | (DAF 2020c) |
| Pig (*Sus scrofa*) | Category 3,4,6 | • Trapping<br>• Shooting<br>• Poisoning | (DAF 2020d) |
| Rabbit (*Oryctolagus cuniculus*) | Category 3,4,5,6 | • Baiting<br>• Fumigation<br>• Trapping<br>• Shooting | (DAF 2020e) |

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# 7.0 Monitoring

The results of the monitoring program outlined in the following sections will be used to inform operational management decisions, including adaptive implementation of this OAMP to ensure the performance criteria and management objectives, and ultimately interim performance targets and completion criteria are met.

The monitoring results will also be used to assess adherence to performance criteria, and to determine when corrective actions are required to be implemented. The results will also be compared to those from previous monitoring events to assess change over time and to inform the ongoing implementation of the OAMP.

## 7.1 Offset area inspections

The aim of offset area inspections is to enable a general assessment of the offset area to identify any potential issues that may require remedial action to be undertaken. Inspections will be undertaken twice per year for the duration of the management period to 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
- incidence of erosion within offset area, particularly around permanent and semi-permanent water bodies or areas subject to inundation or waterlogging
- damage/degradation resulting from pest animal activity within the offset area
- signs of land degradation and over-grazing
- presence of weed/invasive species
- exclusion of livestock, and
- incidental fauna observations and any additional risks to offset values (i.e. evidence of vehicle strike).

## 7.2 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 to control fuel loads.

Biomass is at its greatest at the end of the wet season (April) with fire risk greatest towards the end of the dry season (October). Biomass will be monitored within the offset areas using appropriate photo standards 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 year 1 surveying.

Biomass levels will be managed through strategic grazing events (see Section 6.2.4.1) if the biomass assessment at the end of the wet season shows that biomass is greater than 2,500 kg/ha.

The stocking rate of these strategic grazing events will be determined through a feed budgeting assessment (see Section 7.2.1) 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. >2,500 kg/ha).

### 7.2.1 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[1].
- 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, and
    - calculate 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. 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.

## 7.3 Fuel load monitoring

Fuel load monitoring will be undertaken in accordance with the *Overall Fuel Hazard Assessment Guide* (Hines *et al*. 2010; Appendix E). Fuel load assessment monitoring will include a baseline survey in year 1 (post wet season; April), with ongoing fuel load assessment 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.

[1] See https://futurebeef.com.au/knowledge-centre/pasture-photo-standards/.

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 load assessments will be used to determine if fuel hazard reduction burns are required within the offset area. Weed management and strategic grazing within the offset area will also be undertaken to maintain a fuel hazard rating below extreme.

## 7.4 Weed monitoring

Weed monitoring sites will be randomly stratified, fixed monitoring sites representative of offset values and incorporating natural variability such as aspect (e.g. a mix of north-, east-, south- and west-facing monitoring sites), community type – (e.g. woodland, riparian). There will also be fixed monitoring sites at strategic trafficable areas (e.g. entry gates, creek crossings, stock watering points) to monitor potential introduction and/or irruptions of prohibited and restricted weed species.

The offset area will be monitored for weeds every two years (post wet season), to determine the species richness and abundance, for the duration of the management period. The results of this monitoring will inform the methods for weed treatment and control (see Section 6.2.5).

Non-native plant cover is also assessed as part of the habitat quality assessments detailed in Section 7.6.2, and the presence of weed species will also be recorded as part of the general offset area inspections (see Section 7.1), where noted.

## 7.5 Pest animal monitoring

The offset area will be monitored for evidence of pest animals every two years (post wet season), including a baseline survey in year 1 of the distribution and abundance of pest animals.

Based on the results of year 1 surveys, pest animal monitoring sites will be established in year 1. Monitoring of pest animals 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 and lagoons favoured by feral pigs; Hone 1995). The location of pest animal monitoring sites will be assessed prior to each monitoring event.

Pest animal monitoring will also be undertaken in association with and immediately prior to the pest animal control activities (Section 6.2.6). Initial monitoring results will determine the degree of effort required to control the pest population and post control monitoring will determine the degree of success of control operations.

Monitoring of pest animals will involve the deployment of motion sensing infra-red cameras as well as other techniques such as sand plots as appropriate to determine pest animal species present in the offset area and indicative population numbers.

Methods for determining the presence and relative abundance for foxes, dogs, feral cats, rabbits, and feral pigs are presented in Table 14. Evidence of pest animals, including feral horses, will be documented during the offset area inspections (see Section 7.1)

**Table 14: Pest animal monitoring methodology**

| Pest animal | Methodology to be implemented |
|---|---|
| Fox<br>Wild dog<br>Feral cat | To assess the relative abundance of foxes and feral cats within the 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.<br>• fauna monitoring cameras will be placed in the offset area<br>• cameras will be placed along tracks and left in place for a minimum of three consecutive nights<br>• 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). |
| Feral pig | An assessment of the presence or absence of feral pig signs as a measure of the relative abundance of feral pigs within the offset area in accordance with Mitchell and Balogh (2007a) and Hone (1988), will be undertaken as follows:<br>• nominate randomly stratified sites across the offset area in environments that are more regularly impacted (e.g. drainage lines, moist gullies, around swamps etc)<br>• calculate an abundance score for each transect as the percentage of 'present' feral pig signs<br>• calculate the mean abundance score (and variance) across all transects in the offset area.<br>The average frequency of occurrence across the 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.<br>[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 | An assessment of rabbit impact in accordance with Cooke *et al*. (2008) will be undertaken as follows. Randomly stratified, permanent monitoring points assessing:<br>• Rabbit abundance<br>• Seedling abundance<br>• Rabbit damage<br>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]).<br>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. |

## 7.6 Offset value assessments

### 7.6.1 Rapid monitoring event

Rapid monitoring events will be carried out each year where there is not full monitoring of habitat quality (Section 7.6.2).

These will be aligned with the offset area inspections (see Section 7.1) and carried out by suitably qualified ecologists during spring and early summer (September – mid December).

During each rapid monitoring field assessment, the following will be conducted:

- Incidental fauna surveys will be conducted throughout the rapid monitoring events including early morning and late evening bird surveys and fauna surveys throughout the day.
- Photos will be taken at designated and fixed photo monitoring points as outlined in Section 7.6.3. The locations of the fixed photo monitoring locations will be the same as the habitat quality monitoring locations shown in Figure 11.

### 7.6.2 Habitat quality assessment

Vegetation condition and habitat quality for each MNES will be assessed in accordance with the GTDTHQ (version 1.2; DEHP 2017) and the methods outlined in Appendix A. In order to be consistent with the requirements under the EPBC Act guideline for the *Offsets assessment guide* the species habitat index component of the habitat quality score will be calculated based on the results of the targeted fauna surveys detailed in Section 7.6.4.

Habitat quality assessments were completed in May 2017 and August 2020 at the monitoring locations presented in Figure 11. Habitat quality assessments will be undertaken in year one, and then every two years for the first six years, and then every three years thereafter. As part of year 1 monitoring activities, monitoring points will be finalised (including additional required pointes outlined in Figure 11) and marked with a capped stake and a GPS location will be recorded.

The results of habitat quality assessments for subsequent years will include summary data from previous reporting years, presented to allow trend analysis of each of the measured attributes and assess progress towards achieving the interim performance targets and completion criteria.

### 7.6.3 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 conducted at all habitat quality monitoring locations presented in Figure 11, in accordance with Appendix 4 of *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland Assessment Manual* (version 2.2; Eyre *et al*. 2015).

Photo monitoring will be undertaken as part of habitat quality assessments (Section 7.6.2) and rapid monitoring events (Section 7.6.1).

### 7.6.4 Targeted fauna surveys

Targeted fauna surveys will be conducted to assess the distribution and richness of the fauna offset values within the offset area. The targeted fauna survey methods focus on the MNES species that are unlikely to be detected effectively during the rapid assessment surveys due to cryptic behaviour or localised habitat requirements. Targeted surveys will be undertaken generally in accordance with recommended survey guidelines from the Queensland and Commonwealth governments and/or other reputable published guidelines. Table 15 provides a summary if the proposed methodology, search effort and timing for targeted surveys. It is important to note that the proposed survey methodology will be reviewed prior to each survey event and if considered necessary will be modified to ensure they are based on the ecology, habitat requirements and behavioural aspects of the species of interest.

Targeted fauna surveys will be carried out in conjunction with habitat quality assessments in year 1 and then every two years for the first six years, and then every three years thereafter.

**Table 15: Fauna species survey methods**

| Technique | Regime | Target and method |
|---|---|---|
| Funnel trap | Six at each of five trap sites over four consecutive nights, checked early morning and afternoon. | Placed in pairs either side along a 30 m drift-fence. Targeting Dunmall's Snake and Collared Delma. |
| Harp trap | Two per night for four consecutive nights, locations chosen based on presence of suitable flyways | Targeting South-eastern Long-eared Bat, which is not identifiable by ultrasonic calls. |
| Camera trap | 10 over at least 14 consecutive nights | Focused on stations baited with a mixture of oats, peanut butter, vegetable oil and sardines. Targeting Yakka Skink. (Meek *et al*. 2014). |
| Spotlighting | On foot | Targeting Koala and Dunmall's Snake. |
| Spotlighting | Rocky areas. | Targeting Collared Delma. |
| Spotlighting | By vehicle along tracks. | Targeting Dunmall's Snake and Koala. |
| Scat search | Conducted in habitat considered suitable for target species. | Targeting Koala. The Spot Assessment Technique (SAT), or a variation, were used to survey for Koalas within suitable habitat within the site. |
| Bird survey | Meander along watercourses during the day. | Diurnal Koala search. |
| Diurnal herpetofauna search | Late morning/early afternoon. | Conducted by two searchers, duration is determined by site-specific habitat quality and presence of suitable micro-habitat. Targeting Collared Delma, Dunmall's Snake and Yakka Skink. |

148°18'0"E
148°19'0"E
148°20'0"E
148°21'0"E
25°47'0"S
25°48'0"S
25°49'0"S
25°50'0"S

33WT347
35SP140818

COB01
COB02
COB03
COB04
COB05
COB06
COB07
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**Figure 11**
**Monitoring sites**

Cobbadah
Cobbadah offset area
Access tracks

***BioCondition sites***
Outside offset (existing)
Within offset (existing)
Within offset (new)

***Ground-truthed REs***
11.3.2
11.8.5
11.9.2
11.9.5
11.9.7

Location diagram
Queensland

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data

Date: 10/21/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:22,500@A3

0 0.25 0.5 0.75 1
Kilometres

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CO2 Australia

Path: P:\GIS\Data\Projects\Santos\912_211020_Roma_East_maps\Cobbadah\Figure_11_Monitoring_sites.mxd

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# 8.0 Reporting

## 8.1 Reporting

A report detailing the progress of the offset area in achieving the interim performance targets and completion criteria will be prepared for each management year by the suitably qualified ecologist responsible for conducting the monitoring. The report will contain, at a minimum:

- A description of the monitoring conducted, when it was conducted, and by whom
- A discussion of the weather in the lead up to and during the monitoring
- Results of monitoring events conducted
- An overview of the management actions implemented since the last report
- A description of the performance criteria not met, any triggers that have been exceeded and the corrective actions that were implemented;
- An indication of any risks or potential threats that have become apparent to the management area since the development of this management plan, and activities to be undertaken to manage these threats and/or risks.
- Progress towards achieving the interim performance targets and completion criteria

## 8.2 Update of OAMP

The OAMP will be reviewed, audited and updated every 5 years. In addition, the OAMP will be updated in accordance with the principles of adaptive management, if required, to incorporate any changes identified through management activities, site visits and monitoring activities. This may include the revision of current management actions, identification of additional activities (including monitoring activities) and responses to adaptive management triggers, other environmental threats to the offset area and information obtained through research programs.

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# 9.0 Implementation Schedule

Table 16 and Table 17 summarise the implementation schedule for the management, monitoring and reporting activities presented in this OAMP. Santos will be wholly responsible for the implementation of this OAMP and reporting on the performance of the offset area in meeting the offset obligations under EPBC Approval 2012/6615 and Section 4.0 of this OAMP.

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**Table 16: Implementation of management actions**

| Activity | | Management years<br>✓ Activity required<br>■ Activity to be carried out 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 6.2.1) | Access, vehicles, vegetation clearing, weed hygiene | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | At all times | General offset inspections (Section 7.1) |
| Access tracks (Section 6.2.2) | Maintenance/new tracks | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required | |
| Fencing (Section 6.2.3) | Construction of additional fencing to support strategic grazing and manage access | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required | |
| | Maintenance | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Fire management (Section 6.2.4) | Fuel hazard reduction burns | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required | Biomass monitoring (Section 7.2) |
| | Strategic grazing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required based on the results of biomass monitoring, fuel load monitoring and weed monitoring | Biomass monitoring (Section 7.2)<br>Fuel load monitoring (Section 7.3)<br>Weed monitoring (Section 7.4) |
| Weed management (Section 6.2.5) | *Cenchrus ciliaris*, *Parthenium hysterophorus* and other weeds | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Control activities in addition to strategic grazing to be undertaken as required | Weed monitoring (Section 7.4) |
| Pest animal management (Section 6.2.6) | Wild dog, feral cat, fox rabbit and pig control | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Control activities to be undertaken as required | Pest animal monitoring (Section 7.5) |
| Reporting (Section 8.0) | Annual reporting | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Annual reports to be prepared each year | Reporting (Section 8.0) |
| | Update OAMP | | | | | ■ | | | | | ■ | | | | | ■ | | | | | ■ | OAMP will be reviewed, audited and updated every 5 years | |

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**Table 17: Implementation of monitoring events**

| Survey or monitoring objective | Monitoring activity | Management years<br>✓ Activity required<br>■ Activity to be carried out as required<br>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 | Timing | Survey/monitoring guidelines | Reliability |
|---|---|---|---|---|---|
| Offset area inspections (Section 7.1) | Twice yearly inspections of:<br>• fencing, gates, signs<br>• access tracks and firebreaks<br>• compliance with restrictions for vegetation clearing<br>• incidence of erosion<br>• damage/ degradation resulting from pest animal activity within the offset area<br>• signs of land degradation and over-grazing<br>• weed/invasive species<br>• exclusion of livestock<br>• incidental fauna observations and any additional risks to offset values | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ | 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 7.1 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. |
| Biomass monitoring (Section 7.2) | Biomass monitoring for fire management and to inform strategic grazing regime | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ | Twice every year at the end of the wet season (April) and end of the dry season (October). | Assessment against Future Beef photo standards (Section 7.2.1). | Methodology developed by the Queensland Government. |
| Fuel load monitoring (Section 7.3) | 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; Appendix E). | Method developed by the Victorian Government. |
| Weed monitoring (Section 7.4) | Ongoing weed surveys to assess the effectiveness of weed control | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ | Every two years at the end of the wet season. | Monitoring techniques to be in accordance with published guidelines e.g. NSW Guidelines for Monitoring Weed Control | Assessment will be undertaken generally in accordance with published, reputable guidelines. |

| Survey or monitoring objective | Monitoring activity | Management years<br>✓ Activity required<br>■ Activity to be carried out as required<br>1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Timing | Survey/monitoring guidelines | Reliability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | and recovery of native vegetation (Auld 2009).<br>Photo monitoring of selected sites to assess visual changes in weed species and infestations over time.<br>The use of precision unmanned aerial vehicles (drone) technology, aerial imagery and/or remote sensing. | |
| Pest animal monitoring (Section 7.5) | Ongoing pest animal surveys to assess the effectiveness of pest animal control | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | Every two years at the end of the wet season. | Monitoring method outlined in Section 7.5. | Assessment undertaken generally in accordance with published monitoring techniques developed by the NSW Government. |
| Habitat quality assessment (baseline surveys completed in 2020) (Section 7.6) | Rapid monitoring events | | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | Each year there is not full monitoring of habitat quality (BioCondition, Section 7.6.2). | See Section 7.6.1. | |
| | Assessment of vegetation condition and habitat quality | ✓ | | ✓ | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | Year one, and then every two years for the first six years, and then every three years thereafter. | GTDTHQ (version 1.3; Department of Environment and Science [DES] 2020). | 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 | ✓ | | ✓ | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | 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). |
| | Targeted fauna surveys | ✓ | | ✓ | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | See methods outlined in Section 7.6.4. | Techniques for fauna surveys area based on recommended survey guidelines published by the Queensland and Commonwealth governments. |

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# APPENDIX A

## MNES habitat quality score method

Calculation of a habitat quality score for each MNES considers three attributes:

- site condition
- site context
- species stocking rate.

### *Site condition*

The site condition score for each MNES is calculated generally in accordance with the site condition assessment method outlined in Section 5 of the GTDTHQ (version 1.2; DEHP 2017). 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 community (i.e. RE benchmark).

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

### *Site context*

The method to calculate site context for a site is based on the site context assessment method provided in the GTDTHQ.

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

- Patch size: the size of the patch/assessment unit being assessed and any directly connecting suitable/known habitat and remnant vegetation. To calculate the patch size score:
    - Measure the area of vegetation in which the assessment unit is contained and add on all other directly connecting areas of suitable or known habitat for the threatened species or community and remnant vegetation. Suitable or known habitat will be based on mapped vegetation comprising regional ecosystems known or likely to support the MNES value based on the conservation advice or other species-specific sources endorsed by Queensland and/or Commonwealth Governments. Where the connecting patch comprises an RE that is known or suitable habitat, then 100% of the area of that RE is attributed to the total patch size area. Where the connecting RE is not considered known or suitable habitat (i.e. non-compliant RE); however, is a remnant RE, only 10% of the area of that RE is attributed to the total patch size area sum. The reduced weighting for non-compliant REs acknowledges the importance of these REs in contributing to the overall patch size through its contribution to potential dispersal of species, and the supporting role of these REs for maintaining connectivity to potential source meta-populations.
    - Determine the score for this attribute by matching with the class ranges in Table B1.
- Connectedness: measure the proportion of the assessment unit's boundary which is connected to suitable/known habitat and remnant vegetation. To calculate the connectedness score:
    - Measure the percentage of suitable/known habitat and remnant vegetation along the boundary of the assessment unit.

- Determine the score for this attribute by matching with the class ranges in Table B1.

- Context: measure the percentage of suitable/known habitat and remnant vegetation within a 1 km buffer around the site/assessment unit. To calculate the context score:
  - Create a 1 km buffer around the monitoring site.
  - Measure the percentage cover of remnant vegetation within the buffer area.
  - Determine the score for this attribute by matching with the thresholds Table B1.
  - Ecological corridors: to calculate the ecological corridor score:
    - Determine the proximity of the site to state, bioregional, regional or sub-regional corridors (terrestrial or riparian).
    - Determine the score from Table B1. based on whether the site is located within (wholly or partly); shares a common boundary with; or is not within a corridor.

**Table A1: Site context scoring guide**

| Attribute | Scoring guide | | | | | |
|---|---|---|---|---|---|---|
| Size of Patch | Score | 0 | 2 | 5 | 7 | 10 |
| | Description | <5 ha | 5-25 ha | 26-100 ha | 101-200 ha | >200 ha |
| Connectedness | Score | 0 | 2 | | 4 | 5 |
| | Description | 0-10% | >10%-<50% | | 50-75% | >75% or >500 ha |
| Context | Score | 0 | 2 | | 4 | 5 |
| | Description | <10% | >10-30% | | >30-75% | >75% |
| Ecological corridors | Score | 0 | 4 | | 6 | |
| | Description | Not within | Sharing a common boundary | | Within (whole or part) | |

The total site context score for each MNES at each relevant monitoring site is calculated out of 26.

### *Species habitat index*

A quantitative method is used to determine the species habitat index score for each fauna and flora MNES based on the species habitat index assessment method used as part of the GTDTHQ.

Table B2 to Table B5 summarise the method for calculating species habitat index score out of 50 for Koala, Collared Delma, Dunmall's Snake and Yakka Skink. Each sub-component of species habitat index scoring method is tailored for each MNES to consider species-specific habitat requirements and threats in accordance with conservation advices and other species-specific sources endorsed by Queensland and/or Commonwealth governments.

In the absence of the GTDTHQ including a species habitat index for flora species, the habitat condition scores for Brigalow TEC included a species presence index out of three, whereby: 0 = absent/not confirmed, 2 = single confirmed specimen, 3 = multiple confirmed specimens. The habitat condition score was then calculated as a combination of site condition and site context for the RE assessment unit (representing 60% of the score), with species stocking rate converted to a score out of 3 and contributing 40%.

**Table A2: Species habitat index scoring for Koala**

| Component | Level | Score | Description |
|---|---|---|---|
| Threats to species | High threat level (i.e. likely to result in death, irreversible damage): site subject to a high level of threat, whether being part of a highly fragmented system, without and core area, and previous, present and future management realising an ongoing threat | 1 | • Known presence of wild dogs on site and within adjacent properties and/or evidence of predation known or observed and. No active pest animal management on site.<br>• Public vehicle access to site, with evidence of death through vehicle strike observed or likely.<br>• Habitat is not protected through legislation and/or is likely to be cleared for development or agricultural land use and/or subject to ongoing degradation.<br>• No active fire management on site, with habitat either frequently burnt and/or subject to a high risk of uncontrolled wildfire on site, including from adjacent properties.<br>• Site is not actively managed for conservation purposes and lack of landholder awareness of threatened species habitat and conservation |
| | Moderate threat level: site subject to a moderate, realised level of threat, being part of a fragmented system, with edge effects resulting in a high edge/core area ratio and/or with previous, present and future management resulting in a moderate level of threat | 7 | • Wild dogs observed on site or within adjacent properties and/or limited evidence of known or observed predation. Active pest animal management implemented on site.<br>• Restricted access to the site by authorised personnel only, with no public vehicle access.<br>• Habitat is not protected through legislation and is unlikely to be cleared for development or agricultural land use.<br>• Active fire management and/or low risk of uncontrolled fire on site, including from adjacent properties. |
| | Low threat level (i.e. likely to survive): no actual or realised threats occur on or near the site. Site not part of fragmented system, with no edge effects, and no immediate threat from present or future management | 15 | • No wild dogs observed or known within the vicinity of the site and no known or observed evidence of predation. Successful active pest animal management implemented on site.<br>• Restricted access to the site for authorised personnel only, with no public vehicle access. Reduced speed limits in place and/or driver awareness and/or signs to identify species habitat and/or exclusion fencing to prevent Koalas accessing road.<br>• Habitat protected as part of a legally binding mechanism for an offset and/or National Park and/or Nature Refuge, with management aimed at maintaining or improving habitat.<br>• Active fire management, with controlled burns on site and low risk of uncontrolled fire on site, including from adjacent properties.<br>• Site is actively managed for conservation purposes to enhance habitat for threatened species. |
| Quality and availability of food and foraging habitat | Poor: Very limited species-specific habitat, conditions or resources available | 1 | • Minimum of one eucalypt species present (including species from the genera E*ucalyptus, Corymbia, Angophora* and *Lophostemon*) that is known from the RE, with limited foraging potential for the species. |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 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<br>• >50% of the RE benchmark for number of large trees attribute. |
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 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<br>• >70% of the RE benchmark for attributes number of large trees OR<br>• 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 | Poor: Very limited species-specific habitat, conditions or resources available | 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. |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 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 large trees and/or canopy cover and/or canopy height. |
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 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 | Severely restricted (76–100% reduction) | 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. |

| Component | Level | Score | Description |
|---|---|---|---|
| | | | • 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. |
| | Highly restricted (51–75% reduction) | 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. |
| | Moderately restricted (26–50% reduction) | 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<br>• 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. |
| | Minor restriction (0–25% reduction) | 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 | Not or unlikely to be critical to species' survival:<br>Site likely to support only a small or relictual species population or community, not near the geographical limit of the species/community range OR there are very few records for migratory species. | 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Likely to be critical to species' survival:<br>Site supports an important species population for breeding or dispersal, or a community that is a contiguous or functional link between known, important or key source species populations or communities at the landscape to regional scale OR is an important stopover habitat for migratory species. | 3 | • 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Known to be critical to species' survival:<br>Site known to support 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. | 4 | • Evidence of one or more species records within the last 10 years within 15 km of the site AND<br>• The site contains habitat likely to support a population at or lower than average population density for the species, likely to be representative of a sink population from a nearby source metapopulation. |
| | Critical to species survival:<br>Site supports a key source species population for breeding and/or dispersal or community at the state to national scale, necessary for maintaining genetic diversity AND/OR the population is outside or near the geographical limit of the species/community range OR is critical stopover habitat for migratory species at the national or state scale. | 5 | • Evidence of one or more species records within the last 10 years within 15 km of the site AND<br>• 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. |

Table A3: Species habitat index scoring for Collared Delma

| Component | Level | Score | Description |
|---|---|---|---|
| Threats to species | High threat level (i.e. likely to result in death, irreversible damage): site subject to a high level of threat, whether being part of a highly fragmented system, without and core area, and previous, present and future management realising an ongoing threat | 1 | • Habitat is not protected through legislation and/or is likely to be cleared for development or agricultural land use and/or subject to ongoing degradation.<br>• Overgrazing by livestock resulting in irreversible damage to microhabitat including loss of deep cracks in clay soils, fallen timber and logs.<br>• Known presence of foxes and/or feral cats on site and within adjacent properties and/or known or observed evidence of predation. No active pest animal management on site.<br>• No active fire management on site, with habitat either frequently burnt and/or subject to a high risk of uncontrolled wildfire on site, including from adjacent properties.<br>• Site is not actively managed for conservation purposes and lack of landholder awareness of threatened species habitat and conservation. Removal of fallen timber. |
| | Moderate threat level: site subject to a moderate, realised level of threat, being part of a fragmented system, with edge effects resulting in a high edge/core area ratio and/or with previous, present and future management resulting in a moderate level of threat | 7 | • Habitat is not protected through legislation and is unlikely to be cleared for development or agricultural land use.<br>• Strategic pulse livestock grazing resulting in irreversible damage to critical microhabitat including deep cracks in clay soils, fallen timber and logs.<br>• Foxes and/or feral cats observed on site or within adjacent properties and/or limited evidence of known or observed predation. Active pest animal management implemented on site.<br>• Active fire management and/or low risk of uncontrolled wildfire on site, including from adjacent properties. |
| | Low threat level (i.e. likely to survive): no actual or realised threats occur on or near the site. Site not part of fragmented system, with no edge effects, and no immediate threat from present or future management | 15 | • No foxes and/or feral cats observed or known within the vicinity of the site and no known or observed evidence of predation. Successful active pest animal management implemented on site.<br>• Habitat protected as part of a legally binding mechanism for an offset and/or National Park and/or Nature Refuge, with management aimed at maintaining or improving habitat.<br>• Livestock grazing always excluded from habitat (except for need for fuel load control through strategic grazing, if required)<br>• Active fire management, with controlled burns on site and low risk of uncontrolled wildfire on site, including from adjacent properties.<br>• Site is actively managed for conservation purposes to enhance habitat for threatened species. |
| Quality and availability of food and foraging habitat | Poor: Very limited species-specific habitat, conditions or resources available | 1 | • Overall BioCondition score <5 AND<br>• <50% of the RE benchmark value for coarse woody debris OR leaf litter<br>• Highly disturbed ground layer |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 5 | • Overall BioCondition score >5 - <8 AND<br>• >50% of the RE benchmark for attributes coarse woody debris OR leaf litter.<br>• Evidence of some disturbance to ground layer reducing habitat condition for known food sources, e.g. small skinks and geckos. |
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 10 | • Overall BioCondition score >8 AND<br>• >70% of the RE benchmark for attributes coarse woody debris AND/OR leaf litter.<br>• Limited evidence of disturbance to ground layer likely to support known food sources, e.g. small skinks and geckos. |
| Quality and availability of shelter | Poor: Very limited species-specific habitat, conditions or resources available | 1 | • Overall BioCondition score <5 AND/OR<br>• <50% of the RE benchmark value for coarse woody debris<br>• Limited evidence of potential shelter habitat |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 5 | • Overall BioCondition score >5 - <8 AND<br>• >50% of the RE benchmark for coarse woody debris.<br>• Evidence of disturbance to ground layer with presence of potential shelter sites (i.e. fallen timber and ground litter, cracks in alluvial clay soils) |
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 10 | • Overall BioCondition score >8 AND<br>• >70% of the RE benchmark for coarse woody debris.<br>• No evidence of disturbance to ground layer with presence of potential shelter sites (i.e. fallen timber and ground litter, cracks in alluvial clay soils) |

| Component | Level | Score | Description |
|---|---|---|---|
| Species mobility capacity | Severely restricted (76–100% reduction) | 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.<br>• 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. |
| | Highly restricted (51–75% reduction) | 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. |
| | Moderately restricted (26–50% reduction) | 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<br>• 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. |
| | Minor restriction (0–25% reduction) | 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 | Not or unlikely to be critical to species' survival:<br>Site likely to support only a small or relictual species population or community, not near the geographical limit of the species/community range OR there are very few records for migratory species. | 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Likely to be critical to species' survival:<br>Site supports an important species population for breeding or dispersal, or a community that is a contiguous or functional link between known, important or key source species populations or communities at the landscape to regional scale OR is an important stopover habitat for migratory species. | 3 | • 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Known to be critical to species' survival:<br>Site known to support 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. | 4 | • Evidence of one or more species records within the last 10 years within 15 km of the site AND<br>• The site contains habitat likely to support a population at or lower than average population density for the species, likely to be representative of a sink population from a nearby source metapopulation |
| | Critical to species survival:<br>Site supports a key source species population for breeding and/or dispersal or community at the state to national scale, necessary for maintaining genetic diversity AND/OR the population is outside or near the geographical limit of the species/community range OR is critical stopover habitat for migratory species at the national or state scale. | 5 | • Evidence of one or more species records within the last 10 years within 15 km of the site AND<br>• 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 |

**Table A4: Species habitat index scoring for Dunmall's Snake**

| Component | Level | Score | Description |
|---|---|---|---|
| Threats to species | High threat level (i.e. likely to result in death, irreversible damage): site subject to a high level of threat, whether being part of a highly fragmented system, without and core area, and previous, present and future management realising an ongoing threat | 1 | • Habitat is not protected through legislation and/or is likely to be cleared for development or agricultural land use and/or subject to ongoing degradation.<br>• Overgrazing by livestock resulting in irreversible damage to microhabitat including loss of deep cracks in clay soils, fallen timber and logs.<br>• Known presence of foxes and/or feral cats on site and within adjacent properties and/or known or observed evidence of predation. No active pest animal management on site.<br>• No active fire management on site, with habitat either frequently burnt and/or subject to a high risk of uncontrolled wildfire on site, including from adjacent properties.<br>• Site is not actively managed for conservation purposes and lack of landholder awareness of threatened species habitat and conservation. Removal of fallen timber. |
| | Moderate threat level: site subject to a moderate, realised level of threat, being part of a fragmented system, with edge effects resulting in a high edge/core area ratio and/or with previous, present and future management resulting in a moderate level of threat | 7 | • Habitat is not protected through legislation and is unlikely to be cleared for development or agricultural land use.<br>• Strategic pulse livestock grazing resulting in irreversible damage to critical microhabitat including deep cracks in clay soils, fallen timber and logs.<br>• Foxes and/or feral cats observed on site or within adjacent properties and/or limited evidence of known or observed predation. Active pest animal management implemented on site.<br>• Active fire management and/or low risk of uncontrolled wildfire on site, including from adjacent properties. |
| | Low threat level (i.e. likely to survive): no actual or realised threats occur on or near the site. Site not part of fragmented system, with no edge effects, and no immediate threat from present or future management | 15 | • No foxes and/or feral cats observed or known within the vicinity of the site and no known or observed evidence of predation. Successful active pest animal management implemented on site.<br>• Habitat protected as part of a legally binding mechanism for an offset and/or National Park and/or Nature Refuge, with management aimed at maintaining or improving habitat.<br>• Livestock grazing always excluded from habitat (except for need for fuel load control through strategic grazing, if required)<br>• Active fire management, with controlled burns on site and low risk of uncontrolled wildfire on site, including from adjacent properties.<br>• Site is actively managed for conservation purposes to enhance habitat for threatened species. |
| Quality and availability of food and foraging habitat | Poor: Very limited species-specific habitat, conditions or resources available | 1 | • Overall BioCondition score <5 AND<br>• <50% of the RE benchmark value for coarse woody debris OR leaf litter OR<br>• <50% of the RE benchmark value for coarse woody debris AND leaf litter<br>• Highly disturbed ground layer |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 5 | • Overall BioCondition score >5 - <8 AND<br>• 50-90% of the RE benchmark for attributes coarse woody debris OR leaf litter OR<br>• 50-90% of the RE benchmark for attributes coarse woody debris AND leaf litter<br>• Evidence of some disturbance to ground layer reducing habitat condition for known food sources, e.g. small skinks and geckos. |
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 10 | • Overall BioCondition score >8 AND<br>• >90% of the RE benchmark for attributes coarse woody debris OR leaf litter OR<br>• >90% of the RE benchmark for attributes coarse woody debris AND leaf litter<br>• Limited evidence of disturbance to ground layer likely to support known food sources, e.g. small skinks and geckos. |
| Quality and availability of shelter | Poor: Very limited species-specific habitat, conditions or resources available | 1 | • Overall BioCondition score <5 OR<br>• <50% of the RE benchmark value for coarse woody debris<br>• Limited evidence of potential shelter habitat |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 5 | • Overall BioCondition score >5 - <8 OR<br>• 50-90% of the RE benchmark for coarse woody debris.<br>• Evidence of disturbance to ground layer with presence of potential shelter sites (i.e. fallen timber and ground litter, cracks in alluvial clay soils) |

| Component | Level | Score | Description |
|---|---|---|---|
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 10 | • Overall BioCondition score >8 AND<br>• >90% of the RE benchmark for coarse woody debris<br>• No evidence of disturbance to ground layer with presence of potential shelter sites (i.e. fallen timber and ground litter, cracks in alluvial clay soils) |
| Species mobility capacity | Severely restricted (76–100% reduction) | 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.<br>• 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. |
| | Highly restricted (51–75% reduction) | 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. |
| | Moderately restricted (26–50% reduction) | 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<br>• 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. |
| | Minor restriction (0–25% reduction) | 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 | Not or unlikely to be critical to species' survival<br>Site likely to support only a small or relictual species population or community, not near the geographical limit of the species/community range OR there are very few records for migratory species. | 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Likely to be critical to species' survival:<br>Site supports an important species population for breeding or dispersal, or a community that is a contiguous or functional link between known, important or key source species populations or communities at the landscape to regional scale OR is an important stopover habitat for migratory species. | 3 | • 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Known to be critical to species' survival:<br>Site known to support 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. | 4 | • Evidence of one or more species records within the last 10 years within 15 km of the site AND<br>• The site contains habitat likely to support a population at or lower than average population density for the species, likely to be representative of a sink population from a nearby source metapopulation |
| | Critical to species survival<br>Site supports a key source species population for breeding and/or dispersal or community at the state to national scale, necessary for maintaining genetic diversity AND/OR the population is outside or near the geographical limit of the species/community range OR is critical stopover habitat for migratory species at the national or state scale. | 5 | • Evidence of one or more species records within the last 10 years within 15 km of the site AND<br>• 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 |

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**Table A5: Species habitat index scoring for Yakka Skink**

| Component | Level | Score | Description |
|---|---|---|---|
| Threats to species | High threat level (i.e. likely to result in death, irreversible damage): site subject to a high level of threat, whether being part of a highly fragmented system, without and core area, and previous, present and future management realising an ongoing threat | 1 | • Habitat is not protected through legislation and/or is likely to be cleared for development or agricultural land use and/or subject to ongoing degradation.<br>• Overgrazing by livestock resulting in irreversible damage to microhabitat including logs, dense leaf litter and fallen bark.<br>• Known presence of foxes and/or feral cats on site and within adjacent properties and/or known or observed evidence of predation. No active pest animal management on site.<br>• No active fire management on site, with habitat either frequently burnt and/or subject to a high risk of uncontrolled wildfire on site, including from adjacent properties.<br>• Site is not actively managed for conservation purposes and lack of landholder awareness of threatened species habitat and conservation. Removal of fallen timber. |
| | Moderate threat level: site subject to a moderate, realised level of threat, being part of a fragmented system, with edge effects resulting in a high edge/core area ratio and/or with previous, present and future management resulting in a moderate level of threat | 7 | • Habitat is not protected through legislation and is unlikely to be cleared for development or agricultural development or subject to ongoing degradation.<br>• Strategic pulse livestock grazing resulting in irreversible damage to critical microhabitat including logs, dense leaf litter and fallen bark.<br>• Foxes and/or feral cats observed on site or within adjacent properties and/or limited evidence of known or observed predation. Active pest animal management implemented on site.<br>• Active fire management and/or low risk of uncontrolled wildfire on site, including from adjacent properties. |
| | Low threat level (i.e. likely to survive): no actual or realised threats occur on or near the site. Site not part of fragmented system, with no edge effects, and no immediate threat from present or future management | 15 | • No foxes and/or feral cats observed or known within the vicinity of the site and no known or observed evidence of predation. Successful active pest animal management implemented on site.<br>• Habitat protected as part of a legally binding mechanism for an offset and/or National Park and/or Nature Refuge, with management aimed at maintaining or improving habitat.<br>• Livestock grazing always excluded from habitat (except for need for fuel load control through strategic grazing, if required)<br>• Active fire management, with controlled burns on site and low risk of uncontrolled wildfire on site, including from adjacent properties.<br>• Site is actively managed for conservation purposes to enhance habitat for threatened species. |
| Quality and availability of food and foraging habitat | Poor: Very limited species-specific habitat, conditions or resources available | 1 | • Overall BioCondition score <5 AND<br>• <50% of the RE benchmark value for coarse woody debris OR leaf litter OR<br>• <50% of the RE benchmark value for coarse woody debris AND leaf litter<br>• Highly disturbed ground layer |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 5 | • Overall BioCondition score >5 - <8 AND<br>• 50-90% of the RE benchmark for attributes coarse woody debris OR leaf litter OR<br>• 50-90% of the RE benchmark for attributes coarse woody debris AND leaf litter<br>• Evidence of some disturbance to ground layer reducing habitat condition for known food sources, e.g. soft plant materials and fruits and a wide variety of invertebrates. |
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 10 | • Overall BioCondition score >8 AND<br>• >90% of the RE benchmark for attributes coarse woody debris OR leaf litter OR<br>• >90% of the RE benchmark for attributes coarse woody debris AND leaf litter<br>• Limited evidence of disturbance to ground layer likely to support known food sources, e.g. soft plant materials and fruits and a wide variety of invertebrates. |
| Quality and availability of shelter | Poor: Very limited species-specific habitat, conditions or resources available | 1 | • Overall BioCondition score <5 OR<br>• <50% of the RE benchmark value for coarse woody debris<br>• Limited evidence of potential shelter habitat |
| | Moderate: Species-specific habitat, conditions or resources for most relevant stages of the life cycle are present, yet limited | 5 | • Overall BioCondition score >5 - <8 OR<br>• 50-90% of the RE benchmark for coarse woody debris.<br>• Evidence of disturbance to ground layer with presence of potential shelter sites (i.e. cavities under and between partly buried rocks, logs or tree stumps, root cavities and abandoned animal burrows, large hollow logs) |

| Component | Level | Score | Description |
|---|---|---|---|
| | High: Species-specific habitat, conditions or resources for all relevant stages of the life cycle present | 10 | • Overall BioCondition score >8 AND<br>• >90% of the RE benchmark for coarse woody debris.<br>• No evidence of disturbance to ground layer with presence of potential shelter sites (i.e. cavities under and between partly buried rocks, logs or tree stumps, root cavities and abandoned animal burrows, large hollow logs) |
| Species mobility capacity | Severely restricted (76–100% reduction) | 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.<br>• 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. |
| | Highly restricted (51–75% reduction) | 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. |
| | Moderately restricted (26–50% reduction) | 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<br>• 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. |
| | Minor restriction (0–25% reduction) | 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 | Not or unlikely to be critical to species' survival<br>Site likely to support only a small or relictual species population or community, not near the geographical limit of the species/community range OR there are very few records for migratory species. | 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Likely to be critical to species' survival<br>Site supports an important species population for breeding or dispersal, or a community that is a contiguous or functional link between known, important or key source species populations or communities at the landscape to regional scale OR is an important stopover habitat for migratory species. | 3 | • 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<br>• The site is likely to support only a small or relictual population of the species. |
| | Known to be critical to species' survival:<br>Site known to support 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. | 4 | • Evidence of one or more species records within the last 10 years within 15 km of the site AND<br>• The site contains habitat likely to support a population at or lower than average population density for the species, likely to be representative of a sink population from a nearby source metapopulation |
| | Critical to species survival<br>Site supports a key source species population for breeding and/or dispersal or community at the state to national scale, necessary for maintaining genetic diversity AND/OR the population is outside or near the geographical limit of the species/community range OR is critical stopover habitat for migratory species at the national or state scale. | 5 | • Evidence of one or more species records within the last 10 years within 15 km of the site<br>AND<br>• 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 |

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# APPENDIX B

## Baseline habitat quality score for Cobbadah offset area

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**Table B1: Cobbadah offset habitat quality assessment based on May 2017 and August 2020 surveys (sites COB01 – COB08)**

| Ecological condition indicators | Site COB01 RE 11.8.5 | | | Site COB02 RE 11.8.3 | | | Site COB03 RE 11.9.5 | | | Site COB04 RE 11.8.5 | | | Site COB05 RE 11.9.2 | | | Site COB06 RE 11.9.7 | | | Site COB07 RE 11.9.2 | | | Site COB08 RE 11.9.4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw data | Benchmark (11.8.5) | Score | Raw data | Benchmark (11.8.3) | Score | Raw data | Benchmark (11.9.5 [west]) | Score | Raw data | Benchmark (11.8.5) | Score | Raw data | Benchmark (11.3.6)[A] | Score | Raw data | Benchmark (11.9.7) | Score | Raw data | Benchmark (11.3.6)[A] | Score | Raw data | Benchmark (11.9.4a) | Score |
| **Recruitment of woody perennial species** | **100** | **100** | **5** | **100** | **100** | **5** | **100** | **100** | **5** | **100** | **100** | **5** | **0** | **100** | **0** | **100** | **100** | **5** | **100** | **100** | **5** | **100** | **100** | **5** |
| Native plant species richness - trees | 5 | 2 | 5 | 5 | 15 | 3 | 6 | 4 | 5 | 5 | 2 | 5 | 5 | 3 | 5 | 5 | 3 | 5 | 5 | 3 | 5 | 15 | 16 | 5 |
| Native plant species richness - shrubs | 15 | 3 | 5 | 18 | 15 | 5 | 6 | 5 | 5 | 6 | 3 | 5 | 1 | 3 | 3 | 3 | 5 | 3 | 3 | 3 | 5 | 11 | 14 | 3 |
| Native plant species richness - grasses | 6 | 6 | 5 | 5 | 2 | 5 | 5 | 5 | 5 | 8 | 6 | 5 | 9 | 9 | 5 | 9 | 9 | 5 | 12 | 9 | 5 | 3 | 1 | 5 |
| Native plant species richness - forbs | 4 | 16 | 3 | 8 | 14 | 3 | 9 | 10 | 3 | 7 | 16 | 3 | 8 | 10 | 3 | 16 | 28 | 3 | 18 | 10 | 5 | 9 | 9 | 5 |
| Tree canopy height | 22 | 15 | 5 | 9.52 | 7 | 5 | 9.8 | 15 | 4 | 16.79 | 15 | 5 | 14.8 | 20 | 5 | 20.2 | 16 | 5 | 13 | 20 | 3 | 10.7 | 11 | 5 |
| Tree sub canopy height | 12 | 5 | | 4.8 | 3 | | 6.3 | 8 | | 8.85 | 5 | | - | - | | 10.2 | 9 | | - | - | | 6.1 | 7 | |
| Tree canopy cover | 81 | 13 | 3 | 56.3 | 62 | 5 | 52 | 32 | 5 | 30.5 | 13 | 3 | 40.5 | 23 | 5 | 52.1 | 27 | 5 | 52.3 | 23 | 3 | 73.3 | 54 | 5 |
| Tree sub canopy cover | 31.3 | 3 | | 27.3 | 17 | | 23.9 | 30 | | 24.5 | 3 | | - | - | | 14.7 | 12 | | - | - | | 22 | 23 | |
| Shrub canopy cover | 24.5 | 2 | 3 | 24.4 | 27 | 5 | 4.6 | 19 | 3 | 16.6 | 2 | 3 | 0 | 1 | 0 | 10 | 1 | 3 | 1.8 | 1 | 5 | 39.2 | 41 | 5 |
| Native perennial grass cover | 32 | 60 | 3 | 12.4 | 5 | 5 | 9 | 30 | 1 | 20 | 60 | 1 | 21 | 40 | 3 | 32 | 26 | 5 | 34 | 40 | 3 | 6 | 4 | 5 |
| Organic litter | 33 | 25 | 5 | 33.6 | 45 | 5 | 55 | 49 | 5 | 30 | 25 | 5 | 22 | 35 | 5 | 40.4 | 15 | 3 | 20 | 35 | 5 | 47 | 32 | 5 |
| Large eucalypt trees | 14 | 6 | 15 | - | - | 10 | - | - | 15 | 14 | 6 | 15 | 2 | 20 | 5 | 10 | 14 | 15 | 0 | 20 | 0 | - | - | 15 |
| Large non-eucalypt trees | - | - | | 40 | 70 | | 24 | 10 | | - | - | | - | - | | 14 | 2 | | - | - | | 88 | 17 | |
| Coarse woody debris | 251 | 250 | 5 | 229 | 944 | 2 | 815 | 688 | 5 | 185 | 250 | 5 | 187 | 300 | 5 | 205 | 287 | 5 | 399 | 300 | 5 | 340 | 944 | 2 |
| Non-native plant cover | 0 | 0 | 10 | 0.6 | 0 | 10 | 0.45 | 0 | 10 | 1.1 | 0 | 10 | 37.75 | 0 | 3 | 9.25 | 0 | 5 | 16.25 | 0 | 5 | 0 | 0 | 10 |
| **Total** | | | **72** | | | **68** | | | **71** | | | **70** | | | **47** | | | **67** | | | **54** | | | **75** |
| **/10** | | | **9.00** | | | **8.50** | | | **8.88** | | | **8.75** | | | **5.88** | | | **8.38** | | | **6.75** | | | **9.38** |

[A] In the absence of benchmark for RE 11.9.2 at the time of assessment, RE 11.3.6 as it is a comparable RE from the same broad vegetation group (BVG 17b).

