Proposed Industrial Development – North Maclean

Greater Glider Hollow Monitoring and Maintenance Plan

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Approval for Issue

Name	Position	Date
Wayne Moffitt	**Director**	**24 April 2024**

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Acronyms, Abbreviations & Definitions

Amendably Suitable Hollows – means existing branch and trunk hollows where (i) the hollow opening too small but expanding into a larger chamber; (ii) hollow opening too large but could be reduced to an acceptable size by attaching a face plate with a smaller entrance; or (iii) chamber depth too shallow but could be expanded using a chainsaw or 'Hollow Hog" drilling technique, or (iv) chamber depth too deep but which could be reduced.

Approval Holder – Maclean Estates Pty Ltd.

CCH – Chainsaw Cut Hollows.

Climbing Arborist – Minimum AQF Level 3 arboriculture qualification with suitable tree climbing qualification.

Commencement of the Action – means the date on which the first instance of any on-site Clearing, Construction or other physical activity associated with the Action is undertaken, but does not include minor physical disturbance necessary to:

a) Undertake pre-clearance surveys or monitoring programs.

b) Install signage and/or temporary fencing to prevent unapproved use of the Action area, so long as the signage and/or temporary fencing is located where it does not Harm any Protected Matter.

c) Protect environmental and property assets from fire, weeds, and feral animals, including use of existing surface access tracks.

d) Install temporary site facilities for persons undertaking pre-commencement activities so long as these facilities are located where they do not Harm any Protected Matter.

DCCEEW – Department of Climate Change, Energy, the Environment and Water (Commonwealth).

DESI – Department of Environment Science and Innovation (Queensland).

Ecological Context – means the ability for fauna to survive and persist on account of suitable forage and shelter habitat to facilitate ongoing occupation or movement through an area.

EPBC Act – *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

GGAH Annual Report – Annual report outlining the results of annual abundance monitoring, hollow condition assessments and occupancy assessments. The report will consider non-conformances, and corrective actions arising from the monitoring and will also track both, and any measures undertaken from previous monitoring.

GGAH Baseline Report – Report outlining details of trees and GGAH installed for the Greater Glider denning habitat offset conditions of EPBC Approval 2022/09304. The report will be completed by a SQE at the completion of installation of GGAH. The Report will be prepared and submitted to DCCEEW upon installation GGAH.

Greater Glider – refers to the EPBC Act listed threatened species *Petauroides volans*.

Greater Glider artificial hollows (GGAH) – means amendably suitable branch hollows, existing suitable branch hollows and amendably suitable branch hollows being provided with ecological context, amendably suitable trunk hollows, and new branch and canopy trunk hollows as described in the final Preliminary Documentation dated 17 November 2023.

Greater Glider Expert Technical Note – Technical Note to be prepared prior to confirmatory inspection of 66 proposed GGAH, and final selection of 34 Amendably suitable hollows in consideration of the GGAH strategy to be provided to the **Suitably Qualified Consulting Arborist** to refines desired hollow attributes and hollow orientation for all new trunk, new branch, amended trunk and amended branch hollows.

Greater Glider Expert Technical Paper – Technical Paper (**Attachment 2**) prepared in consideration of the GGAH strategy as encapsulated by this GGHMMP and provision of guidance to the Arboricultural Technical Advice (**Attachment 3**), which fully refines desired hollow attributes and hollow orientation for use by the **Suitably Qualified Consulting Arborist** when undertaking pre-works investigations, to verify continued adequacy of trees previously selected for development of GGAH by CCH and HHH methodologies.

Greater Glider habitat – means any area that provides habitat suitable for the Greater Glider as described in Department of Climate Change, Energy, the Environment and Water (2022). *Conservation Advice for Petauroides volans (greater glider (southern and central)). Canberra: Department of Climate Change, Energy, the Environment and Water. In effect under the EPBC Act from 05-Jul-2022*. At the date of this approval decision this plan can be accessed at: https://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-05072022.pdf. Greater Glider habitat occupies the entire Action area.

HHH – Hollow Hog Hollows.

Minister – means the Australian Government Minister administering the EPBC Act, including any delegate thereof.

Naturally occurring suitable hollows – naturally formed hollows with the following characteristics:

- live tree
- if hollow is a branch entrance may be formed by live or dead tissue
- potential den opening of 80-350 mm diameter
- minimum wall thickness around the hollow void of 50 mm
- hollow void of 0.5 m – 5.0 m
- greater than 6m above natural ground.

New branch and trunk hollows – artificial hollows developed by CCH or HHH techniques with the following features as described in the final Preliminary Documentation dated 17 November 2023 (**Appendix N.2**):

- minimum branch or trunk diameter of 375 mm
- den opening of 130 mm diameter
- 200 mm x 200 mm hollow void in cross section
- minimum wall thickness around the hollow void of 50 mm
- hollow void of 0.5 m – 2.0 m.
- branch hollows >6 m above natural ground, trunk hollows .10 m above natural ground.

Offset Rehabilitation Plan – means Attachment 3 to the Draft Offset Area Management Plan V.3.0. published as an attachment to the 2022/09304 Proposed Industrial Development at North Maclean Preliminary Documentation on 17 November 2023.

Offset Management Plan – means the Draft Offset Area Management Plan V.3, and all associated attachments, written by M. Barnett published as an attachment to the 2022/09304 Proposed Industrial Development at North Maclean Preliminary Documentation on 17 November 2023, or a subsequent version currently approved by the Minister. The Offset Management Plan is to be in effect until Year 20.

Offset Provider – Cherish the Environment Limited.

PD Report – Preliminary Documentation Report, version 7.0 dated 17 November 2023.

Proposed Action – As described by the PD Report version 7.0 dated 17 November 2023, submitted to DCCEEW.

Provision of Ecological Context – Means reinstatement of ecological context (connectivity) through the rehabilitation (Ecological Restoration) of the eastern grassy open woodland areas (category X) of the Offset Site to achieve habitat capably of supporting great glider foraging, shelter and movement.

Regional Ecosystem (RE) –vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil (Sattler and Williams 1999, *Vegetation Management Act 1999*).

Spotter Catcher – Suitably qualified person in possession of a Rehabilitation Permit issued under the *Nature Conservation Act 1992,* and a minimum of 5 years' experience handling wildlife.

Suitably Qualified Consulting Arborist – means an AQF