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**Table B2: Cobbadah offset habitat quality assessment based on May 2017 and August 2020 surveys (sites COB09 – COB16)**

| Ecological condition indicators | Site COB09 RE 11.9.4 | | | Site COB10 RE 11.9.4 (regrowth) | | | Site COB11 RE 11.9.4 | | | Site COB12 RE 11.9.7 | | | Site COB13 RE 11.9.2 | | | Site COB14 RE 11.9.7 | | | Site COB15 RE 11.9.2 | | | Site COB16 RE 11.9.7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw data | Benchmark (11.9.4a) | Score | Raw data | Benchmark (11.9.4a) | Score | Raw data | Benchmark (11.9.4a) | Score | Raw data | Benchmark (11.9.7) | Score | Raw data | Benchmark (11.3.6)[A] | Score | Raw data | Benchmark (11.9.7) | Score | Raw data | Benchmark (11.3.6)[A] | Score | Raw data | Benchmark (11.9.7) | Score |
| **Recruitment of woody perennial species** | **100** | **100** | **5** | **100** | **100** | **5** | **100** | **100** | **5** | **100** | **100** | **5** | **100** | **100** | **5** | **50** | **100** | **3** | **100** | **100** | **5** | **100** | **100** | **5** |
| Native plant species richness - trees | 12 | 16 | 3 | 10 | 16 | 3 | 11 | 16 | 3 | 10 | 3 | 5 | 3 | 3 | 5 | 8 | 3 | 5 | 4 | 3 | 5 | 6 | 3 | 5 |
| Native plant species richness - shrubs | 12 | 14 | 3 | 13 | 14 | 5 | 17 | 14 | 5 | 7 | 5 | 5 | 3 | 3 | 5 | 7 | 5 | 5 | 1 | 3 | 3 | 7 | 5 | 5 |
| Native plant species richness - grasses | 5 | 1 | 5 | 8 | 1 | 5 | 4 | 1 | 5 | 11 | 9 | 5 | 14 | 9 | 5 | 11 | 9 | 5 | 7 | 9 | 3 | 10 | 9 | 5 |
| Native plant species richness - forbs | 10 | 9 | 5 | 9 | 9 | 5 | 9 | 9 | 5 | 13 | 28 | 3 | 7 | 10 | 3 | 11 | 28 | 3 | 12 | 10 | 5 | 8 | 28 | 3 |
| Tree canopy height | 12.8 | 11 | 5 | 6.7 | 11 | 1.5 | 11.3 | 11 | 5 | 16.8 | 16 | 5 | 13 | 20 | 3 | 20 | 16 | 5 | 15 | 20 | 5 | 18.7 | 16 | 5 |
| Tree sub canopy height | 7 | 7 | | 0 | 7 | | 7 | 7 | | 9.4 | 9 | | - | - | | 11 | 9 | | - | - | | 14.4 | 9 | |
| Tree canopy cover | 35 | 54 | 5 | 21.4 | 54 | 1 | 48.7 | 54 | 5 | 39 | 27 | 5 | 23 | 23 | 5 | 41 | 27 | 4 | 47.2 | 23 | 3 | 55.6 | 27 | 4 |
| Tree sub canopy cover | 32.8 | 23 | | 0 | 23 | | 25.4 | 23 | | 17.6 | 12 | | - | - | | 41 | 12 | | - | - | | 11 | 12 | |
| Shrub canopy cover | 33.4 | 41 | 5 | 44.4 | 41 | 5 | 81.6 | 41 | 5 | 7 | 1 | 3 | 0.8 | 1 | 5 | 9.8 | 1 | 3 | | 1 | 0 | 4.1 | 1 | 3 |
| Native perennial grass cover | 12 | 4 | 5 | 34 | 4 | 5 | 3 | 4 | 3 | 30 | 26 | 5 | 40 | 40 | 5 | 29 | 26 | 5 | 37 | 40 | 5 | 46 | 26 | 5 |
| Organic litter | 51 | 32 | 5 | 30 | 32 | 5 | 32 | 32 | 5 | 43 | 15 | 3 | 22 | 35 | 5 | 42.4 | 15 | 3 | 40 | 35 | 5 | 29 | 15 | 5 |
| Large eucalypt trees | - | - | 15 | - | - | 15 | - | - | 15 | 8 | 14 | 10 | 0 | 20 | 0 | 10 | 14 | 10 | 4 | 20 | 5 | 11 | 14 | 15 |
| Large non-eucalypt trees | 86 | 17 | | 24 | 17 | | 104 | 17 | | 8 | 2 | | - | - | | 1 | 2 | | - | - | | 6 | 2 | |
| Coarse woody debris | 645 | 944 | 5 | 113 | 944 | 2 | 825 | 944 | 5 | 394 | 287 | 5 | 69 | 300 | 2 | 225 | 287 | 5 | 222 | 300 | 5 | 132 | 287 | 2 |
| Non-native plant cover | 0.35 | 0 | 10 | 29.5 | 0 | 3 | 2 | 0 | 10 | 2.65 | 0 | 10 | 12.35 | 0 | 5 | 26 | 0 | 3 | 13.1 | 0 | 5 | 8.45 | 0 | 5 |
| **Total** | | | **76** | | | **60.5** | | | **76** | | | **69** | | | **53** | | | **59** | | | **54** | | | **67** |
| **/10** | | | **9.50** | | | **7.56** | | | **9.50** | | | **8.63** | | | **6.63** | | | **7.38** | | | **6.75** | | | **8.38** |

[A] In the absence of benchmark for RE 11.9.2 at the time of assessment, RE 11.3.6 as it is a comparable RE from the same broad vegetation group (BVG 17b).

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**Table B3: Cobbadah offset habitat quality assessment based on May 2017 and August 2020 surveys (sites COB17 – COB21)**

| Ecological condition indicators | Site COB17 RE 11.9.5 | | | Site COB18 RE 11.8.5 | | | Site COB19 RE 11.3.2 | | | Site COB20 RE 11.3.2 | | | Site COB21 RE 11.3.2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw data | Benchmark (11.9.5) | Score | Raw data | Benchmark (11.8.5) | Score | Raw data | Benchmark (11.3.2) | Score | Raw data | Benchmark (11.3.2) | 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 | 0 | 100 | 0 |
| Native plant species richness - trees | 5 | 4 | 5 | 4 | 2 | 5 | 4 | 2 | 5 | 5 | 2 | 5 | 5 | 2 | 5 |
| Native plant species richness - shrubs | 7 | 5 | 5 | 9 | 3 | 5 | 4 | 2 | 5 | 3 | 2 | 5 | 0 | 2 | 2.5 |
| Native plant species richness - grasses | 6 | 5 | 5 | 7 | 6 | 5 | 16 | 9 | 5 | 14 | 9 | 5 | 10 | 9 | 5 |
| Native plant species richness - forbs | 10 | 10 | 5 | 8 | 16 | 3 | 12 | 17 | 3 | 11 | 17 | 3 | 14 | 17 | 3 |
| Tree canopy height | 15.7 | 15 | 5 | 21.4 | 15 | 5 | 16.8 | 18 | 5 | 18.8 | 18 | 5 | 20 | 18 | 5 |
| Tree sub canopy height | 9.2 | 8 | | 10.6 | 5 | | - | - | | - | - | | - | - | |
| Tree canopy cover | 63 | 32 | 5 | 55 | 13 | 3 | 39.3 | 40 | 5 | 62.3 | 40 | 5 | 52.5 | 40 | 5 |
| Tree sub canopy cover | 51.3 | 30 | | 16.3 | 3 | | - | - | | - | - | | - | - | |
| Shrub canopy cover | 1 | 19 | 0 | 21.4 | 2 | 3 | 3.1 | 2 | 5 | 1.5 | 2 | 5 | 0 | 2 | 0 |
| Native perennial grass cover | 37 | 30 | 5 | 37 | 60 | 3 | 31 | 35 | 3 | 24 | 35 | 3 | 25 | 35 | 3 |
| Organic litter | 56 | 49 | 5 | 37 | 25 | 5 | 38 | 30 | 5 | 36 | 30 | 5 | 34 | 30 | 5 |
| Large eucalypt trees | - | - | 15 | 9 | 6 | 15 | 1 | 22 | 5 | 0 | 22 | 0 | 4 | 22 | 5 |
| Large non-eucalypt trees | 36 | 10 | | - | - | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Coarse woody debris | 2016 | 688 | 2 | 413 | 250 | 5 | 146 | 307 | 2 | 117 | 307 | 2 | 413 | 307 | 5 |
| Non-native plant cover | 0.3 | 0 | 10 | 6.1 | 0 | 5 | 5 | 0 | 5 | 3 | 0 | 10 | 2.75 | 0 | 10 |
| **Total** | | | **72** | | | **67** | | | **58** | | | **58** | | | **53.5** |
| **/10** | | | **9.00** | | | **8.38** | | | **7.25** | | | **7.25** | | | **6.69** |

**Table B4: Summary of the MNES habitat quality score for each RE assessment unit contributing to the Cobbadah offset area**

| Assessment unit habitat quality score /10 | Site COB01 RE 11.8.5 | Site COB03 RE 11.9.5 | Site COB04 RE 11.8.5 | Site COB05 RE 11.9.2 | Site COB06 RE 11.9.7 | Site COB07 RE 11.9.2 | Site COB12 RE 11.9.7 | Site COB13 RE 11.9.2 | Site COB14 RE 11.9.7 | Site COB15 RE 11.9.2 | Site COB16 RE 11.9.7 | Site COB17 RE 11.9.5 | Site COB18 RE 11.8.5 | Site COB19 RE 11.3.2 | Site COB20 RE 11.3.2 | Site COB21 RE 11.3.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brigalow TEC** | | | | | | | | | | | | | | | | |
| Site condition score (/80) – 60% of final score | | 71 | | | | | | | | | | 72 | | | | |
| Site context score (/26) – 40% of final score | | 25 | | | | | | | | | | 25 | | | | |
| Habitat quality score (/10) | | 9.17 | | | | | | | | | | 9.25 | | | | |
| **Collared Delma** | | | | | | | | | | | | | | | | |
| Site condition score (/80) – 30% of final score | 72 | 71 | 70 | 47 | 67 | 54 | 69 | 53 | 59 | 54 | 67 | 72 | 67 | 58 | 58 | 54 |
| Site context score (/26) – 30% of final score | 26 | 25 | 26 | 23 | 22 | 25 | 22 | 19 | 22 | 19 | 22 | 25 | 25 | 18 | 16 | 18 |
| Species habitat index score (/50) – 40% of final score | 40 | 40 | 40 | 24 | 34 | 24 | 34 | 20 | 24 | 24 | 20 | 40 | 40 | 23 | 23 | 27 |
| Habitat quality score (/10) | 8.90 | 8.75 | 8.83 | 6.34 | 7.77 | 6.83 | 7.85 | 5.78 | 6.67 | 6.14 | 6.65 | 8.78 | 8.60 | 6.09 | 5.86 | 6.24 |
| **Dunmall's Snake** | | | | | | | | | | | | | | | | |
| Site condition score (/80) – 30% of final score | 72 | 71 | 70 | 47 | 67 | 54 | 69 | 53 | 59 | 54 | 67 | 72 | 67 | 58 | 58 | 54 |
| Site context score (/26) – 30% of final score | 26 | 25 | 26 | 23 | 22 | 25 | 22 | 19 | 22 | 19 | 22 | 25 | 25 | 18 | 16 | 18 |
| Species habitat index score (/50) – 40% of final score | 40 | 40 | 40 | 24 | 34 | 24 | 34 | 20 | 24 | 24 | 20 | 40 | 40 | 23 | 23 | 27 |
| Habitat quality score (/10) | 8.90 | 8.75 | 8.83 | 6.34 | 7.77 | 6.83 | 7.85 | 5.78 | 6.67 | 6.14 | 6.65 | 8.78 | 8.60 | 6.09 | 5.86 | 6.24 |
| **Yakka Skink** | | | | | | | | | | | | | | | | |
| Site condition score (/80) – 30% of final score | 72 | 71 | 70 | 47 | 67 | 54 | 69 | 53 | 59 | 54 | 67 | 72 | 67 | 58 | 58 | 54 |
| Site context score (/26) – 30% of final score | 26 | 25 | 26 | 23 | 22 | 25 | 22 | 19 | 22 | 19 | 22 | 25 | 25 | 18 | 16 | 18 |
| Species habitat index score (/50) – 40% of final score | 40 | 40 | 40 | 24 | 34 | 24 | 34 | 20 | 24 | 24 | 20 | 40 | 40 | 23 | 23 | 27 |
| Habitat quality score (/10) | 5.70 | 8.75 | 8.83 | 6.34 | 7.77 | 6.83 | 7.85 | 5.78 | 6.67 | 6.14 | 6.65 | 8.78 | 8.60 | 6.09 | 5.86 | 6.24 |
| **Koala** | | | | | | | | | | | | | | | | |
| Site condition score (/80) – 30% of final score | - | - | 70 | 47 | 67 | 54 | 69 | 53 | 59 | 54 | 67 | - | 67 | 58 | 58 | 54 |
| Site context score (/26) – 30% of final score | - | - | 26 | 23 | 22 | 25 | 22 | 19 | 22 | 19 | 22 | - | 25 | 18 | 16 | 18 |
| Species habitat index score (/50) – 40% of final score | - | - | 34 | 30 | 35 | 25 | 35 | 25 | 35 | 30 | 35 | - | 34 | 25 | 25 | 35 |
| Habitat quality score (/10) | - | - | 8.35 | 6.82 | 7.85 | 6.91 | 7.93 | 6.18 | 7.55 | 6.62 | 7.85 | | 8.12 | 6.25 | 6.02 | 6.88 |

| Assessment unit habitat quality score /10 | Site COB01 RE 11.8.5 | Site COB03 RE 11.9.5 | Site COB04 RE 11.8.5 | Site COB05 RE 11.9.2 | Site COB06 RE 11.9.7 | Site COB07 RE 11.9.2 | Site COB12 RE 11.9.7 | Site COB13 RE 11.9.2 | Site COB14 RE 11.9.7 | Site COB15 RE 11.9.2 | Site COB16 RE 11.9.7 | Site COB17 RE 11.9.5 | Site COB18 RE 11.8.5 | Site COB19 RE 11.3.2 | Site COB20 RE 11.3.2 | Site COB21 RE 11.3.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**South-eastern Long-eared Bat**

| Assessment unit habitat quality score /10 | Site COB01 RE 11.8.5 | Site COB03 RE 11.9.5 | Site COB04 RE 11.8.5 | Site COB05 RE 11.9.2 | Site COB06 RE 11.9.7 | Site COB07 RE 11.9.2 | Site COB12 RE 11.9.7 | Site COB13 RE 11.9.2 | Site COB14 RE 11.9.7 | Site COB15 RE 11.9.2 | Site COB16 RE 11.9.7 | Site COB17 RE 11.9.5 | Site COB18 RE 11.8.5 | Site COB19 RE 11.3.2 | Site COB20 RE 11.3.2 | Site COB21 RE 11.3.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site condition score (/80) – 30% of final score | 72 | 71 | 70 | 47 | 67 | 54 | 69 | 53 | 59 | 54 | 67 | 72 | 67 | 58 | 58 | 54 |
| Site context score (/26) – 30% of final score | 26 | 25 | 26 | 23 | 22 | 25 | 22 | 19 | 22 | 19 | 22 | 25 | 25 | 18 | 16 | 18 |
| Species habitat index score (/50) – 40% of final score | 37 | 37 | 37 | 27 | 37 | 27 | 37 | 32 | 27 | 27 | 37 | 37 | 37 | 27 | 27 | 27 |
| Habitat quality score (/10) | 8.66 | 8.51 | 8.59 | 6.58 | 8.01 | 7.07 | 8.09 | 6.74 | 6.91 | 6.38 | 8.01 | 8.54 | 8.36 | 6.41 | 6.18 | 6.24 |

**Table B5: Final area-weighted habitat quality score for each MNES to adopt in the *Offsets assessment guide* (OAG)**

| RE | 11.3.2 | 11.8.5 | 11.9.2 | 11.9.5 | 11.9.7 |
|---|---|---|---|---|---|
| **Offset area (ha)** | **-** | **-** | **-** | **72.2** | **-** |
| Average habitat quality score | - | - | - | 9.21 | - |
| Area-weighted contribution to habitat quality score | - | - | - | 9.21 | - |
| **Final OAG habitat quality score** | | | **9** | | |
| Offset area (ha) | 173.8 | 101.5 | 107.2 | 72.2 | 103 |
| Average habitat quality score | 6.07 | 7.71 | 6.27 | 8.77 | 7.23 |
| Area-weighted contribution to habitat quality score | 1.89 | 1.60 | 1.21 | 1.13 | 1.34 |
| **Final OAG habitat quality score** | | | **7** | | |
| Offset area (ha) | 173.8 | 101.5 | 107.2 | 72.2 | 103 |
| Average habitat quality score | 6.07 | 7.71 | 6.27 | 8.77 | 7.23 |
| Area-weighted contribution to habitat quality score | 1.89 | 1.60 | 1.21 | 1.13 | 1.34 |
| **Final OAG habitat quality score** | | | **7** | | |
| Offset area (ha) | 173.8 | 101.5 | 107.2 | 72.2 | 103 |
| Average habitat quality score | 6.07 | 7.71 | 6.27 | 8.77 | 7.23 |
| Area-weighted contribution to habitat quality score | 1.89 | 1.40 | 1.21 | 1.13 | 1.34 |
| **Final OAG habitat quality score** | | | **7** | | |
| Offset area (ha) | 173.8 | 101.5 | 107.2 | - | 103 |
| Average habitat quality score | 6.39 | 7.39 | 6.63 | - | 7.79 |
| Area-weighted contribution to habitat quality score | 2.29 | 1.54 | 1.46 | - | 1.65 |
| **Final OAG habitat quality score** | | | **7** | | |
| Offset area (ha) | 173.8 | 101.5 | 107.2 | 72.2 | 103 |
| Average habitat quality score | 6.28 | 8.53 | 6.69 | 8.53 | 7.75 |
| Area-weighted contribution to habitat quality score | 1.96 | 4.55 | 1.29 | 1.10 | 1.43 |
| **Final OAG habitat quality score** | | | **7** | | |

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# APPENDIX C

## Offset area coordinates

| Point | X coordinate | Y coordinate |
|---|---|---|
| 1 | 631407 | 7146850 |
| 2 | 631650 | 7146825 |
| 3 | 631741 | 7146713 |
| 4 | 631863 | 7146710 |
| 5 | 631931 | 7146745 |
| 6 | 632292 | 7146638 |
| 7 | 632654 | 7146852 |
| 8 | 632835 | 7147191 |
| 9 | 632925 | 7147180 |
| 10 | 632988 | 7147067 |
| 11 | 632964 | 7147001 |
| 12 | 633043 | 7146955 |
| 13 | 633021 | 7146816 |
| 14 | 632945 | 7146812 |
| 15 | 632905 | 7146848 |
| 16 | 632885 | 7146881 |
| 17 | 632835 | 7146881 |
| 18 | 632822 | 7146845 |
| 19 | 632766 | 7146789 |
| 20 | 632544 | 7146650 |
| 21 | 632495 | 7146657 |
| 22 | 632402 | 7146617 |
| 23 | 632386 | 7146577 |
| 24 | 632415 | 7146547 |
| 25 | 632485 | 7146554 |
| 26 | 632505 | 7146574 |
| 27 | 632528 | 7146561 |
| 28 | 632528 | 7146508 |
| 29 | 632541 | 7146481 |
| 30 | 632541 | 7146394 |
| 31 | 632463 | 7146251 |
| 32 | 632149 | 7146126 |
| 33 | 631686 | 7145837 |
| 34 | 631276 | 7145876 |
| 35 | 633741 | 7146956 |
| 36 | 633874 | 7146961 |
| 37 | 634056 | 7147083 |
| 38 | 634115 | 7147087 |
| 39 | 634145 | 7147123 |
| 40 | 634148 | 7147159 |
| 41 | 634138 | 7147202 |
| 42 | 634145 | 7147328 |
| 43 | 634205 | 7147371 |
| 44 | 634327 | 7147401 |
| 45 | 634416 | 7147424 |
| 46 | 634463 | 7147424 |
| 47 | 634578 | 7147473 |
| 48 | 634517 | 7147670 |
| 49 | 634612 | 7147749 |
| 50 | 634811 | 7147807 |
| 51 | 634863 | 7147773 |
| 52 | 634924 | 7147860 |
| 53 | 635363 | 7147831 |
| 54 | 635475 | 7147937 |
| 55 | 635465 | 7147692 |
| 56 | 635412 | 7147622 |
| 57 | 635349 | 7147579 |
| 58 | 635336 | 7147533 |
| 59 | 635349 | 7147411 |
| 60 | 635350 | 7147356 |
| 61 | 635332 | 7147320 |
| 62 | 635076 | 7147016 |
| 63 | 634992 | 7147053 |
| 64 | 634919 | 7147093 |
| 65 | 634846 | 7147113 |
| 66 | 634807 | 7147110 |
| 67 | 634737 | 7147093 |
| 68 | 634668 | 7147103 |
| 69 | 634595 | 7147100 |
| 70 | 634522 | 7147130 |
| 71 | 634420 | 7147103 |
| 72 | 634357 | 7147100 |
| 73 | 634248 | 7147030 |
| 74 | 634158 | 7147010 |
| 75 | 634115 | 7147030 |
| 76 | 634072 | 7147027 |
| 77 | 633996 | 7146991 |
| 78 | 633990 | 7146931 |
| 79 | 634105 | 7146835 |
| 80 | 634105 | 7146789 |
| 81 | 633978 | 7146780 |
| 82 | 633917 | 7146838 |
| 83 | 633834 | 7146862 |
| 84 | 633742 | 7146847 |
| 85 | 633791 | 7146561 |
| 86 | 633967 | 7146652 |
| 87 | 634048 | 7146653 |
| 88 | 634034 | 7146598 |
| 89 | 633950 | 7146558 |
| 90 | 633945 | 7146526 |
| 91 | 633904 | 7146530 |
| 92 | 633864 | 7146464 |
| 93 | 633865 | 7146412 |
| 94 | 633837 | 7146330 |
| 95 | 633793 | 7146344 |
| 96 | 633816 | 7146439 |
| 97 | 634091 | 7146654 |
| 98 | 634172 | 7146656 |
| 99 | 634168 | 7146629 |
| 100 | 634418 | 7146618 |
| 101 | 634384 | 7146538 |
| 102 | 634387 | 7146499 |

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| Point | X coordinate | Y coordinate |
|---|---|---|
| 103 | 634467 | 7146472 |
| 104 | 634540 | 7146519 |
| 105 | 634583 | 7146522 |
| 106 | 634576 | 7146309 |
| 107 | 634543 | 7145848 |
| 108 | 634516 | 7145768 |
| 109 | 634512 | 7145712 |
| 110 | 634421 | 7145651 |
| 111 | 634387 | 7145659 |
| 112 | 634208 | 7145553 |
| 113 | 634188 | 7145493 |
| 114 | 634188 | 7145423 |
| 115 | 634213 | 7145386 |
| 116 | 634185 | 7145178 |
| 117 | 634118 | 7145138 |
| 118 | 634118 | 7145048 |
| 119 | 634151 | 7145002 |
| 120 | 634177 | 7145003 |
| 121 | 634200 | 7144531 |
| 122 | 634168 | 7144441 |
| 123 | 634131 | 7144281 |
| 124 | 634108 | 7144225 |
| 125 | 634068 | 7144228 |
| 126 | 634015 | 7144267 |
| 127 | 633930 | 7144289 |
| 128 | 633836 | 7144328 |
| 129 | 633768 | 7144336 |
| 130 | 633743 | 7144344 |
| 131 | 633566 | 7144326 |
| 132 | 633484 | 7144338 |
| 133 | 633441 | 7144368 |
| 134 | 633431 | 7144417 |
| 135 | 633391 | 7144447 |
| 136 | 633385 | 7144480 |
| 137 | 633222 | 7144454 |
| 138 | 633152 | 7144547 |
| 139 | 633172 | 7144663 |
| 140 | 633172 | 7144733 |
| 141 | 633161 | 7144825 |
| 142 | 633156 | 7144919 |
| 143 | 633116 | 7145055 |
| 144 | 633082 | 7145081 |
| 145 | 633132 | 7145211 |
| 146 | 633116 | 7145300 |
| 147 | 633126 | 7145470 |
| 148 | 633169 | 7145546 |
| 149 | 633361 | 7145679 |
| 150 | 633441 | 7145682 |
| 151 | 633514 | 7145732 |
| 152 | 633645 | 7146044 |
| 153 | 633704 | 7146017 |
| 154 | 633724 | 7146022 |
| 155 | 633765 | 7146084 |
| 156 | 633865 | 7146039 |
| 157 | 633904 | 7146050 |
| 158 | 633911 | 7146101 |
| 159 | 633886 | 7146161 |
| 160 | 633919 | 7146234 |
| 161 | 633906 | 7146260 |
| 162 | 633939 | 7146329 |
| 163 | 633939 | 7146376 |
| 164 | 633952 | 7146442 |
| 165 | 633906 | 7146479 |
| 166 | 633982 | 7146495 |
| 167 | 634045 | 7146529 |
| 168 | 632100 | 7142851 |
| 169 | 632150 | 7142862 |
| 170 | 632180 | 7142891 |
| 171 | 632212 | 7142898 |
| 172 | 632265 | 7142882 |
| 173 | 632284 | 7142856 |
| 174 | 632295 | 7142773 |
| 175 | 632282 | 7142746 |
| 176 | 632291 | 7142585 |
| 177 | 632290 | 7142555 |
| 178 | 632274 | 7142513 |
| 179 | 632227 | 7142444 |
| 180 | 632320 | 7142505 |
| 181 | 632346 | 7142536 |
| 182 | 632346 | 7142587 |
| 183 | 632324 | 7142603 |
| 184 | 632322 | 7142641 |
| 185 | 632356 | 7142754 |
| 186 | 632348 | 7142788 |
| 187 | 632364 | 7142802 |
| 188 | 632384 | 7142802 |
| 189 | 632400 | 7142812 |
| 190 | 632450 | 7142812 |
| 191 | 632444 | 7142794 |
| 192 | 632458 | 7142769 |
| 193 | 632477 | 7142772 |
| 194 | 632493 | 7142757 |
| 195 | 632492 | 7142743 |
| 196 | 632512 | 7142732 |
| 197 | 632511 | 7142696 |
| 198 | 632531 | 7142648 |
| 199 | 632541 | 7142639 |
| 200 | 632586 | 7142633 |
| 201 | 632602 | 7142622 |
| 202 | 632619 | 7142619 |
| 203 | 632642 | 7142596 |
| 204 | 632639 | 7142571 |
| 205 | 632584 | 7142548 |
| 206 | 632544 | 7142507 |
| 207 | 632517 | 7142492 |
| 208 | 632528 | 7142470 |
| 209 | 632598 | 7142489 |
| 210 | 632620 | 7142518 |
| 211 | 632653 | 7142542 |
| 212 | 632699 | 7142585 |
| 213 | 632747 | 7142596 |
| 214 | 632787 | 7142617 |
| 215 | 632833 | 7142635 |
| 216 | 632846 | 7142655 |
| 217 | 632980 | 7142695 |
| 218 | 633030 | 7142728 |
| 219 | 633068 | 7142710 |

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| Point | X coordinate | Y coordinate |
|---|---|---|
| 220 | 633121 | 7142693 |
| 221 | 633162 | 7142655 |
| 222 | 633185 | 7142654 |
| 223 | 633212 | 7142647 |
| 224 | 633274 | 7142604 |
| 225 | 633317 | 7142578 |
| 226 | 633373 | 7142543 |
| 227 | 633396 | 7142539 |
| 228 | 633440 | 7142472 |
| 229 | 633450 | 7142422 |
| 230 | 633431 | 7142412 |
| 231 | 633370 | 7142443 |
| 232 | 633326 | 7142456 |
| 233 | 633310 | 7142430 |
| 234 | 633333 | 7142399 |
| 235 | 633349 | 7142364 |
| 236 | 633384 | 7142316 |
| 237 | 633426 | 7142243 |
| 238 | 633451 | 7142265 |
| 239 | 633483 | 7142267 |
| 240 | 633527 | 7142255 |
| 241 | 633533 | 7142239 |
| 242 | 633509 | 7142220 |
| 243 | 633505 | 7142189 |
| 244 | 633524 | 7142168 |
| 245 | 633520 | 7142115 |
| 246 | 633469 | 7142079 |
| 247 | 633472 | 7142048 |
| 248 | 633495 | 7142026 |
| 249 | 633461 | 7141981 |
| 250 | 633399 | 7141954 |
| 251 | 633317 | 7141917 |
| 252 | 633291 | 7141924 |
| 253 | 633247 | 7141991 |
| 254 | 633202 | 7142026 |
| 255 | 633179 | 7142021 |
| 256 | 633182 | 7141956 |
| 257 | 633201 | 7141907 |
| 258 | 633097 | 7141916 |
| 259 | 633012 | 7141962 |
| 260 | 632980 | 7141996 |
| 261 | 632930 | 7142014 |
| 262 | 632776 | 7142128 |
| 263 | 632726 | 7142128 |
| 264 | 632694 | 7142096 |
| 265 | 632628 | 7141972 |
| 266 | 632557 | 7141901 |
| 267 | 632520 | 7141837 |
| 268 | 632350 | 7141805 |
| 269 | 632271 | 7141808 |
| 270 | 632094 | 7141787 |
| 271 | 632028 | 7141678 |
| 272 | 632020 | 7141541 |
| 273 | 631947 | 7141463 |
| 274 | 631913 | 7141457 |
| 275 | 633099 | 7142723 |
| 276 | 633158 | 7142702 |
| 277 | 633113 | 7142711 |
| 278 | 633246 | 7142671 |
| 279 | 633362 | 7142630 |
| 280 | 633371 | 7142618 |
| 281 | 633341 | 7142610 |
| 282 | 633521 | 7142341 |
| 283 | 633568 | 7142412 |
| 284 | 633614 | 7142437 |
| 285 | 633649 | 7142444 |
| 286 | 633674 | 7142438 |
| 287 | 633715 | 7142476 |
| 288 | 633748 | 7142476 |
| 289 | 633760 | 7142438 |
| 290 | 633764 | 7142402 |
| 291 | 633751 | 7142384 |
| 292 | 633713 | 7142373 |
| 293 | 633680 | 7142371 |
| 294 | 633651 | 7142299 |
| 295 | 633635 | 7142278 |
| 296 | 633639 | 7142240 |
| 297 | 633654 | 7142197 |
| 298 | 633635 | 7142165 |
| 299 | 633623 | 7142133 |
| 300 | 633590 | 7142125 |
| 301 | 633578 | 7142159 |
| 302 | 633587 | 7142259 |
| 303 | 633565 | 7142278 |
| 304 | 633540 | 7142278 |
| 305 | 633530 | 7142290 |
| 306 | 633530 | 7142319 |
| 307 | 633789 | 7142390 |
| 308 | 633809 | 7142407 |
| 309 | 633840 | 7142379 |
| 310 | 633844 | 7142344 |
| 311 | 633868 | 7142318 |
| 312 | 633884 | 7142293 |
| 313 | 633914 | 7142284 |
| 314 | 633904 | 7142261 |
| 315 | 633881 | 7142233 |
| 316 | 633869 | 7142205 |
| 317 | 633865 | 7142173 |
| 318 | 633849 | 7142138 |
| 319 | 633825 | 7142160 |
| 320 | 633821 | 7142220 |
| 321 | 633814 | 7142258 |
| 322 | 633815 | 7142293 |
| 323 | 633825 | 7142315 |
| 324 | 633796 | 7142335 |
| 325 | 633977 | 7142286 |
| 326 | 634207 | 7142297 |
| 327 | 634248 | 7142293 |
| 328 | 634282 | 7142267 |
| 329 | 634288 | 7142221 |
| 330 | 634288 | 7142170 |
| 331 | 634298 | 7142127 |
| 332 | 634285 | 7142047 |
| 333 | 634303 | 7142025 |
| 334 | 634331 | 7142021 |
| 335 | 634350 | 7142024 |
| 336 | 634296 | 7141666 |

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| Point | X coordinate | Y coordinate |
|---|---|---|
| 337 | 634246 | 7141671 |
| 338 | 634200 | 7141714 |
| 339 | 634155 | 7141744 |
| 340 | 634100 | 7141751 |
| 341 | 633912 | 7141718 |
| 342 | 633767 | 7141746 |
| 343 | 633704 | 7141634 |
| 344 | 633694 | 7141464 |
| 345 | 633708 | 7141385 |
| 346 | 633687 | 7141274 |
| 347 | 633614 | 7141242 |
| 348 | 633465 | 7141236 |
| 349 | 633302 | 7141305 |
| 350 | 633184 | 7141333 |
| 351 | 633073 | 7141416 |
| 352 | 633033 | 7141562 |
| 353 | 633056 | 7141582 |
| 354 | 633112 | 7141578 |

| Point | X coordinate | Y coordinate |
|---|---|---|
| 355 | 633190 | 7141646 |
| 356 | 633200 | 7141718 |
| 357 | 633224 | 7141766 |
| 358 | 633229 | 7141792 |
| 359 | 633228 | 7141874 |
| 360 | 633261 | 7141872 |
| 361 | 633267 | 7141823 |
| 362 | 633262 | 7141780 |
| 363 | 633254 | 7141734 |
| 364 | 633236 | 7141684 |
| 365 | 633246 | 7141651 |
| 366 | 633335 | 7141677 |
| 367 | 633428 | 7141674 |
| 368 | 633464 | 7141719 |
| 369 | 633489 | 7141775 |
| 370 | 633521 | 7141824 |
| 371 | 633582 | 7141892 |
| 372 | 633616 | 7141932 |

| Point | X coordinate | Y coordinate |
|---|---|---|
| 373 | 633630 | 7141986 |
| 374 | 633674 | 7142009 |
| 375 | 633750 | 7141999 |
| 376 | 633808 | 7142007 |
| 377 | 633818 | 7142022 |
| 378 | 633795 | 7142045 |
| 379 | 633805 | 7142082 |
| 380 | 633841 | 7142077 |
| 381 | 633875 | 7142037 |
| 382 | 633929 | 7142066 |
| 383 | 633962 | 7142095 |
| 384 | 633956 | 7142109 |
| 385 | 633894 | 7142124 |
| 386 | 633889 | 7142153 |
| 387 | 633936 | 7142175 |
| 388 | 633959 | 7142201 |

148°19'0"E

148°20'0"E

148°21'0"E

25°47'0"S

25°48'0"S

25°49'0"S

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**Figure C1-a**
**Offset area boundary (1/2)**

- Offset area coordinates
- Cobbadah offset area

Location diagram

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data

Date: 10/21/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:15,000@A3

0 200 400 600 800
Metres

N

CO2 Australia

Path: P:\GISData\Projects\Santos\912_211020_Roma_East_maps\Cobbadah\Figure C1_a_offset_area_boundary.mxd

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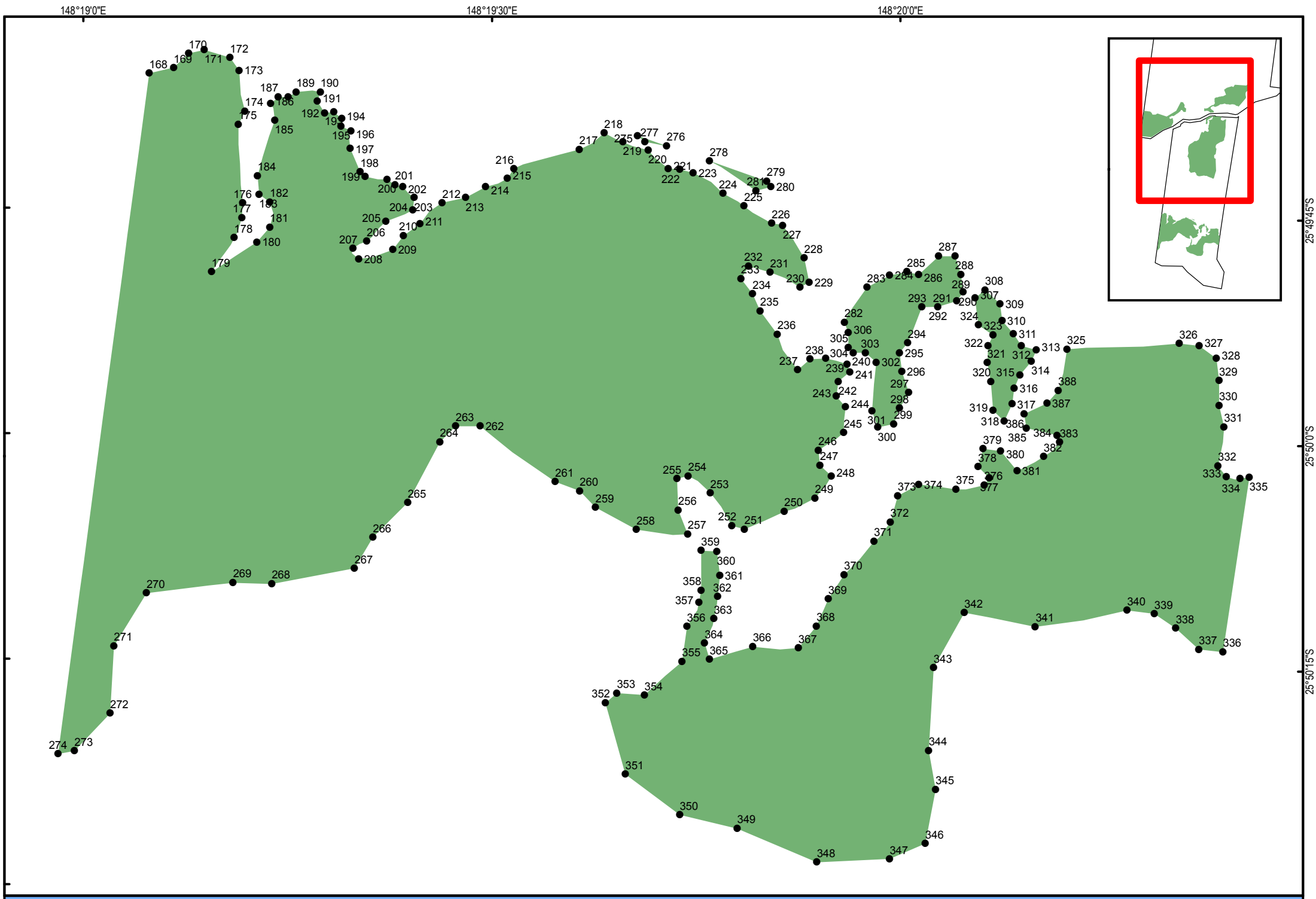
| Coordinate | Easting | Northing | Coordinate | Easting | Northing | Coordinate | Easting | Northing | Coordinate | Easting | Northing | Coordinate | Easting | Northing | Coordinate | Easting | Northing | Coordinate | Easting | Northing | Coordinate | Easting | Northing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 631407 | 7146850 | **51** | 634863 | 7147773 | **101** | 634384 | 7146538 | **151** | 633514 | 7145732 | **201** | 632602 | 7142622 | **251** | 633317 | 7141917 | **301** | 633578 | 7142159 | **351** | 633073 | 7141416 |
| **2** | 631650 | 7146825 | **52** | 634924 | 7147860 | **102** | 634387 | 7146499 | **152** | 633645 | 7146044 | **202** | 632619 | 7142619 | **252** | 633291 | 7141924 | **302** | 633587 | 7142259 | **352** | 633033 | 7141562 |
| **3** | 631741 | 7146713 | **53** | 635363 | 7147831 | **103** | 634467 | 7146472 | **153** | 633704 | 7146017 | **203** | 632642 | 7142596 | **253** | 633247 | 7141991 | **303** | 633565 | 7142278 | **353** | 633056 | 7141582 |
| **4** | 631863 | 7146710 | **54** | 635475 | 7147937 | **104** | 634540 | 7146519 | **154** | 633724 | 7146022 | **204** | 632639 | 7142571 | **254** | 633202 | 7142026 | **304** | 633540 | 7142278 | **354** | 633112 | 7141578 |
| **5** | 631931 | 7146745 | **55** | 635465 | 7147692 | **105** | 634583 | 7146522 | **155** | 633765 | 7146084 | **205** | 632584 | 7142548 | **255** | 633179 | 7142021 | **305** | 633530 | 7142290 | **355** | 633190 | 7141646 |
| **6** | 632292 | 7146638 | **56** | 635412 | 7147622 | **106** | 634576 | 7146309 | **156** | 633865 | 7146039 | **206** | 632544 | 7142507 | **256** | 633182 | 7141956 | **306** | 633530 | 7142319 | **356** | 633200 | 7141718 |
| **7** | 632654 | 7146852 | **57** | 635349 | 7147579 | **107** | 634543 | 7145848 | **157** | 633904 | 7146050 | **207** | 632517 | 7142492 | **257** | 633201 | 7141907 | **307** | 633789 | 7142390 | **357** | 633224 | 7141766 |
| **8** | 632835 | 7147191 | **58** | 635336 | 7147533 | **108** | 634516 | 7145768 | **158** | 633911 | 7146101 | **208** | 632528 | 7142470 | **258** | 633097 | 7141916 | **308** | 633809 | 7142407 | **358** | 633229 | 7141792 |
| **9** | 632925 | 7147180 | **59** | 635349 | 7147411 | **109** | 634512 | 7145712 | **159** | 633886 | 7146161 | **209** | 632598 | 7142489 | **259** | 633012 | 7141962 | **309** | 633840 | 7142379 | **359** | 633228 | 7141874 |
| **10** | 632988 | 7147067 | **60** | 635350 | 7147356 | **110** | 634421 | 7145651 | **160** | 633919 | 7146234 | **210** | 632620 | 7142518 | **260** | 632980 | 7141996 | **310** | 633844 | 7142344 | **360** | 633261 | 7141872 |
| **11** | 632964 | 7147001 | **61** | 635332 | 7147320 | **111** | 634387 | 7145659 | **161** | 633906 | 7146260 | **211** | 632653 | 7142542 | **261** | 632930 | 7142014 | **311** | 633868 | 7142318 | **361** | 633267 | 7141823 |
| **12** | 633043 | 7146955 | **62** | 635076 | 7147016 | **112** | 634208 | 7145553 | **162** | 633939 | 7146329 | **212** | 632699 | 7142585 | **262** | 632776 | 7142128 | **312** | 633884 | 7142293 | **362** | 633262 | 7141780 |
| **13** | 633021 | 7146816 | **63** | 634992 | 7147053 | **113** | 634188 | 7145493 | **163** | 633939 | 7146376 | **213** | 632747 | 7142596 | **263** | 632726 | 7142128 | **313** | 633914 | 7142284 | **363** | 633254 | 7141734 |
| **14** | 632945 | 7146812 | **64** | 634919 | 7147093 | **114** | 634188 | 7145423 | **164** | 633952 | 7146442 | **214** | 632787 | 7142617 | **264** | 632694 | 7142096 | **314** | 633904 | 7142261 | **364** | 633236 | 7141684 |
| **15** | 632905 | 7146848 | **65** | 634846 | 7147113 | **115** | 634213 | 7145386 | **165** | 633906 | 7146479 | **215** | 632833 | 7142635 | **265** | 632628 | 7141972 | **315** | 633881 | 7142233 | **365** | 633246 | 7141651 |
| **16** | 632885 | 7146881 | **66** | 634807 | 7147110 | **116** | 634185 | 7145178 | **166** | 633982 | 7146495 | **216** | 632846 | 7142655 | **266** | 632557 | 7141901 | **316** | 633869 | 7142205 | **366** | 633335 | 7141677 |
| **17** | 632835 | 7146881 | **67** | 634737 | 7147093 | **117** | 634118 | 7145138 | **167** | 634045 | 7146529 | **217** | 632980 | 7142695 | **267** | 632520 | 7141837 | **317** | 633865 | 7142173 | **367** | 633428 | 7141674 |
| **18** | 632822 | 7146845 | **68** | 634668 | 7147103 | **118** | 634118 | 7145048 | **168** | 632100 | 7142851 | **218** | 633030 | 7142728 | **268** | 632350 | 7141805 | **318** | 633849 | 7142138 | **368** | 633464 | 7141719 |
| **19** | 632766 | 7146789 | **69** | 634595 | 7147100 | **119** | 634151 | 7145002 | **169** | 632150 | 7142862 | **219** | 633068 | 7142710 | **269** | 632271 | 7141808 | **319** | 633825 | 7142160 | **369** | 633489 | 7141775 |
| **20** | 632544 | 7146650 | **70** | 634522 | 7147130 | **120** | 634177 | 7145003 | **170** | 632180 | 7142891 | **220** | 633121 | 7142693 | **270** | 632094 | 7141787 | **320** | 633821 | 7142220 | **370** | 633521 | 7141824 |
| **21** | 632495 | 7146657 | **71** | 634420 | 7147103 | **121** | 634200 | 7144531 | **171** | 632212 | 7142898 | **221** | 633162 | 7142655 | **271** | 632028 | 7141678 | **321** | 633814 | 7142258 | **371** | 633582 | 7141892 |
| **22** | 632402 | 7146617 | **72** | 634357 | 7147100 | **122** | 634168 | 7144441 | **172** | 632265 | 7142882 | **222** | 633185 | 7142654 | **272** | 632020 | 7141541 | **322** | 633815 | 7142293 | **372** | 633616 | 7141932 |
| **23** | 632386 | 7146577 | **73** | 634248 | 7147030 | **123** | 634131 | 7144281 | **173** | 632284 | 7142856 | **223** | 633212 | 7142647 | **273** | 631947 | 7141463 | **323** | 633825 | 7142315 | **373** | 633630 | 7141986 |
| **24** | 632415 | 7146547 | **74** | 634158 | 7147010 | **124** | 634108 | 7144225 | **174** | 632295 | 7142773 | **224** | 633274 | 7142604 | **274** | 631913 | 7141457 | **324** | 633796 | 7142335 | **374** | 633674 | 7142009 |
| **25** | 632485 | 7146554 | **75** | 634115 | 7147030 | **125** | 634068 | 7144228 | **175** | 632282 | 7142746 | **225** | 633317 | 7142578 | **275** | 633099 | 7142723 | **325** | 633977 | 7142286 | **375** | 633750 | 7141999 |
| **26** | 632505 | 7146574 | **76** | 634072 | 7147027 | **126** | 634015 | 7144267 | **176** | 632291 | 7142585 | **226** | 633373 | 7142543 | **276** | 633158 | 7142702 | **326** | 634207 | 7142297 | **376** | 633808 | 7142007 |
| **27** | 632528 | 7146561 | **77** | 633996 | 7146991 | **127** | 633930 | 7144289 | **177** | 632290 | 7142555 | **227** | 633396 | 7142539 | **277** | 633113 | 7142711 | **327** | 634248 | 7142293 | **377** | 633818 | 7142022 |
| **28** | 632528 | 7146508 | **78** | 633990 | 7146931 | **128** | 633836 | 7144328 | **178** | 632274 | 7142513 | **228** | 633440 | 7142472 | **278** | 633246 | 7142671 | **328** | 634282 | 7142267 | **378** | 633795 | 7142045 |
| **29** | 632541 | 7146481 | **79** | 634105 | 7146835 | **129** | 633768 | 7144336 | **179** | 632227 | 7142444 | **229** | 633450 | 7142422 | **279** | 633362 | 7142630 | **329** | 634288 | 7142221 | **379** | 633805 | 7142082 |
| **30** | 632541 | 7146394 | **80** | 634105 | 7146789 | **130** | 633743 | 7144344 | **180** | 632320 | 7142505 | **230** | 633431 | 7142412 | **280** | 633371 | 7142618 | **330** | 634288 | 7142170 | **380** | 633841 | 7142077 |
| **31** | 632463 | 7146251 | **81** | 633978 | 7146780 | **131** | 633566 | 7144326 | **181** | 632346 | 7142536 | **231** | 633370 | 7142443 | **281** | 633341 | 7142610 | **331** | 634298 | 7142127 | **381** | 633875 | 7142037 |
| **32** | 632149 | 7146126 | **82** | 633917 | 7146838 | **132** | 633484 | 7144338 | **182** | 632346 | 7142587 | **232** | 633326 | 7142456 | **282** | 633521 | 7142341 | **332** | 634285 | 7142047 | **382** | 633929 | 7142066 |
| **33** | 631686 | 7145837 | **83** | 633834 | 7146862 | **133** | 633441 | 7144368 | **183** | 632324 | 7142603 | **233** | 633310 | 7142430 | **283** | 633568 | 7142412 | **333** | 634303 | 7142025 | **383** | 633962 | 7142095 |
| **34** | 631276 | 7145876 | **84** | 633742 | 7146847 | **134** | 633431 | 7144417 | **184** | 632322 | 7142641 | **234** | 633333 | 7142399 | **284** | 633614 | 7142437 | **334** | 634331 | 7142021 | **384** | 633956 | 7142109 |
| **35** | 633741 | 7146956 | **85** | 633791 | 7146561 | **135** | 633391 | 7144447 | **185** | 632356 | 7142754 | **235** | 633349 | 7142364 | **285** | 633649 | 7142444 | **335** | 634350 | 7142024 | **385** | 633894 | 7142124 |
| **36** | 633874 | 7146961 | **86** | 633967 | 7146652 | **136** | 633385 | 7144480 | **186** | 632348 | 7142788 | **236** | 633384 | 7142316 | **286** | 633674 | 7142438 | **336** | 634296 | 7141666 | **386** | 633889 | 7142153 |
| **37** | 634056 | 7147083 | **87** | 634048 | 7146653 | **137** | 633222 | 7144454 | **187** | 632364 | 7142802 | **237** | 633426 | 7142243 | **287** | 633715 | 7142476 | **337** | 634246 | 7141671 | **387** | 633936 | 7142175 |
| **38** | 634115 | 7147087 | **88** | 634034 | 7146598 | **138** | 633152 | 7144547 | **188** | 632384 | 7142802 | **238** | 633451 | 7142265 | **288** | 633748 | 7142476 | **338** | 634200 | 7141714 | **388** | 633959 | 7142201 |
| **39** | 634145 | 7147123 | **89** | 633950 | 7146558 | **139** | 633172 | 7144663 | **189** | 632400 | 7142812 | **239** | 633483 | 7142267 | **289** | 633760 | 7142438 | **339** | 634155 | 7141744 | | | |
| **40** | 634148 | 7147159 | **90** | 633945 | 7146526 | **140** | 633172 | 7144733 | **190** | 632450 | 7142812 | **240** | 633527 | 7142255 | **290** | 633764 | 7142402 | **340** | 634100 | 7141751 | | | |
| **41** | 634138 | 7147202 | **91** | 633904 | 7146530 | **141** | 633161 | 7144825 | **191** | 632444 | 7142794 | **241** | 633533 | 7142239 | **291** | 633751 | 7142384 | **341** | 633912 | 7141718 | | | |
| **42** | 634145 | 7147328 | **92** | 633864 | 7146464 | **142** | 633156 | 7144919 | **192** | 632458 | 7142769 | **242** | 633509 | 7142220 | **292** | 633713 | 7142373 | **342** | 633767 | 7141746 | | | |
| **43** | 634205 | 7147371 | **93** | 633865 | 7146412 | **143** | 633116 | 7145055 | **193** | 632477 | 7142772 | **243** | 633505 | 7142189 | **293** | 633680 | 7142371 | **343** | 633704 | 7141634 | | | |
| **44** | 634327 | 7147401 | **94** | 633837 | 7146330 | **144** | 633082 | 7145081 | **194** | 632493 | 7142757 | **244** | 633524 | 7142168 | **294** | 633651 | 7142299 | **344** | 633694 | 7141464 | | | |
| **45** | 634416 | 7147424 | **95** | 633793 | 7146344 | **145** | 633132 | 7145211 | **195** | 632492 | 7142743 | **245** | 633520 | 7142115 | **295** | 633635 | 7142278 | **345** | 633708 | 7141385 | | | |
| **46** | 634463 | 7147424 | **96** | 633816 | 7146439 | **146** | 633116 | 7145300 | **196** | 632512 | 7142732 | **246** | 633469 | 7142079 | **296** | 633639 | 7142240 | **346** | 633687 | 7141274 | | | |
| **47** | 634578 | 7147473 | **97** | 634091 | 7146654 | **147** | 633126 | 7145470 | **197** | 632511 | 7142696 | **247** | 633472 | 7142048 | **297** | 633654 | 7142197 | **347** | 633614 | 7141242 | | | |
| **48** | 634517 | 7147670 | **98** | 634172 | 7146656 | **148** | 633169 | 7145546 | **198** | 632531 | 7142648 | **248** | 633495 | 7142026 | **298** | 633635 | 7142165 | **348** | 633465 | 7141236 | | | |
| **49** | 634612 | 7147749 | **99** | 634168 | 7146629 | **149** | 633361 | 7145679 | **199** | 632541 | 7142639 | **249** | 633461 | 7141981 | **299** | 633623 | 7142133 | **349** | 633302 | 7141305 | | | |
| **50** | 634811 | 7147807 | **100** | 634418 | 7146618 | **150** | 633441 | 7145682 | **200** | 632586 | 7142633 | **250** | 633399 | 7141954 | **300** | 633590 | 7142125 | **350** | 633184 | 7141333 | | | |

**GDA94 Zone 55 projection**

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**Location diagram**

**Figure C1-b**
**Offset area boundary (2/2)**

- Offset area coordinates
- Cobbadah offset area

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data

Date: 10/21/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:9,250@A3

0 100 200 300 400
Metres

N

CO2 Australia

Path: P:\GIS\Data\Projects\Santos\912_211020_Roma_East_maps\Cobbadah\Figure C1_b_offset_area_boundary.mxd

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# APPENDIX D

## Risk Assessment

The following risk assessment assesses the potential risk of failing to achieve the management objectives, interim performance targets and completion criteria for the offset area as outlined in this OAMP.

For each risk identified, the potential consequence of the risk (rated from 1 (no impact) to 6 (irreversible impact; Table D1) was assessed against the likelihood of that risk occurring (Table D2) to determine a risk rating. The risk rating was evaluated by using the matrix in Table D2.

The consequence and likelihood of each risk was first considered without the management measures in place to provide an initial risk rating. The consequence and likelihood of each risk occurring was then reassessed following the implementation of the management measures to provide a residual risk rating.

Table D3 provides the risk register which was used to document the findings of the risk assessment process.

**Table D1: Consequence rating relative to offset value**

| | Consequence |
|---|---|
| I | No impact to MNES Value |
| II | Small-scale impact to MNES |
| III | Moderate-scale impact to MNES |
| IV | Large-scale impact to MNES |
| V | Extensive population or community scale impact to MNES |
| VI | Irreversible impact to MNES. |

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**Table D2: Likelihood classification and risk matrix**

## Santos Risk Matrix

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Consequence | **Safety** | **Negligible Harm**<br>+ No bodily damage or minimal harm or impairment (hours to days) | **Minor Harm**<br>+ Short term impairment (days to weeks) | **Moderate Harm**<br>+ Temporary disablement or medium term impairment (weeks to months) | **Severe Harm**<br>+ Long term/life altering disablement or impairment | **Single Fatality OR Critical Life Threatening Injuries** | **Multiple Fatalities** |
| | **Environment** | + No impact to Environmental Value (EV). | + Small-scale impact to EV(s) of conservation significance<br>+ Potential surface or groundwater impact. | + Moderate-scale impact to EV(s) of conservation significance<br>+ Localised surface or groundwater impact. | + Large-scale impact to EV(s) of conservation significance<br>+ Moderate-scale surface water impact;<br>+ Localised impact to groundwater with potential or known beneficial use. | + Extensive population or community scale impact to EV(s) of conservation significance<br>+ Extensive impact to other EV(s). | + Irreversible impact to EV(s). |
| | **Community & Reputation** | + No actual or potential community criticism<br>+ Details remain within Santos sites and/or offices | + Minor level local community criticism (< week)<br>+ No reputation impact | + Local community criticism (> week) or one-day community protest<br>+ Local company reputation impacted | + State-level community criticism or protest over multiple days/locations<br>+ State-based company reputation impacted<br>+ Very short-term share price impact (< week) | + National community criticism or large scale protest<br>+ Company reputation and approvals impacted<br>+ Shareholder intervention or short-term share price impact (< month) | + Sustained national community criticism or widespread protest<br>+ Industry reputation and approvals impacted<br>+ Changes at executive/board level or long-term share price impact (> month) |
| | **Financial (A$)** | < $30k | $30k to $300k | $300k to $3m | $3m to $30m | $30m to $300m | > $300m |
| | **Workforce** | + Will require some staff attention over several days.<br>+ No actual or potential impact to culture | + Will require several days local management time.<br>+ Minor impact to employee engagement and limited staff turnover | + Will require head office staff and take several weeks of site management time.<br>+ Moderate impact to employee engagement and staff turnover above industry average with some key roles | + Will require several weeks of senior management time<br>+ Impact to employee engagement (< 6 months), moderate turnover of key roles and no succession | + Will require several months of senior management time<br>+ Impact to employee engagement (< 18 months), high staff turnover and attraction issues | + Will require more than a year of senior management involvement and operations severely disrupted<br>+ Impact to employee engagement (> 18 months), significant key role turnover and attraction issues |
| | **Compliance** | + Non-conformance with legislation, instruments (e.g. tenure licence) or contract<br>+ No regulatory or punitive action | + Minor breach of legislation, instruments or contract<br>+ Notification/report to; request for information by; and/or administrative/ warning notice from the regulator<br>+ LOCI Tier 3 or non-hydrocarbon releases notifiable to the regulator | + Limited number of minor breaches of legislation, instruments or contract<br>+ Statutory notice from the regulator<br>+ LOCI Tier 2 or non-hydrocarbon releases immediately reportable to the regulator | + Systemic minor breaches (or one moderate breach) of legislation, instruments or contract<br>+ Company charged with an offence with minor penalty/fine<br>+ LOCI Tier 1 or cumulative regulator notification of non-hydrocarbon releases | + Systemic moderate breaches (OR single material breach) of legislation, instruments or contract<br>+ Company charged with an offence with moderate penalty/fine | + Material breaches of legislation, instruments or contract<br>+ Company or officers charged with an offence with material penalty/fine, or loss of tenure/operatorship |
| | | I | II | III | IV | V | VI |
| Likelihood | **ALMOST CERTAIN (< 4 monthly)** Occurs in almost all circumstances OR could occur *within days to weeks* | f | Low | Medium | High | Very High | Very High | Very High |
| | **LIKELY (4 monthly - 1 yearly)** Occurs in most circumstances OR could occur *within weeks to months* | e | Low | Medium | High | High | Very High | Very High |
| | **OCCASIONAL (1 - 3 yearly)** Has occurred before in Santos OR could occur *within months to years* | d | Low | Low | Medium | High | High | Very High |
| | **POSSIBLE (3 - 10 yearly)** Has occurred before in the industry OR could occur *within the next few years* | c | Very Low | Low | Low | Medium | High | Very High |
| | **UNLIKELY (10 - 30 yearly)** Has occurred elsewhere OR could occur *within decades* | b | Very Low | Very Low | Low | Low | Medium | High |
| | **REMOTE (30 - 100 yearly)** Requires exceptional circumstances and is unlikely even in the long term OR only occurs as a *"one in 100 year event"* | a | Very Low | Very Low | Very Low | Low | Medium | Medium |

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**Table D3: Risk assessment**

| Management objective | Risk description | 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 offset values, which include the habitat quality scores in this OAMP. | Completion criteria and habitat quality improvements are not achieved | D | IV | H | • Implementation of this OAMP, including the management actions and monitoring program outlined in Section 6.0 and Section 7.0.<br>• Implementation of the adaptive management process outlined in Section 5.0. Obtain advice with the aim of identifying appropriate additional management interventions if interim performance targets are not achieved for one or more offset values by year 5,10 or 15.<br>• If it is considered that the completion criteria cannot be achieved, Santos will update this OAMP proposing alternative offset areas in order to acquit the required offset requirements in accordance. The revised OAMP will be submitted to the Commonwealth Government. | B | IV | L |
| Maintain the extent of offset value habitat within the offset area. | Habitat or vegetation loss through land clearing. | D | V | H | • Protection of the offset area via a Voluntary Declaration under section 19E and 19F of the VMA, as described in Section 2.7.<br>• Comply with the restrictions outlined in Table 11.<br>• Construction and maintenance of access tracks, fencing and firebreaks will be undertaken in accordance with Sections 6.2.2, 6.2.3 and 6.2.4.<br>• Restoration of impacted areas subject to any unauthorised clearing. | B | V | M |
| Ensure that the livestock grazing restrictions for fire management and weed control assist in the enhancement of ground cover attributes for offset values and does not result in the degradation of habitat. | Degradation of offset value habitat quality as a result of livestock grazing | E | III | H | • Implementation of strategic grazing to reduce fuel loads and control exotic pasture grasses and promote the establishment of native perennial grass species in accordance with Section 6.2.4.1.<br>• Annual biomass monitoring to inform strategic grazing regimes.<br>• Rapid monitoring events and habitat quality assessments will be undertaken in accordance with Section 7.6.1 and 7.6.2 including an assessment of % cover of native perennial grasses. | B | III | L |
| Minimise predation risk by wild dogs to threatened fauna species. | Predation of threatened fauna by wild dogs. | D | III | M | • Regular monitoring for pest animals will be undertaken in accordance with the methods detailed in Section 7.5 and pest animal control will be implemented following the results of monitoring in accordance with Section 6.2.6. | C | III | L |
| Minimise predation risk by foxes to threatened fauna species. | Predation of threatened fauna by foxes. | D | III | M | | C | III | L |
| Minimise predation risk by feral cats to threatened fauna species. | Predation of threatened fauna by cats. | D | III | M | | C | III | L |
| Minimise degradation of offset value habitat by feral pigs. | Degradation of habitat by feral pigs. | D | III | M | | C | III | L |
| Minimise degradation of offset value habitat by rabbits. | Degradation of habitat by rabbits. | D | III | M | | C | III | L |
| Manage invasive weed species to reduce degradation of offset value habitat. | Invasion of habitat by weed species, including exotic grasses. | D | III | M | • Regular weed monitoring will be undertaken in accordance with Section 7.4.<br>• Based on the results of monitoring events, weeds will be managed using biological, chemical and/or mechanical control in accordance with the control | C | III | L |

| Management objective | Risk description | Initial risk rating | | | Control strategies | Residual risk rating | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk rating | | Likelihood | Consequence | Overall risk rating |
| | | | | | measures outlined in the Biosecurity Queensland Fact Sheets, for the relevant weed species (see Section 6.2.5). | | | |
| Reduce the risk of adverse impacts to offset value habitat by 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. | D | IV | H | • Fuel loads within the offset area will be managed through strategic livestock grazing and fuel hazard reduction burns as outlined in Section 6.2.4.<br>• Firebreaks will be established and maintained around the boundary of the offset area, with green firebreaks established where the offset area joins native vegetation. Firebreaks will be maintained at least annually in mid / late autumn and, or early spring to remove overhanging trees or fallen debris and dense vegetation. | B | IV | L |
| Achieve the interim performance targets and completion criteria for each offset value within 5, 10, 15 and 20 years, respectively.. | Interim performance targets are not achieved for offset values by year 5, 10 or 15.<br>Completion criteria are not achieved for offset values by year 20. | E | III | H | • Monitoring of the offset area will be undertaken in accordance with Section 7.0 including:<br>  ○ Offset area inspections (Section 7.1).<br>  ○ Offset value assessments (Section 7.6).<br>• 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 8.0). | B | III | L |

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# APPENDIX E

## Overall Fuel Hazard Assessment Guide

Department of Sustainability and Environment

# Overall fuel hazard assessment guide

**4th edition July 2010**

## Fire and adaptive management

report no. 82

State Government Victoria

**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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**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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# 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

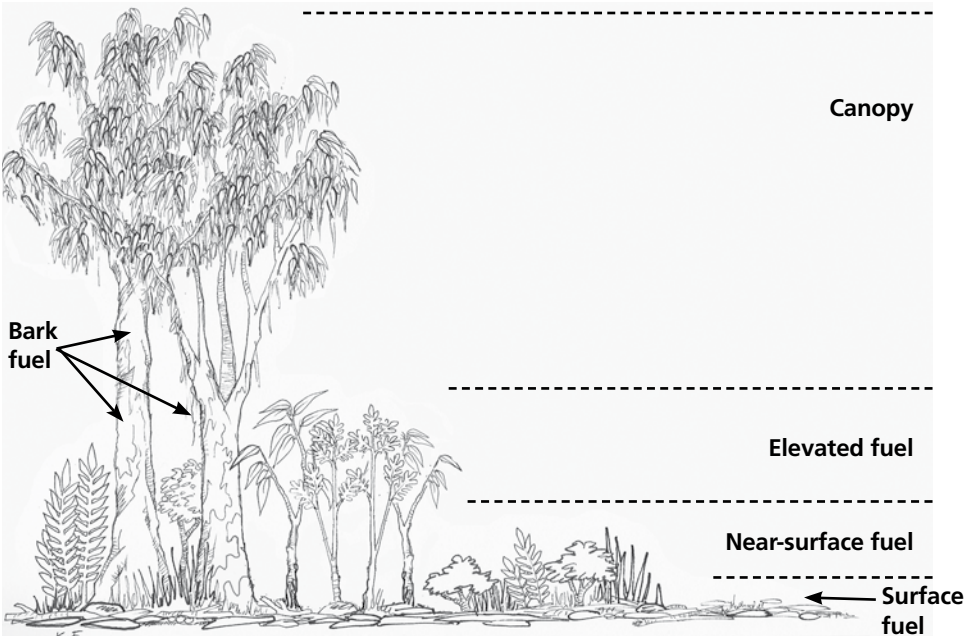
This guide is a tool for rapidly assessing fuel arrangement and its effect on the chances of controlling a bushfire. It may also be used for a range of other fire management purposes, as shown in the table below. Users of this guide should understand the underlying assumptions and limitations before 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.<br><br>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.<br>• 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.<br>• Generally most of the plant material is closer to the top of this fuel layer.<br>• Sometimes contains suspended leaves, bark or twigs.<br>• Fuels that have a clear gap between them and the surface fuels.<br>• Can be highly variable in ground coverage.<br>• 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.<br>• Fuel has a mixture of vertical and horizontal orientation.<br>• 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.<br>• Sometimes contains suspended leaves, bark or twigs.<br>• Coverage may range from continuous to having gaps many times the size of the fuel patch.<br>• Low-intensity fire (flame height of less than 0.5m) will consume most or all of this fuel.<br>• 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.<br>• 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.<br>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.<br>• 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.<br>• Bark fibres resemble the fine fibres that are twisted together to form natural string.<br>• Old bark is retained on the trunk of the tree for decades, forming a relatively spongy fibrous mass with deep vertical fissures.<br>• Outer bark may weather to a greyish colour, while underlying bark retains its original colour.<br>• Bark may form large strands when peeled off.<br>• 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).<br>• Fires will readily climb the tree and branches. |
| **How bark is attached** | • Young or new bark is held tightly to the trunk.<br>• As bark ages it becomes less tightly held.<br>• 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:<br>• Very fine lightweight fibres that will be carried for less than 100m.<br>• Small lightweight wads (about the size of a thumb) that will be carried for less than 300m.<br>• 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.<br>• Small wads of bark that will burn out within 2–3 minutes.<br>• Very large wads of bark that will burn for up to 10 minutes. |
| **Hazard accumulation** | • Bark hazard can reach Extreme.<br>• Bark hazard increases over time as the thickness and looseness of the old bark increases.<br>• 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.<br>Requires substantial effort to break off bark by hand. | Very little combustible bark.<br>Entire trunk almost completely black or charred. | Moderate | Spotting generally does not hinder fire control.<br>Fires will not climb these trees. |
| Bark is mostly tightly held with a few pieces loosely attached. | Limited amount of combustible bark.<br>50–90% of trunk charred.<br>Most of the bark is charred, especially on the lower part of the trunk. | High | Infrequent spotting.<br>Fires will climb some of these trees. |
| Many pieces of bark loosely held.<br>Deep fissures present in bark. | Large amounts of combustible bark.<br>10–50% of trunk charred.<br>Upper parts of the tree may not be charred at all. | Very High | Substantial spotting.<br>Fires will climb most of these trees. |
| Outer bark on trees is weakly attached.<br>Light hand pressure will break off large wads of bark.<br>Deep fissures present in bark. | Huge amounts of combustible bark.<br><10% of trunk charred.<br>Minimal evidence of charring. | Extreme | Quantity of spotting generated makes fire control very difficult or impossible.<br>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

## 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.<br>• Bark is shed in the form of long strips or ribbons of bark.<br>• Long strips of bark curl tightly inwards to form a candle-like shape (see image lower right).<br>• Bark strips 50cm or more in length fall off and often drape around the trunk and over branches and surrounding shrubs.<br>• Strips of bark are usually less than 2mm thick.<br>• 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).<br>• 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.<br>• 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.<br>• Bark hazard tends to increase over the long term as ribbons accumulate on the tree.<br>• 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<br>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.<br>Trunk and branches of trees almost entirely smooth. | Moderate | Spotting generally does not hinder fire control.<br>Fires will not climb these trees. |
| Long ribbons of bark present on upper trunk (>4m above ground) and in head of trees.<br>Lower trunk mainly smooth. | High | Infrequent spotting.<br>Fires will climb some of these trees. |
| Long ribbons of bark in the head and upper trunk with:<br>• ribbons hanging down to ground level or,<br>• flammable bark covers trunk. | Very High | Substantial spotting.<br>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.<br>• Bark becomes rough, compacted and furrowed with age<br>• Bark feels very abrasive when rubbed by hand.<br>• Bark pieces tend to be more than 2mm thick when they break off.<br>• 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.<br>• Layers of old dead bark are retained on the trunk and branches.<br>• Unlike stringybark trees, the bark on these trees forms only short strands or chunks when peeled off.<br>• Evidence of charring on the bark may last for up to 10 years. |
| **Hazard accumulation** | • Bark hazard never exceeds High.<br>• Bark hazard increases over the long term as the thickness and looseness of the old bark increases. |

**Example**

### 3.5.3 Papery barks

| | |
|---|---|
| **Physical description** | • Shrubs and trees growing from 2m to 30m tall, often with flaky shedding bark.<br>• Old bark is retained on the trunk and branches and builds up into a thick spongy mass.<br>• Bark layers tend to split allowing sheets of bark to become loose and eventually peel off.<br>• Evidence of charring on the bark may last for up to 10 years. |
| **Hazard accumulation** | • Bark hazard never exceeds High.<br>• 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.<br>• Bark shed is often seasonal and often annual.<br>• Species where the old bark tends to peel into large slabs (<50cm in length) or small flakes when shed.<br>• Most of the bark falls off the tree soon after it is shed.<br>• Some small amounts of bark may be retained on the stem or branches for several months before falling off, leading to a mottled effect.<br>• The mottled effect leads to discontinuous bark fuel up the tree. |
| **Hazard accumulation** | • Bark hazard never exceeds Moderate.<br>• 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.<br>or<br>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.<br>Fires will climb some of these trees. |
| Light hand pressure will break bark off. | Large amounts of combustible bark. | High | Infrequent spotting.<br>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.

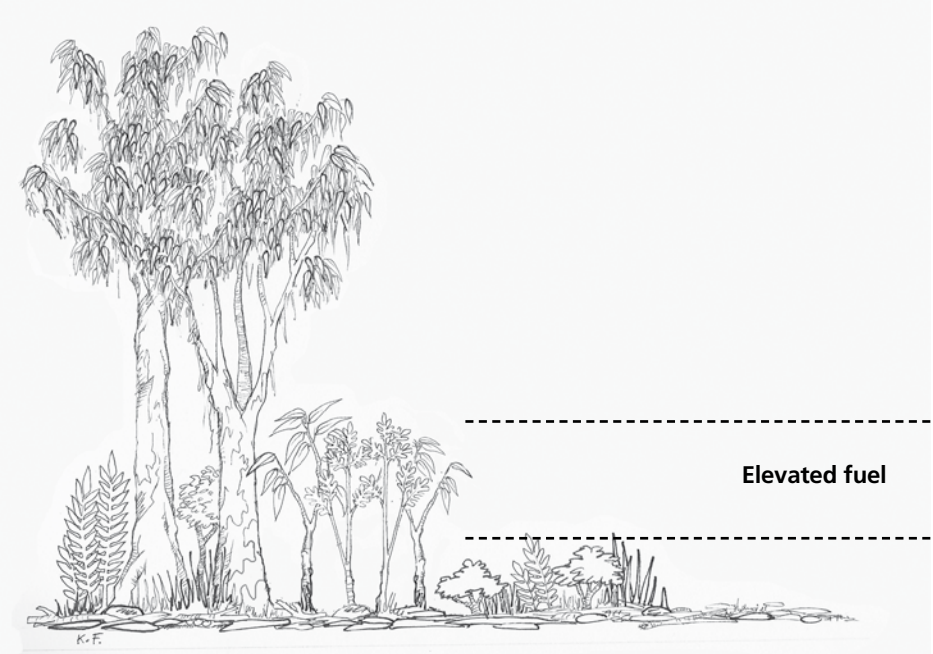
**Table 3.6 Examples of other bark types**

| | | |
|---|---|---|
| **Low** | No trees present.<br><br>or<br><br>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.

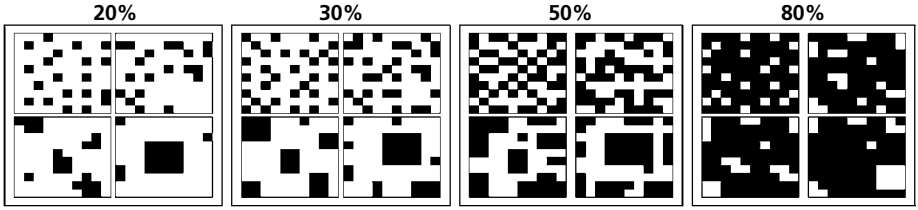
**Table 4.1 Assessing elevated fine fuel hazard**

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** | | |

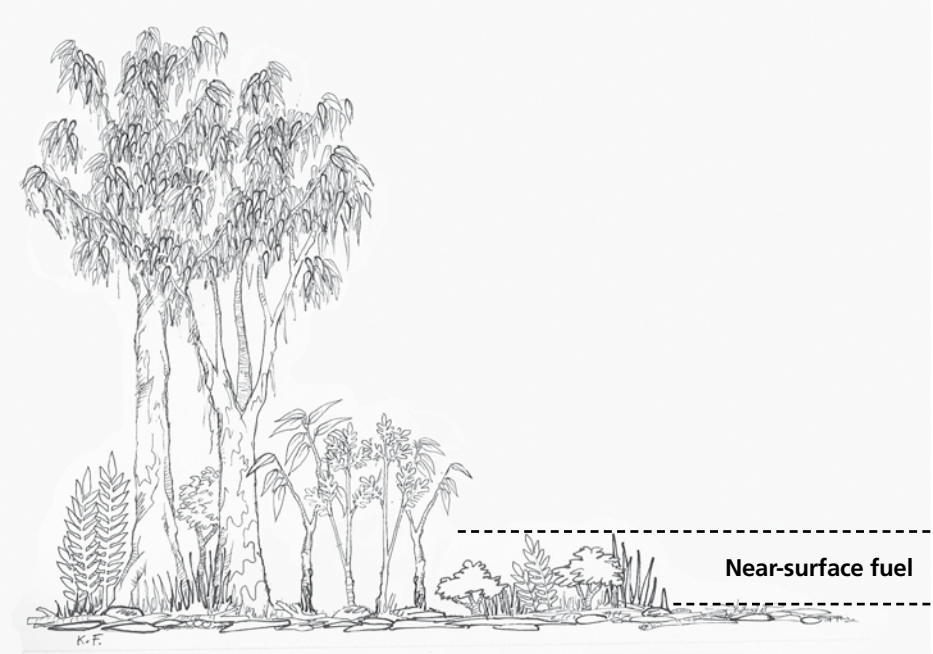
Assess elevated hazard over a plot 10m in radius. Assessing multiple plots will give better results.

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.

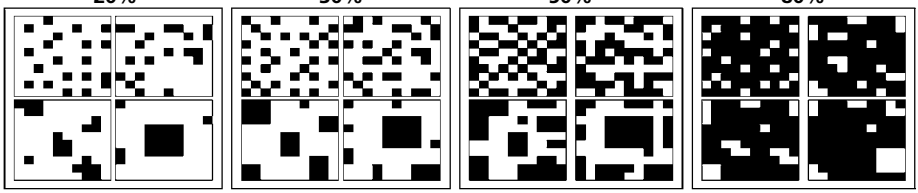
**Table 5.1 Assessing near-surface fine fuel hazard**

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.<br>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.<br>A fire will spread readily in this layer without having to consume the surface layer. |
| >60% | >50% | Very small gaps between fuel patches.<br>Logs and rocks obscured. | Extreme | Contributes significantly to fire spread and flame height.<br>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.

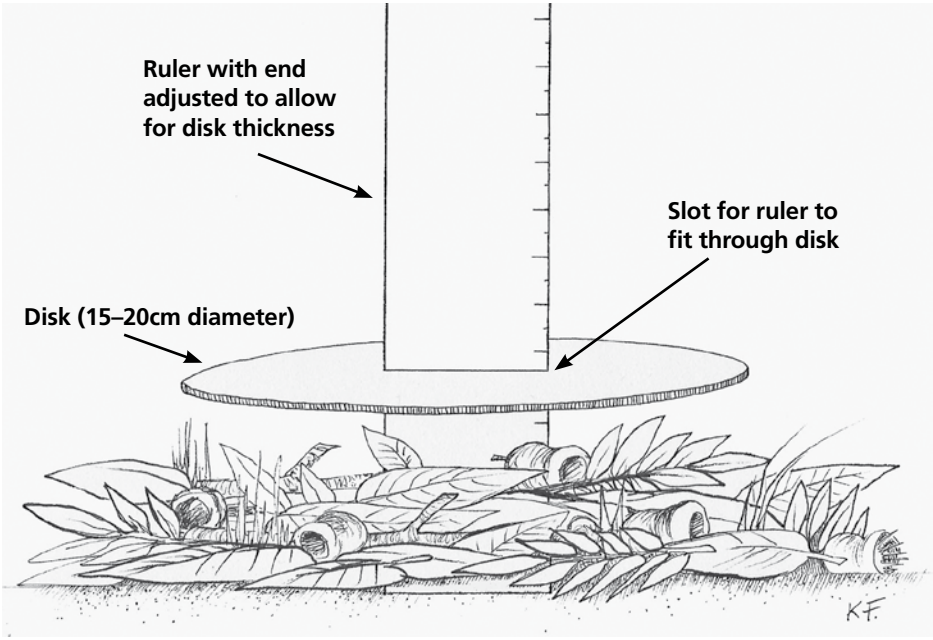
## 6.2 Assessment

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**

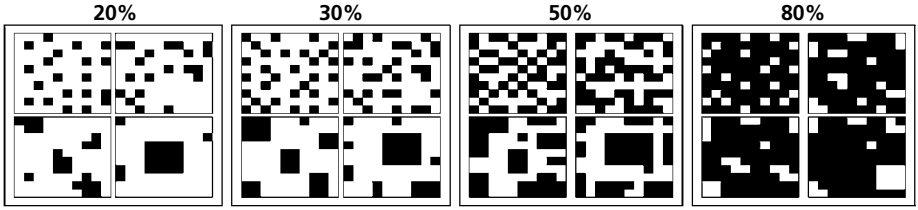
To achieve a given hazard rating a best fit of all key attributes should be sought. Choices for the hazard rating of fuels that fit across several descriptions may be informed by the effect that different levels of key attributes have on fire behaviour.

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

| ❶ Surface fine fuel hazard rating | ❷ Near-surface fine fuel hazard rating | | | | |
|---|---|---|---|---|---|
| | Low | Moderate | High | Very High | Extreme |
| | ❸ 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)<br><br>1 to 2 small 4WD tankers (400l)<br><br>6 firefighters | 5 x 4WD heavy tankers (4000l) each with 5 firefighters | Small dozer (D4) or tractor with scrub roller<br><br>1 to 2 small 4WD tankers (400l)<br><br>6 firefighters | Small dozer (D4)<br><br>1 to 2 small 4WD tankers (400l)<br><br>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 v3

| | |
|---|---|
| Date Assessed: | Assessors: |
| Sampling Location: | Veg Type: |

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

| **Canopy height (Assess over a 20m radius)** | | | |
|---|---|---|---|
| Average Height to Top of Canopy: | m | m | m |
| Average Height to Base of Canopy: | m | m | m |

| **Bark fuel (Assess over a 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 | | |

Select the Bark Hazard rating from above that will be used to determine Overall Fuel Hazard. (Only use the Stringybark hazard rating if more than 10% of the trees are Stringybark **AND** it has the highest rating. Otherwise use the bark with next highest rating.)

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bark Fuel Hazard: | L | M | H | VH | E | L | M | H | VH | E | L | M | H | VH | E |

| **Elevated fuel layer (Assess over a 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 (Assess over a 10m radius)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Near-surface % Cover: | % | | | | | % | | | | | % | | | | |
| Near-surface % Dead | % | | | | | % | | | | | % | | | | |
| NS Average Height (cm): | cm | | | | | cm | | | | | cm | | | | |
| NS Fuel Hazard: | L | M | H | VH | E | L | M | H | VH | E | L | M | H | VH | E |

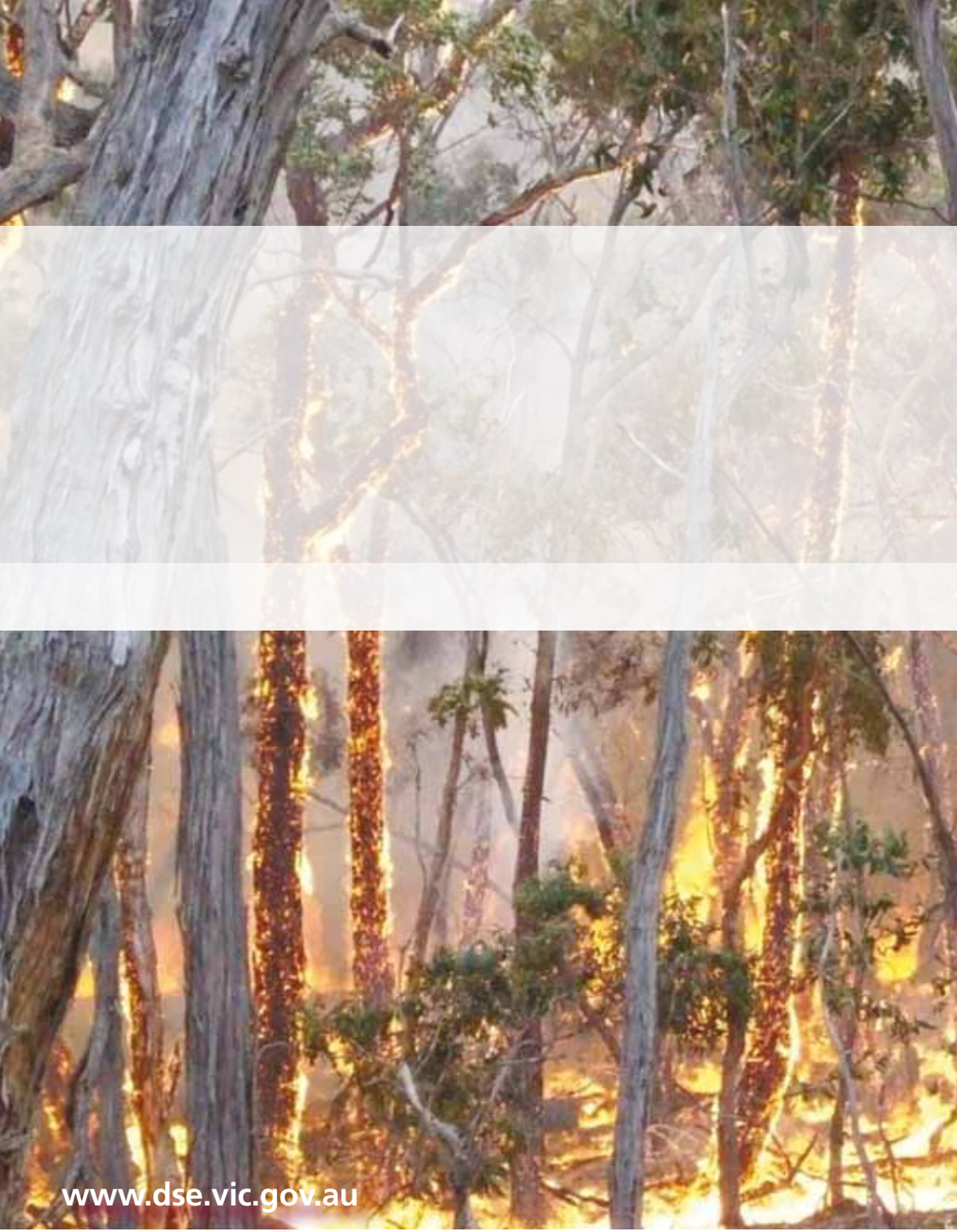
| **Surface fuel layer (Assess over a 10m radius)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surface Litter % Cover: | % | | | | | % | | | | | % | | | | |
| Average Litter Depth (mm): | mm | | | | | mm | | | | | mm | | | | |
| Surface Fuel Hazard | 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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# APPENDIX B

## Offsets assessment guides for the Cobbadah offset area

Table B1 summarises the *Offsets assessment guide* inputs for each MNES to be offset on Cobbadah. The inputs included in the *Offsets assessment guides* are based on the following justifications.

### *Quality of impact area*

The average quality of the impact area for each MNES was compiled based on ecological survey data collected from Roma East (eastern portion of the Roma Gas Field, primarily within PL 281 and PL 282) in 2021 (refer Appendix F):

- Ground-truthing of REs and assessment of vegetation condition (i.e. remnant or regrowth).
- RE and TEC assessment.
- BioCondition assessments in accordance with the *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland Assessment Manual* (Eyre et al. 2015).
- Threatened species habitat assessment and mapping.

Habitat quality scoring was undertaken generally in accordance with the method described in Appendix E of this acquittal summary. This method has been developed based on a combination of assessment methods outlined in the Queensland Herbarium's BioCondition Manual and the GTDTHQ (version 1.3; DES 2020) to be consistent with the requirements under the EPBC Act guideline for the *Offsets assessment guide*.

### *Quality of offset area*

A baseline habitat quality score for each MNES offset value was determined generally in accordance with the GTDTHQ (version 1.2; DEHP 2017) based on the results of the detailed field assessments of the Cobbadah offset area (see Section 2.4 of the Cobbadah OAMP). The baseline habitat quality method is described in Appendix A of the Cobbadah OAMP, with scores derived from that method detailed in Appendix B of the OAMP. The offset area on Cobbadah is based on ground-truthed vegetation mapping undertaken on Cobbadah, matching to known or potential habitat associations for each MNES.

### *Future quality without offset management*

Based on a business-as-usual scenario without offset management, habitat quality scores on Cobbadah are not expected to change, with the exception of Brigalow TEC which is expected to reduce in habitat quality.

*Future quality with offset management*

The Cobbadah offset area will be secured and managed to improve the quality of vegetation communities and habitat for MNES. The Cobbadah OAMP will be implemented and includes specific management actions aimed at reducing the scope and severity of species-specific threats to each MNES, the impact of threatening processes and improving the quality of MNES habitat within the offset area (see Section 6.0 of the Cobbadah OAMP). This includes:

- Access restrictions
- Fire management
- Weed management
- Pest animal management.

*Confidence in result – future quality*

The Cobbadah OAMP has been developed in accordance with approved conservation advice, recovery plans and recommended threat abatement and management advice for the species, and negotiations with the landholder. The OAMP details specific management outcomes aimed at improving the quality of MNES habitat. Ongoing monitoring of the offset area will also be undertaken to regularly assess the progress of the offset and ensure the offset area management plans achieves its required outcomes. The OAMP will support an efficient, effective, timely, transparent, scientifically robust and reasonable approach to managing and monitoring the offset area.

*Risk of loss without offset*

Risk of loss without offset is 0%.

*Risk of loss with offset*

The offset area will be secured through declaration as an area of high nature conservation value under section 19F of the VM Act, therefore the risk of loss is 0%.

*Confidence in result – risk of loss*

The legally binding mechanism will be registered on the land title and bind all current and future landowners to ensure that the offset is protected.

*Time over which loss is averted (years)*

The offset area will be protected by a legally binding mechanism which will remain in effect as required by the applicable Commonwealth legislative requirements, therefore, the time over which loss is averted is considered to be the maximum allowable time of 20 years.

*Time until ecological benefit (years)*

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. An ecological benefit is expected to be realised in 20 years.

**Table B1: Summary of *Offsets assessment guide* inputs for each Stage 5 MNES on Cobbadah**

| Inputs | | Brigalow TEC | Collared Delma | Dunmall's Snake | Yakka Skink | Koala | South-eastern Long-eared Bat |
|---|---|---|---|---|---|---|---|
| Impact | Area (ha) | 6.49 | 144 | 144 | 141 | 116 | 144 |
| | Quality | 7 | 4 | 4 | 5 | 7 | 4 |
| Offset start hectares (ha) | | 72.2 | 557.7 | 557.7 | 557.7 | 485.5 | 557.7 |
| Offset quality | Start quality | 9 | 7 | 7 | 7 | 7 | 7 |
| | Future quality without offset | 8 | 7 | 7 | 7 | 7 | 7 |
| | Future quality with offset | 9 | 8 | 8 | 8 | 8 | 8 |
| | Confidence in result (%) | 80 | 80 | 80 | 80 | 80 | 80 |
| Risk of loss (%) | Without offset | 0 | 0 | 0 | 0 | 0 | 0 |
| | With offset | 0 | 0 | 0 | 0 | 0 | 0 |
| | Confidence in result | 90 | 90 | 90 | 90 | 90 | 90 |
| Risk related time horizon/time over which loss is averted (max. 20 years) | | 20 | 20 | 20 | 20 | 20 | 20 |
| Time until ecological benefit | | 20 | 20 | 20 | 20 | 20 | 20 |

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# APPENDIX C

## Kentucky Offset Area Management Plan

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# Santos GLNG

# Kentucky Offset Area Management Plan

# (EPBC 2012/6615 Stage 5)

**Document Number: 0007-650-EMP-0026**

| Date | Rev | Reason For Issue | Reviewed | Endorsed | Approved |
|---|---|---|---|---|---|
| 16 November 2021 | 0 | For DAWE submission | MB | MB | JC/ED |
| 01 March 2022 | 1 | Updated based on DAWE review | MB | MB | JC/ED |
| 16 March 2022 | 2 | Updated based on DAWE review | MB | MB | JC/ED |

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## Appendices

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Appendix B - Kentucky offset area boundary co-ordinates

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Appendix D - Overall Fuel Hazard Assessment Guide

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## Abbreviations

| Acronym | Description |
|---|---|
| BPA | Biodiversity Planning Assessment |
| CSG | Coal Seam Gas |
| DAF | Department of Agriculture and Forestry (Qld) |
| DAWE | Department of Agriculture, Water and the Environment; formerly Department of the Environment and Energy (DEE) |
| DES | Department of Environment and Science; formerly Department of Environment and Heritage Protection (DEHP) |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Cth) |
| GFD | Gas Fields Development |
| GTP | Gas Transmission Pipeline |
| GIS | Geographic Information System |
| GLNG | Gladstone Liquefied Natural Gas |
| GTDTHQ | *Guide to Determining Terrestrial Habitat Quality* |
| MNES | Matters of National Environmental Significance |
| OAMP | Offset Area Management Plan |
| PMAV | Property Map of Assessable Vegetation |
| RE | Regional Ecosystem |
| REDD | Reginal Ecosystem Description Database |
| SEVT | Semi-evergreen vine thicket |
| spp | species |
| TEC | Threatened Ecological Community |
| VM Act | *Vegetation Management Act 1999* (Qld) |

# Executive Summary

This offset area management plan (OAMP) has been prepared to address the offset requirements for matters of national environmental significance (MNES) associated with Stage 5 of the Gas Fields Development (GFD) Project in accordance with the Santos Gladstone Liquefied Natural Gas (GLNG) Project *Environment Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act) approval EPBC 2012/6615.

Santos will draw down on an 806.5 hectare (ha) area of the existing 4,302.3 ha offset area secured on the Kentucky property (Lot 1 WT37) to partially acquit MNES offset requirements for Stage 5 of the GFD Project under EPBC 2012/6615 (Table ES 1). The remaining 3,495.8 ha of offset area on Kentucky is currently being used to acquit offset obligations for the Gas Transmission Pipeline Project (EPBC 2008/4096) and the GLNG project (EPBC 2008/4059), as well as provide surplus area that Santos will draw down on for future offset requirements. This OAMP relates to the 806.5 ha offset area required to partially acquit Stage 5 of EPBC 2012/6615, as calculated in accordance with the EPBC Act *Offsets assessment guide* to support the overall conservation gain of the offset area. The remaining obligations under EPBC 2012/6615 will be satisfied on another property.

The Kentucky property is located within the Santos GLNG Project tenements approximately 50 kilometres north-east of Injune and contiguous with Expedition (Limited Depth) National Park to the east and Lonesome Holding (proposed National Park) to the north. The property is mapped within a state conservation corridor. Key desktop and field surveys of the Kentucky property have been completed to confirm the presence of offset values and suitability to satisfy the Project's offset obligations as follows:

- 2010
    - Preliminary desktop assessment of biodiversity offset values (Ecofund 2010).
    - Detailed field assessment undertaken by Boobook Ecological Consulting (Boobook), in May 2010, to ground truth vegetation and confirm presence of environmental values (Boobook 2011).
- 2015
    - Further refine ground-truthed and potential regional ecosystem (RE) types and their extent as well as confirming location of potential areas to support biodiversity offsets based on examination of high-resolution aerial photography provided for the property by Santos (Boobook, 2015).
- 2020 (January to May)
    - Update fine-scale RE mapping and BioCondition assessments (Boobook 2020a).
    - Targeted flora and fauna surveys and habitat assessments (Boobook 2020a).

The outcome of this OAMP is to partially acquit the offset obligations under EPBC 2012/6615. The Kentucky offset area will be managed and monitored, based on an adaptive management framework, to achieve the interim performance targets and completion criteria presented in Table ES 2.

The key management actions to be implemented include:

- restricting access to the offset area
- management and restoration of regrowth threatened ecological community (TEC)

- maintenance and upgrades of existing access tracks, fencing and firebreaks
- fire management through strategic grazing and fuel hazard reduction burns
- weed management
- pest animal management.

Ongoing monitoring events will be undertaken to assess the effectiveness of the management actions and progress of the offset area in achieving the interim performance targets and completion criteria, including:

- biannual offset area inspections
- biomass monitoring
- fuel load monitoring
- weed monitoring
- pest animal monitoring
- rapid monitoring events
- habitat quality assessments
- photo monitoring.

Annual reports will be prepared to detail progress of the offset area in achieving the interim performance targets and completion criteria for each management year including the results of management and monitoring activities completed.

Santos will apply to have the offset area protected via a Voluntary Declaration under section 19E and 19F of the Queensland *Vegetation Management Act 1999* (VM Act) (including surplus areas identified in Table ES 1). In accordance with previous OAMPs over the Kentucky property, Santos will lodge the Voluntary Declaration application by 23 March 2022 and the Voluntary Declaration will remain in place for the life of EPBC 2012/6615.

**Table ES 1: Summary of Stage 5 MNES offset requirements acquit on the Kentucky offset area**

| MNES | Status under EPBC Act[1] | Impact area (ha) | Surplus area remaining on Kentucky following acquittal of EPBC 2008/4059 and 2008/4096 (ha) | Offset area to be secured under EPBC 2012/6615 in accordance with the *Offsets assessment guide* (ha) | % acquittal | Surplus area available (ha) |
|---|---|---|---|---|---|---|
| **Listed threatened ecological communities** | | | | | | |
| Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community (Brigalow TEC) | E | 6.5 | 0 | - | 0^ | 0 |
| **Listed threatened species** | | | | | | |
| Collared Delma (*Delma torquata*) | V | 143.6 | 1,323.7 | 806.5 | 107.9 | 517.2 |
| Dunmall's Snake (*Furina dunmalli*) | V | 144.0 | 1,375.4 | 806.5 | 107.6 | 568.9 |
| Yakka Skink (*Egernia rugosa*) | V | 140.8 | 1,375.4 | 806.5 | 88.1^ | 568.9 |
| Koala (*Phascolarctos cinereus*) | E | 116.3 | 1,323.7 | 806.5 | 62.4^ | 517.2 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 144.0 | 1,375.4 | 806.5 | 107.6 | 568.9 |

[1] E = Endangered; V = Vulnerable.

^ Remaining offset requirement satisfied on another property.

**Table ES 2: Interim performance targets and completion criteria for the Kentucky offset area**

| MNES | Baseline habitat quality score | Interim performance targets | | | Completion criteria |
|---|---|---|---|---|---|
| | | Year 5 | Year 10 | Year 15 | Year 20 |
| Collared Delma (*Delma torquata)* | 8 (8.1) | 8.3 | 8.6 | 8.8 | 9 |
| Dunmall's Snake (*Furina dunmalli)* | 8 (8.2) | 8.4 | 8.6 | 8.8 | 9 |
| Yakka Skink (*Egernia rugosa*) | 7 (7.2) | 7.4 | 7.6 | 7.8 | 8 |
| Koala (*Phascolarctos cinereus*) | 8 (8.0) | 8.2 | 8.5 | 8.8 | 9 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | 8 (7.7) | 8.0 | 8.3 | 8.7 | 9 |

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# 1.0 Introduction

The Santos Gladstone Liquefied Natural Gas (GLNG) Project involves the development of Coal Seam Gas (CSG) resources in the Surat and Bowen Basins in Queensland, to supply gas via a 430 kilometre (km) gas transmission pipeline (GTP) to the liquefied natural gas (LNG) Facility located on Curtis Island. Throughout the development of the Santos GLNG Project and in accordance with Santos GLNG Project approvals, potentially impacted environmental values are systematically identified and assessed and in order of preference are avoided, minimised or mitigated.

The Santos GLNG Project is required to provide environmental offsets for significant residual impacts on matters of national environmental significance (MNES) in accordance with approvals granted under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act).

This offset area management plan (OAMP) has been prepared to address the acquittal of the MNES significant residual impacts for Stage 5 of the Gas Fields Development (GFD) Project under the GLNG Project approval EPBC 2012/6615, outlined in Table 1, on the Kentucky offset area (Figure 1).

**Table 1: Impacted MNES required to be offset for Stage 5 of the GFD Project under EPBC 2012/6615**

| MNES | Status under EPBC Act[1] | Impact area (ha) |
|---|---|---|
| **Listed threatened ecological communities (TECs)** | | |
| Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow TEC) | E | 6.5 |
| **Listed threatened species** | | |
| Collared Delma (*Delma torquata*) | V | 143.6 |
| Yakka Skink (*Egernia rugosa*) | V | 140.8 |
| Dunmall's Snake (*Furina dunmalli*) | V | 144.0 |
| Koala (*Phascolarctos cinereus*) | E | 116.3 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 144.0 |

[1] E= Endangered; V= Vulnerable.

## 1.1 Purpose

This OAMP provides a detailed management and monitoring framework for the Kentucky offset area in accordance with the requirements of EPBC 2012/6615 as presented in Table 2 below.

Table 2: Approval conditions satisfied through this OAMP

| Condition number | Condition | How the conditions are met |
|---|---|---|
| **EPBC Act approval 2012/6615** | | |
| **11** | The approval holder must ensure that environmental offsets comply with the principles of the EPBC Act Environmental Offsets Policy. | Offsets to compensate for significant residual impacts associated with Stage 5 of the GFD Project will be delivered in accordance with the principles of the EPBC Act *Environmental Offsets Policy*.<br><br>An offset area will be secured on Kentucky to partially acquit offset obligations for the MNES matters outlined in Table 1.<br><br>The Kentucky offset area has been identified to comply with the requirements for an offset under the EPBC Act *Environmental Offsets Policy* as detailed in Section 2.9 of this OAMP. |
| **12** | The approval holder may carry out the action in project stages. The approval holder must deliver environmental offsets for residual significant impacts to matters of national environmental significance for each project stage. | The action will be carried out in stages. An offset plan has been prepared to address offset requirements for residual significant impacts on MNES associated with Stage 5 of the GFD Project. |
| **13** | The approval holder must submit an Offset Management Plan for the Minister's written approval. The Offset Management Plan may be prepared and submitted to the Minister for written approval in stages. If the approval holder submits the Offset Management Plan in stages, each version of the Offset Management Plan must address the known and predicted impacts of the completed, current, and next proposed project phases. | An offset plan has been prepared to address offset requirements for residual significant impacts on MNES associated with Stage 5 of the GFD Project. This OAMP for the Kentucky offset area is submitted as part of the offset plan to address Stage 5 of the GFD Project.<br><br>A reconciliation of impacts for Stage 1-4 of the GFD Project is included in the offset plan. |
| **14** | The Offset Management Plan must include:<br>a. a method for assessing residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities;<br>b. results from pre-disturbance surveys and/or an alternative approved methodology (if used) for the project phase as required under conditions 4 and 5;<br>c. details of the offset areas required to address predicted residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities for the project phase;<br>d. a survey and description of the current condition (prior to any management activities) of each offset area proposed, including existing vegetation (the baseline condition). This must include a shapefile of each offset property boundary;<br>e. information about how the offset areas provide connectivity with other relevant habitats and biodiversity corridors, including a map depicting the offset areas in relation to other habitats and biodiversity corridors;<br>f. performance and completion criteria for evaluating the management of the offset area, and criteria for triggering remedial action (if necessary);<br>g. a description of the management measures that will be implemented for the protection of EPBC threatened species, EPBC migratory species and EPBC communities, including a discussion of how measures outlined take into account relevant conservation advice and are consistent with the measures in relevant recovery plans and threat abatement plans;<br>h. a program to monitor and report on the effectiveness of these measures, and progress against the performance and completion criteria;<br>i. a description of potential risks to the successful implementation of the plan, and a description of the contingency measures that would be implemented to mitigate against these risks;<br>j. a timeline for when actions identified in the Offset Management Plan will be implemented for each offset area; and<br>k. the proposed legal mechanism for securing the offset. | The Kentucky offset area is proposed to be secured to partially acquit offset requirements for Stage 5 of the GFD Project. An OAMP for the Kentucky offset area has been developed in accordance with the requirements outlined in condition 14. A summary of how each requirement has been addressed is provided below.<br>a. The method for assessing residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities is discussed in the offset plan, submitted in conjunction with this OAMP.<br>b. Details of the relevant field assessments within the Stage 5 GFD Project development area are provided in the offset plan, submitted in conjunction with this OAMP.<br>c. A summary of the significant residual impacts associated with Stage 5 of the GFD Project is provided in Table 1 of this OAMP and the offset plan. A summary of the offset area required to acquit the Stage 5 offset requirements is provided in the offset plan, with a summary of the proposed offset area on Kentucky and how it partially acquits the Stage 5 offset requirements provided in Section 2.6 of this OAMP. In accordance with the EPBC Act *Environmental Offsets Policy* the proposed offset areas required to be secured for the MNES were determined using the *Offsets assessment guide* as described in Section 2.6.<br>d. A summary of the ecological field surveys undertaken on the Kentucky offset area is described in Section 2.4. Details of the baseline ecological condition are provided in Section 2.5 and Appendix A of this OAMP.<br>e. Details on the connectivity and the landscape context are provided in Section 2.2.<br>f. Individual completion criteria have been developed for the MNES as part of the environmental outcomes to be achieved for the Kentucky offset area (Section 4.0). In addition, specific management objectives and performance criteria have been developed which will provide the basis for achieving the MNES completion criteria. The complete adaptive management process for this OAMP is encapsulated in Table 11 and includes management actions, monitoring events, adaptive management triggers and corrective actions that have been assigned to each management objective and performance criteria.<br>g. Management measures to be implemented as part of this OAMP have been developed to address key threats known or with the potential to occur within the Kentucky offset area identified as part of detailed field surveys and take into account relevant conservation advice and are consistent with the measures in relevant recovery plans and threat abatement plans. A summary of the known and potential threats is detailed in Section 3.0 and proposed management measures are detailed in Section 6.0.<br>h. The monitoring program to measure the effectiveness of the management measures and progress against the performance and completion criteria is detailed in Section 7.0.<br>i. Risks to the successful implementation of this plan are included in the risk assessment presented in Appendix C.<br>j. The timing for implementation of the management and monitoring program are provided in Section 9.0. |

| Condition number | Condition | How the conditions are met |
|---|---|---|
| | | k. Details on how the Kentucky offset area for Stage 5 of the GFD Project will be legally secured are provided in Section 2.8 of this OAMP. |
| **15** | The currently approved Offset Management Plan must be implemented by the approval holder. | Once approved, this OAMP will be implemented. |
| **16** | The approval holder must register and legally secure offsets for the first project phase identified in the Offset Management Plan within two years of commencement of the first project phase. | Details on how the Kentucky offset area for Stage 5 of the GFD Project will be legally secured are provided in Section 2.8. |
| **17** | The approval holder must register and legally secure offsets for a project phase which are sufficient to acquit the residual significant impacts of that project phase. | Details on how the Kentucky offset area for Stage 5 of the GFD Project will be legally secured are provided in Section 2.8. |
| **18** | If the approval holder submits the Offset Management Plan in stages, the approval holder must prepare and submit an updated Offset Management Plan for each subsequent project phase, for written approval by the Minister. The updated Offset Management Plan must:<br>a. include the information required for the Offset Management Plan at condition 14 for the next project phase;<br>b. include a reconciliation of actual and predicted but yet to be actualised residual significant impacts to EPBC threatened species, EPBC migratory species and EPBC communities against offsets secured for the commenced project phases and may be subtracted from the obligations required for the subsequent project phases. Any shortfall in secured offsets relative to the requirements arising from actual and predicted but yet to be actualised impacts of any commenced project phases must be added to the obligations required for the next project phase; and<br>c. demonstrate how the offset builds on offsets already secured for previous project stages and will contribute to a larger strategic offset for cumulative project impacts. | An updated version of this OAMP will be submitted for any subsequent stages of the GFD project. |
| **19** | The approval holder must not commence the project phase until the Offset Management Plan, updated for that project phase has been approved by the Minister in writing. | This OAMP is submitted for the approval of the Minister.<br>Stage 5 will not commence until this OAMP for the project stage has been approved. |

148°20'0"E 148°40'0"E 149°0'0"E 149°20'0"E 149°40'0"E

25°20'0"S 25°40'0"S 26°0'0"S 26°20'0"S 26°40'0"S

Carnarvon National Park
Eden State Forest
Boxvale State Forest
Howe State Forest
Forrest State Forest
Doonkuna State Forest
Presho State Forest
Mebir State Forest
Expedition (Limited Depth) National Park
Belington Hut State Forest
Gwambagwine State Forest
Lake Murphy Conservation Park
Beilba State Forest
Expedition Resources Reserve
Stephenton State Forest
Hallett State Forest
Carraba Conservation Park
Walhallow State Forest
Taboonbay State Forest
Gubberamunda State Forest 3
Gubberamunda State Forest 2
Gubberamunda State Forest 1
Woodduck State Forest
Emu State Forest
Combabula State Forest
Mount Organ State Forest
Hinchley State Forest
Dinoun State Forest
Juandah State Forest
Inglebogie State Forest
Yuleba State Forest
Wallabella State Forest 2
Wallabella State Forest 1
Tinowon State Forest
Trinidad State Forest 2
Trinidad State Forest 1
Brucedale State Forest
Yalebone State Forest 1
Yalebone State Forest 2

PL 450
PL 1062
Arcadia West
PL 235
PL 440
PL 1059
Towrie
PL 420
PL 1017
Arcadia Branch
PL 421
PL 234
PL 233
PL 90
PL 91
PL 232
PL 457
PL 92
PL 1012
East Lynne
PL 99
PL 100
PL 1019
PL 309 Replacement
PL 322
PL 314
PL 1021
Maisey PL application
PL 282
PL 1020
PL 310 Replacement
PL 3
PL 315
PL 93
PL 313
PL 281
PL 6
PL 316
PL 317
PL 318
PL 8
PL 319
PL 9
PL 320
PL 321
PL 11

Injune
Roma
Wallumbilla
Yuleba
Dulacca

SANTOS

Location diagram

**Figure 1**
**Project context**

Kentucky - 1WT37
Santos Petroleum Lease

***Protected Area***
National Park
State Forest
Conservation Park
Resources Reserve
Nature Refuge

***Statewide Corridors v1.4***
State
Regional

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Petroleum leases
- Protected areas
- Statewide corridors

Date: 10/22/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:550,000@A3

0 5 10 15 20
Kilometres

N

CO2 Australia

Path: P:\GISData\Projects\Santos\912_211020_Roma_East_maps\Kentucky\Figure 1 - Project context.mxd

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# 2.0 Kentucky Property

## 2.1 Property Overview

Kentucky (Lot 1 WT37) is a 4,368 ha property located approximately 50 km east north-northeast of Injune in south central Queensland (Figure 1). The property is owned by Santos and was acquired primarily for its potential environmental offset values for the Santos GLNG Project. Kentucky is situated within Subregion 20 (Arcadia) of the Brigalow Belt South Bioregion (Sattler and Williams 1999) within the jurisdiction of the Maranoa Regional Council. Access to the property is via the Beilba Road, east of the Carnarvon Developmental Road between Injune and Rolleston. Current land uses on the property include cattle grazing, activities associated with CSG exploration and production as well as areas dedicated to environmental offsets. The Santos GLNG pipeline also traverses the property in a roughly south-north direction; however, has been excluded from all assessment and offset areas discussed as part of this OAMP (Figure 2).

The property lies within rugged terrain and contains large vegetation remnants that are contiguous with Expedition (Limited Depth) National Park to the east and Lonesome Holding (proposed National Park) to the north. The property is located entirely within the Dawson River Catchment, part of the Fitzroy River Basin, with the major watercourses being the Dawson River and Baffle Creek. The topography is varied and is comprised mainly of hills, ridges, plateaux and steep scarps, with sandstone of the Precipice and Evergreen Formations forming the underlying geology. Small alluvial flats occur beside the Dawson River. Baffle Creek and its associated tributaries have associated deep gorges which provide a visually spectacular landscape.

Prior to Santos' ownership, vegetation clearing on the property was most extensive in the southern one-third of the property, between Baffle Creek and a steep plateau scarp to the north, for former pastoral development and use. Historical thinning and/or clearing of woody vegetation had also occurred on lowlands associated with the Dawson River in the north of the property. Evidence of historical wildfire, and possibly controlled burning for pastoral purposes, is present throughout the property, with some Brigalow and other communities showing severe fire damage.

Table 3 summarises Kentucky landholder and property details.

**Table 3: Kentucky landholder and property details**

| Landholder and Property Details | |
|---|---|
| Registered Owner/s on Title: | Total GNG Australia<br>Santos GLNG Pty Ltd<br>PAPL (Downstream) Pty Ltd<br>KGLNG Liquefaction Pty Ltd |
| ABN/ACN: | ABN 12 131 271 648 (Santos GLNG Pty Ltd) |
| Postal Address: | PO Box 329, Roma Queensland 4455 |
| Lot on plan(s): | Lot 1 WT37 |
| Address: | 764 Beilba Rd, Beilba Queensland |

| | |
|---|---|
| Tenure: | Freehold |
| Area: | 4,368 ha |
| Primary Local Government Area: | Maranoa Regional Council |
| **Permits** | |
| Petroleum and gas production permit | PL 90 and PL 91 Santos Toga Pty Ltd |
| Infrastructure permit | PPL 166 Santos GLNG Pty Ltd |

## 2.2 Connectivity

The Kentucky property is mapped within a state conservation corridor (Figure 1). Conservation corridors have been mapped as part of the Queensland Government's Biodiversity Planning Assessments (BPA) which assess the biodiversity significance of land in a bioregion. The mapping of corridors within the Brigalow Belt Bioregion, in which the Kentucky property is located, has focused on those corridors that link adjacent bioregions or connect wildlife refugia. Corridors identified as of state significance are considered of the greatest importance at the bioregional scale. As illustrated in Figure 1, the state conservation corridor runs along the eastern portion of the property as part of the contiguous tract of remnant vegetation including Expedition (Limited Depth) National Park.

148°50'0"E
148°52'0"E
148°54'0"E
25°30'0"S
25°32'0"S
25°34'0"S
25°36'0"S

SANTOS

**Figure 2**
**Property overview**

Kentucky - 1WT37
Petroleum pipeline (PPL 166)
Kentucky offset area
2012/6615 Stage 5 offset area

***2008/4059 offset area***
Phase 1
Phase 2

2008/4059 rehab offset
2008/4096 offset area
Surplus offset area
Future habitat areas approved under 2008/4059

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Petroleum pipeline
Kentucky offset area provided by SANTOS

Date: 3/1/2022 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:37,500@A3

0 0.5 1 1.5 2
Kilometres

N

CO2 Australia

Location diagram

Path: P:\GIS\Data\Projects\Santos\912_211020_Roma_East_maps\Kentucky\Fig_2_Property_overview.mxd

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## 2.3 Climate

The Kentucky property is characterised by a hotter wet season (typically November to March) and a cooler dry season (typically April to October) (see Figure 3). Weather records from the Injune weather station (#43015), approximately 50 km south-west of Kentucky, show the mean monthly rainfall for the period 1961-1990 ranges from 24.9 millimetres (mm) (September) to 94.6 mm (January). Mean monthly maximum temperatures range from 19.6 degrees Celsius (°C) (July) to 33.7°C (January) and mean monthly minimum temperatures range from 3°C (July) to 19.2°C (January).

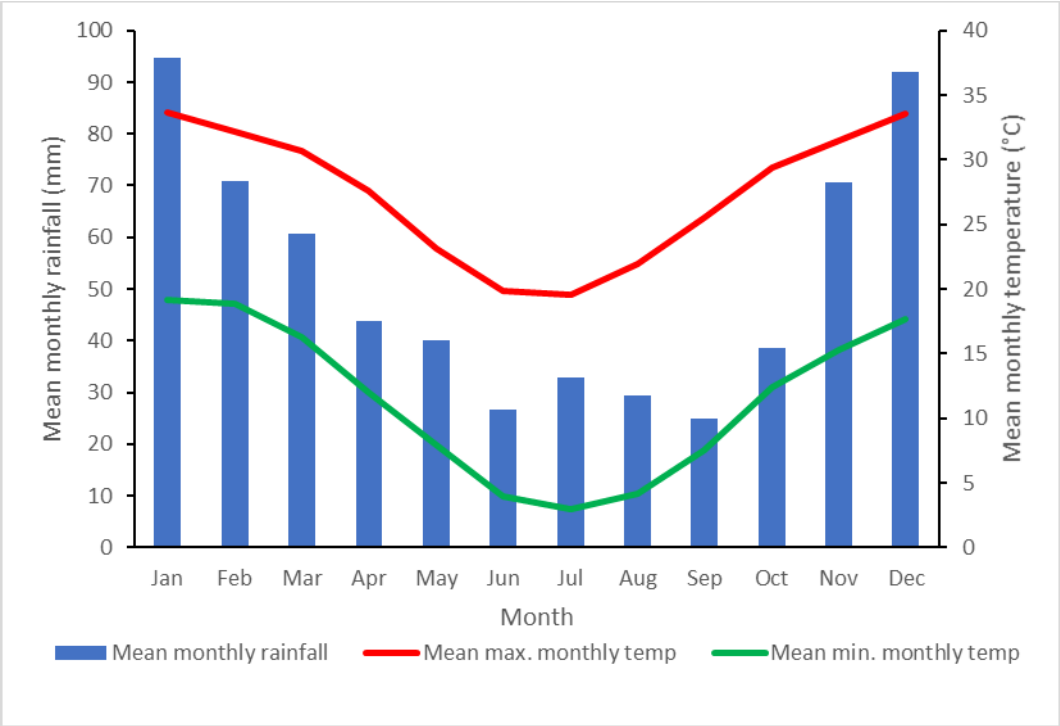


**Figure 3: Mean monthly temperature and rainfall records from Injune Post Office weather station (ID: 43015) 1961-1990 (Bureau of Meteorology 2021)**

## 2.4 On-ground property assessments

Santos has dedicated the majority of the Kentucky property for environmental offsets (4,302.3 ha; herein referred to as the offset area) with the exception of the area excluded for the Santos GLNG pipeline and associated infrastructure (65.6 ha).

A combination of desktop and detailed on-ground assessments of the offset area have been undertaken to confirm the suitability of the area to satisfy the Project's offset obligations. The key desktop and field surveys of the offset area completed to date are summarised below:

- 2010
    - Preliminary desktop assessment of biodiversity offset values (Ecofund 2010).
    - Detailed field assessment undertaken by Boobook, in May 2010, to ground truth vegetation and confirm presence of environmental values (Boobook 2011).

- 2015
    - Further refine ground-truthed and potential regional ecosystem (RE) types and their extent as well as confirming location of potential areas to support biodiversity offsets based on examination of high-resolution aerial photography provided for the property by Santos (Boobook 2015).
- 2020 (January to May)
    - Update large-scale RE mapping across the offset area including verification of presence and extent of remnant and regrowth vegetation communities and TEC (Boobook 2020a). For each area of potential TEC an assessment of vegetation survey data was made against TEC threshold criteria.
    - BioCondition assessments within the offset area in accordance with the BioCondition methodology (Eyre *et al*. 2015). Scores for BioCondition sites were calculated in accordance with Eyre *et al*. (2015) which compares the values obtained at each survey site with values in the benchmark document for that particular RE (Queensland Herbarium 2019). Photo monitoring sites were established at all BioCondition assessment sites.
    - Updated RE-based predictive habitat mapping for EPBC Act-listed threatened flora and fauna species confirmed, likely or potentially present within the offset area based on the results of field surveys including microhabitat assessments were conducted at each BioCondition site combined with ecologist knowledge.
    - Targeted fauna surveys to assess fauna species richness for the endangered and vulnerable species as summarised in Table 4 below.
    - Incidental searches for threatened flora species listed under the EPBC Act and/or Queensland *Nature Conservation Act 1992* were carried out at vegetation assessment sites and during meanders in targeted habitat types, including remnant and non-remnant vegetation.
    - The timing (season) and duration of the survey period during summer and autumn coincided with good conditions for the identification of spring-summer growing and flowering herbaceous plant species. However, the recent (and continuing) rainfall events that fostered good conditions for plant growth and detectability followed a protracted period of extraordinarily low rainfall which had prevailed over most of the previous two years. These conditions were almost certain to have impacted on the detectability of fauna: for many groups (e.g. reptiles, birds), animals would have left the property or died, and it is likely that this impact continued at least partially into the survey period as animal population responses lag to some extent, depending on the taxa involved. For example, it was noted during the survey that small ground-dwelling reptiles were scarce (Boobook 2020a).

**Table 4: Survey techniques for threatened species potentially present within the offset area (Boobook 2020a)**

| Species | Survey methods | Survey effort |
|---|---|---|
| Collared Delma | • Diurnal active searches | • 14 diurnal searches, 2 x 30 min = 14 person/hours |
| Dunmall's Snake | • Diurnal active searches<br>• Nocturnal active searches | • 14 diurnal searches, 2 x 30 min = 14 person/hours<br>• 11 nocturnal searches, 2 x 1.0-2.5 hr = 29 person/hrs |
| Yakka Skink | • Diurnal active searches | • 14 diurnal searches, 2 x 30 min = 14 person/hours |
| Koala | • Nocturnal spotlight searches (on foot)<br>• Nocturnal spotlight searches (driven)<br>• Diurnal searches (on foot) for animals, scats, scratches | • 11 nocturnal searches, 2 x 1.0-2.5 hr = 29 person/hrs<br>• 2 hrs/5 km per night for 3 nights = 6 hrs/15 km<br>• 14 diurnal searches, 2 x 30 min = 14 person/hours |
| South-eastern Long-eared Bat | • Harp trapping in potential habitat | • 20 harp trap-nights |

## 2.5 Ground truthed vegetation and habitat mapping

Based on the results of detailed ecological field assessments, ground-truthed vegetation within the offset area has been classified as remnant vegetation, vegetation consistent with RE (advanced regrowth) or non-remnant vegetation (Santos 2014). Within the 4,302.3 ha offset area approximately 3,996.9 ha of vegetation (3,305.4 ha of remnant and 691.5 ha of regrowth) was mapped, the remaining is considered non-remnant.

The suitability of areas of vegetation as fauna habitat was determined by the presence and abundance of microhabitat features relevant to the needs of individual species or groups of species (e.g. terrestrial reptiles; Boobook 2020a). The results of detailed field assessments were combined with ecologist knowledge to develop RE-based predictive habitat mapping for EPBC Act-listed threatened flora and fauna species confirmed, likely or potentially present within the offset area. This assessment also considered the habitat mapping rules for the Santos GLNG Project area outlined in the *Predictive Habitat Mapping Rules for Selected MNES Fauna Species within the Roma, Fairview and Arcadia Gas Fields* report (Boobook 2020b).

### 2.5.1 Vegetation description

Table 5 provides a summary of the ground-truthed RE mapped on the offset area.

Soils at the offset area are predominantly sandy loams and duplex soils. These support vegetation communities dominated by ironbark (*Eucalyptus* species [spp.]). Sandy lithosols on plateau crests support shrubby open forests and woodlands of *Eucalyptus, Corymbia* and *Acacia* spp. Smaller areas of clay loam soils derived from fine-grained sediments are present on hill slopes and small valleys: these support Poplar Box (*E. populnea*), Mountain Coolibah (*E. orgadophila*), Brigalow (*A. harpophylla*) and SEVT communities. The Dawson River, at the extreme north of the offset area, features deep sandy to silty loam alluvium on riverbanks and associated floodplain which support riparian open forest of Queensland Blue Gum (*E. tereticornis*), Rough-barked Apple (*Angophora floribunda*) and Weeping Bottlebrush (*Melaleuca viminalis*); and grassy woodlands of Poplar Box and/or Silver-leaved Ironbark (*E. melanophloia*). There is only limited development of these alluvial or riparian communities on Baffle Creek, which for much of its extent at the offset area is narrowly bounded by steep sandstone cliffs. Grey Gums (*E. major, E. longirostrata*) are present on escarpment slopes and within gorges (Boobook 2020a).

**Table 5: Ground-truthed RE mapped on the Kentucky offset area**

| RE | Description | Type | Kentucky offset area (ha) | | | | |
|---|---|---|---|---|---|---|---|
| | | | EPBC 2008/4059 Phase 1 and 2 offset area | EPBC 2008/4096 offset area | EPBC 2012/6615 offset area | Surplus offset | Total Area |
| 11.3.2 | *Eucalyptus populnea* woodland on alluvial plains | Remnant | 30.32 | - | - | - | 30.32 |
| 11.3.25 | *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines | Remnant | 11.67 | - | - | - | 11.67 |
| 11.3.27 | Freshwater wetlands | Remnant | 1.03 | - | - | - | 1.03 |
| 11.3.39 | *Eucalyptus melanophloia* +/- *E. chloroclada* open woodland on undulating plains and valleys with sandy soils | Remnant | 46.73 | - | - | - | 46.73 |
| 11.9.10 | *Eucalyptus populnea* open forest with a secondary tree layer of *Acacia harpophylla* and sometimes *Casuarina cristata* on fine-grained sedimentary rocks | Remnant | 60.34 | - | - | - | 60.34 |
| 11.9.2 | *Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks | Regrowth | 41.71 | - | - | - | 41.71 |
| | | Remnant | 107.76 | - | - | - | 107.76 |
| 11.9.4 | Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks | Remnant | 22.73 | 19.79 | - | - | 42.52 |
| 11.9.5 | *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks. | Remnant | 67.78 | - | - | - | 67.78 |
| | | Regrowth | 3.33 | - | - | - | 3.33 |
| 11.10.3 | *Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks. Crests and scarps | Remnant | 29.17 | - | - | 51.67 | 80.84 |
| 11.10.7 | *Eucalyptus crebra* woodland on coarse-grained sedimentary rocks | Regrowth | 421.45 | - | - | - | 421.45 |
| | | Remnant | 1,314.32 | - | - | - | 1,314.32 |
| 11.10.8 | Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks | Remnant | 4.96 | - | - | - | 4.96 |
| 11.10.11 | *Eucalyptus populnea, E. melanophloia* +/- *Callitris glaucophylla* woodland on coarse-grained sedimentary rocks | Regrowth | 3.58 | - | - | - | 3.58 |
| 11.10.13 | *Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands | Remnant | 419.44 | - | 806.50 | 311.17 | 1,537.11 |
| | | Regrowth | 15.45 | - | - | 206.03 | 221.48 |
| Non-remnant | | - | - | - | - | - | 305.35 |
| **Total** | | - | **2,601.77** | **19.79** | **806.50** | **568.87** | **4,302.28** |

### 2.5.2 Habitat description

Table 6 summarises the mapping rules and total area of potential habitat for MNES within the offset area based on the results of detailed field assessments (Boobook 2020a).

An additional description of the offset area for each MNES is provided in Section 3.0.

**Table 6: Extent of suitable habitat for MNES associated with disturbance under Stage 5 of EPBC 2012/6615 on the Kentucky offset area**

| Species | Potentially suitable RE | Habitat mapping rules | Mapped extent of potential habitat (ha)* |
|---|---|---|---|
| Brigalow TEC | 11.9.5 | Remnant and regrowth RE 11.9.5 where *Acacia harpophylla* is dominant in the canopy or the vegetation otherwise meets condition criteria (Department of the Environment [DotE] 2013). | 0 |
| Collared Delma | 11.3.2, 11.3.39, 11.9.2, 11.9.10, 11.10.7, 11.10.11, 11.10.13 | Mapped habitat includes all areas of remnant and regrowth vegetation of the nominated RE. | 1,323.7 |
| Yakka Skink | 11.3.2, 11.3.39, 11.9.2, 11.9.5, 11.9.10, 11.10.3, 11.10.7, 11.10.11, 11.10.13 | Mapped habitat is based on known records within the nominated RE and includes all remnant and regrowth vegetation of the nominated RE. This may include sub-optimal habitat. | 1,375.37 |
| Dunmall's Snake | 11.3.2, 11.3.25, 11.3.27, 11.3.39, 11.9.2, 11.9.4, 11.9.5, 11.9.10, 11.10.3, 11.10.7, 11.10.8, 11.10.11, 11.10.13 | Mapped habitat includes all remnant and regrowth vegetation of the nominated RE. | 1,375.37 |
| Koala | 11.3.2, 11.3.25, 11.3.27, 11.3.39, 11.9.2, 11.9.10, 11.10.7, 11.10.11, 11.10.13 | Mapped habitat includes all remnant and regrowth vegetation of RE dominated by Myrtaceae species. | 1,323.7 |
| South-eastern Long-eared Bat | 11.3.2, 11.3.25, 11.3.27, 11.3.39, 11.9.2, 11.9.4, 11.9.5, 11.9.10, 11.10.3, 11.10.7, 11.10.8, 11.10.11, 11.10.13 | Mapped habitat includes all areas of remnant and regrowth vegetation that may be suitable for foraging or shelter. | 1,375.37 |

* Extent of habitat available to acquit offset requirements under EPBC 2012/6615 following acquittal of offsets requirements for EPBC 2008/4059 and EPBC 2008/4096.

148°50'0"E
148°52'0"E
148°54'0"E
25°32'0"S
25°34'0"S
25°36'0"S

***Ground-truthed vegetation***

- 11.9.2
- 11.9.2 (regrowth)
- 11.9.4
- 11.9.5
- 11.9.5 (regrowth)
- 11.9.10
- 11.10.3
- 11.10.7
- 11.10.7 (regrowth)
- 11.10.8
- 11.10.11 (regrowth)
- 11.10.13
- 11.10.13 (regrowth)
- 11.3.2
- 11.3.25
- 11.3.27
- 11.3.39

**SANTOS**

**Location diagram**

**Figure 4**
**Kentucky ground-truthed vegetation**

- Kentucky - 1WT37
- Kentucky offset area
- Future habitat areas

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Petroleum pipeline
Kentucky offset area provided by SANTOS

Date: 6/11/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:35,000@A3

0 0.5 1 1.5 2 Kilometres

N

CO2 Australia

Path: P:\GIS\Data\Projects\Santos\ENV_20_00419.GTP_Offset_Maps\Kentucky\Figure 4 - Vegetation and offset area.mxd

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## 2.6 Offset Area

The offset area is 4,302.3 ha and comprises the majority of the 4,367.9 ha property, as illustrated in Figure 4. The Santos GLNG pipeline and associated infrastructure is located within the remaining 65.6 ha and has been excluded from the offset area and this OAMP. The offset area includes:

- 19.79 ha to acquit offset requirements under EPBC 2008/4096 (conditions 15-22) and the GTP SSMP.
- 2,533.29 ha to acquit offset obligations under EPBC 2008/4059 plus 305.4 ha of future habitat area that will support threatened species in the future following appropriate management (approved by DAWE 23 March 2021; however, was provided in addition to acquitting MNES offset obligations under EPBC 2008/4059 to support the overall conservation gain of the offset area).
- 806.5 ha to partially acquit offset obligations under EPBC 2012/6615
- 801.37 ha of remaining surplus offset value comprising habitat for MNES and will be used by Santos to acquit future project offset requirements.

Table 7 provides a summary the offset area including the offset area allocated to partially acquit the current MNES offset requirements for Stage 5 under EPBC 2012/6615 and area of surplus offset values available which will be used by Santos to acquit future project offset requirements. For MNES where a surplus is noted, Santos proposes to draw down on these to acquit future offset requirements under approvals related that are yet to be granted. In addition to the remnant and regrowth vegetation areas in the offset area identified below, there are 305.4 ha of future habitat areas that will regenerate and benefit from management in accordance with this plan (Figure 4). These areas will be managed as part of this OAMP in addition to the offset areas required under EPBC 2012/6615 and the EPBC Act *Offsets assessment guide* to support the overall conservation gain of the offset area.

The results of the detailed field assessments including the ground-truthed RE mapping and fauna habitat associations discussed in Section 2.5, were used to inform the suitability to acquit the MNES offset requirements.

The minimum offset area required to be secured for the MNES was determined in accordance with the EPBC Act *Offsets assessment guide*.

A baseline habitat quality score for the MNES offset value was determined generally in accordance with the *Guide to Determining Terrestrial Habitat Quality* (GTDTHQ) (version 1.2; Department of Environment and Heritage Protection [DEHP] 2017) based on the results of the detailed field assessments (Section 2.4). The baseline habitat quality score was used to inform the *Offsets assessment guide* for the MNES under EPBC 2012/6615. The habitat quality score will be used as a measure to assess the success of the OAMP through the interim performance targets and completion criteria outlined in Section 4.0. A detailed summary of the baseline habitat quality scores for the MNES is provided in Appendix A.

**Table 7: Summary of the Kentucky offset area and acquittal**

| MNES | Status under EPBC Act[1] | Impact area (ha) | Area available on Kentucky (after GTP [2008/4096] and GLNG [2008/4059] acquittals) (ha) | Offset area to be secured under EPBC 2012/6615 in accordance with the *Offsets assessment guide*[2] (ha) | % acquittal | Surplus area available (ha) |
|---|---|---|---|---|---|---|
| **Listed threatened ecological communities** | | | | | | |
| Brigalow TEC | E | 6.5 | 0 | 0 | 0^ | 0 |
| **Listed threatened species** | | | | | | |
| Collared Delma (*Delma torquata*) | V | 143.6 | 1,323.70 | 806.5 | 107.9 | 517.2 |
| Dunmall's Snake (*Furina dunmalli*) | V | 144.0 | 1,375.37 | 806.5 | 107.6 | 568.9 |
| Yakka Skink (*Egernia rugosa*) | V | 140.8 | 1,375.37 | 806.5 | 88.1^ | 568.9 |
| Koala (*Phascolarctos cinereus*) | E | 116.3 | 1,323.70 | 806.5 | 62.4^ | 517.2 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | V | 144.0 | 1,375.37 | 806.5 | 107.6 | 568.9 |

[1] E = Endangered; V = Vulnerable.

^ Remaining offset requirement satisfied on another property.

## 2.7 Development and land use

Santos has committed to excluding any development for the Project from the offset area.

The areas on the Kentucky property outside of the offset area may be utilised for petroleum and/or farming infrastructure and facilities; however, no infrastructure will be located within the offset area or impact the offset area's ability to achieve the completion criteria outlined in this OAMP.

Prior to being acquired by Santos GLNG, the Kentucky property was formerly utilised for grazing purposes. The following ancillary infrastructure is still present on the property and will be maintained ongoing without impact to the offset area:

- Cattle yards; and
- Kentucky house.

## 2.8 Offset Protection

The 4,302.3 ha offset area (including surplus areas identified in Table 7) will be protected via a Voluntary Declaration under section 19E and 19F of the Queensland *Vegetation Management Act 1999* (VM Act) and will be declared as an area of high nature conservation value. Santos will apply for the offset area to be secured under a Voluntary Declaration by 23 March 2022. The Voluntary Declaration will be registered on the property title and will be binding on current and future landowners.

A Voluntary Declaration under the VM Act is an authorised legally binding mechanism and is considered appropriate to legally secure MNES values and protect the area from vegetation clearing. The offset area will be mapped as a Category A area on the Property Map of Assessable Vegetation (PMAV). A Category A area on a PMAV is described as an "Area subject to compliance notices, offsets and voluntary declarations".

The Voluntary Declaration will remain in place for the life of EPBC 2012/6615. The Voluntary Declaration may only be removed in accordance with the provisions of the VM Act or if the chief executive the Queensland Department of Natural Resources, Mines and Energy considers it necessary.

Offset area coordinates for the proposed declared area for the Voluntary Declaration are given in Appendix B.

In addition, once areas of regrowth vegetation on the Kentucky property have reached the requirements to achieve remnant status Santos will apply to these areas reclassified as remnant vegetation in accordance with the relevant Queensland legislation. Santos will notify the Department of Agriculture, Water and the Environment (DAWE) within 30 business days of the reclassification occurring.

## 2.9 EPBC Act Environmental Offset Policy

Table 8 outlines how the Stage 5 GFD Project offset obligations acquit on the offset area meet the requirements of the EPBC Act *Environmental Offsets Policy*.

**Table 8: Assessment against Principles of the Offset Policy**

| Principle | How the principle is met in this offset proposal |
|---|---|
| 1. 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 | The offset area partially acquits MNES offset requirements under EPBC 2012/6615 as outlined in Table 7. The remaining will be acquit elsewhere.<br><br>The offset area will be managed and monitored to improve the viability of habitat for threatened species. This will include the management of regrowth vegetation to become self-sustaining functional remnant vegetation communities.<br><br>This OAMP sets out specific management objectives with interim performance targets and completion criteria. Management actions are outlined with accompanying adaptive management triggers and corrective actions in the event that monitoring identifies that interim performance targets are not attained or completion criteria are not attained and/or maintained. The offset area will be managed and monitored from approval of the OAMP for a minimum of 20 years. It is anticipated that the completion criteria will be achieved within a 20-year period. |
| 2. be built around direct offsets but may include other compensatory measures | MNES offset obligations under EPBC 2012/6615 will be acquit through the delivery of direct land-based offsets on the offset area and additional land-based offset areas to be secured by Santos. |
| 3. be in proportion to the level of statutory protection that applies to the protected matter | The threatened status of the impacted protected matter is considered in the *Offsets assessment guide* in calculating the area of the offset to be provided. |
| 4. be of a size and scale proportionate to the residual impacts on the protected matter | The size of the offset area to be secured for offset obligations has been calculated in accordance with the *Offsets assessment guide* (Santos 2021). |
| 5. effectively account for and manage the risks of the offset not succeeding | This OAMP has been developed in consideration of known and identified threats to the offset value to manage the risk of failing to the achieve the completion criteria and overall environmental outcomes for the offset area.<br><br>Threats to the offset site are managed through the implementation of the management measures discussed in Section 6.0, including:<br>• Fire prevention and management<br>• Weed monitoring and control<br>• Clearing protection<br>• Management of grazing<br>• Restricted access.<br><br>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 based on the results of |

| Principle | How the principle is met in this offset proposal |
|---|---|
| | field surveys and discussions with the landholder. The results of the risk assessment, presented in Appendix C, have informed the adaptive management process including the identification of threats to offset values, management objectives, performance criteria, management actions, monitoring programs, adaptive management triggers and corrective actions. If the offset cannot attain and maintain the completion criteria then additional offsets will be provided to compensate for the impact and the failed offset (see Section 5.2.4). |
| 6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action) | The environmental outcomes proposed to be achieved through the implementation of this OAMP are based on additional management and monitoring measures conducted as part of business as usual on the Kentucky property. For example, under the Queensland *Biosecurity Act 2014* a person has a general biosecurity obligation to: take all reasonable and practical steps to prevent or minimise each biosecurity risk. The steps proposed in this OAMP are above reasonable and practical steps required to control feral animals and weeds in central Queensland.<br><br>Once the Voluntary Declaration has been secured over the offset area, environmental laws prevent other land uses inconsistent with this OAMP being approved over this part of the property. |
| 7. be efficient, effective, timely, transparent, scientifically robust and reasonable | The offset area has been identified to be suitable using an evidence based and scientifically robust approach.<br>The environmental outcomes to be achieved through this OAMP will be delivered progressively over 20 years. The offset area will be legally secured through a Voluntary Declaration under the VM Act therefore any vegetation clearing contravention of this OAMP is not permissible without specific Queensland government approval.<br>The preparation and implementation of this OAMP supports the efficient, effective, timely, transparent and scientifically robust approach to providing offsets. |
| 8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced. | This OAMP includes a detailed monitoring program which will assess the effectiveness of the management actions undertaken and the progress of the offset area in achieving the environmental outcomes.<br>The results of all management and monitoring programs will be included in annual reports (Section 8.1). An implementation schedule for monitoring and management is provided in Section 9.0 which will be reviewed at least annually to ensure the timely implementation of this OAMP. |

# 3.0 Offset Values

The following sections provide a description of the offset area and potential threats that will be managed as part of this OAMP for each MNES offset value. Figure 5 and Figure 6 present the MNES offset areas on Kentucky.

## 3.1 South-eastern Long-eared Bat

### 3.1.1 Offset area

Habitat for South-eastern Long-eared Bat comprises areas of remnant RE 11.10.13.

The South-eastern Long-eared Bat is known to occur in a variety of dry forest habitats including River Red Gum (*Eucalyptus camaldulensis*), open woodland, mallee, Brigalow and other arid and semi-arid habitats (TSSC 2015). The preferred habitat is mallee and *Callitris* woodlands (Pennay *et al*. 2011), and habitats that have a distinct canopy with a dense, cluttered understorey (Turbill and Ellis 2006). Surveys have suggested the species requires large tracts of forest to occur (Turbill *et al*. 2008). They typically roost in dead trees, dead spouts of living trees or under bark (New South Wales National Parks and Wildlife Service [NSW NPWS] 2003; TSSC 2015). The majority of Kentucky is considered to provide suitable habitat for the South-eastern Long-eared Bat and contains several REs with an understorey of *Callitris* (Boobook 2020a).

### 3.1.2 Threats

The following key threats to the South-eastern Long-eared Bat identified on the property will be addressed through the implementation of this OAMP (Boobook 2015):

- habitat loss through clearing, and
- destruction and abandonment of nursery sites and roosting hollows.

## 3.2 Collared Delma

### 3.2.1 Offset area

Habitat for Collared Delma within the offset area comprises areas of remnant RE 11.10.13.

Habitat for Collared Delma is present over much of the Kentucky property, especially in areas of remnant and regrowth vegetation that have not recently been heavily cleared (the northern two thirds of the property).

The Collared Delma is known to occur in REs on land zones 3, 9 and 10 (Brigalow Belt Reptiles Workshop 2010), and appears to require rocks, timber, bark or other surface debris for shelter (DAWE 2021a). It tends to prefer eucalypt woodlands and open forest that provides these suitable microhabitat features (Brigalow Belt Reptiles Workshop 2010). Potential habitat within the offset area is widespread throughout the property with many of the eucalypt woodlands and forests providing adequate fallen timber, rocks and/or groundcover (Boobook 2020a).

### 3.2.2 Threats

The following key threats to the Collared Delma identified on the property will be addressed through the implementation of this OAMP (Boobook 2015; DAWE 2021a):

- habitat loss through clearing

- habitat degradation from overgrazing by stock, and
- inappropriate fire regimes and management.

## 3.3 Dunmall's Snake

### 3.3.1 Offset area

Habitat for Dunmall's Snake within the offset area comprises areas of remnant RE 11.10.13.

Habitat for Dunmall's Snake can be found over much of the Kentucky property, especially in areas of remnant and regrowth vegetation that have not recently been heavily cleared (the northern two thirds of the property).

Dunmall's Snake occurs in a variety of open dry sclerophyll woodlands and forests (typically dominated by *Eucalyptus, Acacia* and *Callitris* spp.) and on a broad range of land zones (Brigalow Belt Reptiles Workshop 2010; DAWE 2021b). They are associated with partly buried rocks and boulders, fallen timber and root cavities for shelter (DAWE 2021b). Areas comprising abundant fallen timber, large rocks and extensive rock crevice habitat are particularly prevalent along patches of Brigalow and SEVT understorey. Several eucalypt woodlands throughout the property are also associated with suitable microhabitat features. These areas are considered to provide suitable foraging and shelter habitat for Dunmall's Snake. One individual has been recorded within the offset area encountered during nocturnal active searching (spotlighting) in regrowth of RE 11.9.2 (Boobook 2020a).

### 3.3.2 Threats

The following key threats to Dunmall's Snake identified on the property will be addressed through the implementation of this OAMP (Boobook 2015; DAWE 2021b):

- habitat loss through clearing
- habitat degradation from overgrazing by stock, and
- inappropriate fire regimes and management.

## 3.4 Yakka Skink

### 3.4.1 Offset area

Habitat for the Yakka Skink within the offset area comprises areas of remnant RE 11.10.13.

Habitat for the Yakka Skink on Kentucky extends across most of the property where woodland and scrub vegetation are present. The species is commonly found under partly buried rocks and logs or in abandoned animal burrows (Brigalow Belt Reptiles Workshop 2010). Remnant vegetation along the Dawson River in the north and other large tracts of remnant and regrowth vegetation throughout the property (particularly Narrow-leaved Ironbark [*Eucalyptus crebra*] woodland) provide variable cover of woody debris and ground litter. Older growth communities contain good structure in the form of developed shrub and ground layers and fallen timber and deep leaf litter (Boobook 2020a).

### 3.4.2 Threats

The following key threats to the Yakka Skink identified on the property will be addressed through the implementation of this OAMP (Boobook 2015; DAWE 2021c):

- habitat loss and fragmentation through clearing

- habitat degradation from overgrazing by stock, and
- Inappropriate fire regimes and management.

## 3.5 Koala

### 3.5.1 Offset area

Habitat for the Koala within the offset area comprises areas of remnant RE 11.10.13.

Koala habitat is broadly defined as eucalypt forests and woodlands or shrubland with emergent eucalypt species and can include both remnant and regrowth communities, provided adequate mature Koala food trees are present (DAWE 2021d). Potential habitat for the Koala within the offset area is widespread. Characteristic scratches were detected on the bark of Grey Gums (*Eucalyptus major*) in RE 11.10.13 and *Eucalyptus tereticornis* in REs 11.3.25 and 11.3.27 as part of targeted field surveys from January to May 2020. Scats of this species have also previously been reported from the property in RE 11.10.11 (*Eucalyptus populnea* regrowth) (Boobook 2020a).

### 3.5.2 Threats

The following key threats to the Koala identified on the property will be addressed through the implementation of this OAMP (DAWE 2021d):

- degradation and fragmentation of habitat
- predation by feral predators, and
- inappropriate fire regimes and management.

South-eastern long-eared bat and dunmall's snake

Collared delma and koala

SANTOS

Location diagram

**Figure 5**
**Kentucky MNES offset areas habitat - 1**

- Kentucky - 1WT37
- Kentucky offset area
- MNES offset habitat

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data

Date: 2/25/2022 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:55,000@A3

0 0.5 1 1.5 2
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Queensland

Path: P:\GISData\Projects\Santos\912_211020_Roma_East_maps\Kentucky\Figure 5 - MNES offset areas 1.mxd

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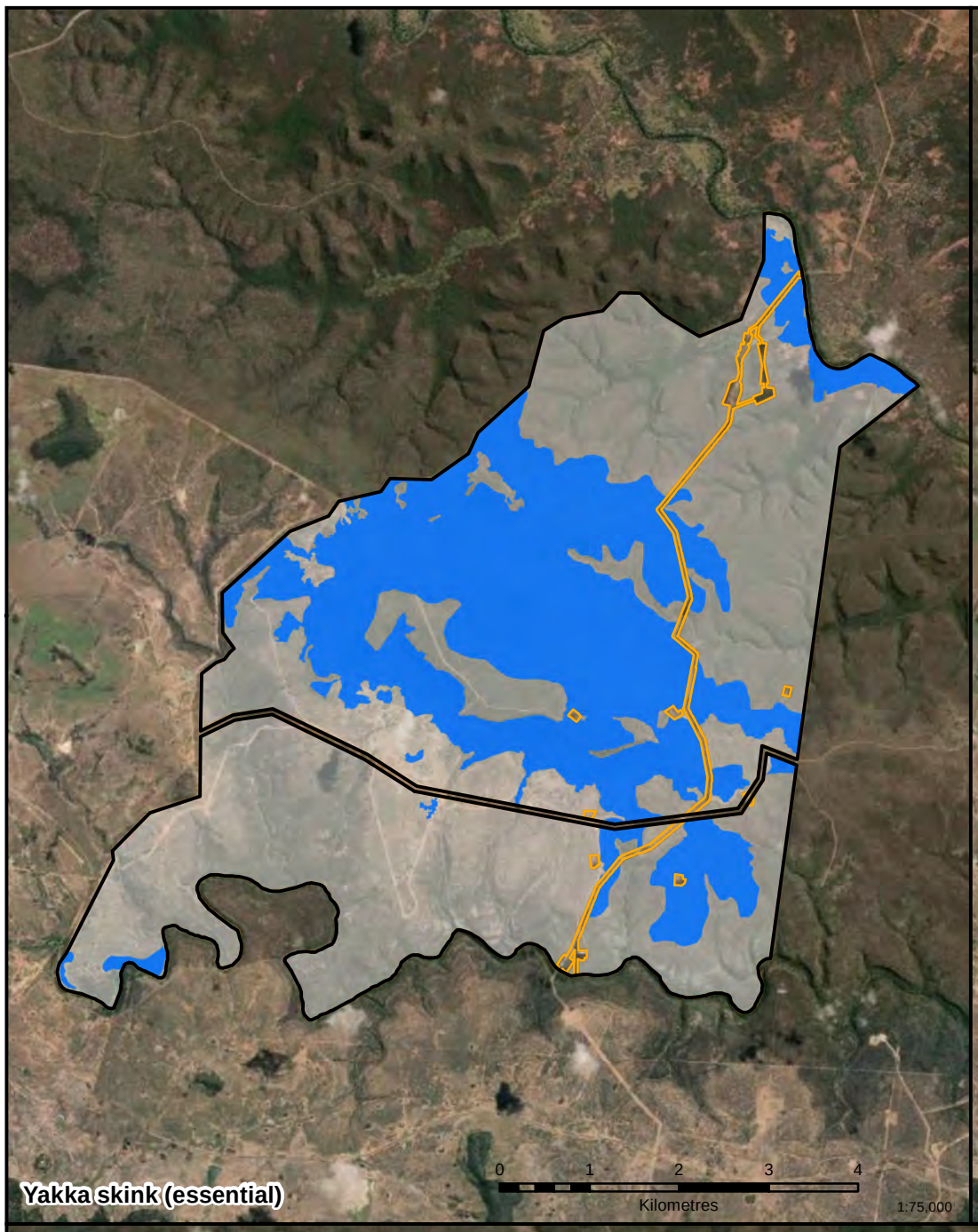


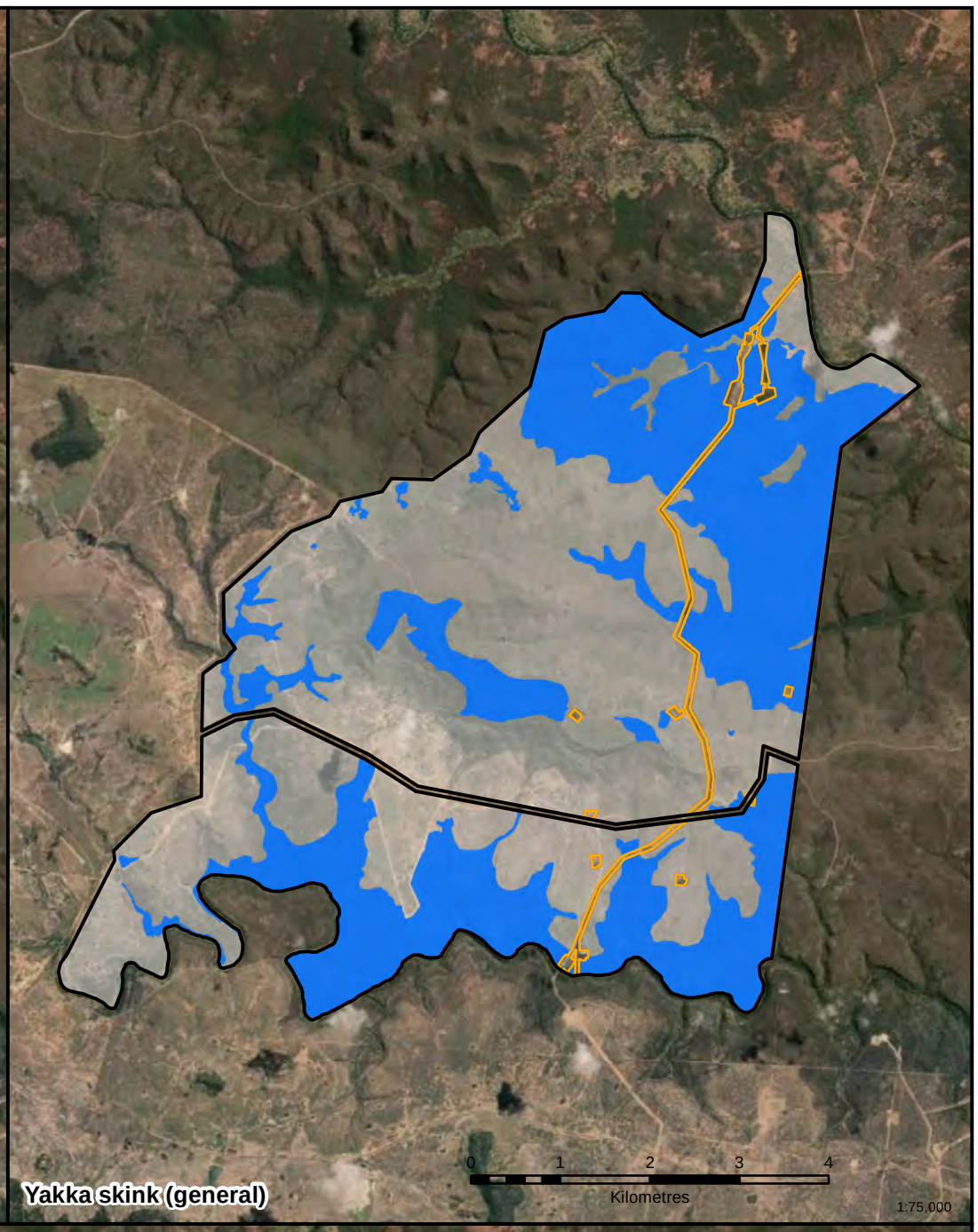


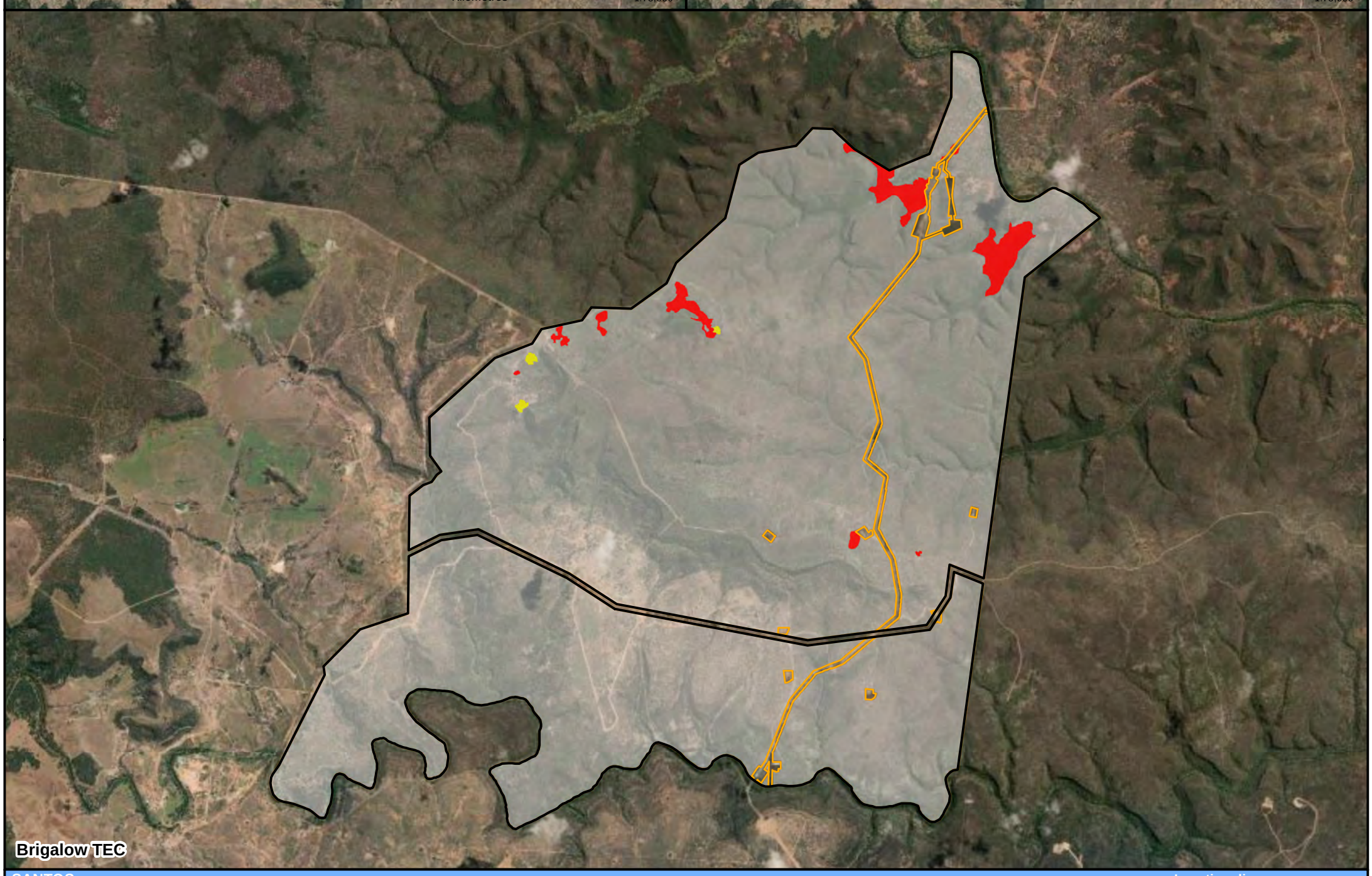


SANTOS

Location diagram

**Figure 6**
**Kentucky MNES offset areas habitat - 2**

- Kentucky - 1WT37
- Kentucky offset area
- MNES offset habitat

***Brigalow TEC***

- 11.9.5
- 11.9.5 (regrowth)

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data

Date: 2/25/2022 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:55,000@A3

0 0.5 1 1.5 2
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Path: P:\GIS\Data\Projects\Santos\912_211020_Roma_East_maps\Kentucky\Figure 6 - MNES offset areas 2.mxd

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# 4.0 Environmental Outcomes to be Achieved

The outcome of this OAMP will partially acquit the Stage 5 offset obligations for the GFD Project under EPBC Approval 2012/6615 in accordance with the EPBC Act *Environmental Offset Policy*.

The specific environmental outcomes to be achieved for the offset on Kentucky are defined as interim performance targets and completion criteria, detailed in Table 9, based on the proposed habitat quality score to be achieved for each MNES in the *Offsets assessment guides* (Santos 2021).

**Table 9: Interim performance targets and completion criteria for the Kentucky offset area**

| MNES | Baseline habitat quality score | Interim performance targets | | | Completion criteria |
|---|---|---|---|---|---|
| | | Year 5 | Year 10 | Year 15 | Year 20 |
| Collared Delma (*Delma torquata)* | 8 (8.1) | 8.3 | 8.6 | 8.8 | 9 |
| Dunmall's Snake (*Furina dunmalli)* | 8 (8.2) | 8.4 | 8.6 | 8.8 | 9 |
| Yakka Skink (*Egernia rugosa*) | 7 (7.2) | 7.4 | 7.6 | 7.8 | 8 |
| Koala (*Phascolarctos cinereus*) | 8 (8.0) | 8.2 | 8.5 | 8.8 | 9 |
| South-eastern Long-eared Bat (*Nyctophilus corbeni*) | 8 (7.7) | 8.0 | 8.3 | 8.7 | 9 |

# 5.0 Adaptive Management

## 5.1 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:

- establishment of the key components of a management framework including engaging stakeholders, developing clear and measurable objectives and performance criteria, 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 management decision making process.
- 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, outlined as follows, with how they have been addressed through the development of this OAMP:

- environmental variation:
    - 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
    - largely outside of the control of the manager (Williams 2011), and
    - 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.
- partial observability:
    - includes potential uncertainty arising 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), and
    - addressed in this OAMP through the development of a monitoring program based on scientifically tested and repeatable methods.
- partial controllability:
    - relates to the difference between the intended effect of the management measures to be implemented through this OAMP and the actual effect of their implementation on the ground (Williams and Brown 2016), and
    - addressed through adherence to an adaptive management approach including regular monitoring of conformance with performance criteria, assessment of adaptive management triggers, the implementation of corrective actions, review and amendments to the OAMP, and reporting to ensure that management measures are being effectively implemented on the ground.

- structural and 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), and
    - addressed through the adaptive management approach. Following the results of ongoing management, monitoring and reporting, the OAMP will be reviewed and updated as required to incorporate learnings, updated conservation advice and best practice management techniques.

## 5.2 OAMP adaptive management framework

### 5.2.1 Risk assessment

The adaptive management process for this OAMP is supported by a risk assessment through which the known and potential risks for each offset value have been evaluated. 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. As presented in Appendix C, the risk assessment included an assessment of the likelihood and consequence for each identified risk, both with and without the implementation of control strategies. The results of the risk assessment have informed the adaptive management process including the identification of threats to offset values, management objectives, performance 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 overall outcome sought by this OAMP are achieved.

### 5.2.2 Adaptive management process

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 or other offset matter 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 actio**n – 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 to assess whether management actions are meeting the performance criteria and management objectives, and ultimately, whether the OAMP is supporting the delivery of 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
- **corrective actions** – 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. Corrective actions include the implementation of a feasible, appropriate and effective action to address the identified issue and ensure the performance criteria is satisfied.

Figure 7 illustrates the ongoing adaptive management 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 for the life of the approval.

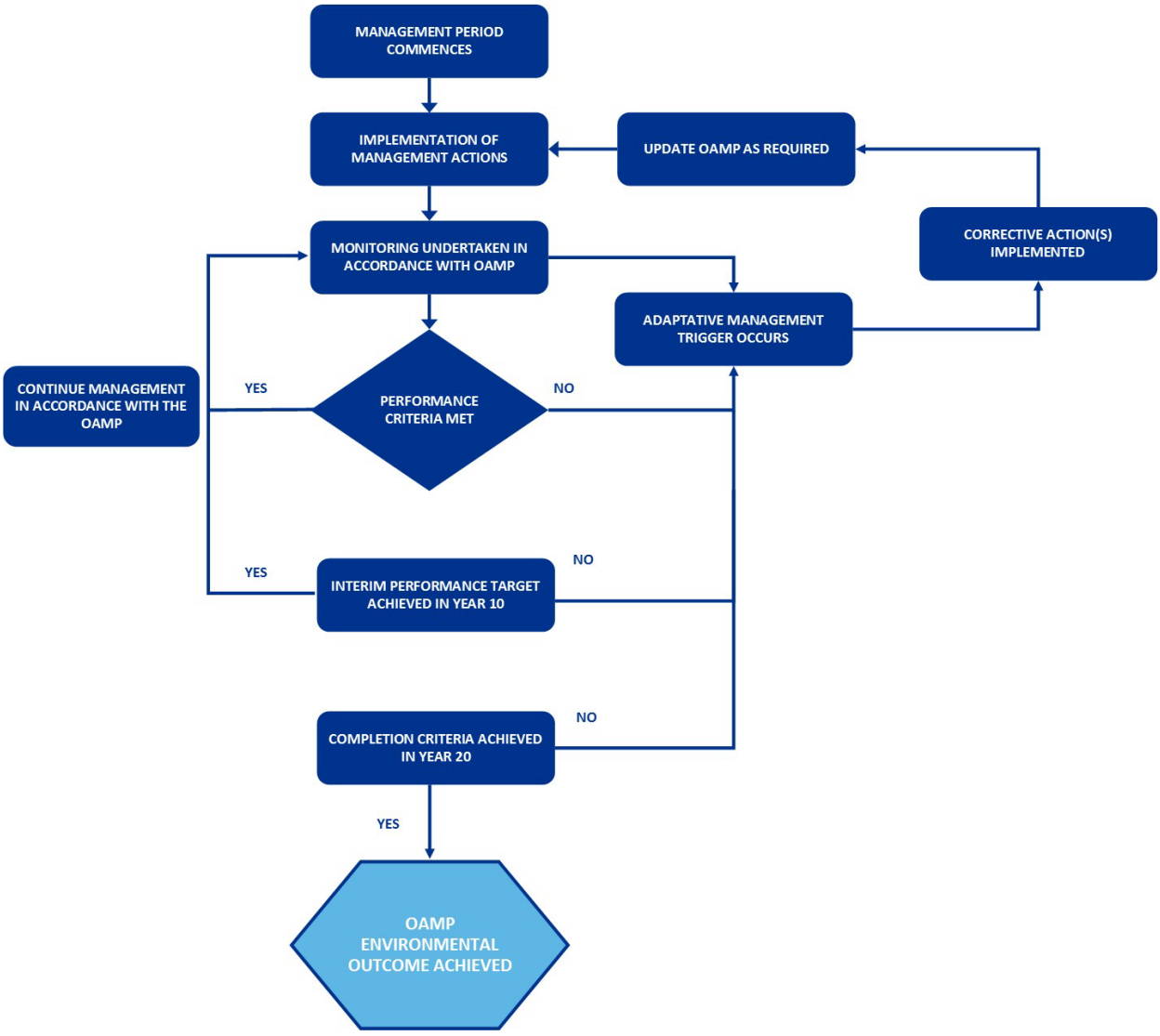


**Figure 7: Process for implementation of the OAMP**

### 5.2.3 Timing for implementation of the OAMP

The 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 within the proposed 20-year management period. However, if the interim performance targets and/or completion criteria for offset values have not been achieved within the anticipated timeframes, management and monitoring will continue beyond the 20-year management period in accordance with this OAMP until the completion criteria have been achieved. Once attained, completion criteria will be maintained for at least the life of the EPBC Act approval relevant to this OAMP.

### 5.2.4 Risk of offset failure

Based on the adaptive approach to management and the proposed management and monitoring program, it is considered that the management objectives, interim performance targets and completion criteria will be successfully achieved.

In the unlikely event that the interim performance targets are not achieved for one or more offset values by year 5, 10 or 15 for those offset values, Santos will obtain advice from suitably qualified people/groups with the aim of identifying appropriate additional management interventions.

It should be noted that unavoidable temporary perturbations such as severe drought, or insect/fungal pest invasion that may cause a temporary decrease in metrics such as canopy or shrub cover from which the community still may recover within the next 5-year period should not preclude assessment of a satisfactory increase in ecological condition by the completion date.

If it is considered that the completion criteria cannot be achieved, Santos will update this OAMP proposing alternative offset areas in order to acquit the required offset requirements. The revised OAMP will be submitted to the Commonwealth Government.

# 6.0 Management Program

## 6.1 Management objectives

A summary of the management objectives and performance criteria for the offset area is presented in Table 10, and the complete adaptive management process for this OAMP is encapsulated in Table 11. The management measures provided in this section (Section 6.0) take into account the information in the relevant conservation advices for each MNES. For the MNES being offset in this OAMP, none have a recovery plan or relevant threat abatement plan. Management actions, monitoring events, adaptive management triggers and corrective actions have been assigned to each management objective and performance criteria.

**Table 10: Summary of the management objectives and performance criteria**

| Management objectives | Performance criteria |
|---|---|
| Achieve the completion criteria including habitat quality improvements for offset values and remnant status for those regrowth vegetation communities. | Increase the habitat quality scores for each offset value at each habitat quality assessment site based on the results of baseline and subsequent monitoring events so as to achieve the scores in the completion criteria.<br>Achieve structural and floristic components for a vegetation community to be reclassified as remnant. |
| Maintain the extent of offset value habitat within the offset area | No unapproved and/or intentional clearing of habitat within the offset area, with the exception of clearing that is required for fencing, access, firebreaks and public safety as outlined in Table 12. |
| Ensure that the livestock grazing restrictions outlined in Section 6.2.5.1 for fire management and weed control assist in the enhancement of ground cover attributes for offset values and does not result in the degradation of habitat. | 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. |
| | Biomass levels of 2,500 kilograms per ha (kg/ha) are retained at each of the monitoring sites at the end of the dry season. |
| | Livestock are only observed to be grazing in the offset area during strategic grazing event/s. |
| Minimise predation risk by wild dogs to threatened fauna species. | Reduction in Catling* Index for wild dogs from year 1 and subsequent monitoring events. |
| Minimise predation risk by feral cats to threatened fauna species. | Reduction in Catling* Index for feral cats from year 1 and subsequent monitoring events. |
| Minimise predation risk by foxes to threatened fauna species. | Reduction in Catling* Index for foxes from year 1 and subsequent monitoring events. |
| Minimise degradation of offset value habitat by feral horses. | Reduction in the observed presence of feral horse on the property. |

| Management objectives | Performance criteria |
|---|---|
| Minimise degradation of offset value habitat by feral pigs. | Reduction in mean feral pig abundance score from year 1 and subsequent monitoring events. |
| Manage invasive weed species to reduce degradation of offset value habitat. | A decrease in species richness and relative abundance of weed species at 80% of monitoring sites from year 1 and subsequent monitoring events.<br>No new weed species are identified at any monitoring site (based on year 1 and subsequent monitoring data). |
| Reduce the risk of adverse impacts to offset value habitat by inappropriate fire regimes or unplanned fire. | No unplanned fire within the offset area.<br>Increase in habitat quality scores as a result of implementation of any fire management measures. |
| Achieve the interim performance targets and completion criteria for each offset value within 5, 10, and 20 years, respectively. | The interim performance targets are achieved for all offset values by year 5, 10 or 15.<br>The completion criteria are achieved for all offset values by year 20. |

* Catling index provides a measure of relative abundance of wild dogs, foxes and feral cats within the 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 6.2.7.

**Table 11: Management objectives, performance criteria, adaptive management triggers and corrective actions**

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| Degradation of habitat. | Achieve the completion criteria including habitat quality improvements for offset values and remnant status for those regrowth vegetation communities. | Increase the habitat quality scores for each offset value at each habitat quality assessment site based on the results of baseline and subsequent monitoring events to achieve the scores in the completion criteria.<br><br>Achieve structural and floristic components for a vegetation community to be reclassified as remnant. | Implementation of the management actions and adaptive management framework as outlined in this OAMP. | Monitoring of offset value habitat quality scores and condition of habitat will be undertaken in accordance with Section 7.0 including:<br><br>Offset area inspections (Section 7.1).<br><br>Rapid monitoring events (Section 7.6.1).<br><br>Habitat quality assessments to determine habitat quality scores (Section 7.6.2).<br><br>Targeted fauna surveys (Section 7.6.4).<br><br>The results of monitoring events will be compared against the interim performance targets and completion criteria to determine the progress of the offset area and recorded as part of reporting (Section 8.0). | Interim performance targets are not achieved for one or more offset values by year 5, 10 or 15.<br><br>Completion criteria are not achieved for one or more offset values by year 20. | Step 1: Investigate cause of trigger<br>• Investigate reasons why the interim performance targets or the completion criteria were not achieved within the specified timeframes.<br>• Re-evaluate the suitability of the relevant management measures in the OAMP.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Third party review of the OAMP to provide input on the effectiveness of the management actions.<br>○ Increasing the frequency and intensity of pest animal and weed control measures, or revising the type of measures to be implemented.<br>○ Modifying the strategic grazing regime to better support enhancement of offset values.<br>○ For offset values that have not achieved interim performance targets by year 5, 10 or 15 for those offset values, Santos will obtain advice from suitably qualified people/groups with the aim of identifying appropriate additional management interventions.<br>○ If it is considered that the completion criteria cannot be achieved, Santos will update this OAMP proposing alternative offset areas in order to acquit the required offset requirements in accordance with the *Offsets assessment guide*. The revised OAMP will be submitted to the Commonwealth Government. |
| Habitat loss through vegetation clearing. | Maintain the extent of offset value habitat within the offset area. | No unapproved and/or intentional clearing of habitat within the offset area, with the exception of clearing that is required for fencing, access, firebreaks and public safety as outlined in Table 12. | Protection of the offset area via a Voluntary Declaration under section 19E and 19F of the VM Act, as described in Section 2.7. | Reporting to the Commonwealth Government consistent with EPBC approval. | Any activities in contravention of the Voluntary Declaration and this OAMP. | Step 1: Investigate cause of trigger<br>• Investigate reasons why unapproved clearing occurred e.g. unauthorised access<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Addition fencing, signage and/or security for the offset area.<br>○ Restoration of the impacted area. |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| | | | Comply with the restrictions outlined in Table 12.<br><br>Construction and maintenance of access tracks, fencing and firebreaks will be undertaken in accordance with Sections 6.2.2, 6.2.4 and 6.2.5<br><br>If vegetation clearing is required for fencing, access, firebreaks or public safety, all activities will be planned, recorded and monitored. | 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 7.1). | Clearing for access, fencing, firebreaks or public safety is not undertaken in accordance with the restrictions outlined in Section 6.2. | Step 1: Investigate cause of trigger<br>• If restrictions for clearing associated with fencing, access, firebreaks or public safety are not adhered to, Santos will ensure that all clearing activities cease immediately.<br>• Investigate the reason for unapproved or unintentional clearing.<br>• Following clearing, the area is to be assessed by a suitably qualified ecologist/expert to determine the total clearing extent of offset value habitat.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>  ○ Reviewing and modifying protocols for the establishment of fences, access tracks, and firebreaks.<br>  ○ 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.<br>  ○ Rehabilitation of the impacted area. |
| Degradation of habitat by livestock overgrazing. | Ensure that the livestock grazing restrictions outlined in 0 for fire management and weed control assist in the enhancement of ground cover attributes for offset values and does not result in the degradation of habitat. | 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 and promote the establishment of native perennial grass species in accordance with Section 6.2.5.1. | Rapid monitoring events and habitat quality assessments will be undertaken in accordance with Section 7.6.1 and 7.6.2. These will include assessment of % cover of native perennial grasses and incidental flora surveys. | Decrease in the richness and average % cover of native perennial grasses at one or more habitat quality assessment sites based on the results of baseline and subsequent monitoring events. | Step 1: Investigate cause of trigger<br>• Investigate the reason for the decrease in richness and average % cover of native perennial grasses.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>  ○ Modifying the strategic grazing regime including modifying the frequency, intensity and/or duration of grazing events.<br>  ○ Constructing additional fencing should the current fencing be considered insufficient to manage livestock in accordance with the grazing regime.<br>  ○ Installing additional watering points for livestock to manage livestock in accordance with the grazing regime. |
| | | Biomass levels of 2,500 kg/ha are retained at each of the monitoring sites at the end of the dry season. | Implementation of a strategic grazing regime to protect and maintain environmental values in accordance with Section 6.2.5.1. | Biomass monitoring will be undertaken in accordance with Section 7.2. | Biomass monitoring results indicate less than 2,500 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<br>• Investigate the reason for biomass being less than 2,500 kg/ha.<br>• Re-evaluate the strategic grazing regime to assess the suitability of grazing to ensure no less than an average of 2,500 kg/ha of biomass is retained at the end of the dry season.<br>• Identify appropriate corrective actions. |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| | | | | | | Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>  ○ Removal of stock or spelling grazing from the area of the offset in which less than 2,500 kg/ha of biomass was identified.<br>  ○ Review adherence to livestock grazing restrictions in Section 6.2.5.1.<br>  ○ Where relevant, amending livestock management practices in the OAMP, including amending stocking rates, and/or duration and/or frequency of strategic grazing events. |
| | | Livestock are only observed to be grazing in the offset area during strategic grazing event/s. | Existing fencing is always maintained as outlined in Section 6.2.4. | Offset area inspections to be undertaken at least annually (Section 7.1) and will include monitoring to assess the:<br>• condition of fencing to identify any necessary maintenance requirements.<br>• presence of livestock within the offset area. | Livestock are observed within the offset area when not permitted within that area.<br>Damaged fencing is observed. | Step 1: Investigate cause of trigger<br>• If livestock are identified in the offset area, remove stock immediately.<br>• Inspect and evaluate fencing and identify the cause of livestock within the offset area.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>  ○ Repairing fencing where required to ensure its condition is satisfactory to exclude livestock.<br>  ○ Constructing additional fencing should the current fencing be considered insufficient to exclude livestock. |
| Predation by wild dogs. | Minimise predation risk by wild dogs to threatened fauna species. | Reduction in Catling* Index for wild dogs from year 1 and subsequent monitoring events. | Implement control actions for wild dogs in accordance with Section 6.2.7. | Undertake monitoring for wild dogs in accordance with Section 7.5. | An increase in Catling* Index for wild dogs from year 1 and subsequent monitoring events. | Step 1: Investigate cause of trigger<br>• Investigate potential sources or reasons that may have attributed to an increase in the:<br>  ○ Catling* index for wild dogs, feral cats and/or foxes.<br>  ○ relative abundance of feral pigs and horses.<br>  ○ Review adherence to pest management control measures as outlined in Section 6.2.7.<br>  ○ Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>  ○ The appropriate corrective actions will be implemented and may include:<br>  ○ Increasing the frequency and intensity of pest animal control.<br>  ○ 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. |
| Predation by feral cats. | Minimise predation risk by feral cats to threatened fauna species. | Reduction in Catling* Index for feral cats from year 1 and subsequent monitoring events. | Implement control actions for feral cats in accordance with Section 6.2.7. | Undertake monitoring for feral cats in accordance with Section 7.5. | An increase in Catling* Index for feral cats from year 1 and subsequent monitoring events. | |
| Predation by foxes. | Minimise predation risk by foxes to threatened fauna species. | Reduction in Catling* Index for foxes from year 1 and subsequent monitoring events. | Implement control actions for foxes in accordance with Section 6.2.7. | Undertake monitoring for foxes in accordance with Section 7.5. | An increase in Catling* Index for foxes from year 1 and subsequent monitoring events. | |
| Degradation of habitat by feral horses. | Minimise degradation of offset value habitat by feral horses. | Reduction in the observed presence of feral horse on the property. | Implement control actions for feral horses in accordance with Section 6.2.7. | Undertake monitoring for feral horses in accordance with Section 7.5. | An increase in the observed presence of feral horses across monitoring events. | |
| Degradation of habitat by feral pigs. | Minimise degradation of offset value habitat by feral pigs. | Reduction in mean feral pig abundance score from year 1 and subsequent monitoring events. | Implement control actions for feral pigs in accordance with Section 6.2.7. | Undertake monitoring for feral pigs in accordance with Section 7.5. | An increase in mean feral pig abundance score from year 1 and subsequent monitoring events. | |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| | | | | | | ○ Updating pest animal control methods in the OAMP and targeted pest animal control programs. |
| Invasion of habitat by weed species, including exotic grasses. | Manage invasive weed species to reduce degradation of offset value habitat. | A decrease in species richness and relative abundance of weed species at 80% of monitoring sites from year 1 and subsequent monitoring events.<br>No new weed species are identified at any monitoring site (based on year 1 and subsequent monitoring data). | Implement weed control actions in accordance with Section 6.2.6.<br>Adhere to weed hygiene restrictions in accordance with Section 6.2.1. | Undertake weed monitoring in accordance with Section 7.3. | An increase in species richness and relative abundance of weed species at more than 20% of monitoring sites from year 1 and subsequent monitoring events.<br>A new weed species is identified at one or more monitoring sites. | Step 1: Investigate cause of trigger<br>• Investigate potential sources or reasons that may have attributed to an increase in species richness and/or relative abundance of weeds.<br>• Investigate potential sources or reasons for the occurrence of the new weed species.<br>• Review adherence to weed management control measures as outlined in Section 6.2.6.<br>• Review adherence to weed hygiene restrictions as outlined in Section 6.2.1.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Amending weed hygiene restrictions.<br>○ Providing additional educational awareness training for all staff and contractors to ensure weed hygiene restrictions are adhered to.<br>○ Revising weed control methods in accordance with the *Biosecurity Act 2014* (Qld).<br>○ Increasing the frequency and intensity of weed control.<br>○ Updating weed control methods in the OAMP and targeted weed control programs. |
| Inappropriate fire regimes. | Reduce the risk of adverse impacts to offset value habitat by inappropriate fire regimes or unplanned fire. | No unplanned fire within the offset area.<br>Increase in habitat quality scores as a result of implementation of any fire management measures. | All fire management measures to be implemented in accordance with the program outlined in Section 6.2.5. | Habitat quality assessments to determine habitat quality scores will be undertaken in accordance with Section 7.6.2.<br>Rapid monitoring events will be undertaken to assess the general condition of vegetation in accordance with Section 7.6.1. | As a result of fire management measures, or an unplanned fire, there is a decrease in the habitat quality score for any offset value from baseline and subsequent monitoring events. | Step 1: Investigate cause of trigger<br>• Investigate reasons why the fire management measures have resulted in a decrease in habitat quality scores.<br>• Review adherence to the fire management measures as outlined in Section 6.2.5.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Increasing the frequency of biomass monitoring.<br>○ Increasing the frequency of weed control measures.<br>○ Amending the strategic grazing regime.<br>○ Reviewing effectiveness of firebreaks, and establishment of additional fire breaks.<br>○ Review timing and intensity of fuel hazard reduction burns in accordance with the Regional Ecosystem Description Database (REDD) fire management |

| Identified threats to offset values | Management objective | Performance criteria | Management action | Monitoring | Trigger for adaptive management and corrective actions | Corrective actions |
|---|---|---|---|---|---|---|
| | | | | | | guidelines and conservation advice for the particular offset value. |
| Offset fails to achieve the interim performance targets and completion criteria within the anticipated 5-, 10-, 15- and 20-year timeframes, respectively. | Achieve the interim performance targets and completion criteria for each offset value within 5, 10, 15 and 20 years, respectively. | The interim performance targets are achieved for all offset values by year 5, 10 or 15.<br>The completion criteria are achieved for all offset values by year 20. | All management actions outlined in Section 6.0 will be implemented to ensure that the interim performance targets and completion criteria are achieved. | Monitoring of the offset area will be undertaken in accordance with Section 7.0 including:<br>• Offset area inspections (Section 7.1).<br>• Offset value assessments (Section 7.6).<br>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 8.0). | Interim performance targets are not achieved for one or more offset values by year 5, 10 or 15.<br>Completion criteria are not achieved for one or more offset values by year 20. | Step 1: Investigate cause of trigger<br>• Investigate reasons why the interim performance targets or the completion criteria were not achieved within the specified timeframes.<br>• Re-evaluate the suitability of the relevant management measures in the OAMP.<br>• Identify appropriate corrective actions.<br>Step 2: Implementation of corrective action/s<br>• The appropriate corrective actions will be implemented and may include:<br>○ Third party review of the OAMP to provide input on the effectiveness of the management actions.<br>○ Increasing the frequency and intensity of pest animal and weed control measures, or revising the type of measures to be implemented.<br>○ Modifying the strategic grazing regime, or fire management measures, to better support enhancement of offset values. |

## 6.2 Management actions

### 6.2.1 General restrictions

Table 12 details the restrictions to be implemented for the offset area to ensure the completion criteria and management objectives are met.

**Table 12: Offset area restrictions**

| Restrictions | Details |
|---|---|
| Weed hygiene | • Weed hygiene measures will be implemented to prevent the movement of weed material into the offset area.<br>• All persons entering the offset area will be required to ensure vehicles and equipment are weed free.<br>• All contractors entering the offset area must hold a current weed hygiene certificate or equivalent for all vehicles and equipment.<br>• Evidence is to be provided on request to the Santos land advisor of the Kentucky property that vehicles, slashers or any machinery implementing management actions are clean prior to entry to minimise potential weed spread. |
| Vehicles | • Vehicle movement will be limited to designated access tracks in the offset area and access will be restricted to authorised personnel only.<br>• Vehicles will travel to track conditions to minimise the risk of vehicle strike to fauna. |
| Vegetation clearing | • Clearing will be excluded from the offset area through demarcation and protection by means of Voluntary Declaration under the VM Act. Clearing for timber gathering and development will also be excluded.<br>• Clearing of native vegetation will not be permitted within the offset area as part of any management and monitoring activities associated with this OAMP, except for clearing that is required for:<br>  ○ maintenance of access tracks and/or fire breaks<br>  ○ fence construction and maintenance, and<br>  ○ ensuring public safety or as directed by emergency management response personnel in the event of unplanned fire or other emergency or associated procedure.<br>• If vegetation clearing is required for fencing, access, firebreaks or public safety, all activities will be appropriately planned, recorded and monitored.<br>• Machinery will not be allowed on site after heavy or prolonged rainfall events until after the site has dried to allow for safe movement of traffic. |
| Unauthorised access or use | • Access into the offset area will be restricted to authorised personnel only.<br>• The offset area will be demarcated as an exclusion zone in the Santos GIS.<br>• Signs will be installed in prominent locations (i.e. at access points into the offset area) which recognise that the areas are protected for conservation purposes. The signs will advise that access into the offset area is restricted to authorised personnel only.<br>• The property will be suitably fenced to restrict access by unauthorised persons. |

| Restrictions | Details |
|---|---|
| | • At no time can persons access the site without first approaching the Santos land advisor of the Kentucky property and informing them of their intent.<br>• When entering and leaving the property, the land advisor must be advised.<br>• Contractors will only be permitted to access the property following the direct engagement by Santos. |

### 6.2.2 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, ongoing maintenance because of erosion following rain events.

Existing and new access tracks will be no wider than 5 metres (m) and vegetation disturbance will be minimised.

### 6.2.3 Fencing

To assist with management of livestock control for weed and fuel load management existing fencing will be maintained, as presented in Figure 8.

Any additional fencing required to be installed will comprise of a 4 wire fence consisting of 3 strand 1.57HT barb with a plain high tensile wire at the top, wood and/or steel posts at 7 m spacing, a strainer post every 100 m and 1 gate located every 1 km. This type of fencing is also considered appropriate to facilitate the fauna movement across the property. Importantly, the movement of the species being offset will not be impeded by the proposed fencing design.

Any vegetation disturbance associated with new fence construction will be minimised in accordance with Table 12.

Regular inspections of all fencing will be undertaken in accordance with Section 7.1, and repairs to the fences will be made as required.

### 6.2.4 Fire management

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

- minimise the risk and impacts of unplanned fire (by monitoring and controlling fuel loads, if required) especially to fire sensitive Brigalow and SEVT TEC
- improve habitat quality through:
    - controlling weeds and fuel loads
    - supporting development of structural components of habitat for offset values (e.g. recruitment of native plants, establishment of fire sensitive native herbs and groundcover, important microhabitat including fallen logs and leaf litter, and increased understorey), and
    - promoting germination and recruitment of Eucalypt species and other species characteristic of the specific RE.

Unplanned fire risk will be managed through:

- establishment and regular maintenance of firebreaks (Figure 8)
- monitoring and managing fuel loads primarily through the implementation of a controlled grazing regime (Section 6.2.5.1), and
- fuel hazard reduction burns (if required; Section 6.2.5.2).

Where possible, firebreaks will be established and maintained around the boundary of the offset area, with green firebreaks established where the offset area joins native vegetation, see Figure 8. Firebreaks will be maintained at least annually in mid / late autumn and, or early spring to remove overhanging trees or fallen debris and dense vegetation. Firebreak maintenance will be undertaken to a width of up to 10 m.

#### 6.2.4.1 Strategic grazing

The Kentucky property has in the past been managed as an open grazing enterprise where the focus has been on production and sustaining a viable income from domestic stock.

Strategic grazing within the offset area will be used to manage fuel loads and control exotic weeds and pasture grasses such as *Cenchrus ciliaris*. As increasing grazing intensity is correlated with an increase in weedy cover (Franks 2002), and a decrease in native grass species richness, grazing will be permitted in the offset area on a managed and limited basis to control weeds and reduce fuel loads.

Best practice management for strategic livestock grazing within the offset area will be undertaken as follows:

- livestock will only be permitted in the offset area to reduce fuel loads, avoid weed seed set and reduce weed cover
- within the offset area a minimum of 2,500 kg/ha of biomass will be retained at the end of the dry season.

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 strategic grazing areas will be reviewed annually based on the results of management and monitoring events.

The suitability of conditions for undertaking a grazing event will be informed by biomass monitoring events as described in Section 7.2.

#### 6.2.4.2 Fuel hazard reduction burns

The aim of fuel hazard reduction burns is to manage excess fuel loads, to initiate regeneration of eucalypt communities and to create habitat with a mosaic of different fire frequencies and times since fire.

Fire management, through fuel hazard reductions burns will be guided by conservation advice documentation (e.g. for MNES) and the REDD (Queensland Herbarium 2021), which provides recommendations for fire management for each of the component RE (Table 13), guidelines published in Fire and Biodiversity Monitoring Manual published by South East Queensland Fire and Biodiversity Consortium (2002), local regional fire plans, regional fire authorities and local knowledge of fire behaviour.

Hazard reduction burns will be considered if fuel hazard ratings within the offset area are unable to be maintained below extreme in accordance with the Overall Fuel Hazard Assessment Guide (Hines *et al*. 2010; Appendix D) through the implementation of strategic grazing and weed control. However, the location and timing for fuel hazard reduction burns will be informed by the results of biomass monitoring (Section 7.2) and fuel load monitoring (Section 7.3) in conjunction with the results of habitat quality assessments and considering the REDD fire management guidelines for the vegetation community and MNES conservation advices.

In general, fire management will be undertaken in a mosaic pattern at the appropriate time of year when:

- soil and fuel moisture levels are high, ideally following minimum of 40 mm of rainfall
- ambient temperature and wind speed are low
- atmospheric humidity is high
- the risk of long-term impacts/high intensity fire is low, and/or
- plants approach a more active growing phase.

**Table 13: Fire management guidelines for vegetation communities on the Kentucky offset area**

| RE | Associated TEC | Fire Exclusion? | Fire Management |
|---|---|---|---|
| 11.10.13 | - | Yes | • Protection from fire is necessary.<br>• Burn surrounding country only under conditions of good soil moisture and when plants are actively growing.<br>• Will be difficult to burn owing to a lack of ground fuel that normally occurs in this RE. |

### 6.2.5 Weed management

Weed management in the offset area will aim to minimise the introduction, establishment and spread of restricted and prohibited pest plants under the *Biosecurity Act 2014* (Qld) and other invasive species not regulated under the *Biosecurity Act 2014*, that present a threat to vegetation communities and species habitat in the offset area. Weed management will focus on reducing the extent of existing weeds as well as minimising the risk of introduction of additional weed species to the offset areas.

Ecological assessments of the Kentucky property (Section 2.4) identified a small number of *Opuntia* spp. (Prickly pear [*Opuntia stricta*], Tree Pear [*Opuntia tomentosa*], Tiger Pear [*Opuntia aurantiaca*]); however, the species/populations were deemed to cause no measurable threat to the site or management objectives. In addition, it was noted that the existing biological control measures for the *Opuntia* spp. were quite effective and that little, if any, further management of these species would be required (Boobook 2015).

Parthenium (*Parthenium hysterophorus*) presents a high potential for introduction to the property, due to its presence in the surrounding region (known to occur in the southern arcadia valley) and ability to disperse.

Reductions in the extent of *Cenchrus ciliaris*, Green Panic (*Panicum maximum* var. *trichoglume*) and *Parthenium hysterophorus* are most effectively achieved by maximising the competitive advantage of native ground cover species. This requires native species richness and abundance to be maximised. In historically grazed environments the most effective way to ensure high species richness is through conservatively managed cattle grazing (Fensham 1998). Conservative cattle grazing requires maintenance of enough biomass to maximise grass growth and appropriate spelling to allow for native species to set seed.

Accordingly, a strategic grazing regime will be implemented to reduce the presence and biomass of exotic pasture grasses in the offset areas (refer to Section 6.2.5.1). To supplement this, weeds will be managed using biological, chemical and/or mechanical control in accordance with the control measures outlined in the Biosecurity Queensland Fact Sheets, for the relevant weed species.

Biological control measures will continue to be used to manage *Opuntia* spp.; however, the species will not be completely eradicated from the Kentucky property. For the biological control measures currently in place to remain effective, a small number of plants are required to remain on site.

### 6.2.6 Pest animal management

Pest animals present or that have the potential to occur on or within the immediate vicinity of the Kentucky property and pose the following threats:

- predation of fauna by foxes, cats and wild dogs, and
- erosion and degradation of habitat and competition by pigs and feral horses.

Pest animal control activities will be undertaken to minimise the introduction of pest animals and control existing pest animal populations. Control methods utilised will be in accordance with the *Biosecurity Act 2014*. Table 14 provides examples of approved species-specific pest animal control measures recommended by the Queensland and Commonwealth governments. Results of pest animal assessments will be reviewed following each reporting event to inform the need for, location and timing of species-specific control measures in subsequent years.

**Table 14: Examples of species-specific control methods for pest animal species**

| Species | Status under *Biosecurity Act 2014* | Example control method | Reference |
|---|---|---|---|
| Wild dog (*Canis familiaris*) | Category 3,4,6 | • Ground baiting<br>• Foot hold traps<br>• Shooting | (DAF 2020a) |
| Fox (*Vulpes vulpes*) | Category 3,4,5,6 | • Ground baiting<br>• Trapping<br>• Shooting | (DAF 2020b) |
| Feral cat (*Felis catus*) | Category 3,4,6 | • Night shooting<br>• Poisoning<br>• Trapping | (DAF 2020c) |

| Species | Status under *Biosecurity Act 2014* | Example control method | Reference |
|---|---|---|---|
| Pig (*Sus scrofa*) | Category 3,4,6 | • Trapping<br>• Shooting<br>• Poisoning | (DAF 2020d) |
| Feral horse (*Equus caballus*) | - | • Relocation through mustering or trapping | (DAF 2016) |

148°50'0"E
148°52'0"E
148°54'0"E
25°30'0"S
25°32'0"S
25°34'0"S
25°36'0"S

SANTOS

Location diagram

**Figure 8**
**Kentucky infrastructure**

- Kentucky - 1WT37
- Kentucky offset area
- Petroleum pipeline (PPL 166)

***Infrastructure***

- Roads/tracks
- Dams
- Existing fencing

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Petroleum pipeline
Kentucky offset area and infrastructure provided by SANTOS

Date: 7/30/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:37,500@A3

0 0.5 1 1.5 2
Kilometres

N

CO2 Australia

Path: P:\GIS\Data\Projects\Santos\ENV_20_00419.GTP_Offset_Maps\Kentucky\Figure 8 - Infrastructure.mxd

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# 7.0 Monitoring

The results of the monitoring program outlined in the following sections will be used to inform operational management decisions, including adaptive implementation of this OAMP to ensure the performance criteria and management objectives, and ultimately interim performance targets and completion criteria are met.

The monitoring results will also be used to assess adherence to performance criteria, and to determine when corrective actions are required to be implemented. The results will also be compared to those from previous monitoring events to assess change over time and to inform the ongoing implementation of the OAMP.

## 7.1 Offset area inspections

The aim of offset area inspections is to enable a general assessment of the offset area to identify any potential issues that may require remedial action to be undertaken. Inspections will be undertaken twice per year for the duration of the management period to assess the following:

- condition of fencing, gates and signs and existing gas field infrastructure
- condition of access tracks
- condition of firebreaks
- compliance with restrictions for vegetation clearing associated with maintenance and establishment of access tracks, fencing and firebreaks
- incidence of erosion within offset area, particularly around permanent and semi-permanent water bodies or areas subject to inundation or waterlogging
- damage/degradation resulting from pest animal activity within the offset area
- signs of land degradation and over-grazing
- presence of weed/invasive species
- exclusion of livestock, and
- incidental fauna observations and any additional risks to offset values (i.e. evidence of vehicle strike).

## 7.2 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 to control fuel loads.

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 (October). Biomass will be monitored within the offset areas using appropriate photo standards[1] 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 year 1 monitoring.

Fuel loads will be managed through strategic grazing events (see Section 6.2.5.1) if the biomass assessment at the end of the wet season shows that biomass is greater than 2,500 kg/ha within the offset area.

The stocking rate of these strategic grazing events will be determined through a feed budgeting assessment (see Section 7.2.1) 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. >2,500 kg/ha).

### 7.2.1 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[1].
- 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, and
    - calculate 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. 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.

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

## 7.3 Fuel load monitoring

Fuel load monitoring will be undertaken in accordance with the *Overall Fuel Hazard Assessment Guide* (Hines *et al*. 2010; Appendix D). Fuel load assessment monitoring will include a baseline survey in year 1 (post wet season; April), with ongoing fuel load assessment 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 load assessments will be used to determine if fuel hazard reduction burns are 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.

## 7.4 Weed monitoring

Weed monitoring sites will be randomly stratified, fixed monitoring sites representative of offset values and 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, riparian). There will also be fixed monitoring sites at strategic trafficable areas (e.g. entry gates, creek crossings, stock watering points) to monitor potential introduction and/or irruptions of prohibited and restricted weed species.

The offset area will be monitored for weeds every two years (post wet season) to determine the species richness and abundance, for the duration of the management period. The results of this monitoring will inform the methods for weed treatment and control (see Section 6.2.6).

Non-native plant cover is also assessed as part of the habitat quality assessments detailed in Section 7.6.2, and the presence of weed species will also be recorded as part of the general offset area inspections (see Section 7.1), where noted.

## 7.5 Pest animal monitoring

The offset area will be monitored for evidence of pest animals every two years (post wet season), including a baseline survey in year 1 of the distribution and abundance of pest animals.

Based on the results of year 1 surveys, pest animal monitoring sites will be established in year 1. Monitoring of pest animals 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 and lagoons favoured by feral pigs; Hone 1995). The location of pest animal monitoring sites will be assessed prior to each monitoring event.

Pest animal monitoring will also be undertaken in association with and immediately prior to the pest animal control activities (Section 6.2.7). Initial monitoring results will determine the degree of effort required to control the pest population and post control monitoring will determine the degree of success of control operations.

Monitoring of pest animals will involve the deployment of motion sensing infra-red cameras as well as other techniques such as sand plots as appropriate to determine pest animal species present in the offset area and indicative population numbers.

Methods for determining the presence and relative abundance for foxes, feral cats, rabbits and feral pigs are presented in Table 15. Evidence of pest animals, including feral horses, will be documented during the offset area inspections (see Section 7.1)

**Table 15: Pest animal monitoring methodology**

| Pest animal | Methodology to be implemented |
|---|---|
| Fox | To assess the relative abundance of foxes, dogs and feral cats within the 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.<br>• fauna monitoring cameras will be placed in the offset area<br>• cameras will be placed along tracks and left in place for a minimum of three consecutive nights, and<br>• 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, 2007c). |
| Wild dog | |
| Feral cat | |
| Feral pig | An assessment of the presence or absence of feral pig signs[a] as a measure of the relative abundance of feral pigs within the offset area in accordance with Mitchell and Balogh (2007a) and Hone (1988), will be undertaken as follows:<br>• nominate randomly stratified sites across the offset area in environments that are more regularly impacted (e.g. drainage lines, moist gullies, around swamps etc)<br>• calculate an abundance score for each transect as the percentage of 'present' feral pig signs, and<br>• calculate the mean abundance score (and variance) across all transects in the offset area.<br>The average frequency of occurrence across the 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.<br>[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. |

## 7.6 Offset value assessments

### 7.6.1 Rapid monitoring events

Rapid monitoring events will be carried out each year monitoring events are not completed for habitat quality assessments (Section 7.6.2) and targeted fauna survey (Section 7.6.4).

These will be aligned with the offset area inspections (see Section 7.1) and carried out by suitably qualified ecologists during spring and early summer (October to January) to coincide with the optimal time of year for fauna in the Brigalow Belt Bioregion (Eyre *et al*. 2018).

During each rapid monitoring field assessment, the following will be conducted:

- Incidental fauna surveys including early morning and late evening bird surveys and other MNES fauna species will be conducted throughout the day by the ecologists.
- Photos will be taken at designated and fixed photo monitoring points as outlined in Section 7.6.3. The locations of the fixed photo monitoring points are shown in Figure 9.

### 7.6.2 Habitat quality assessment

A detailed baseline assessment of habitat quality was completed in April 2020, including establishment of BioCondition sites in all major vegetation communities.

Vegetation condition and habitat quality for each MNES will be assessed in accordance with the GTDTHQ (version 1.2; DEHP 2017) to measure the habitat quality of a land-based offset. The species habitat index component of the habitat quality score will be calculated based on the results of the targeted fauna surveys detailed in Section 7.6.4.

Fixed transects were established and assessed as part of the baseline in 2020 (see Figure 9). BioCondition assessments will be undertaken at each of the transects in year 1 and then every two years for the first six years, and then every three years thereafter. As part of year 1 monitoring activities, monitoring points will be marked with a capped stake and a GPS location will be recorded.

The results of habitat quality assessments for subsequent years will include summary data from previous reporting years, presented to allow trend analysis of each of the measured attributes and assess progress towards achieving the interim performance targets and completion criteria.

### 7.6.3 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 conducted at all BioCondition sites presented in Figure 9, 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).

Photo monitoring will be undertaken as part of habitat quality assessments (Section 7.6.2) and rapid monitoring events (Section 7.6.1).

### 7.6.4 Targeted fauna surveys

Targeted fauna surveys will be conducted to assess the distribution and richness of the fauna offset values within the offset area. The targeted fauna survey will focus on the MNES species that are unlikely to be detected effectively during the rapid assessment surveys due to cryptic behaviour or localised habitat requirements. Targeted surveys will be undertaken generally in accordance with recommended surveys guidelines from the Queensland and Commonwealth governments and/or other reputable published guidelines. Table 16 provides a summary of the proposed methodology, search effort and timing for targeted surveys. It is important to note that the proposed survey methodology will be reviewed prior to each survey event and if considered necessary will be modified to ensure they are based on the ecology, habitat requirements and behavioural aspects of the species of interest.

Targeted fauna surveys will be carried out in conjunction with habitat quality assessments, every two years for the first six years, and then every three years thereafter.

**Table 16: Fauna species survey methods**

| Technique | Regime | Target and method |
|---|---|---|
| Funnel trap | Six at each of five trap sites over four consecutive nights, checked early morning and afternoon. | Placed in pairs either side along a 30m drift-fence. Targeting Dunmall's Snake and Collared Delma. |
| Harp trap | Two per night for four consecutive nights, locations chosen based on presence of suitable flyways | Targeting South-eastern Long-eared Bat, which is not identifiable by ultrasonic calls |
| Camera trap | 10 over at least 14 consecutive nights | Focused on stations baited with a mixture of oats, peanut butter, vegetable oil and sardines. Targeting Yakka Skink. (Meek *et al*. 2014). |
| Spotlighting | On foot | Targeting Koala and Dunmall's Snake. |
| Spotlighting | Rocky areas. | Targeting Collared Delma. |
| Spotlighting | By vehicle along tracks. | Targeting Dunmall's Snake and Koala. |
| Scat search | Conducted in habitat considered suitable for target species. | Targeting Koala. The Spot Assessment Technique (SAT), or a variation, were used to survey for Koalas within suitable habitat within the site. |
| Bird survey | Meander along watercourses during the day. | Diurnal Koala search. |
| Diurnal herpetofauna search | Late morning/early afternoon. | Conducted by two searchers, duration is determined by site-specific habitat quality and presence of suitable micro-habitat. Targeting Collared Delma, Dunmall's Snake and Yakka Skink. |

148°50'0"E
148°52'0"E
148°54'0"E
25°30'0"S
25°32'0"S
25°34'0"S
25°36'0"S

KYB40
KYB41
KYB42
KYB53
KYB48
KYB52
KYB49
KYB50
KYB44
KYB43
KYB20
KYB47
KYB45
KYB21
KYB46
KYB22
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KYB08
KYB15
KYB07
KYB05
KYB17
KYB11
KYB16
KYB32
KYB06
KYB03
KYB04

SANTOS

Location diagram

**Figure 9**
**Kentucky monitoring sites**

- Kentucky - 1WT37
- Kentucky offset area
- Future habitat areas
- Petroleum pipeline (PPL 166)
- Habitat quality assessment sites

***MNES habitat within Kentucky offset area***

- Extent of current MNES offset habitat
- Rehabilitation offset (EPBC 2008/4059 condition 34)

DATA SOURCE:
The following datasets are © State of Qld:
- Cadastral data
- Petroleum pipeline
Kentucky offset area and habitat quality assessment sites provided by SANTOS

Date: 8/18/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:37,500@A3

0 0.5 1 1.5 2
Kilometres

N

CO2 Australia

Queensland

Path: P:\GIS\Data\Projects\Santos\ENV_20_0049\GTP_Offset_Maps\Kentucky\Figure 9 - Monitoring points.mxd

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# 8.0 Reporting

## 8.1 Reporting

A report detailing the progress of the offset area in achieving the interim performance targets and completion criteria will be prepared for each management year by the suitably qualified ecologist responsible for conducting the monitoring. The report will contain, at a minimum:

- a description of the monitoring conducted, when it was conducted, and by whom
- a discussion of the weather in the lead up to and during the monitoring
- results of monitoring events conducted
- an overview of the management actions implemented since the last report
- a description of any performance criteria not met, any triggers that have been exceeded and the corrective actions that were implemented
- an indication of any risks or potential threats that have become apparent to the management area since the development of this management plan, and activities to be undertaken to manage these threats and/or risks
- progress towards achieving the interim performance targets and completion criteria.

## 8.2 Update of OAMP

The OAMP will be reviewed, audited and updated every 5 years. In addition, the OAMP will be updated in accordance with the principles of adaptive management, if required, to incorporate any changes identified through management activities, site visits and monitoring activities. This may include the revision of current management actions, identification of additional activities (including monitoring activities) and responses to adaptive management triggers, other environmental threats to the offset area and information obtained through research programs.

# 9.0 Implementation Schedule

Table 17 and Table 18 summarise the implementation schedule for the management, monitoring and reporting activities presented in this OAMP. Santos will be wholly responsible for the implementation of this OAMP and reporting on the performance of the offset area in meeting the offset obligations under EPBC Approval 2012/6615 and Section 4.0 of this OAMP.

**Table 17: Implementation of management actions**

| Activity | | Management years<br>✓ Activity required<br>■ Activity to be carried out 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 6.2.1) | Access, vehicles, vegetation clearing, weed hygiene | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | At all times | General offset inspections (Section 7.1) |
| Access tracks (Section 6.2.2) | Maintenance/new tracks | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required | |
| Fencing (Section 6.2.4) | Construction of additional fencing to support livestock exclusion and strategic grazing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required | |
| | Maintenance | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Fire management (Section 6.2.5) | Fuel hazard reduction burns | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required | Biomass monitoring (Section 7.2) |
| Grazing (Section 6.2.5.1) | Strategic grazing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | As required based on the results of biomass monitoring, and informed by weed monitoring | Biomass monitoring (Section 7.2)<br>Weed monitoring (Section 7.4) |
| Weed management (Section 6.2.6) | *Cenchrus ciliaris* and other weeds | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Control activities in addition to strategic grazing to be undertaken as required | Weed monitoring (Section 7.4) |
| Pest animal management (Section 6.2.7) | Wild dog, feral cat, fox, pig and feral horse | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Control activities to be undertaken as required | Pest animal monitoring (Section 7.5) |
| Reporting (Section 8.0) | Annual reporting | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Annual reports to be prepared each year.<br>The OAMP will be reviewed, audited and updated every 5 years. | Reporting (Section 7.6.5) |
| | Update OAMP | | | | | ■ | | | | | ■ | | | | | ■ | | | | | ■ | | |

**Table 18: Offset Plan monitoring events**

| Survey or monitoring objective | Monitoring activity | Management years<br>✓ Activity required<br>■ 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 7.1) | 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.<br>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 7.1 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. |
| Biomass monitoring (Section 7.2) | 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 7.2) | Methodology developed by the Queensland Government. |
| Fuel load monitoring (Section 7.3) | 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; Appendix D) | Method developed by the Victorian Government. |
| Weed monitoring (Section 7.4) | Ongoing weed surveys to assess the effectiveness of weed control | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | Every two years post wet season | NSW *Guidelines for Monitoring Weed Control and Recovery of Native Vegetation* (Auld 2009).<br>Photo monitoring of selected sites to assess visual changes in weed species and infestations over time.<br>The use of precision unmanned aerial vehicles (drone) technology, aerial imagery and/or remote sensing. | Assessment will be undertaken generally in accordance with published, reputable guidelines. |
| Pest animal monitoring (Section 7.5) | Ongoing pest animal surveys to assess the effectiveness of pest animal control | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | Every two years post wet season | Monitoring method outlined in Section 7.5 | Assessment undertaken generally in accordance with published monitoring techniques developed by the NSW Government. |
| | Rapid monitoring events | | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | Each year monitoring events are not | See Section 7.6.1 | |

| Survey or monitoring objective | Monitoring activity | Management years<br>✓ Activity required<br>■ Activity to be carried out as required<br>1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Timing | Survey/monitoring guidelines | Reliability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | completed for habitat quality assessments (Section 7.6.2), targeted fauna survey (Section 7.6.4) | | |
| Offset value assessments (Section 7.6) | Assessment of vegetation condition and habitat quality | ✓ | | ✓ | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | Every two years for the first six years following the 2020 baseline, and then every three years thereafter | GTDTHQ (version 1.2; DEHP 2017) | 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 | ✓ | | ✓ | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | 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) |
| | Targeted fauna surveys | ✓ | | ✓ | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | See methods outlined in Section 7.6.4 | Techniques for fauna surveys area based on recommended survey guidelines published by the Queensland and Commonwealth governments. |

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# APPENDIX A

## Baseline habitat quality score for Kentucky offset area

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**Table A1: Baseline habitat quality score for Kentucky offset area (sites KYB01 – KYB21)**

| Site | KYB01 | KYB02 | KYB03 | KYB04 | KYB05 | KYB06 | KYB07 | KYB08 | KYB09 | KYB10 | KYB11 | KYB12 | KYB13 | KYB14 | KYB15 | KYB16 | KYB17 | KYB18 | KYB19 | KYB20 | KYB21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | 11.10.7 | 11.10.13 | 11.10.7 | 11.3.25 | 11.10.7 | 11.3.25 | 11.10.13 | 11.10.13 | 11.9.2 | 11.10.7 | 11.10.11 | 11.10.7 | 11.10.13 | 11.10.7 | 11.10.7 | 11.10.13 | 11.10.7 | 11.10.3 | 11.9.5 | 11.10.13 | 11.10.3 |
| Site type* | Rem | Rem | Reg | Rem | Reg | Rem | Rem | Reg | Reg | Reg | Reg | Reg | Reg | Rem | Reg | Reg | Rem | Rem | Rem | Rem | Rem |
| Site condition (/10) | 8.0 | 7.6 | 6.9 | 6.4 | 4.8 | 6.6 | 8.9 | 5.4 | 7.2 | 7.1 | 7.9 | 6.2 | 6.9 | 9.1 | 6.5 | 5.7 | 7.6 | 7.8 | 8.6 | 7.9 | 7.6 |
| Site context (/10) | 10.0 | 10.0 | 3.0 | 2.0 | 7.0 | 7.0 | 9.5 | 9.0 | 3.0 | 9.0 | 0.0 | 6.0 | 9.0 | 9.5 | 9.5 | 9.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| **Species habitat index /10** | | | | | | | | | | | | | | | | | | | | | |
| Collared Delma | 8.2 | 8.2 | 6.2 | 2.4 | 6.2 | 2.4 | 8.2 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 | 8.2 | 6.2 | 6.2 | 8.2 | 8.2 | 4.2 | 8.2 | 8.2 |
| Dunmall's Snake | 8.2 | 8.2 | 6.2 | 8.2 | 6.2 | 8.2 | 8.2 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 | 8.2 | 6.2 | 6.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 |
| Yakka Skink | 6.6 | 6.6 | 4.8 | 2.4 | 4.8 | 2.4 | 3.6 | 3.6 | 4.8 | 5.6 | 5.6 | 5.6 | 3.6 | 5.6 | 5.6 | 3.6 | 5.6 | 3.6 | 4.2 | 3.6 | 3.6 |
| Koala | 8.4 | 8.4 | 5.6 | 10.0 | 6.2 | 3.4 | 6.2 | 3.4 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 | 8.4 | 6.2 | 3.4 | 8.4 | 5.2 | 5.2 | 7.2 | 5.2 |
| South-eastern Long-eared Bat | 7.2 | 7.2 | 3.6 | 9.8 | 3.6 | 9.8 | 7.2 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 7.2 | 3.6 | 3.6 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| **Habitat quality score fauna species /10 (site condition 30%, site context 30%, species habitat index 40%)** | | | | | | | | | | | | | | | | | | | | | |
| Collared Delma | 8.7 | 8.6 | 5.5 | 3.5 | 6.0 | 5.0 | 8.8 | 6.8 | 5.5 | 7.3 | 4.8 | 6.1 | 7.2 | 8.9 | 7.3 | 6.9 | 8.6 | 8.6 | 7.3 | 8.6 | 8.6 |
| Dunmall's Snake | 8.7 | 8.6 | 5.5 | 5.8 | 6.0 | 7.4 | 8.8 | 6.8 | 5.5 | 7.3 | 4.8 | 6.1 | 7.2 | 8.9 | 7.3 | 6.9 | 8.6 | 8.6 | 8.9 | 8.6 | 8.6 |
| Yakka Skink | 8.1 | 7.9 | 4.9 | 3.5 | 5.5 | 5.1 | 7.0 | 5.8 | 5.0 | 7.1 | 4.6 | 5.9 | 6.2 | 7.8 | 7.0 | 5.9 | 7.5 | 6.8 | 7.3 | 6.8 | 6.7 |
| Koala | 8.8 | 8.6 | 5.2 | 6.5 | 6.0 | 8.1 | 8.0 | 5.7 | 5.5 | 7.3 | 4.8 | 6.1 | 7.2 | 9.0 | 7.3 | 5.8 | 8.6 | 7.4 | 7.7 | 8.2 | 7.4 |
| South-eastern Long-eared Bat | 8.3 | 8.2 | 4.4 | 6.5 | 5.0 | 8.0 | 8.4 | 5.8 | 4.5 | 6.3 | 3.8 | 5.1 | 6.2 | 8.5 | 6.2 | 5.9 | 8.2 | 8.2 | 8.5 | 8.2 | 8.2 |

* Site type: Rem = remnant; Reg = regrowth.

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**Table A2: Baseline habitat quality score for Kentucky offset area (sites KYB22 – KYB42)**

| Site | KYB22 | KYB23 | KYB24 | KYB25 | KYB26 | KYB27 | KYB28 | KYB29 | KYB30 | KYB31 | KYB32 | KYB33 | KYB34 | KYB35 | KYB36 | KYB37 | KYB38 | KYB39 | KYB40 | KYB41 | KYB42 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | 11.10.13 | 11.10.13 | 11.10.7 | 11.10.7 | 11.9.2 | 11.9.4 | 11.9.5 | 11.9.2 | 11.10.8 | 11.9.2 | 11.10.7 | 11.9.2 | 11.10.13 | 11.10.13 | 11.9.5 | 11.9.5 | 11.9.2 | 11.10.3 | 11.3.25 | 11.3.2 | 11.3.27 |
| Site type* | Rem | Rem | Rem | Rem | Rem | Rem | Rem | Rem | Rem | Reg | Rem | Reg | Rem | Rem | Reg | Reg | Rem | Rem | Rem | Rem | Rem |
| Site condition (/10) | 7.6 | 7.7 | 8.1 | 8.4 | 9.6 | 8.1 | 7.4 | 8.4 | 7.9 | 6.3 | 6.4 | 5.7 | 7.3 | 9.0 | 7.4 | 5.5 | 7.7 | 7.1 | 7.6 | 6.7 | 7.6 |
| Site context (/10) | 10.0 | 10.0 | 10.0 | 9.5 | 9.5 | 10.0 | 10.0 | 10.0 | 9.5 | 2.0 | 4.0 | 3.0 | 10 | 10 | 9.0 | 10.0 | 10.0 | 10.0 | 9.0 | 10.0 | 10.0 |
| **Species habitat index /10** | | | | | | | | | | | | | | | | | | | | | |
| Collared Delma | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 2.2 | 4.2 | 8.2 | 2.2 | 6.2 | 8.2 | 6.2 | 8.2 | 8.2 | 4.2 | 4.2 | 8.2 | 8.2 | 2.4 | 8.2 | 2.4 |
| Dunmall's Snake | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 6.2 | 8.2 | 6.2 | 8.2 | 8.2 | 6.2 | 6.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 |
| Yakka Skink | 3.6 | 3.6 | 6.6 | 6.6 | 6.6 | 2.4 | 4.2 | 6.6 | 2.4 | 4.8 | 6.6 | 4.8 | 6.6 | 6.6 | 2.4 | 2.4 | 6.6 | 3.6 | 2.4 | 6.6 | 2.4 |
| Koala | 7.2 | 7.2 | 8.4 | 8.4 | 8.4 | 4.2 | 5.2 | 8.4 | 4.2 | 5.6 | 8.4 | 5.6 | 8.4 | 8.4 | 4.2 | 3.4 | 8.4 | 5.2 | 10.0 | 8.4 | 9.4 |
| South-eastern Long-eared Bat | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 6.4 | 3.6 | 7.2 | 3.6 | 7.2 | 7.2 | 3.6 | 3.6 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| **Habitat quality score fauna species /10 (site condition 30%, site context 30%, species habitat index 40%)** | | | | | | | | | | | | | | | | | | | | | |
| Collared Delma | 8.6 | 8.6 | 8.7 | 8.7 | 9.0 | 6.3 | 6.9 | 8.8 | 6.1 | 5.0 | 6.4 | 5.1 | 8.5 | 9.0 | 6.6 | 6.3 | 8.6 | 8.4 | 5.9 | 8.3 | 6.2 |
| Dunmall's Snake | 8.6 | 8.6 | 8.7 | 8.7 | 9.0 | 8.7 | 8.5 | 8.8 | 8.5 | 5.0 | 6.4 | 5.1 | 8.5 | 9.0 | 7.4 | 7.1 | 8.6 | 8.4 | 8.3 | 8.3 | 8.6 |
| Yakka Skink | 6.7 | 6.8 | 8.1 | 8.0 | 8.4 | 6.4 | 6.9 | 8.2 | 6.2 | 4.4 | 5.8 | 4.5 | 7.8 | 8.3 | 5.9 | 5.6 | 8.0 | 6.6 | 5.9 | 7.7 | 6.2 |
| Koala | 8.2 | 8.2 | 8.8 | 8.7 | 9.1 | 7.1 | 7.3 | 8.9 | 6.9 | 4.7 | 6.5 | 4.9 | 8.5 | 9.1 | 6.6 | 6.0 | 8.7 | 7.2 | 9.0 | 8.4 | 9.0 |
| South-eastern Long-eared Bat | 8.2 | 8.2 | 8.3 | 8.3 | 8.6 | 8.3 | 8.1 | 8.4 | 7.8 | 3.9 | 6.0 | 4.1 | 8.1 | 8.6 | 6.4 | 6.1 | 8.2 | 8.0 | 7.9 | 7.9 | 8.2 |

* Site type: Rem = remnant; Reg = regrowth.

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**Table A3: Baseline habitat quality score for Kentucky offset area (sites KYB43 – KYB53)**

| Site | KYB43 | KYB44 | KYB45 | KYB46 | KYB47 | KYB48 | KYB49 | KYB50 | KYB51 | KYB52 | KYB53 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | 11.3.39 | 11.9.4 | 11.9.4 | 11.9.5 | 11.9.10 | 11.9.10 | 11.9.5 | 11.9.10 | 11.10.8 | 11.3.39 | 11.3.2 |
| Site type* | Rem | Rem | Rem | Rem | Rem | Rem | Rem | Rem | Rem | Rem | Rem |
| Site condition (/10) | 5.7 | 6.4 | 7.6 | 9.1 | 6.9 | 7.6 | 8.3 | 9.6 | 8.1 | 9.1 | 7.8 |
| Site context (/10) | 9.5 | 10.0 | 10.0 | 10.0 | 10.0 | 9.5 | 10.0 | 9.5 | 10.0 | 10.0 | 10.0 |
| **Species habitat index /10** | | | | | | | | | | | |
| Collared Delma | 8.2 | 2.2 | 2.2 | 4.2 | 8.2 | 8.2 | 4.2 | 8.2 | 2.2 | 8.2 | 8.2 |
| Dunmall's Snake | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 |
| Yakka Skink | 6.6 | 2.4 | 2.4 | 4.2 | 6.6 | 6.6 | 4.2 | 6.6 | 2.4 | 6.6 | 6.6 |
| Koala | 8.4 | 4.2 | 4.2 | 5.2 | 7.2 | 8.4 | 5.2 | 8.4 | 4.2 | 8.4 | 8.4 |
| South-eastern Long-eared Bat | 7.2 | 6.4 | 6.4 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 6.4 | 7.2 | 7.2 |
| **Habitat quality score fauna species /10 (site condition 30%, site context 30%, species habitat index 40%)** | | | | | | | | | | | |
| Collared Delma | 7.8 | 5.8 | 6.2 | 7.4 | 8.3 | 8.4 | 7.4 | 9.0 | 6.3 | 9.0 | 8.6 |
| Dunmall's Snake | 7.8 | 8.2 | 8.6 | 9.0 | 8.3 | 8.4 | 8.8 | 9.0 | 8.7 | 9.0 | 8.6 |
| Yakka Skink | 7.2 | 5.9 | 6.2 | 7.4 | 7.7 | 7.8 | 7.2 | 8.4 | 6.4 | 8.4 | 8.0 |
| Koala | 7.9 | 6.6 | 7.0 | 7.8 | 7.9 | 8.5 | 7.6 | 9.1 | 7.1 | 9.1 | 8.7 |
| South-eastern Long-eared Bat | 7.4 | 7.5 | 7.8 | 8.6 | 7.9 | 8.0 | 8.4 | 8.6 | 8.0 | 8.6 | 8.2 |

* Site type: Rem = remnant; Reg = regrowth.

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# APPENDIX B

## Kentucky offset area boundary co-ordinates (GDA94)

| Point | Easting | Northing |
|---|---|---|
| 1 | 689696 | 7176244 |
| 2 | 689873 | 7176227 |
| 3 | 689999 | 7176134 |
| 4 | 690042 | 7175915 |
| 5 | 690079 | 7175737 |
| 6 | 690094 | 7175679 |
| 7 | 690115 | 7175600 |
| 8 | 690076 | 7175590 |
| 9 | 689620 | 7175021 |
| 10 | 689594 | 7174994 |
| 11 | 689527 | 7174955 |
| 12 | 689514 | 7174900 |
| 13 | 689477 | 7174908 |
| 14 | 689464 | 7174830 |
| 15 | 689462 | 7174808 |
| 16 | 689478 | 7174803 |
| 17 | 689469 | 7174783 |
| 18 | 689436 | 7174784 |
| 19 | 689427 | 7174711 |
| 20 | 689414 | 7174709 |
| 21 | 689403 | 7174694 |
| 22 | 689411 | 7174681 |
| 23 | 689407 | 7174660 |
| 24 | 689387 | 7174640 |
| 25 | 689390 | 7174601 |
| 26 | 689408 | 7174509 |
| 27 | 689413 | 7174448 |
| 28 | 689395 | 7174397 |
| 29 | 689369 | 7174376 |
| 30 | 689318 | 7174356 |
| 31 | 689308 | 7174340 |
| 32 | 689232 | 7174116 |
| 33 | 689311 | 7174091 |
| 34 | 689284 | 7173922 |
| 35 | 689274 | 7173901 |
| 36 | 689255 | 7173874 |
| 37 | 688498 | 7172945 |
| 38 | 688495 | 7172926 |
| 39 | 688675 | 7172680 |
| 40 | 688685 | 7172652 |
| 41 | 688843 | 7171973 |
| 42 | 688839 | 7171948 |
| 43 | 688671 | 7171526 |
| 44 | 688673 | 7171511 |
| 45 | 688911 | 7171311 |
| 46 | 688793 | 7170711 |
| 47 | 688986 | 7170350 |
| 48 | 689060 | 7169942 |
| 49 | 689039 | 7169717 |
| 50 | 688805 | 7169523 |
| 51 | 688029 | 7169424 |
| 52 | 685816 | 7169844 |
| 53 | 685265 | 7170199 |
| 54 | 684212 | 7170707 |
| 55 | 683767 | 7170642 |
| 56 | 683407 | 7170465 |
| 57 | 683415 | 7171101 |
| 58 | 683575 | 7171223 |
| 59 | 683673 | 7171260 |
| 60 | 683735 | 7171345 |
| 61 | 683783 | 7171381 |
| 62 | 683655 | 7171562 |
| 63 | 683646 | 7172004 |
| 64 | 684405 | 7172694 |
| 65 | 684836 | 7172862 |
| 66 | 684945 | 7173031 |
| 67 | 685417 | 7173133 |
| 68 | 685520 | 7173282 |
| 69 | 685983 | 7173268 |
| 70 | 686393 | 7173559 |
| 71 | 686503 | 7173796 |
| 72 | 687071 | 7174313 |
| 73 | 687235 | 7174936 |
| 74 | 687456 | 7175075 |
| 75 | 687892 | 7175154 |
| 76 | 688086 | 7175358 |
| 77 | 688315 | 7175351 |
| 78 | 688571 | 7175115 |
| 79 | 688975 | 7174869 |
| 80 | 689440 | 7175060 |
| 81 | 689690 | 7175719 |
| 82 | 690095 | 7175565 |
| 83 | 690122 | 7175565 |
| 84 | 690124 | 7175555 |
| 85 | 690086 | 7175554 |
| 86 | 688684 | 7170740 |
| 87 | 688738 | 7170670 |
| 88 | 688750 | 7170693 |
| 89 | 688767 | 7170696 |
| 90 | 688777 | 7170687 |
| 91 | 688781 | 7170673 |
| 92 | 688780 | 7170639 |
| 93 | 688697 | 7170591 |
| 94 | 688584 | 7170680 |
| 95 | 687561 | 7170702 |
| 96 | 687654 | 7170629 |
| 97 | 687604 | 7170562 |
| 98 | 687687 | 7169566 |
| 99 | 687815 | 7169567 |

| Point | Easting | Northing |
|---|---|---|
| 100 | 687782 | 7169486 |
| 101 | 687682 | 7169494 |
| 102 | 690080 | 7175524 |
| 103 | 690129 | 7175525 |
| 104 | 690135 | 7175494 |
| 105 | 690149 | 7175437 |
| 106 | 690151 | 7175380 |
| 107 | 690156 | 7175309 |
| 108 | 690168 | 7175253 |
| 109 | 690177 | 7175170 |
| 110 | 690179 | 7175120 |
| 111 | 690193 | 7175044 |
| 112 | 690205 | 7174951 |
| 113 | 690230 | 7174840 |
| 114 | 690243 | 7174811 |
| 115 | 690264 | 7174725 |
| 116 | 690354 | 7174584 |
| 117 | 690420 | 7174533 |
| 118 | 690510 | 7174510 |
| 119 | 690638 | 7174535 |
| 120 | 690773 | 7174615 |
| 121 | 690842 | 7174654 |
| 122 | 690883 | 7174664 |
| 123 | 691038 | 7174597 |
| 124 | 691223 | 7174482 |
| 125 | 691417 | 7174319 |
| 126 | 690545 | 7173632 |
| 127 | 690069 | 7170142 |
| 128 | 689675 | 7170299 |
| 129 | 689625 | 7169937 |
| 130 | 689522 | 7169777 |
| 131 | 689456 | 7169758 |
| 132 | 689479 | 7169710 |
| 133 | 689408 | 7169599 |
| 134 | 688914 | 7169541 |
| 135 | 689090 | 7169693 |
| 136 | 689114 | 7169944 |
| 137 | 689037 | 7170368 |
| 138 | 688850 | 7170718 |
| 139 | 688930 | 7171171 |
| 140 | 688958 | 7171306 |
| 141 | 688950 | 7171335 |
| 142 | 688729 | 7171523 |
| 143 | 688889 | 7171927 |
| 144 | 688890 | 7171955 |
| 145 | 688730 | 7172659 |
| 146 | 688721 | 7172686 |
| 147 | 688686 | 7172741 |
| 148 | 688552 | 7172927 |
| 149 | 688555 | 7172942 |
| 150 | 689294 | 7173851 |
| 151 | 689328 | 7173913 |
| 152 | 689353 | 7174057 |
| 153 | 689590 | 7174151 |
| 154 | 689609 | 7174105 |
| 155 | 689812 | 7174200 |
| 156 | 689803 | 7174293 |
| 157 | 689727 | 7174297 |
| 158 | 689723 | 7174344 |
| 159 | 689743 | 7174346 |
| 160 | 689709 | 7174498 |
| 161 | 689702 | 7174569 |
| 162 | 689708 | 7174662 |
| 163 | 689721 | 7174793 |
| 164 | 689681 | 7174791 |
| 165 | 689678 | 7174828 |
| 166 | 689630 | 7174881 |
| 167 | 689644 | 7174977 |
| 168 | 689924 | 7170965 |
| 169 | 690000 | 7170944 |
| 170 | 689978 | 7170842 |
| 171 | 689901 | 7170862 |
| 172 | 689553 | 7174936 |
| 173 | 689612 | 7174965 |
| 174 | 689598 | 7174873 |
| 175 | 689649 | 7174816 |
| 176 | 689651 | 7174790 |
| 177 | 689622 | 7174789 |
| 178 | 689674 | 7174545 |
| 179 | 689657 | 7174338 |
| 180 | 689693 | 7174341 |
| 181 | 689697 | 7174299 |
| 182 | 689670 | 7174301 |
| 183 | 689671 | 7174235 |
| 184 | 689571 | 7174195 |
| 185 | 689578 | 7174178 |
| 186 | 689394 | 7174107 |
| 187 | 689442 | 7174280 |
| 188 | 689439 | 7174299 |
| 189 | 689442 | 7174329 |
| 190 | 689423 | 7174358 |
| 191 | 689444 | 7174431 |
| 192 | 689441 | 7174517 |
| 193 | 689448 | 7174537 |
| 194 | 689443 | 7174573 |
| 195 | 689451 | 7174592 |
| 196 | 689451 | 7174610 |
| 197 | 689480 | 7174661 |
| 198 | 689507 | 7174695 |
| 199 | 689527 | 7174727 |
| 200 | 689536 | 7174758 |
| 201 | 689515 | 7174771 |
| 202 | 689519 | 7174790 |
| 203 | 689535 | 7174794 |
| 204 | 689561 | 7174851 |
| 205 | 689564 | 7174888 |
| 206 | 689544 | 7174892 |
| 207 | 687508 | 7170636 |
| 208 | 689724 | 7170214 |
| 209 | 690061 | 7170078 |
| 210 | 689766 | 7167921 |
| 211 | 689684 | 7167896 |
| 212 | 689630 | 7167833 |
| 213 | 689634 | 7167755 |
| 214 | 689665 | 7167667 |
| 215 | 689675 | 7167590 |
| 216 | 689652 | 7167517 |
| 217 | 689599 | 7167407 |
| 218 | 689539 | 7167337 |
| 219 | 689442 | 7167323 |

| Point | Easting | Northing |
|---|---|---|
| 220 | 689388 | 7167366 |
| 221 | 689332 | 7167431 |
| 222 | 689304 | 7167504 |
| 223 | 689222 | 7167532 |
| 224 | 689114 | 7167530 |
| 225 | 689010 | 7167500 |
| 226 | 688881 | 7167485 |
| 227 | 688800 | 7167491 |
| 228 | 688642 | 7167544 |
| 229 | 688594 | 7167603 |
| 230 | 688546 | 7167665 |
| 231 | 688539 | 7167703 |
| 232 | 688298 | 7167925 |
| 233 | 688247 | 7167937 |
| 234 | 688211 | 7167923 |
| 235 | 688169 | 7167906 |
| 236 | 688123 | 7167861 |
| 237 | 688054 | 7167784 |
| 238 | 687955 | 7167747 |
| 239 | 687801 | 7167733 |
| 240 | 687722 | 7167744 |
| 241 | 687612 | 7167733 |
| 242 | 687618 | 7167916 |
| 243 | 687661 | 7167896 |
| 244 | 687691 | 7167903 |
| 245 | 687689 | 7167932 |
| 246 | 687715 | 7167932 |
| 247 | 687715 | 7168012 |
| 248 | 687621 | 7168012 |
| 249 | 687623 | 7168111 |
| 250 | 687853 | 7168699 |
| 251 | 688122 | 7169030 |
| 252 | 688298 | 7169101 |
| 253 | 688405 | 7169133 |
| 254 | 688471 | 7169172 |
| 255 | 688817 | 7169461 |
| 256 | 689444 | 7169543 |
| 257 | 689506 | 7169640 |
| 258 | 689531 | 7169638 |
| 259 | 689565 | 7169629 |
| 260 | 689574 | 7169655 |
| 261 | 689574 | 7169725 |
| 262 | 689565 | 7169730 |
| 263 | 689684 | 7169917 |
| 264 | 688701 | 7168862 |
| 265 | 688790 | 7168850 |
| 266 | 688789 | 7168808 |
| 267 | 688819 | 7168805 |
| 268 | 688808 | 7168763 |
| 269 | 688770 | 7168733 |
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| 271 | 683406 | 7170397 |
| 272 | 683785 | 7170584 |
| 273 | 684203 | 7170645 |
| 274 | 685235 | 7170146 |
| 275 | 685794 | 7169787 |
| 276 | 688027 | 7169363 |
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| 278 | 688419 | 7169201 |
| 279 | 688120 | 7169079 |
| 280 | 688084 | 7169055 |
| 281 | 687815 | 7168726 |
| 282 | 687534 | 7168022 |
| 283 | 687486 | 7167949 |
| 284 | 687466 | 7167967 |
| 285 | 687437 | 7167934 |
| 286 | 687380 | 7167848 |
| 287 | 687404 | 7167824 |
| 288 | 687397 | 7167806 |
| 289 | 687340 | 7167860 |
| 290 | 687299 | 7167939 |
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| 292 | 687093 | 7168089 |
| 293 | 687012 | 7168074 |
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| 295 | 686900 | 7167965 |
| 296 | 686874 | 7167939 |
| 297 | 686801 | 7167926 |
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| 299 | 686636 | 7168029 |
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| 301 | 686301 | 7168239 |
| 302 | 686250 | 7168223 |
| 303 | 686210 | 7168159 |
| 304 | 686168 | 7168098 |
| 305 | 686118 | 7168026 |
| 306 | 686076 | 7167951 |
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| 308 | 685893 | 7167937 |
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| 311 | 685676 | 7167901 |
| 312 | 685632 | 7167834 |
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| 314 | 685436 | 7167656 |
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| 317 | 684975 | 7167396 |
| 318 | 684825 | 7167318 |
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| 320 | 684630 | 7167237 |
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| 323 | 684538 | 7167465 |
| 324 | 684526 | 7167545 |
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| 330 | 684605 | 7167997 |
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| 332 | 684825 | 7168065 |
| 333 | 684870 | 7168082 |
| 334 | 684921 | 7168206 |
| 335 | 684919 | 7168371 |
| 336 | 684940 | 7168428 |
| 337 | 684914 | 7168518 |
| 338 | 684848 | 7168610 |
| 339 | 684810 | 7168672 |

| Point | Easting | Northing |
|---|---|---|
| 340 | 684735 | 7168749 |
| 341 | 684640 | 7168764 |
| 342 | 684489 | 7168720 |
| 343 | 684369 | 7168690 |
| 344 | 684248 | 7168671 |
| 345 | 684096 | 7168705 |
| 346 | 683979 | 7168791 |
| 347 | 683760 | 7168841 |
| 348 | 683642 | 7168851 |
| 349 | 683520 | 7168855 |
| 350 | 683394 | 7168777 |
| 351 | 683379 | 7168655 |
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| 353 | 683522 | 7168458 |
| 354 | 683800 | 7168245 |
| 355 | 683840 | 7168151 |
| 356 | 683865 | 7168054 |
| 357 | 683822 | 7167910 |
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| 364 | 683380 | 7168174 |
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| 366 | 683114 | 7168289 |
| 367 | 683007 | 7168263 |
| 368 | 682983 | 7168211 |
| 369 | 683038 | 7167991 |
| 370 | 683036 | 7167910 |
| 371 | 683004 | 7167744 |
| 372 | 682973 | 7167709 |
| 373 | 682930 | 7167711 |
| 374 | 682706 | 7167817 |
| 375 | 682644 | 7167869 |
| 376 | 682571 | 7167866 |
| 377 | 682528 | 7167792 |
| 378 | 682518 | 7167621 |
| 379 | 682493 | 7167511 |

| Point | Easting | Northing |
|---|---|---|
| 380 | 682459 | 7167421 |
| 381 | 682437 | 7167371 |
| 382 | 682370 | 7167369 |
| 383 | 682291 | 7167434 |
| 384 | 682136 | 7167505 |
| 385 | 681972 | 7167549 |
| 386 | 681864 | 7167600 |
| 387 | 681825 | 7167675 |
| 388 | 681805 | 7167770 |
| 389 | 681824 | 7167856 |
| 390 | 681873 | 7167931 |
| 391 | 681909 | 7167981 |
| 392 | 682434 | 7169023 |
| 393 | 682418 | 7169122 |
| 394 | 682843 | 7169551 |
| 395 | 683397 | 7169733 |
| 396 | 687749 | 7169070 |
| 397 | 687852 | 7169069 |
| 398 | 687857 | 7168967 |
| 399 | 687798 | 7168935 |
| 400 | 687768 | 7168931 |
| 401 | 687581 | 7168018 |
| 402 | 687572 | 7167729 |
| 403 | 687541 | 7167728 |
| 404 | 687499 | 7167742 |
| 405 | 687431 | 7167783 |
| 406 | 687446 | 7167807 |
| 407 | 687490 | 7167764 |
| 408 | 687574 | 7167894 |
| 409 | 687525 | 7167926 |

148°50'0"E

148°52'0"E

148°54'0"E

25°32'0"S

25°34'0"S

25°36'0"S

SANTOS

**Figure B1**
**Kentucky offset area boundary coordinates**

- Reference coordinates
- Kentucky offset area

Location diagram

0 0.25 0.5 0.75 1
Kilometres

N

CO2 Australia

Date: 6/11/2021 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:37,500@A3

Path: P:\GISData\Projects\Santos\ENV_20_0049.GTP_Offset_Maps\Kentucky\Figure C-1 - Offset area boundary co-ordinates.mxd

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# APPENDIX C

## Risk assessment

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## Risk Assessment Summary

The following risk assessment assess the potential risk of failing to achieve the management objectives, interim performance targets and completion criteria for the offset area as outlined in this OAMP.

For each risk identified, the potential consequence of the risk (rated from 1 (no impact) to 6 (irreversible impact; Table C1) was assessed against the likelihood of that risk occurring (Table C2) to determine a risk rating. The risk rating was evaluated by using the matrix in Table C2.

The consequence and likelihood of each risk was first considered without the management measures in place to provide an initial risk rating. The consequence and likelihood of each risk occurring was then reassessed following the implementation of the management measures to provide a residual risk rating.

Table C3 provides the risk register which was used to document the findings of the risk assessment process.

**Table C1: Consequence rating relative to offset value**

| | Consequence |
|---|---|
| I | No impact to MNES Value |
| II | Small-scale impact to MNES |
| III | Moderate-scale impact to MNES |
| IV | Large-scale impact to MNES |
| V | Extensive population or community scale impact to MNES |
| VI | Irreversible impact to MNES. |

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**Table C2: Likelihood classification and risk matrix**

# Santos Risk Matrix

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| Consequence | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Safety** | **Negligible Harm**<br>+ No bodily damage or minimal harm or impairment (hours to days) | **Minor Harm**<br>+ Short term impairment (days to weeks) | **Moderate Harm**<br>+ Temporary disablement or medium term impairment (weeks to months) | **Severe Harm**<br>+ Long term/life altering disablement or impairment | **Single Fatality OR Critical Life Threatening Injuries** | **Multiple Fatalities** |
| | **Environment** | + No impact to Environmental Value (EV). | + Small-scale impact to EV(s) of conservation significance<br>+ Potential surface or groundwater impact. | + Moderate-scale impact to EV(s) of conservation significance<br>+ Localised surface or groundwater impact. | + Large-scale impact to EV(s) of conservation significance<br>+ Moderate-scale surface water impact;<br>+ Localised impact to groundwater with potential or known beneficial use. | + Extensive population or community scale impact to EV(s) of conservation significance<br>+ Extensive impact to other EV(s). | + Irreversible impact to EV(s). |
| | **Community & Reputation** | + No actual or potential community criticism<br>+ Details remain within Santos sites and/or offices | + Minor level local community criticism (< week)<br>+ No reputation impact | + Local community criticism (> week) or one-day community protest<br>+ Local company reputation impacted | + State-level community criticism or protest over multiple days/locations<br>+ State-based company reputation impacted<br>+ Very short-term share price impact (< week) | + National community criticism or large scale protest<br>+ Company reputation and approvals impacted<br>+ Shareholder intervention or short-term share price impact (< month) | + Sustained national community criticism or widespread protest<br>+ Industry reputation and approvals impacted<br>+ Changes at executive/board level or long-term share price impact (> month) |
| | **Financial (A$)** | < $30k | $30k to $300k | $300k to $3m | $3m to $30m | $30m to $300m | > $300m |
| | **Workforce** | + Will require some staff attention over several days.<br>+ No actual or potential impact to culture | + Will require several days local management time.<br>+ Minor impact to employee engagement and limited staff turnover | + Will require head office staff and take several weeks of site management time.<br>+ Moderate impact to employee engagement and staff turnover above industry average with some key roles | + Will require several weeks of senior management time<br>+ Impact to employee engagement (< 6 months), moderate turnover of key roles and no succession | + Will require several months of senior management time<br>+ Impact to employee engagement (< 18 months), high staff turnover and attraction issues | + Will require more than a year of senior management involvement and operations severely disrupted<br>+ Impact to employee engagement (> 18 months), significant key role turnover and attraction issues |
| | **Compliance** | + Non-conformance with legislation, instruments (e.g. tenure licence) or contract<br>+ No regulatory or punitive action | + Minor breach of legislation, instruments or contract<br>+ Notification/report to; request for information by; and/or administrative/ warning notice from the regulator<br>+ LOCI Tier 3 or non-hydrocarbon releases notifiable to the regulator | + Limited number of minor breaches of legislation, instruments or contract<br>+ Statutory notice from the regulator<br>+ LOCI Tier 2 or non-hydrocarbon releases immediately reportable to the regulator | + Systemic minor breaches (or one moderate breach) of legislation, instruments or contract<br>+ Company charged with an offence with minor penalty/fine<br>+ LOCI Tier 1 or cumulative regulator notification of non-hydrocarbon releases | + Systemic moderate breaches (OR single material breach) of legislation, instruments or contract<br>+ Company charged with an offence with moderate penalty/fine | + Material breaches of legislation, instruments or contract<br>+ Company or officers charged with an offence with material penalty/fine, or loss of tenure/operatorship |
| | | I | II | III | IV | V | VI |
| Likelihood | **ALMOST CERTAIN (< 4 monthly)**<br>Occurs in almost all circumstances OR could occur *within days to weeks* | f | Low | Medium | High | Very High | Very High | Very High |
| | **LIKELY (4 monthly - 1 yearly)**<br>Occurs in most circumstances OR could occur *within weeks to months* | e | Low | Medium | High | High | Very High | Very High |
| | **OCCASIONAL (1 - 3 yearly)**<br>Has occurred before in Santos OR could occur *within months to years* | d | Low | Low | Medium | High | High | Very High |
| | **POSSIBLE (3 - 10 yearly)**<br>Has occurred before in the industry OR could occur *within the next few years* | c | Very Low | Low | Low | Medium | High | Very High |
| | **UNLIKELY (10 - 30 yearly)**<br>Has occurred elsewhere OR could occur *within decades* | b | Very Low | Very Low | Low | Low | Medium | High |
| | **REMOTE (30 - 100 yearly)**<br>Requires exceptional circumstances and is unlikely even in the long term OR only occurs as a *"one in 100 year event"* | a | Very Low | Very Low | Very Low | Low | Medium | Medium |

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**Table C3: Risk assessment**

| Management objective | Risk description | 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 offset values and remnant status for those regrowth vegetation communities. | Completion criteria and habitat quality improvements are not achieved | D | IV | H | • Implementation of this OAMP, including the management actions and monitoring program outlined in Section 6.0 and Section 7.0.<br>• Implementation of the adaptive management process outlined in Section 5.0.<br>• Obtain advice with the aim of identifying appropriate additional management interventions if interim performance targets are not achieved for one or more offset values by year 5,10 or 15.<br>• If it is considered that the completion criteria cannot be achieved, Santos will update this OAMP proposing alternative offset areas in order to acquit the required offset requirements in accordance with the *Offsets assessment guide*. The revised OAMP will be submitted to the Commonwealth Government. | B | IV | L |
| Maintain the extent of offset value habitat within the offset area. | Habitat or vegetation loss through land clearing. | D | V | H | • Protection of the offset area via a Voluntary Declaration under section 19E and 19F of the VM Act, as described in Section 2.8.<br>• Comply with the restrictions outlined in Table 13.<br>• Construction and maintenance of access tracks, fencing and firebreaks will be undertaken in accordance with Sections 6.2.2, 6.2.3 and 6.2.4.<br>• Restoration of impacted areas subject to any unauthorised clearing. | B | V | M |
| Ensure that the livestock grazing restrictions for fire management and weed control assist in the enhancement of ground cover attributes for offset values and does not result in the degradation of habitat. | Degradation of offset value habitat quality as a result of livestock grazing | E | III | H | • Implementation of strategic grazing to reduce fuel loads and control exotic pasture grasses and promote the establishment of native perennial grass species in accordance with Section 6.2.4.1.<br>• Annual biomass monitoring to inform strategic grazing regimes.<br>• Rapid monitoring events and habitat quality assessments will be undertaken in accordance with Section 7.6.1 and 7.6.2 including an assessment of % cover of native perennial grasses. | B | III | L |
| Minimise predation risk by wild dogs to threatened fauna species. | Predation of threatened fauna by wild dogs. | D | III | M | • Regular monitoring for pest animals will be undertaken in accordance with the methods detailed in Section 7.5 and pest animal control will be implemented following the results of monitoring in accordance with Section 6.2.6. | C | III | L |
| Minimise predation risk by foxes to threatened fauna species. | Predation of threatened fauna by foxes. | D | III | M | | C | III | L |
| Minimise predation risk by feral cats to threatened fauna species. | Predation of threatened fauna by cats. | D | III | M | | C | III | L |
| Minimise degradation of offset value habitat by feral pigs. | Degradation of habitat by feral pigs. | D | III | M | | C | III | L |

| Management objective | Risk description | Initial risk rating | | | Control strategies | Residual risk rating | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk rating | | Likelihood | Consequence | Overall risk rating |
| Minimise degradation of offset value habitat by feral horses. | Degradation of habitat by feral horses. | D | III | M | | C | III | L |
| Manage invasive weed species to reduce degradation of offset value habitat. | Invasion of habitat by weed species, including exotic grasses. | D | III | M | • Regular weed monitoring will be undertaken in accordance with Section 7.4.<br>• Based on the results of monitoring events, weeds will be managed using biological, chemical and/or mechanical control in accordance with the control measures outlined in the Biosecurity Queensland Fact Sheets, for the relevant weed species (see Section 6.2.5). | C | III | L |
| Reduce the risk of adverse impacts to offset value habitat by 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. | D | IV | H | • Fuel loads within the offset area will be managed through strategic livestock grazing and fuel hazard reduction burns as outlined in Section 6.2.4.<br>• Firebreaks will be established and maintained around the boundary of the offset area, with green firebreaks established where the offset area joins native vegetation. Firebreaks will be maintained at least annually in mid / late autumn and, or early spring to remove overhanging trees or fallen debris and dense vegetation. | B | IV | L |
| Achieve the interim performance targets and completion criteria for each offset value within 5, 10, 15 and 20 years, respectively. | Interim performance targets are not achieved for offset values by year 5, 10 or 15.<br>Completion criteria are not achieved for offset values by year 20. | E | III | H | • Monitoring of the offset area will be undertaken in accordance with Section 7.0 including:<br>  ○ Offset area inspections (Section 7.1).<br>  ○ Offset value assessments (Section 7.6).<br>• 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 8.0). | B | III | L |

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# APPENDIX D

## Overall Fuel Hazard Assessment Guide

Department of Sustainability and Environment

# Overall fuel hazard assessment guide

**4th edition July 2010**

## Fire and adaptive management

report no. 82

State Government Victoria

**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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Australian Government

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**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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# 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

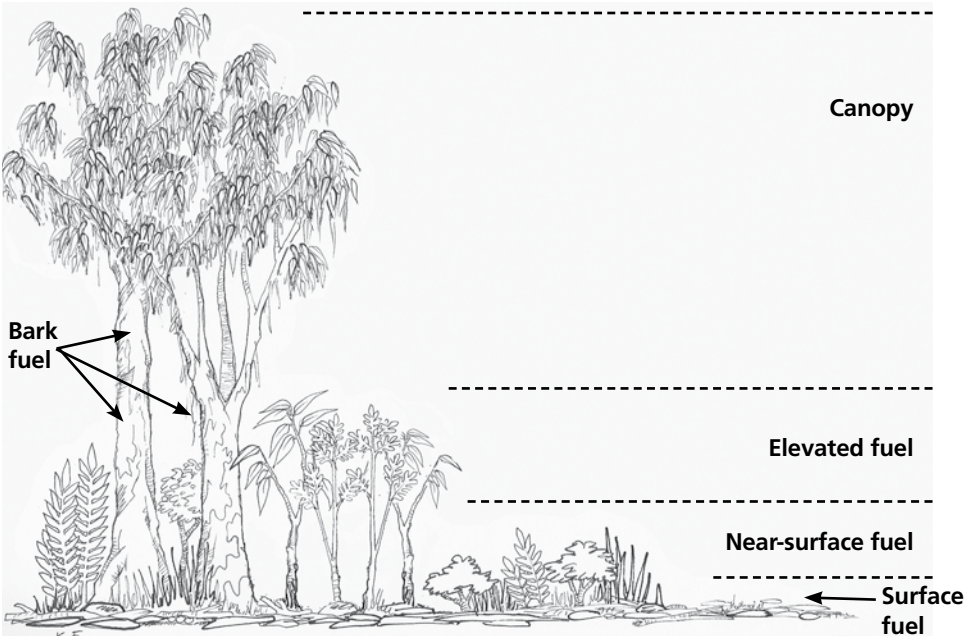
This guide is a tool for rapidly assessing fuel arrangement and its effect on the chances of controlling a bushfire. It may also be used for a range of other fire management purposes, as shown in the table below. Users of this guide should understand the underlying assumptions and limitations before 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.<br><br>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.<br>• 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.<br>• Generally most of the plant material is closer to the top of this fuel layer.<br>• Sometimes contains suspended leaves, bark or twigs.<br>• Fuels that have a clear gap between them and the surface fuels.<br>• Can be highly variable in ground coverage.<br>• 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.<br>• Fuel has a mixture of vertical and horizontal orientation.<br>• 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.<br>• Sometimes contains suspended leaves, bark or twigs.<br>• Coverage may range from continuous to having gaps many times the size of the fuel patch.<br>• Low-intensity fire (flame height of less than 0.5m) will consume most or all of this fuel.<br>• 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.<br>• 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.<br>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.<br>• 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.<br>• Bark fibres resemble the fine fibres that are twisted together to form natural string.<br>• Old bark is retained on the trunk of the tree for decades, forming a relatively spongy fibrous mass with deep vertical fissures.<br>• Outer bark may weather to a greyish colour, while underlying bark retains its original colour.<br>• Bark may form large strands when peeled off.<br>• 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).<br>• Fires will readily climb the tree and branches. |
| **How bark is attached** | • Young or new bark is held tightly to the trunk.<br>• As bark ages it becomes less tightly held.<br>• 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:<br>• Very fine lightweight fibres that will be carried for less than 100m.<br>• Small lightweight wads (about the size of a thumb) that will be carried for less than 300m.<br>• 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.<br>• Small wads of bark that will burn out within 2–3 minutes.<br>• Very large wads of bark that will burn for up to 10 minutes. |
| **Hazard accumulation** | • Bark hazard can reach Extreme.<br>• Bark hazard increases over time as the thickness and looseness of the old bark increases.<br>• 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.<br>Requires substantial effort to break off bark by hand. | Very little combustible bark.<br>Entire trunk almost completely black or charred. | Moderate | Spotting generally does not hinder fire control.<br>Fires will not climb these trees. |
| Bark is mostly tightly held with a few pieces loosely attached. | Limited amount of combustible bark.<br>50–90% of trunk charred.<br>Most of the bark is charred, especially on the lower part of the trunk. | High | Infrequent spotting.<br>Fires will climb some of these trees. |
| Many pieces of bark loosely held.<br>Deep fissures present in bark. | Large amounts of combustible bark.<br>10–50% of trunk charred.<br>Upper parts of the tree may not be charred at all. | Very High | Substantial spotting.<br>Fires will climb most of these trees. |
| Outer bark on trees is weakly attached.<br>Light hand pressure will break off large wads of bark.<br>Deep fissures present in bark. | Huge amounts of combustible bark.<br><10% of trunk charred.<br>Minimal evidence of charring. | Extreme | Quantity of spotting generated makes fire control very difficult or impossible.<br>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

## 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.<br>• Bark is shed in the form of long strips or ribbons of bark.<br>• Long strips of bark curl tightly inwards to form a candle-like shape (see image lower right).<br>• Bark strips 50cm or more in length fall off and often drape around the trunk and over branches and surrounding shrubs.<br>• Strips of bark are usually less than 2mm thick.<br>• 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).<br>• 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.<br>• 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.<br>• Bark hazard tends to increase over the long term as ribbons accumulate on the tree.<br>• 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<br>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.<br>Trunk and branches of trees almost entirely smooth. | Moderate | Spotting generally does not hinder fire control.<br>Fires will not climb these trees. |
| Long ribbons of bark present on upper trunk (>4m above ground) and in head of trees.<br>Lower trunk mainly smooth. | High | Infrequent spotting.<br>Fires will climb some of these trees. |
| Long ribbons of bark in the head and upper trunk with:<br>• ribbons hanging down to ground level or,<br>• flammable bark covers trunk. | Very High | Substantial spotting.<br>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.<br>• Bark becomes rough, compacted and furrowed with age<br>• Bark feels very abrasive when rubbed by hand.<br>• Bark pieces tend to be more than 2mm thick when they break off.<br>• 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.<br>• Layers of old dead bark are retained on the trunk and branches.<br>• Unlike stringybark trees, the bark on these trees forms only short strands or chunks when peeled off.<br>• Evidence of charring on the bark may last for up to 10 years. |
| **Hazard accumulation** | • Bark hazard never exceeds High.<br>• Bark hazard increases over the long term as the thickness and looseness of the old bark increases. |

**Example**

### 3.5.3 Papery barks

| | |
|---|---|
| **Physical description** | • Shrubs and trees growing from 2m to 30m tall, often with flaky shedding bark.<br>• Old bark is retained on the trunk and branches and builds up into a thick spongy mass.<br>• Bark layers tend to split allowing sheets of bark to become loose and eventually peel off.<br>• Evidence of charring on the bark may last for up to 10 years. |
| **Hazard accumulation** | • Bark hazard never exceeds High.<br>• 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.<br>• Bark shed is often seasonal and often annual.<br>• Species where the old bark tends to peel into large slabs (<50cm in length) or small flakes when shed.<br>• Most of the bark falls off the tree soon after it is shed.<br>• Some small amounts of bark may be retained on the stem or branches for several months before falling off, leading to a mottled effect.<br>• The mottled effect leads to discontinuous bark fuel up the tree. |
| **Hazard accumulation** | • Bark hazard never exceeds Moderate.<br>• 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.<br>or<br>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.<br>Fires will climb some of these trees. |
| Light hand pressure will break bark off. | Large amounts of combustible bark. | High | Infrequent spotting.<br>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.

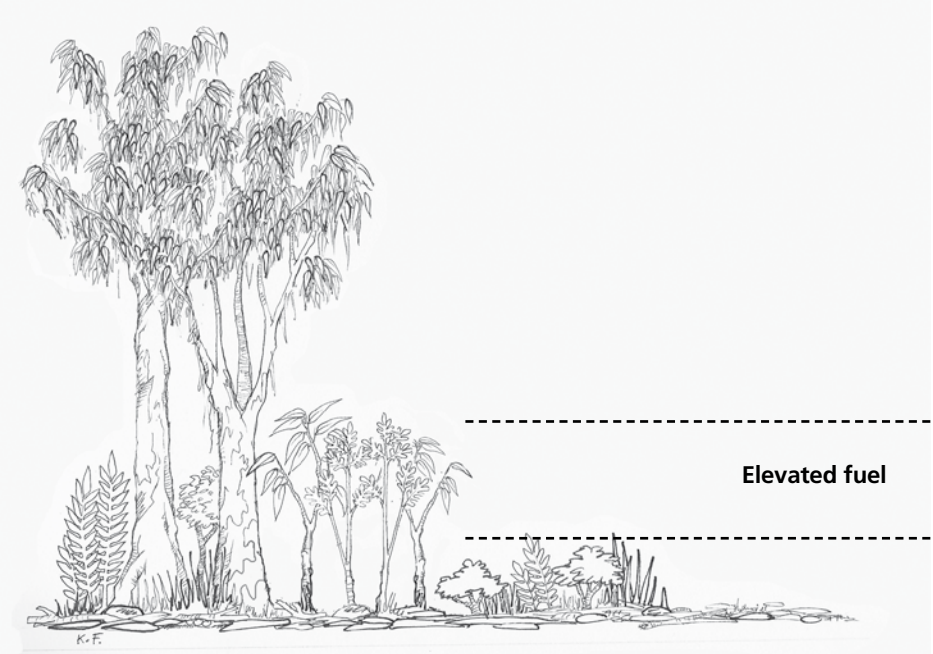
**Table 3.6 Examples of other bark types**

| | | |
|---|---|---|
| **Low** | No trees present.<br><br>or<br><br>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.

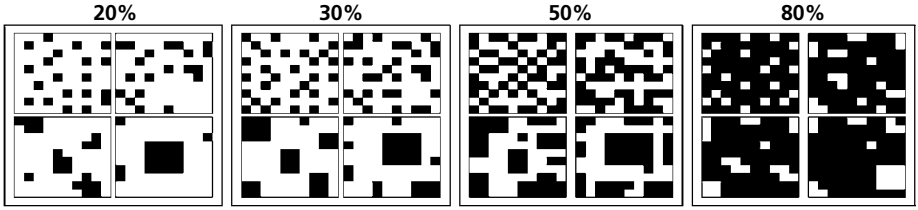
**Table 4.1 Assessing elevated fine fuel hazard**

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** | | |

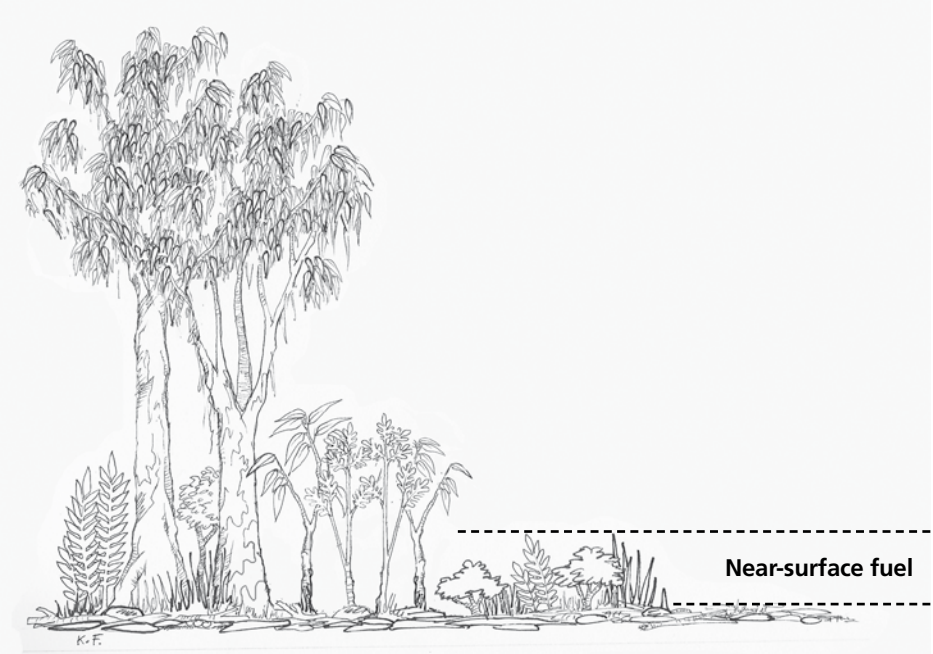
Assess elevated hazard over a plot 10m in radius. Assessing multiple plots will give better results.

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.

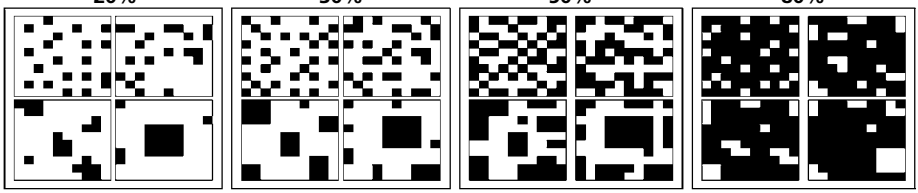
**Table 5.1 Assessing near-surface fine fuel hazard**

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.<br>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.<br>A fire will spread readily in this layer without having to consume the surface layer. |
| >60% | >50% | Very small gaps between fuel patches.<br>Logs and rocks obscured. | Extreme | Contributes significantly to fire spread and flame height.<br>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.

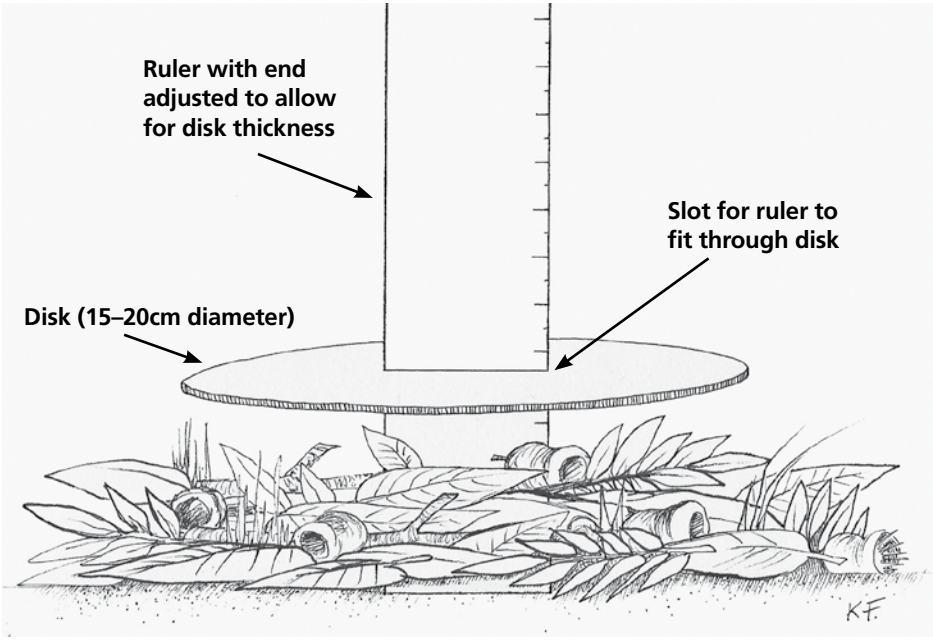
## 6.2 Assessment

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**

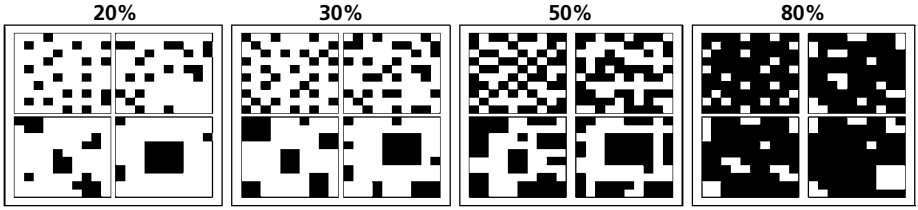
To achieve a given hazard rating a best fit of all key attributes should be sought. Choices for the hazard rating of fuels that fit across several descriptions may be informed by the effect that different levels of key attributes have on fire behaviour.

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

| ❶ Surface fine fuel hazard rating | ❷ Near-surface fine fuel hazard rating | | | | |
|---|---|---|---|---|---|
| | Low | Moderate | High | Very High | Extreme |
| | ❸ 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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Wilson, AAG 1993, *Elevated fuel guide*, research report no. 35, Fire Management Branch, Department of Conservation and Environment, Victoria.

# 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)<br><br>1 to 2 small 4WD tankers (400l)<br><br>6 firefighters | 5 x 4WD heavy tankers (4000l) each with 5 firefighters | Small dozer (D4) or tractor with scrub roller<br><br>1 to 2 small 4WD tankers (400l)<br><br>6 firefighters | Small dozer (D4)<br><br>1 to 2 small 4WD tankers (400l)<br><br>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 v3

| | |
|---|---|
| Date Assessed: | Assessors: |
| Sampling Location: | Veg Type: |

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

| **Canopy height (Assess over a 20m radius)** | | | |
|---|---|---|---|
| Average Height to Top of Canopy: | m | m | m |
| Average Height to Base of Canopy: | m | m | m |

| **Bark fuel (Assess over a 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 | | |

Select the Bark Hazard rating from above that will be used to determine Overall Fuel Hazard. (Only use the Stringybark hazard rating if more than 10% of the trees are Stringybark **AND** it has the highest rating. Otherwise use the bark with next highest rating.)

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bark Fuel Hazard: | L | M | H | VH | E | L | M | H | VH | E | L | M | H | VH | E |

| **Elevated fuel layer (Assess over a 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 (Assess over a 10m radius)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Near-surface % Cover: | % | | | | | % | | | | | % | | | | |
| Near-surface % Dead | % | | | | | % | | | | | % | | | | |
| NS Average Height (cm): | cm | | | | | cm | | | | | cm | | | | |
| NS Fuel Hazard: | L | M | H | VH | E | L | M | H | VH | E | L | M | H | VH | E |

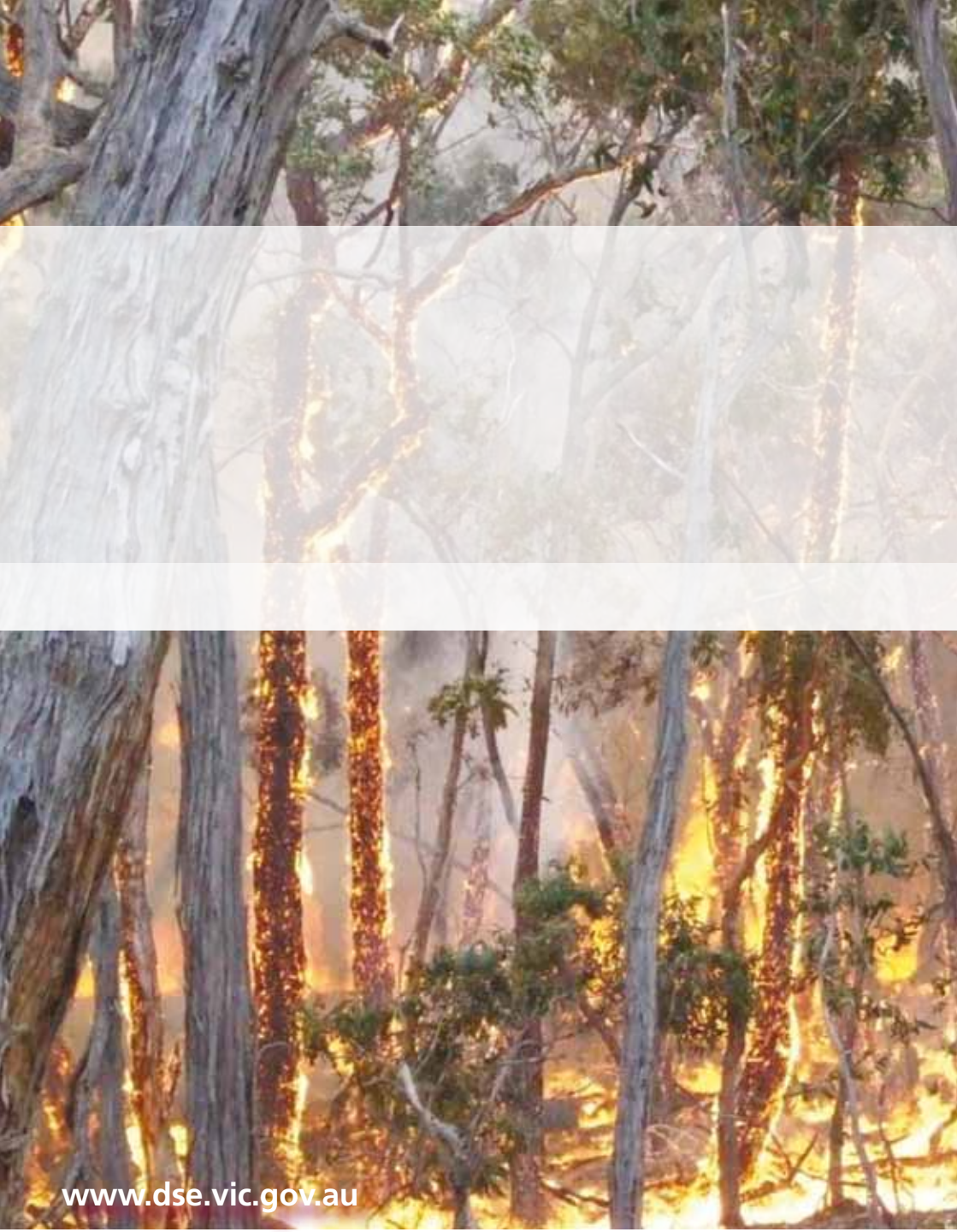
| **Surface fuel layer (Assess over a 10m radius)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surface Litter % Cover: | % | | | | | % | | | | | % | | | | |
| Average Litter Depth (mm): | mm | | | | | mm | | | | | mm | | | | |
| Surface Fuel Hazard | 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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# APPENDIX D

## Offsets assessment guides for the Kentucky offset area

Table D1 summarises the *Offsets assessment guide* inputs for the MNES to be offset on Kentucky. The inputs included are based on the following justifications.

### *Quality of impact area*

The average quality of the impact area for each MNES was compiled based on ecological survey data collected from Roma East (eastern portion of the Roma Gas Field, primarily within PL 281 and PL 282) in 2021.

- Ground-truthing of REs and assessment of vegetation condition (i.e. remnant or regrowth).
- RE and TEC assessment.
- BioCondition assessments in accordance with the *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland Assessment Manual* (Eyre et al. 2015).
- Threatened species habitat assessment and mapping.

Habitat quality scoring was undertaken generally in accordance with the method described in Appendix E of this acquittal summary. This method has been developed based on a combination of assessment methods outlined in the Queensland Herbarium's BioCondition Manual and the GTDTHQ (version 1.3; DES 2020) to be consistent with the requirements under the EPBC Act guideline for the *Offsets assessment guide*.

### *Quality of offset area*

A baseline habitat quality score for each MNES offset value was determined generally in accordance with the GTDTHQ (version 1.2; DEHP 2017) based on the results of the detailed field assessments of the offset area (see Section 2.4 of the Kentucky OAMP). The baseline habitat quality scores are detailed in Appendix A of the Kentucky OAMP. The offset areas for each MNES are based on areas of remnant and regrowth vegetation identified as suitable habitat as part of detailed field assessments and presented in Section 2.5 of the Kentucky OAMP.

### *Future quality without offset management*

Kentucky is wholly located across two Petroleum Leases (PL) operated by Santos (PL 90 and PL 91) and occupies approximately 12% of the land surface of PL 90. From 2015 to 2019 Santos GLNG proposed the following two different development scenarios for the Kentucky property to allow for gas field development and the provision of offsets:

- a flexible offset concept where a certain percentage of offset area was excised from the total property area and development would proceed anywhere within the property up to the percentage excised.
- infrastructure would be scouted throughout the offset, as per the usual practice, and then these areas would be excised and the remainder of the areas of vegetation between the infrastructure would be secured as offsets.

When presented with this proposal, the Commonwealth advised that such a development within the offset areas on both properties was unacceptable. The two uses were considered incompatible due to the potential for adverse impacts on the offset areas, including edge effects, habitat alteration and increased pest animal activity.

Based on the above, in early 2020, Santos made the decision to exclude petroleum activities from the proposed offset areas on Kentucky property. Santos' long term supply plan included an appraisal program on Kentucky planned for 2021, to support a broader production program to follow. The Kentucky subproject would develop and realise an estimated 30 petajoules for an estimated value exceeding $4M. Gas value would be realised by a well spacing of approximately 1,000 m with an associated network of gas flowlines and access tracks. Steep topography across this property would result in larger than average disturbances to support safe and stable infrastructure. The decision not to proceed with the gas field development at Kentucky has been enacted using a Santos formal decision sheet process that has been endorsed by accountable persons within Santos.

The decision not to proceed with development comes at a cost to Santos, and without the legal security of these vegetated areas afforded through an approved offset plan and a Voluntary Declaration under the VM Act, development will proceed, leading to a direct loss of existing and potential MNES values and a decreased level of condition across areas remaining. Research in central Queensland has shown vegetation within 1 km of an edge was degraded as a result of edge effects and habitat fragmentation associated with linear infrastructure (Neldner *et al*. 2017). Therefore, approval of the Offset Plan will result in avoidance of significant impacts to MNES values consistent with the first step of the mitigation hierarchy.

The Kentucky property is currently grazed by DOCE Pty Ltd, a wholly owned subsidiary of Santos. If the offset area on Kentucky was not approved and secured Santos was planning to continue cattle grazing and the maximum return for grazing would be sought by DOCE Pty Ltd.

Eyre *et al*. (2009) identified the significant changes that grazing can cause in Brigalow Belt ecosystems. As these areas are now being used as offsets, grazing will only be used strategically and on a limited basis to manage fuel loads and control exotic weeds and pasture grasses – consequently, through the management of strategic grazing potential impacts on MNES, particularly those comprising regrowth communities, will be avoided.

### *Future quality with offset management*

In 2020 Santos approved the decision to exclude all petroleum activities from the Kentucky offset area.

The offset area will be secured and managed, to improve the quality of vegetation communities and habitat for MNES. The Kentucky OAMP will be implemented and includes specific management actions aimed at reducing the impact of threatening processes and improving the quality of MNES habitat within the offset area, including:

- Pest animal control
- Livestock management
- Weed control
- Fire management
- Regrowth restoration management.

*Confidence in result – future quality*

The Kentucky OAMP has been developed in accordance with approved conservation advice, recovery plans and recommended threat abatement and management advice for the species, and negotiations with the landholder. The OAMP details specific management outcomes aimed at improving the quality of MNES habitat. Ongoing monitoring of the offset area will also be undertaken to regularly assess the progress of the offset and ensure the OAMP achieves its required outcomes. The OAMP will support an efficient, effective, timely, transparent, scientifically robust and reasonable approach to managing and monitoring the offset area.

*Risk of loss without offset*

Risk of loss without offset is 0%.

*Risk of loss with offset*

The offset area will be secured through declaration as an area of high nature conservation value under section 19F of the VM Act, therefore the risk of loss is 0%.

*Confidence in result – risk of loss*

The legally binding mechanism will be registered on the land title and bind all current and future landowners to ensure that the offset is protected.

*Time over which loss is averted (years)*

The offset area will be protected by a legally binding mechanism which will remain in effect as required by the applicable Commonwealth legislative requirements, therefore, the time over which loss is averted is considered to be the maximum allowable time of 20 years.

*Time until ecological benefit (years)*

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. An ecological benefit is expected to be realised in 20 years.

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**Table D1: Summary of *Offsets assessment guide* inputs for each Stage 5 MNES on Kentucky**

| Inputs | | Collared Delma | Dunmall's Snake | Yakka Skink | Koala | South-eastern Long-eared Bat |
|---|---|---|---|---|---|---|
| Impact | Area (ha) | 143.6 | 144 | 140.8 | 116.3 | 144 |
| | Quality | 4 | 4 | 5 | 7 | 4 |
| Offset start (ha) | | 806.5 | 806.5 | 806.5 | 806.5 | 806.5 |
| Offset quality | Start quality | 8 | 8 | 7 | 8 | 8 |
| | Future quality without offset | 8 | 8 | 7 | 8 | 8 |
| | Future quality with offset | 9 | 9 | 8 | 9 | 9 |
| | Confidence in result (%) | 80% | 80% | 80% | 80% | 80% |
| Risk of loss (%) | Without offset | 0% | 0% | 0% | 0% | 0% |
| | With offset | 0% | 0% | 0% | 0% | 0% |
| | Confidence in result | 90% | 90% | 90% | 90% | 90% |
| Risk related time horizon/time over which loss is averted (max. 20 years) | | 20 | 20 | 20 | 20 | 20 |
| Time until ecological benefit | | 20 | 20 | 20 | 20 | 20 |

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# APPENDIX E

## Impact area habitat quality scoring method for MNES

### Summary

The habitat quality score for each MNES will be assessed based on a combination of assessment methods outlined in the Queensland Herbarium's BioCondition Assessment Manual (version 2.2; Eyre *et al*. 2015), the GTDTHQ (version 1.3; DES 2020) and the methods outlined below in order to be consistent with the requirements under the EPBC Act guideline for the *Offsets assessment guide*.

### MNES habitat quality scoring method

The habitat quality for each MNES, for use in the *Offsets assessment guide*, 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 will be assessed for threatened fauna and flora; however, for TECs (i.e. Brigalow TEC) only site condition and site context components will form 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 site-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 the site-based assessment are scored based on the scoring guide provided in the BioCondition Assessment Manual (Eyre *et al.* 2015) 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 *Offsets assessment guide* 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 E1 summarises how each of the requirements of the *Offsets assessment guide* are considered as part of determining the site condition score for an offset value.

**Table E1: 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 (Eyre *et al.* 2015). 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).<br>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 (Eyre *et al.* 2015) 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.<br>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.<br>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 (Eyre *et al*. 2015) as well as an assessment of threats that occur on or near the site to ensure the requirements for site context under the *Offsets assessment guide* 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 (Eyre *et al*. 2015) 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 (Eyre *et al.* 2015) 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 vegetation. To calculate the patch size score:

1. The area of remnant vegetation in which the monitoring site is located is measured, summing together with this all other directly connecting areas of remnant vegetation. Where a monitoring site is within an area not considered remnant vegetation (i.e. regrowth vegetation), the patch size is 0 ha.
2. Determine the score for this attribute by matching with the class ranges in Table E2.

*Connectedness (fragmented subregion)*

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

1. The percentage of remnant vegetation along the boundary of the assessment unit patch containing the monitoring site was measured.
2. Determine the score for this attribute by matching with the class ranges in Table E2.

*Context (fragmented subregion)*

Assessment of context involves measuring the percentage of remnant vegetation within a 1 km buffer around the monitoring site. To calculate the context score:

1. Create a 1 km buffer around the monitoring site.
2. Measure the percentage of remnant vegetation within the 1 km buffer.
3. Determine the score for this attribute by matching with the thresholds in Table E2.

*Threats*

The measure of threat is calculated for each MNES and is undertaken generally in accordance with Section 2.4.4.4 (Absence of threats) of the GTDTHQ (version 1.3; DES 2020) by considering scope and severity of threats. This attribute indicates the magnitude of all known or potential threats within, or within close proximity to, the matter area that may negatively impact on the species' habitat and/or the species' ability to exist and persist in the matter area.

A list of known and potential threats is 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 site-based assessments, a refinement of identified threats for each matter is undertaken (whether involving the removal or addition of threats), resulting in a final list of threats.

A conservative estimate of an 'absence of threat' was assessed, considering scope and severity, with scores assigned between 0 to 5 where:

- A score of zero (0) implies identified threats are likely to be widespread or pervasive in their scope, affecting the species' habitat or the species' local population across a majority (>60%) of its occurrence or population within the matter area. The severity of the threats is also likely to destroy, seriously degrade, or otherwise reduce the species' habitat/local population by >40% within ten years or three generations.

- A score of five (5) implies identified threats are likely to be very narrow in their scope, affecting the species' habitat or the species' local population across a negligible proportion (<20%) of its occurrence or population within the matter area. The severity of the threats is likely to have negligible damage or will only degrade or reduce the species' habitat/local population by <5% within ten years or three generations.

The total site context score for each MNES at each relevant monitoring site is calculated out of 45, based on the following:

1. Summing the patch size, connectedness and context scores, out of 20.
2. Calculating the average threats score, out of 25.
3. Calculating a final weighted score for site context as:
    a. 50% weighting of the combined patch size, connectedness and context
    b. 50% weighting of the threats score.

**Table E2: Site context scoring guide**

| Attribute | | Score | | | | |
|---|---|---|---|---|---|---|
| Size of patch | Score | 0 | 2 | 5 | 7 | 10 |
| | Description | <5 ha | 5-25 ha | 26-100 ha | 101-200 ha | >200 ha |
| Connectedness | Score | 0 | 2 | | 4 | 5 |
| | Description | 0-10% | >10%-<50% | | 50-75% | >75% or >500 ha |
| Context | Score | 0 | 2 | | 4 | 5 |
| | Description | <10% | >10-30% | | >30-75% | >75% |
| Level of threat | Score | 0 | 2 | 3 | 4 | 5 |
| | Description | Very high | High | Medium | Low | Very low |

***Offsets assessment guide requirements***

In accordance with the *Offsets assessment guide*, 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 E3 summarises how each of the requirements above are considered as part of determining the site context score for an offset value.

**Table E3: 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:<br>• Patch size – measuring the size of the patch of remnant vegetation being assessed and any directly connecting remnant vegetation.<br>• 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 (Eyre *et al.* 2015) measure of context, representing the percentage of remnant vegetation within a 1 km buffer around a given monitoring site.<br>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 Tables E8 – E17. |

### *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), as well as the requirements for species stocking rate under the *Offsets assessment guide*. Table E4 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 advices 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 regard to the overall species population.

**Table E4: 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 5, where:<br>• 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<br>• a score of **5** represents species-specific foraging habitat, conditions or food resources are present for all relevant stages of the life cycle. | **1 – 5** |

| Component | Sub-component/scoring | Score |
|---|---|---|
| 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 5, where:<br>• 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<br>• a score of **5** represents presence of abundant, available species-specific shelter and breeding habitat, conditions and resources for all relevant stages of the life cycle. | **1 – 5** |
| 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 5, where:<br>• 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)<br>• a score of **5** 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 – 5** |
| 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. | **3** |
| | 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. | **4** |
| | 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. | **5** |

***Offsets assessment guide requirements***

In accordance with the *Offsets assessment guide* species stocking rate is assessed based on the usage and/or density of a species at a particular site and the role of the site population in regard 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 in regard to the overall species population?

Table E5 summarises how each of the requirements above are considered as part of determining the species habitat index score for an offset value.

**Table E5: 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 components assessed as part of the method quantify the presence, density and role of the site's ability to actually or likely support a species population. It also provides a measure of the quality and availability of food, foraging habitat, shelter and breeding habitat for each species.<br>The relative presence and density of the MNES on the site will be assessed as part of ongoing targeted surveys undertaken in accordance with the Department of Science, Information Technology, Innovation and the Arts *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al*. 2014), *Survey Guidelines for Australia's Threatened Birds* (Department of the Environment, Water, Heritage and the Arts 2010), *Survey guidelines for Australia's Threatened Reptiles* (Department of Sustainability, Environment, Water, Population and Communities 2011) and other species-specific survey guidelines endorsed by Queensland and/or Commonwealth Government. |
| What is the density of species known to utilise the site? | |
| What is the role of the site population in regard to the overall species population? | |

### *Final habitat quality score*

Table E6 provides a summary of the components used to score habitat quality for each MNES and the maximum score and relevant weighting for each component. The habitat quality score for each MNES is calculated as the average score across each of the monitoring sites within a given assessment unit (RE), area-weighted for the contribution of those REs to the area of interest (i.e. impact area).

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**Table E6: Scores for each attribute contributing to each of the habitat quality score components, including their weightings. These scores are assigned for each monitoring point.**

| Site condition | | | Site context | | | | Species habitat index | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Attributes** | **Score** | **Weighting** | **Attributes** | **Score** | **Weighting** | | **Attributes** | **Score** | **Weighting** | |
| Recruitment of woody perennial species | 5 | 6.25% | Size of patch | 10 | 50% | 25% | Quality and availability of food and habitat required for foraging | 5 | 50% | 16.7% |
| Native plant species richness - trees | 5 | 6.25% | Connectivity | 5 | | 12.5% | Quality and availability of habitat required for shelter and breeding | 5 | | 16.7% |
| Native plant species richness - shrubs | 5 | 6.25% | Context | 5 | | 12.5% | Quality and availability of habitat required for mobility | 5 | | 16.7% |
| Native plant species richness - grasses | 5 | 6.25% | Threats | 5 | 50% | | Role of site location to species overall population in the state | 5 | 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% | - | - | - | | - | - | - | |
| 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** | **/25** | **100%** | | **Total** | **/20** | **100%** | |
| **MNES – Fauna Site condition weighting** | | **30%** | **Site context weighting** | | **30%** | | **Species habitat index weighting** | | **40%** | |
| **MNES - TEC Site condition weighting** | | **70%** | **Site context weighting** | | **30%** | | **-** | | **-** | |



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**Table E7: Threats informing habitat quality scoring for Brigalow TEC**

| Component | Attribute | Species-specific considerations |
|---|---|---|
| Site context | Threats | • Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat<br>• Alteration of the structure and integrity of TEC habitat as a consequence of unsuitable fire regime<br>• Invasive weeds, particularly introduced grasses<br>• Disturbance by pest animals, particularly feral pigs<br>• Inappropriate grazing regimes |

**Table E8: Threats and species-specific considerations informing habitat quality scoring for Collared Delma**

| Component | Attribute | Species-specific considerations |
|---|---|---|
| Site context | Threats | • Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat<br>• Alteration of ground cover as a consequence of unsuitable fire regime<br>• Alteration of habitat suitability through the presence and extent of non-native, invasive weeds<br>• Predation by feral predators (e.g. cats, foxes, wild dogs)<br>• Removal of foraging and shelter habitat (e.g. rocks, coarse woody debris, ground litter)<br>• Change in ground layer composition as a consequence of livestock grazing and feral horse browsing |
| Species habitat index | Quality and availability of food and habitat required for foraging | • Presence and abundance of evidence of small invertebrates<br>• Presence and cover of leaf litter and loose stones, used as shelter by prey |
| | Quality and availability of habitat required for shelter and breeding | • Presence and cover of leaf litter and loose stones considered suitable for sheltering |
| | Quality and availability of habitat required for mobility | • Presence and cover of litter and loose stones<br>• Extent of suitable habitat as well as presence and extent of contiguous remnant/regrowth cover |



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**Table E9: Threats and species-specific considerations informing habitat quality scoring for Dunmall's Snake**

| Component | Attribute | Species-specific considerations |
|---|---|---|
| Site context | Threats | • Alteration of ground cover as a consequence of unsuitable fire regime<br>• Change in ground layer composition as a consequence of livestock grazing and feral horse browsing<br>• Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat<br>• Predation by feral predators (e.g. cats, foxes, pigs)<br>• Alteration of habitat suitability through the presence and extent of non-native, invasive weeds |
| Species habitat index | Quality and availability of food and habitat required for foraging | • Presence and cover of leaf litter and coarse woody debris, used as shelter by prey |
| | Quality and availability of habitat required for shelter and breeding | • Presence and abundance of coarse woody debris, particularly large, hollow-bearing logs used as shelter |
| | Quality and availability of habitat required for mobility | • Extent of suitable habitat as well as presence and extent of contiguous remnant/regrowth cover |

**Table E10: Threats and species-specific considerations informing habitat quality scoring for Yakka Skink**

| Component | Attribute | Species-specific considerations |
|---|---|---|
| Site context | Threats | • Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat<br>• Predation by feral predators (e.g. cats, foxes, pigs)<br>• Alteration of ground cover as a consequence of unsuitable fire regime<br>• Removal of foraging and shelter habitat (e.g. rocks, coarse woody debris, ground litter)<br>• Destruction of potential shelter habitat associated with rabbit warren ripping<br>• Alteration of habitat suitability through the presence and extent of non-native, invasive weeds |
| Species habitat index | Quality and availability of food and habitat required for foraging | • Evidence and abundance of insect and other arthropod prey<br>• Presence and quality of ground foraging habitat, particularly leaf litter and native grass cover |
| | Quality and availability of habitat required for shelter and breeding | • Presence and abundance of coarse woody debris, particularly large, hollow-bearing logs used as shelter<br>• Any direct evidence of occupation (e.g. burrows, communal defecation sites) |
| | Quality and availability of habitat required for mobility | • Extent of suitable habitat as well as presence and extent of contiguous remnant/regrowth cover |



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**Table E11: Threats and species-specific considerations informing habitat quality scoring for Koala**

| Component | Attribute | Species-specific considerations |
|---|---|---|
| Site context | Threats | • Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat<br>• Mortality due to vehicle collision<br>• Predation by feral predators, particularly wild or domesticated dogs<br>• 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<br>• Evidence for the presence of disease within the population (i.e. *Chlamydia pecorum*) |
| Species habitat index | Quality and availability of food and habitat required for foraging | • Extent and dominance of myrtaceous trees (i.e. *Eucalyptus*, *Angophora*, *Corymbia*)<br>• Abundance and extent of large trees used for foraging<br>• Presence of favoured feed species (e.g. *E. tereticornis, E. camaldulensis, E. major, E. longirostrata*), as well as other feed trees (*E. chloroclada, E. populnea, E. crebra, E. melanophloia, E. orgadophila, C. citriodora*)<br>• Presence of nearby waterbodies and ephemeral or perennial watercourses |
| | Quality and availability of habitat required for shelter and breeding | • Presence and extent of large myrtaceous trees (i.e., *Eucalyptus*, *Angophora*, *Corymbia*) |
| | Quality and availability of habitat required for mobility | • Extent of suitable habitat as well as presence and extent of contiguous remnant/regrowth cover |



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**Table E12: Threats and species-specific considerations informing habitat quality scoring for South-eastern Long-eared Bat**

| Component | Attribute | Species-specific considerations |
|---|---|---|
| Site context | Threats | • Loss of suitable habitat through land clearing and effects associated with fragmentation of habitat<br>• Alteration of the structure of suitable habitat (e.g. mix of shrubby and open structure habitat) including loss of hollow-bearing trees as a consequence of unsuitable fire regime<br>• Impacts on understorey habitat suitability as a consequence of livestock grazing and feral horse browsing, impacting habitat for flying invertebrate prey in the understorey<br>• Competition for hollows from native fauna species (e.g. parrots and cockatoos) and non-native fauna species (e.g. European Honeybees, Common Myna), especially where hollows are limited |
| Species habitat index | Quality and availability of food and habitat required for foraging | • Presence of an intact, mature canopy cover<br>• Presence and extent of White Cypress Pine (*Callitris glaucophylla*) favoured as foraging habitat |
| | Quality and availability of habitat required for shelter and breeding | • Presence and abundance of decorticating and loose bark on trees used for shelter and breeding<br>• Presence and abundance of small tree hollows used for shelter and breeding |
| | Quality and availability of habitat required for mobility | • Extent of suitable habitat as well as presence and extent of contiguous remnant/regrowth cover |



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# APPENDIX F

## Impact area habitat quality scores



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**Table F1: Impact area habitat quality scores for sites within Roma East (Stage 5 – sites 914 to 1336)**

| Site ID | | | | 914 | 916 | 918 | 920 | 922 | 924 | 940 | 984 | 989 | 1007 | 1171 | 1229 | 1232 | 1247 | 1249 | 1255 | 1278 | 1330 | 1332 | 1334 | 1336 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.3.2 | 11.3.2 | 11.3.2 | 11.3.25 | 11.3.25 | 11.3.25 | 11.3.2b | 11.3.2b | 11.3.2b | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.5 | 11.5.5 | 11.5.5 | 11.5.5 | 11.7.2 | 11.7.2 | 11.7.2 |
| **Attributes** | | **Max. score** | **Weighting** | rem* | rem* | rem* | reg* | reg* | reg* | rem* | reg* | rem* | rem* | reg* | reg* | reg* | reg* | reg* | reg* | rem* | rem* | reg* | reg* | rem* |
| **Site condition** | Recruitment of woody perennial species | 5 | 6% | 5 | 3 | 5 | 5 | 3 | 5 | 0 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 3 |
| | Species richness - trees | 5 | 6% | 5 | 5 | 5 | 2.5 | 5 | 2.5 | 5 | 2.5 | 2.5 | 2.5 | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 5 | 2.5 | 2.5 | 5 | 5 |
| | Species richness - shrubs | 5 | 6% | 2.5 | 5 | 2.5 | 5 | 5 | 2.5 | 2.5 | 0 | 2.5 | 0 | 0 | 0 | 2.5 | 2.5 | 2.5 | 2.5 | 5 | 2.5 | 5 | 2.5 | 5 |
| | Species richness - grasses | 5 | 6% | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 0 | 0 | 2.5 | 2.5 | 2.5 | 2.5 | 5 | 5 | 2.5 | 2.5 | 5 | 5 | 5 | 2.5 | 2.5 |
| | Species richness - forbs | 5 | 6% | 0 | 2.5 | 0 | 2.5 | 0 | 0 | 0 | 0 | 0 | 2.5 | 2.5 | 2.5 | 5 | 5 | 5 | 0 | 5 | 2.5 | 5 | 0 | 2.5 |
| | Canopy height | 5 | 6% | 3 | 3 | 3 | 0 | 3 | 3 | 5 | 1.5 | 5 | 3 | 1.5 | 3 | 5 | 1.5 | 5 | 5 | 4 | 1.5 | 5 | 3 | 3 |
| | Canopy cover | 5 | 6% | 5 | 2.5 | 2.5 | 2.5 | 5 | 5 | 5 | 2.5 | 5 | 5 | 2.5 | 1.5 | 2.5 | 3.5 | 3.5 | 2 | 2.5 | 5 | 4 | 5 | 2.5 |
| | Shrub canopy cover | 5 | 6% | 0 | 5 | 0 | 3 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 0 | 0 | 0 | 0 | 5 |
| | Native perennial grass cover | 5 | 6% | 0 | 0 | 3 | 0 | 0 | 5 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 5 | 5 | 0 | 5 | 1 | 3 | 0 | 0 |
| | Organic litter cover | 5 | 6% | 3 | 3 | 5 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 3 | 3 | 3 | 3 |
| | Large trees | 15 | 19% | 0 | 5 | 5 | 0 | 15 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 5 |
| | Coarse woody debris | 5 | 6% | 3 | 5 | 2 | 0 | 3 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 5 | 5 | 5 | 3 | 2 | 5 | 5 | 3 | 5 |
| | Weed cover | 10 | 13% | 10 | 10 | 10 | 10 | 10 | 10 | 0 | 10 | 10 | 0 | 0 | 0 | 5 | 10 | 5 | 10 | 10 | 10 | 10 | 10 | 10 |
| | **Weighted site condition subtotal (/100)** | | 100% | 48.8 | 64.4 | 56.9 | 47.5 | 74.4 | 56.9 | 46.9 | 38.1 | 49.4 | 36.9 | 37.5 | 35 | 54.4 | 60 | 61.3 | 56.9 | 66.9 | 53.8 | 65.6 | 48.8 | 64.4 |
| **Collared Delma** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 10 | 5 | 5 | 5 | 2 | 10 | 5 | 5 | 5 | 5 | 0 | 2 | 2 | 2 | 2 | 2 | 5 | 10 | 2 | 10 |
| | Connectivity | 5 | 13% | 5 | 5 | 5 | 0 | 2 | 0 | 5 | 4 | 4 | 5 | 2 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 5 | 5 | 2 |
| | Context | 5 | 13% | 4 | 2 | 2 | 0 | 2 | 2 | 4 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 4 | 4 | 4 |
| | Absence of threats | 25 | 50% | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 |
| | Weighted site context subtotal (/100) | | 100% | 62.2 | 57.2 | 44.7 | 27.2 | 37.2 | 24.7 | 62.2 | 42.2 | 42.2 | 49.7 | 32.2 | 14.7 | 19.7 | 19.7 | 24.7 | 24.7 | 34.7 | 37.2 | 62.2 | 42.2 | 54.7 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 3 | 3 | 3 | 2 | 2 | 1 | 4 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 3 | 3 | 3 | 2 | 2 | 1 | 4 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 4 | 4 | 2 | 2 | 1 | 4 | 2 | 2 | 3 | 4 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 4 | 4 | 4 |
| | Role of the site population in regard to the overall species population | 5 | 50% | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Weighted species habitat index subtotal (/100) | | 100% | 43.3 | 43.3 | 43.3 | 30 | 30 | 20 | 50 | 30 | 30 | 40 | 43.3 | 30 | 30 | 33.3 | 33.3 | 33.3 | 36.7 | 36.7 | 43.3 | 40 | 43.3 |
| **Habitat quality score** | Site condition | 80 | 30% | 88.1 | 73.1 | 48.8 | 64.4 | 56.9 | 47.5 | 74.4 | 56.9 | 46.9 | 38.1 | 49.4 | 36.9 | 37.5 | 35 | 54.4 | 60 | 61.3 | 56.9 | 66.9 | 53.8 | 65.6 |
| | Site context | 25 | 30% | 62.2 | 57.2 | 44.7 | 27.2 | 37.2 | 24.7 | 62.2 | 42.2 | 42.2 | 49.7 | 32.2 | 14.7 | 19.7 | 19.7 | 24.7 | 24.7 | 34.7 | 37.2 | 62.2 | 42.2 | 54.7 |
| | Species habitat index | 20 | 40% | 43.3 | 43.3 | 43.3 | 30 | 30 | 20 | 50 | 30 | 30 | 40 | 43.3 | 30 | 30 | 33.3 | 33.3 | 33.3 | 36.7 | 36.7 | 43.3 | 40 | 43.3 |
| | Final weighted habitat quality score (/10) | | 100% | 6.2 | 5.6 | 4.5 | 4.0 | 4.0 | 3.0 | 6.1 | 4.2 | 3.9 | 4.2 | 4.2 | 2.8 | 2.9 | 3.0 | 3.7 | 3.9 | 4.3 | 4.3 | 5.6 | 4.5 | 5.3 |
| | **Total/10 (rounded)** | | | **6** | **6** | **5** | **4** | **4** | **3** | **6** | **4** | **4** | **4** | **4** | **3** | **3** | **3** | **4** | **4** | **4** | **4** | **6** | **4** | **5** |
| **Dunmall's Snake** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 10 | 5 | 5 | 5 | 2 | 10 | 5 | 5 | 5 | 5 | 0 | 2 | 2 | 2 | 2 | 2 | 5 | 10 | 2 | 10 |
| | Connectivity | 5 | 13% | 5 | 5 | 5 | 0 | 2 | 0 | 5 | 4 | 4 | 5 | 2 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 5 | 5 | 2 |
| | Context | 5 | 13% | 4 | 2 | 2 | 0 | 2 | 2 | 4 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 4 | 4 | 4 |



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Santos

| Site ID | | | | 914 | 916 | 918 | 920 | 922 | 924 | 940 | 984 | 989 | 1007 | 1171 | 1229 | 1232 | 1247 | 1249 | 1255 | 1278 | 1330 | 1332 | 1334 | 1336 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.3.2 | 11.3.2 | 11.3.2 | 11.3.25 | 11.3.25 | 11.3.25 | 11.3.2b | 11.3.2b | 11.3.2b | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.5 | 11.5.5 | 11.5.5 | 11.5.5 | 11.7.2 | 11.7.2 | 11.7.2 |
| **Attributes** | | **Max. score** | **Weighting** | rem* | rem* | rem* | reg* | reg* | reg* | rem* | reg* | rem* | rem* | reg* | reg* | reg* | reg* | reg* | reg* | rem* | rem* | reg* | reg* | rem* |
| | Absence of threats | 25 | 50% | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 |
| | Weighted site context subtotal (/100) | | 100% | 62.7 | 57.7 | 45.2 | 27.7 | 37.7 | 25.2 | 62.7 | 42.7 | 42.7 | 50.2 | 32.7 | 15.2 | 20.2 | 20.2 | 25.2 | 25.2 | 35.2 | 37.7 | 62.7 | 42.7 | 55.2 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 4 | 4 | 4 | 2 | 2 | 1 | 4 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 4 | 4 | 4 | 2 | 2 | 1 | 4 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 4 | 4 | 2 | 2 | 1 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 4 | 4 | 4 |
| | Role of the site population in regard to the overall species population | 5 | 50% | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Weighted species habitat index subtotal (/100) | | 100% | 50 | 50 | 50 | 30 | 30 | 20 | 50 | 30 | 30 | 50 | 36.7 | 30 | 30 | 33.3 | 23.3 | 23.3 | 30 | 36.7 | 40 | 43.3 | 43.3 |
| **Habitat quality score** | Site condition | 80 | 30% | 88.1 | 73.1 | 48.8 | 64.4 | 56.9 | 47.5 | 74.4 | 56.9 | 46.9 | 38.1 | 49.4 | 36.9 | 37.5 | 35 | 54.4 | 60 | 61.3 | 56.9 | 66.9 | 53.8 | 65.6 |
| | Site context | 25 | 30% | 62.7 | 57.7 | 45.2 | 27.7 | 37.7 | 25.2 | 62.7 | 42.7 | 42.7 | 50.2 | 32.7 | 15.2 | 20.2 | 20.2 | 25.2 | 25.2 | 35.2 | 37.7 | 62.7 | 42.7 | 55.2 |
| | Species habitat index | 20 | 40% | 50 | 50 | 50 | 30 | 30 | 20 | 50 | 30 | 30 | 50 | 36.7 | 30 | 30 | 33.3 | 23.3 | 23.3 | 30 | 36.7 | 40 | 43.3 | 43.3 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 6.5 | 5.9 | 4.8 | 4.0 | 4.0 | 3.0 | 6.1 | 4.2 | 3.9 | 4.7 | 3.9 | 2.8 | 2.9 | 3.0 | 3.3 | 3.5 | 4.1 | 4.3 | 5.5 | 4.6 | 5.4 |
| | **Total/10 (rounded)** | | | **7** | **6** | **5** | **4** | **4** | **3** | **6** | **4** | **4** | **5** | **4** | **3** | **3** | **3** | **3** | **3** | **4** | **4** | **5** | **5** | **5** |
| **Yakka Skink** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 10 | 5 | 5 | 5 | 2 | 10 | 5 | 5 | 5 | 5 | 0 | 2 | 2 | 2 | 2 | 2 | 5 | 10 | 2 | 10 |
| | Connectivity | 5 | 13% | 5 | 5 | 5 | 0 | 2 | 0 | 5 | 4 | 4 | 5 | 2 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 5 | 5 | 2 |
| | Context | 5 | 13% | 4 | 2 | 2 | 0 | 2 | 2 | 4 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 4 | 4 | 4 |
| | Absence of threats | 25 | 50% | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 |
| | Weighted site context subtotal (/100) | | 100% | 62.4 | 57.4 | 44.9 | 27.4 | 37.4 | 24.9 | 62.4 | 42.4 | 42.4 | 49.9 | 32.4 | 14.9 | 19.9 | 19.9 | 24.9 | 24.9 | 34.9 | 37.4 | 62.4 | 42.4 | 54.9 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 4 | 4 | 3 | 2 | 2 | 1 | 4 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 4 | 4 | 3 | 2 | 2 | 1 | 4 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 4 | 4 | 2 | 2 | 1 | 4 | 2 | 2 | 3 | 4 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 4 | 4 | 4 |
| | Role of the site population in regard to the overall species population | 5 | 50% | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | Weighted species habitat index subtotal (/100) | | 100% | 70 | 70 | 63.3 | 50 | 50 | 40 | 70 | 50 | 50 | 60 | 63.3 | 50 | 50 | 53.3 | 43.3 | 43.3 | 56.7 | 56.7 | 63.3 | 60 | 63.3 |
| **Habitat quality score** | Site condition | 80 | 30% | 88.1 | 73.1 | 48.8 | 64.4 | 56.9 | 47.5 | 74.4 | 56.9 | 46.9 | 38.1 | 49.4 | 36.9 | 37.5 | 35 | 54.4 | 60 | 61.3 | 56.9 | 66.9 | 53.8 | 65.6 |
| | Site context | 25 | 30% | 62.4 | 57.4 | 44.9 | 27.4 | 37.4 | 24.9 | 62.4 | 42.4 | 42.4 | 49.9 | 32.4 | 14.9 | 19.9 | 19.9 | 24.9 | 24.9 | 34.9 | 37.4 | 62.4 | 42.4 | 54.9 |
| | Species habitat index | 20 | 40% | 70 | 70 | 63.3 | 50 | 50 | 40 | 70 | 50 | 50 | 60 | 63.3 | 50 | 50 | 53.3 | 43.3 | 43.3 | 56.7 | 56.7 | 63.3 | 60 | 63.3 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 7.3 | 6.7 | 5.3 | 4.8 | 4.8 | 3.8 | 6.9 | 5.0 | 4.7 | 5.0 | 5.0 | 3.6 | 3.7 | 3.8 | 4.1 | 4.3 | 5.2 | 5.1 | 6.4 | 5.3 | 6.2 |
| | **Total/10 (rounded)** | | | **7** | **7** | **5** | **5** | **5** | **4** | **7** | **5** | **5** | **5** | **5** | **4** | **4** | **4** | **4** | **4** | **5** | **5** | **6** | **5** | **6** |
| **Koala** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 10 | 5 | 5 | 5 | 2 | 10 | 5 | 5 | 5 | 5 | 0 | 2 | 2 | 2 | 2 | 2 | 5 | 10 | 2 | 10 |
| | Connectivity | 5 | 13% | 5 | 5 | 5 | 0 | 2 | 0 | 5 | 4 | 4 | 5 | 2 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 5 | 5 | 2 |
| | Context | 5 | 13% | 4 | 2 | 2 | 0 | 2 | 2 | 4 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 4 | 4 | 4 |
| | Absence of threats | 25 | 50% | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 |



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Santos

| Site ID | | | | 914 | 916 | 918 | 920 | 922 | 924 | 940 | 984 | 989 | 1007 | 1171 | 1229 | 1232 | 1247 | 1249 | 1255 | 1278 | 1330 | 1332 | 1334 | 1336 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.3.2 | 11.3.2 | 11.3.2 | 11.3.25 | 11.3.25 | 11.3.25 | 11.3.2b | 11.3.2b | 11.3.2b | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.5 | 11.5.5 | 11.5.5 | 11.5.5 | 11.7.2 | 11.7.2 | 11.7.2 |
| **Attributes** | | **Max. score** | **Weighting** | rem* | rem* | rem* | reg* | reg* | reg* | rem* | reg* | rem* | rem* | reg* | reg* | reg* | reg* | reg* | reg* | rem* | rem* | reg* | reg* | rem* |
| | Weighted site context subtotal (/100) | | 100% | 63.9 | 58.9 | 46.4 | 28.9 | 38.9 | 26.4 | 63.9 | 43.9 | 43.9 | 51.4 | 33.9 | 16.4 | 21.4 | 21.4 | 26.4 | 26.4 | 36.4 | 38.9 | 63.9 | 43.9 | 56.4 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 4 | 4 | 1 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 4 |
| | Quality as shelter, breeding habitat | 5 | 17% | 4 | 4 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 |
| | Quality as mobility habitat | 5 | 17% | 3 | 3 | 4 | 3 | 3 | 1 | 4 | 2 | 4 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 4 | 4 | 4 |
| | Role of the site population in regard to the overall species population | 5 | 50% | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Weighted species habitat index subtotal (/100) | | 100% | 76.67 | 76.67 | 66.67 | 63.33 | 63.33 | 50 | 66.67 | 63.33 | 73.33 | 60 | 60 | 60 | 60 | 70 | 70 | 70 | 60 | 60 | 66.67 | 70 | 76.67 |
| **Habitat quality score** | Site condition | 80 | 30% | 88.13 | 73.13 | 48.75 | 64.38 | 56.88 | 47.5 | 74.38 | 56.88 | 46.88 | 38.13 | 49.38 | 36.88 | 37.5 | 35 | 54.38 | 60 | 61.25 | 56.88 | 66.88 | 53.75 | 65.63 |
| | Site context | 25 | 30% | 63.9 | 58.9 | 46.4 | 28.9 | 38.9 | 26.4 | 63.9 | 43.9 | 43.9 | 51.4 | 33.9 | 16.4 | 21.4 | 21.4 | 26.4 | 26.4 | 36.4 | 38.9 | 63.9 | 43.9 | 56.4 |
| | Species habitat index | 20 | 40% | 76.67 | 76.67 | 66.67 | 63.33 | 63.33 | 50 | 66.67 | 63.33 | 73.33 | 60 | 60 | 60 | 60 | 70 | 70 | 70 | 60 | 60 | 66.67 | 70 | 76.67 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 7.63 | 7.03 | 5.52 | 5.33 | 5.41 | 4.22 | 6.81 | 5.56 | 5.66 | 5.09 | 4.90 | 4.00 | 4.17 | 4.49 | 5.22 | 5.39 | 5.33 | 5.27 | 6.59 | 5.73 | 6.73 |
| | **Total/10 (rounded)** | | | **8** | **7** | **6** | **5** | **5** | **4** | **7** | **6** | **6** | **5** | **5** | **4** | **4** | **4** | **5** | **5** | **5** | **5** | **7** | **6** | **7** |
| **South-eastern Long-eared Bat** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 10 | 5 | 5 | 5 | 2 | 10 | 5 | 5 | 5 | 5 | 0 | 2 | 2 | 2 | 2 | 2 | 5 | 10 | 2 | 10 |
| | Connectivity | 5 | 13% | 5 | 5 | 5 | 0 | 2 | 0 | 5 | 4 | 4 | 5 | 2 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 5 | 5 | 2 |
| | Context | 5 | 13% | 4 | 2 | 2 | 0 | 2 | 2 | 4 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 4 | 4 | 4 |
| | Absence of threats | 25 | 50% | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| | Weighted site context subtotal (/100) | | 100% | 63.5 | 58.5 | 46 | 28.5 | 38.5 | 26 | 63.5 | 43.5 | 43.5 | 51 | 33.5 | 16 | 21 | 21 | 26 | 26 | 36 | 38.5 | 63.5 | 43.5 | 56 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 4 | 4 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 4 | 3 | 3 | 4 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| | Quality as mobility habitat | 5 | 17% | 3 | 3 | 4 | 4 | 4 | 2 | 4 | 4 | 3 | 4 | 4 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 4 | 4 | 4 |
| | Role of the site population in regard to the overall species population | 5 | 50% | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Weighted species habitat index subtotal (/100) | | 100% | 43.33 | 43.33 | 40 | 40 | 40 | 23.33 | 43.33 | 36.67 | 33.33 | 43.33 | 43.33 | 30 | 36.67 | 33.33 | 36.67 | 36.67 | 40 | 33.33 | 40 | 46.67 | 43.33 |
| **Habitat quality score** | Site condition | 80 | 30% | 88.13 | 73.13 | 48.75 | 64.38 | 56.88 | 47.5 | 74.38 | 56.88 | 46.88 | 38.13 | 49.38 | 36.88 | 37.5 | 35 | 54.38 | 60 | 61.25 | 56.88 | 66.88 | 53.75 | 65.63 |
| | Site context | 25 | 30% | 63.5 | 58.5 | 46 | 28.5 | 38.5 | 26 | 63.5 | 43.5 | 43.5 | 51 | 33.5 | 16 | 21 | 21 | 26 | 26 | 36 | 38.5 | 63.5 | 43.5 | 56 |
| | Species habitat index | 20 | 40% | 43.33 | 43.33 | 40 | 40 | 40 | 23.33 | 43.33 | 36.67 | 33.33 | 43.33 | 43.33 | 30 | 36.67 | 33.33 | 36.67 | 36.67 | 40 | 33.33 | 40 | 46.67 | 43.33 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 6.28 | 5.68 | 4.44 | 4.39 | 4.46 | 3.14 | 5.87 | 4.48 | 4.04 | 4.41 | 4.22 | 2.79 | 3.22 | 3.01 | 3.88 | 4.05 | 4.52 | 4.19 | 5.51 | 4.78 | 5.38 |
| | **Total/10 (rounded)** | | | **6** | **6** | **4** | **4** | **4** | **3** | **6** | **4** | **4** | **4** | **4** | **3** | **3** | **3** | **4** | **4** | **5** | **4** | **6** | **5** | **5** |
| **Brigalow TEC** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 50% | 10 | 10 | 5 | 5 | 5 | 2 | 10 | 5 | 5 | 5 | 5 | 0 | 2 | 2 | 2 | 2 | 2 | 5 | 10 | 2 | 10 |
| | Connectivity | 5 | 25% | 5 | 5 | 5 | 0 | 2 | 0 | 5 | 4 | 4 | 5 | 2 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 5 | 5 | 2 |
| | Context | 5 | 25% | 4 | 2 | 2 | 0 | 2 | 2 | 4 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 4 | 4 | 4 |
| | Weighted site context subtotal (/100) | | 100% | 95 | 85 | 60 | 25 | 45 | 20 | 95 | 55 | 55 | 70 | 35 | 0 | 10 | 10 | 20 | 20 | 40 | 45 | 95 | 55 | 80 |
| | Site condition | | 60% | 88.13 | 73.13 | 48.75 | 64.38 | 56.88 | 47.50 | 74.38 | 56.88 | 46.88 | 38.13 | 49.38 | 36.88 | 37.5 | 35 | 54.38 | 60 | 61.25 | 56.88 | 66.88 | 53.75 | 65.63 |



UNCONTROLLED IF PRINTED

Santos

| Site ID | | | | 914 | 916 | 918 | 920 | 922 | 924 | 940 | 984 | 989 | 1007 | 1171 | 1229 | 1232 | 1247 | 1249 | 1255 | 1278 | 1330 | 1332 | 1334 | 1336 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.3.2 | 11.3.2 | 11.3.2 | 11.3.25 | 11.3.25 | 11.3.25 | 11.3.2b | 11.3.2b | 11.3.2b | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.1 | 11.5.5 | 11.5.5 | 11.5.5 | 11.5.5 | 11.7.2 | 11.7.2 | 11.7.2 |
| Attributes | | Max. score | Weighting | rem* | rem* | rem* | reg* | reg* | reg* | rem* | reg* | rem* | rem* | reg* | reg* | reg* | reg* | reg* | reg* | rem* | rem* | reg* | reg* | rem* |
| Habitat quality score | Site context | | 40% | 95 | 85 | 60 | 25 | 45 | 20 | 95 | 55 | 55 | 70 | 35 | 0 | 10 | 10 | 20 | 20 | 40 | 45 | 95 | 55 | 80 |
| | Final weighted habitat quality score (/10) | | 100% | 9.09 | 7.79 | 5.33 | 4.86 | 5.21 | 3.65 | 8.26 | 5.61 | 5.01 | 5.09 | 4.36 | 2.21 | 2.65 | 2.5 | 4.06 | 4.4 | 5.28 | 5.21 | 7.81 | 5.43 | 7.14 |
| | **Total/10 (rounded)** | | | **9** | **8** | **5** | **5** | **5** | **4** | **8** | **6** | **5** | **5** | **4** | **2** | **3** | **3** | **4** | **4** | **5** | **5** | **8** | **5** | **7** |

*rem = remnant vegetation; reg = regrowth vegetation.

**Table F2: Impact area habitat quality scores for sites within Roma East (Stage 5 – sites 1338 to 1819)**

| Site ID | | | | 1338 | 1340 | 1342 | 1344 | 1348 | 1350 | 1353 | 1355 | 1357 | 1359 | 1361 | 1363 | 1366 | 1368 | 1370 | 1372 | 1374 | 1376 | 1394 | 1396 | 1819 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.7.2 | 11.7.2 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.7 | 11.7.7 | 11.7.7 | 11.7.7 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.5 | 11.9.6 | 11.9.6 | 11.9.7 |
| Attributes | | Max. score | Weighting | reg* | reg* | reg* | rem* | rem* | rem* | reg* | reg* | reg* | rem* | rem* | rem* | rem* | reg* | rem* | reg* | rem* | rem* | reg* | rem* | rem* |
| Site condition | Recruitment of woody perennial species | 5 | 6% | 5 | 0 | 5 | 3 | 5 | 3 | 3 | 5 | 5 | 3 | 5 | 3 | 5 | 3 | 0 | 3 | 5 | 3 | 5 | 5 | 5 |
| | Species richness - trees | 5 | 6% | 5 | 5 | 2.5 | 5 | 5 | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 5 | 5 | 5 |
| | Species richness - shrubs | 5 | 6% | 5 | 5 | 2.5 | 0 | 2.5 | 2.5 | 0 | 0 | 0 | 2.5 | 2.5 | 2.5 | 2.5 | 0 | 0 | 0 | 0 | 2.5 | 2.5 | 2.5 | 2.5 |
| | Species richness - grasses | 5 | 6% | 0 | 2.5 | 5 | 2.5 | 5 | 2.5 | 5 | 2.5 | 5 | 5 | 5 | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 0 | 5 | 2.5 | 2.5 | 0 |
| | Species richness - forbs | 5 | 6% | 5.00 | 5.00 | 5.00 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.5 | 2.5 | 5.00 | 2.5 | 2.5 | 2.50 | 5.00 | 2.5 | 0.00 |
| | Canopy height | 5 | 6% | 0 | 5 | 1.5 | 3 | 3 | 3 | 5 | 1.5 | 0 | 5 | 5 | 5 | 2.5 | 1.5 | 2.5 | 2.5 | 2.5 | 5 | 5 | 3 | 5 |
| | Canopy cover | 5 | 6% | 4.00 | 3.50 | 2.50 | 4.00 | 4.00 | 2.5 | 4.00 | 2.50 | 2.50 | 3.50 | 5.00 | 5.00 | 2.5 | 2.5 | 2.50 | 2.5 | 2.50 | 5.00 | 2.00 | 2.00 | 2.50 |
| | Shrub canopy cover | 5 | 6% | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 5 | 5 | 3 |
| | Native perennial grass cover | 5 | 6% | 0 | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 | 5 | 1 | 5 | 5 | 5 | 1 | 1 | 1 |
| | Organic litter cover | 5 | 6% | 3.00 | 3.00 | 5 | 3 | 5 | 5.00 | 5.00 | 5.00 | 5.00 | 3.00 | 3.00 | 5 | 5.00 | 5.00 | 5.00 | 5.00 | 5 | 5.00 | 3 | 5.00 | 3.00 |
| | Large trees | 15 | 19% | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 5 | 0.00 | 0.00 | 0.00 | 0.00 | 15.00 | 15.00 | 15 | 0 | 15.00 | 0 | 15 | 15.00 | 5.00 | 5 | 5.00 |
| | Coarse woody debris | 5 | 6% | 5 | 5 | 5 | 3 | 5 | 5 | 3 | 5 | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 5 | 5 | 5 | 5 | 5 |
| | Weed cover | 10 | 13% | 10.00 | 10.00 | 10 | 10 | 10 | 10.00 | 10.00 | 10.00 | 3.00 | 10.00 | 10.00 | 3 | 10.00 | 10.00 | 10.00 | 10.00 | 10 | 10.00 | 10 | 10.00 | 10.00 |
| | Weighted site condition subtotal (/100) | | 100% | 52.50 | 61.25 | 61.25 | 48.75 | 62.50 | 70.00 | 56.25 | 51.88 | 40.63 | 58.75 | 81.88 | 73.13 | 70.00 | 49.38 | 63.75 | 50.63 | 68.75 | 81.88 | 70.00 | 66.88 | 58.75 |
| **Collared Delma** | | | | | | | | | | | | | | | | | | | | | | | | |
| Site context | Patch size | 10 | 25% | 10 | 5 | 5 | 5 | 5 | 2 | 5 | 2 | 0 | 5 | 5 | 5 | 7 | 7 | 2 | 5 | 2 | 5 | 2 | 5 | 5 |
| | Connectivity | 5 | 13% | 5 | 2 | 2 | 5 | 2 | 0 | 2 | 0 | 0 | 4 | 0 | 0 | 5 | 5 | 0 | 2 | 0 | 2 | 2 | 4 | 4 |
| | Context | 5 | 13% | 4 | 0 | 0 | 2 | 2 | 0 | 4 | 4 | 4 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 0 | 4 | 2 |
| | Absence of threats | 25 | 50% | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 |
| | Weighted site context subtotal (/100) | | 100% | 62.17 | 32.17 | 32.17 | 44.67 | 37.17 | 19.67 | 42.17 | 29.67 | 24.67 | 47.17 | 32.17 | 32.17 | 54.67 | 54.67 | 24.67 | 37.17 | 24.67 | 42.17 | 24.67 | 47.17 | 42.17 |
| Species habitat index | Quality as foraging habitat | 5 | 17% | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |



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| Site ID | | | | 1338 | 1340 | 1342 | 1344 | 1348 | 1350 | 1353 | 1355 | 1357 | 1359 | 1361 | 1363 | 1366 | 1368 | 1370 | 1372 | 1374 | 1376 | 1394 | 1396 | 1819 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.7.2 | 11.7.2 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.7 | 11.7.7 | 11.7.7 | 11.7.7 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.5 | 11.9.6 | 11.9.6 | 11.9.7 |
| Attributes | | Max. score | Weighting | reg* | reg* | reg* | rem* | rem* | rem* | reg* | reg* | reg* | rem* | rem* | rem* | rem* | reg* | rem* | reg* | rem* | rem* | reg* | rem* | rem* |
| | Role of the site population in regard to the overall species population | 5 | 50% | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Weighted species habitat index subtotal (/100) | | 100% | 43.33 | 33.33 | 33.33 | 36.67 | 30 | 30 | 40 | 33.33 | 23.33 | 40 | 43.33 | 43.33 | 36.67 | 23.33 | 30 | 30 | 30 | 40 | 30 | 36.67 | 36.67 |
| **Habitat quality score** | Site condition | 80 | 30% | 52.5 | 61.25 | 61.25 | 48.75 | 62.5 | 70 | 56.25 | 51.88 | 40.63 | 58.75 | 81.88 | 73.13 | 70 | 49.38 | 63.75 | 50.625 | 68.75 | 81.88 | 70 | 66.88 | 58.75 |
| | Site context | 25 | 30% | 62.17 | 32.17 | 32.17 | 44.67 | 37.17 | 19.67 | 42.17 | 29.67 | 24.67 | 47.17 | 32.17 | 32.17 | 54.67 | 54.67 | 24.67 | 37.17 | 24.67 | 42.17 | 24.67 | 47.17 | 42.17 |
| | Species habitat index | 20 | 40% | 43.33 | 33.33 | 33.33 | 36.67 | 30 | 30 | 40 | 33.33 | 23.33 | 40 | 43.33 | 43.33 | 36.67 | 23.33 | 30 | 30 | 30 | 40 | 30 | 36.67 | 36.67 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 5.17 | 4.14 | 4.14 | 4.27 | 4.19 | 3.89 | 4.55 | 3.78 | 2.89 | 4.78 | 5.15 | 4.89 | 5.21 | 4.05 | 3.85 | 3.83 | 4.00 | 5.32 | 4.04 | 4.89 | 4.49 |
| | **Total/10 (rounded)** | | | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 3 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 |
| **Dunmall's Snake** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 5 | 5 | 5 | 5 | 2 | 5 | 2 | 0 | 5 | 5 | 5 | 7 | 7 | 2 | 5 | 2 | 5 | 2 | 5 | 5 |
| | Connectivity | 5 | 13% | 5 | 2 | 2 | 5 | 2 | 0 | 2 | 0 | 0 | 4 | 0 | 0 | 5 | 5 | 0 | 2 | 0 | 2 | 2 | 4 | 4 |
| | Context | 5 | 13% | 4 | 0 | 0 | 2 | 2 | 0 | 4 | 4 | 4 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 0 | 4 | 2 |
| | Absence of threats | 25 | 50% | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 |
| | Weighted site context subtotal (/100) | | 100% | 62.7 | 32.7 | 32.7 | 45.2 | 37.7 | 20.2 | 42.7 | 30.2 | 25.2 | 47.7 | 32.7 | 32.7 | 55.2 | 55.2 | 25.2 | 37.7 | 25.2 | 42.7 | 25.2 | 47.7 | 42.7 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| | Role of the site population in regard to the overall species population | 5 | 50% | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Weighted species habitat index subtotal (/100) | | 100% | 43.33 | 36.67 | 36.67 | 36.67 | 30 | 30 | 40 | 33.33 | 23.33 | 36.67 | 43.33 | 43.33 | 33.33 | 23.33 | 33.33 | 33.33 | 33.33 | 40 | 30 | 36.67 | 36.67 |
| **Habitat quality score** | Site condition | 80 | 30% | 52.5 | 61.25 | 61.25 | 48.75 | 62.5 | 70 | 56.25 | 51.88 | 40.63 | 58.75 | 81.88 | 73.13 | 70 | 49.38 | 63.75 | 50.63 | 68.75 | 81.88 | 70 | 66.88 | 58.75 |
| | Site context | 25 | 30% | 62.7 | 32.7 | 32.7 | 45.2 | 37.7 | 20.2 | 42.7 | 30.2 | 25.2 | 47.7 | 32.7 | 32.7 | 55.2 | 55.2 | 25.2 | 37.7 | 25.2 | 42.7 | 25.2 | 47.7 | 42.7 |
| | Species habitat index | 20 | 40% | 43.33 | 36.67 | 36.67 | 36.67 | 30 | 30 | 40 | 33.33 | 23.33 | 36.67 | 43.33 | 43.33 | 33.33 | 23.33 | 33.33 | 33.33 | 33.33 | 40 | 30 | 36.67 | 36.67 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 5.19 | 4.29 | 4.29 | 4.29 | 4.21 | 3.91 | 4.57 | 3.80 | 2.91 | 4.66 | 5.17 | 4.91 | 5.09 | 4.07 | 4.00 | 3.98 | 4.15 | 5.34 | 4.06 | 4.90 | 4.51 |
| | **Total/10 (rounded)** | | | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 3 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 5 |
| **Yakka Skink** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 5 | 5 | 5 | 5 | 2 | 5 | 2 | 0 | 5 | 5 | 5 | 7 | 7 | 2 | 5 | 2 | 5 | 2 | 5 | 5 |
| | Connectivity | 5 | 13% | 5 | 2 | 2 | 5 | 2 | 0 | 2 | 0 | 0 | 4 | 0 | 0 | 5 | 5 | 0 | 2 | 0 | 2 | 2 | 4 | 4 |
| | Context | 5 | 13% | 4 | 0 | 0 | 2 | 2 | 0 | 4 | 4 | 4 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 0 | 4 | 2 |
| | Absence of threats | 25 | 50% | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 | 7.43 |
| | Weighted site context subtotal (/100) | | 100% | 62.36 | 32.36 | 32.36 | 44.86 | 37.36 | 19.86 | 42.36 | 29.86 | 24.86 | 47.36 | 32.36 | 32.36 | 54.86 | 54.86 | 24.86 | 37.36 | 24.86 | 42.36 | 24.86 | 47.36 | 42.36 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 | 3 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |



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| Site ID | | | | 1338 | 1340 | 1342 | 1344 | 1348 | 1350 | 1353 | 1355 | 1357 | 1359 | 1361 | 1363 | 1366 | 1368 | 1370 | 1372 | 1374 | 1376 | 1394 | 1396 | 1819 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.7.2 | 11.7.2 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.7 | 11.7.7 | 11.7.7 | 11.7.7 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.5 | 11.9.6 | 11.9.6 | 11.9.7 |
| Attributes | | Max. score | Weighting | reg* | reg* | reg* | rem* | rem* | rem* | reg* | reg* | reg* | rem* | rem* | rem* | rem* | reg* | rem* | reg* | rem* | rem* | reg* | rem* | rem* |
| | Role of the site population in regard to the overall species population | 5 | 50% | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | Weighted species habitat index subtotal (/100) | | 100% | 63.33 | 53.33 | 53.33 | 56.67 | 50 | 50 | 60 | 53.33 | 43.33 | 60 | 63.33 | 63.33 | 56.67 | 43.33 | 46.67 | 46.67 | 46.67 | 60 | 50 | 56.67 | 56.67 |
| **Habitat quality score** | Site condition | 80 | 30% | 52.5 | 61.25 | 61.25 | 48.75 | 62.5 | 70 | 56.25 | 51.88 | 40.63 | 58.75 | 81.88 | 73.13 | 70 | 49.38 | 63.75 | 50.63 | 68.75 | 81.88 | 70 | 66.88 | 58.75 |
| | Site context | 25 | 30% | 62.36 | 32.36 | 32.36 | 44.86 | 37.36 | 19.86 | 42.36 | 29.86 | 24.86 | 47.36 | 32.36 | 32.36 | 54.86 | 54.86 | 24.86 | 37.36 | 24.86 | 42.36 | 24.86 | 47.36 | 42.36 |
| | Species habitat index | 20 | 40% | 63.33 | 53.33 | 53.33 | 56.67 | 50 | 50 | 60 | 53.33 | 43.33 | 60 | 63.33 | 63.33 | 56.67 | 43.33 | 46.67 | 46.67 | 46.67 | 60 | 50 | 56.67 | 56.67 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 5.98 | 4.94 | 4.94 | 5.07 | 5.00 | 4.70 | 5.36 | 4.59 | 3.70 | 5.58 | 5.96 | 5.70 | 6.01 | 4.86 | 4.52 | 4.51 | 4.67 | 6.13 | 4.85 | 5.69 | 5.30 |
| | **Total/10 (rounded)** | | | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 6 | 5 | 6 | 5 |
| **Koala** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 5 | 5 | 5 | 5 | 2 | 5 | 2 | 0 | 5 | 5 | 5 | 7 | 7 | 2 | 5 | 2 | 5 | 2 | 5 | 5 |
| | Connectivity | 5 | 13% | 5 | 2 | 2 | 5 | 2 | 0 | 2 | 0 | 0 | 4 | 0 | 0 | 5 | 5 | 0 | 2 | 0 | 2 | 2 | 4 | 4 |
| | Context | 5 | 13% | 4 | 0 | 0 | 2 | 2 | 0 | 4 | 4 | 4 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 0 | 4 | 2 |
| | Absence of threats | 25 | 50% | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 |
| | Weighted site context subtotal (/100) | | 100% | 63.9 | 33.9 | 33.9 | 46.4 | 38.9 | 21.4 | 43.9 | 31.4 | 26.4 | 48.9 | 33.9 | 33.9 | 56.4 | 56.4 | 26.4 | 38.9 | 26.4 | 43.9 | 26.4 | 48.9 | 43.9 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 3 | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 |
| | Role of the site population in regard to the overall species population | 5 | 50% | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Weighted species habitat index subtotal (/100) | | 100% | 70 | 60 | 60 | 56.67 | 66.67 | 66.67 | 63.33 | 56.67 | 53.33 | 63.33 | 73.33 | 73.33 | 60 | 53.33 | 66.67 | 66.67 | 66.67 | 70 | 60 | 63.33 | 66.67 |
| **Habitat quality score** | Site condition | 80 | 30% | 52.5 | 61.25 | 61.25 | 48.75 | 62.5 | 70 | 56.25 | 51.875 | 40.63 | 58.75 | 81.88 | 73.13 | 70 | 49.38 | 63.75 | 50.63 | 68.75 | 81.88 | 70 | 66.88 | 58.75 |
| | Site context | 25 | 30% | 63.9 | 33.9 | 33.9 | 46.4 | 38.9 | 21.4 | 43.9 | 31.4 | 26.4 | 48.9 | 33.9 | 33.9 | 56.4 | 56.4 | 26.4 | 38.9 | 26.4 | 43.9 | 26.4 | 48.9 | 43.9 |
| | Species habitat index | 20 | 40% | 70 | 60 | 60 | 56.67 | 66.67 | 66.67 | 63.33 | 56.67 | 53.33 | 63.33 | 73.33 | 73.33 | 60 | 53.33 | 66.67 | 66.67 | 66.67 | 70 | 60 | 63.33 | 66.67 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 6.29 | 5.25 | 5.25 | 5.12 | 5.71 | 5.41 | 5.54 | 4.76 | 4.14 | 5.76 | 6.41 | 6.14 | 6.19 | 5.31 | 5.37 | 5.35 | 5.52 | 6.57 | 5.29 | 6.01 | 5.75 |
| | **Total/10 (rounded)** | | | 6 | 5 | 5 | 5 | 6 | 5 | 6 | 5 | 4 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 6 | 7 | 5 | 6 | 6 |
| **South-eastern Long-eared Bat** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 25% | 10 | 5 | 5 | 5 | 5 | 2 | 5 | 2 | 0 | 5 | 5 | 5 | 7 | 7 | 2 | 5 | 2 | 5 | 2 | 5 | 5 |
| | Connectivity | 5 | 13% | 5 | 2 | 2 | 5 | 2 | 0 | 2 | 0 | 0 | 4 | 0 | 0 | 5 | 5 | 0 | 2 | 0 | 2 | 2 | 4 | 4 |
| | Context | 5 | 13% | 4 | 0 | 0 | 2 | 2 | 0 | 4 | 4 | 4 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 0 | 4 | 2 |
| | Absence of threats | 25 | 50% | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| | Weighted site context subtotal (/100) | | 100% | 63.5 | 33.5 | 33.5 | 46 | 38.5 | 21 | 43.5 | 31 | 26 | 48.5 | 33.5 | 33.5 | 56 | 56 | 26 | 38.5 | 26 | 43.5 | 26 | 48.5 | 43.5 |
| **Species habitat index** | Quality as foraging habitat | 5 | 17% | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 2 | 2 | 3 | 4 | 4 | 3 | 2 | 2 | 2 | 2 | 4 | 3 | 4 | 3 |
| | Quality as shelter, breeding habitat | 5 | 17% | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | Quality as mobility habitat | 5 | 17% | 4 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 |



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Santos

| Site ID | | | | 1338 | 1340 | 1342 | 1344 | 1348 | 1350 | 1353 | 1355 | 1357 | 1359 | 1361 | 1363 | 1366 | 1368 | 1370 | 1372 | 1374 | 1376 | 1394 | 1396 | 1819 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RE | | | | 11.7.2 | 11.7.2 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.6 | 11.7.7 | 11.7.7 | 11.7.7 | 11.7.7 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.10 | 11.9.5 | 11.9.6 | 11.9.6 | 11.9.7 |
| Attributes | | Max. score | Weighting | reg* | reg* | reg* | rem* | rem* | rem* | reg* | reg* | reg* | rem* | rem* | rem* | rem* | reg* | rem* | reg* | rem* | rem* | reg* | rem* | rem* |
| | Role of the site population in regard to the overall species population | 5 | 50% | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Weighted species habitat index subtotal (/100) | | 100% | 40 | 33.33 | 33.33 | 36.67 | 40 | 40 | 40 | 33.33 | 26.67 | 40 | 46.67 | 46.67 | 36.67 | 30 | 33.33 | 33.33 | 33.33 | 43.33 | 36.67 | 43.33 | 36.67 |
| **Habitat quality score** | Site condition | 80 | 30% | 52.5 | 61.25 | 61.25 | 48.75 | 62.5 | 70 | 56.25 | 51.88 | 40.63 | 58.75 | 81.88 | 73.13 | 70 | 49.375 | 63.75 | 50.63 | 68.75 | 81.88 | 70 | 66.88 | 58.75 |
| | Site context | 25 | 30% | 63.5 | 33.5 | 33.5 | 46 | 38.5 | 21 | 43.5 | 31 | 26 | 48.5 | 33.5 | 33.5 | 56 | 56 | 26 | 38.5 | 26 | 43.5 | 26 | 48.5 | 43.5 |
| | Species habitat index | 20 | 40% | 40 | 33.33 | 33.33 | 36.67 | 40 | 40 | 40 | 33.33 | 26.67 | 40 | 46.67 | 46.67 | 36.67 | 30 | 33.33 | 33.33 | 33.33 | 43.33 | 36.67 | 43.33 | 36.67 |
| | Final weighted habitat quality score (/10) | 10 | 100% | 5.08 | 4.18 | 4.18 | 4.31 | 4.63 | 4.33 | 4.59 | 3.82 | 3.07 | 4.82 | 5.33 | 5.07 | 5.25 | 4.36 | 4.03 | 4.01 | 4.18 | 5.49 | 4.35 | 5.19 | 4.53 |
| | **Total/10 (rounded)** | | | 5 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 3 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 5 |
| **Brigalow TEC** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Site context** | Patch size | 10 | 50% | 10 | 5 | 5 | 5 | 5 | 2 | 5 | 2 | 0 | 5 | 5 | 5 | 7 | 7 | 2 | 5 | 2 | 5 | 2 | 5 | 5 |
| | Connectivity | 5 | 25% | 5 | 2 | 2 | 5 | 2 | 0 | 2 | 0 | 0 | 4 | 0 | 0 | 5 | 5 | 0 | 2 | 0 | 2 | 2 | 4 | 4 |
| | Context | 5 | 25% | 4 | 0 | 0 | 2 | 2 | 0 | 4 | 4 | 4 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 0 | 4 | 2 |
| | Weighted site context subtotal (/100) | | 100% | 95 | 35 | 35 | 60 | 45 | 10 | 55 | 30 | 20 | 65 | 35 | 35 | 80 | 80 | 20 | 45 | 20 | 55 | 20 | 65 | 55 |
| **Habitat quality score** | Site condition | | 60% | 52.5 | 61.25 | 61.25 | 48.75 | 62.5 | 70 | 56.25 | 51.88 | 40.63 | 58.75 | 81.88 | 73.13 | 70 | 49.38 | 63.75 | 50.63 | 68.75 | 81.88 | 70 | 66.88 | 58.75 |
| | Site context | | 40% | 95 | 35 | 35 | 60 | 45 | 10 | 55 | 30 | 20 | 65 | 35 | 35 | 80 | 80 | 20 | 45 | 20 | 55 | 20 | 65 | 55 |
| | Final weighted habitat quality score (/10) | | 100% | 6.95 | 5.08 | 5.08 | 5.33 | 5.55 | 4.6 | 5.58 | 4.31 | 3.24 | 6.13 | 6.31 | 5.79 | 7.4 | 6.16 | 4.63 | 4.84 | 4.93 | 7.11 | 5 | 6.61 | 5.73 |
| | **Total/10 (rounded)** | | | 7 | 5 | 5 | 5 | 6 | 5 | 6 | 4 | 3 | 6 | 6 | 6 | 7 | 6 | 5 | 5 | 5 | 7 | 5 | 7 | 6 |

*rem = remnant vegetation; reg = regrowth vegetation.



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**Table F3: Final area-weighted habitat quality score contribution for each MNES per RE (Stage 5)**

| RE | Area (ha) | South-eastern Long-eared Bat | Koala | Collared Delma | Yakka Skink | Dunmall's Snake | Brigalow TEC |
|---|---|---|---|---|---|---|---|
| 11.3.2 | 5.3 | 0.2 | 6.7 | 0.2 | 0.3 | 0.2 | 0 |
| 11.3.25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.3.2b | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.5.1 | 69.4 | 1.7 | 0 | 1.7 | 2.1 | 1.7 | 0 |
| 11.5.5 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.7.2 | 20.9 | 0.7 | 0 | 0.7 | 0.9 | 0.7 | 0 |
| 11.7.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.7.7 | 2.9 | 0.1 | 0 | 0.1 | 0 | 0.1 | 0 |
| 11.9.10 | 25.5 | 0.8 | 0 | 0.8 | 0.9 | 0.8 | 0 |
| 11.9.5 | 6.1 | 0.2 | 0 | 0.2 | 0.3 | 0.2 | 7.1 |
| 11.9.6 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.9.7 | 12.7 | 0.4 | 0 | 0.4 | 0.5 | 0.4 | 0 |
| Final weighted habitat quality score | | 4.2 | 6.7 | 4.1 | 4.9 | 4.1 | 7.1 |
| **Final rounded habitat quality score** | | **4** | **7** | **4** | **5** | **4** | **7** |



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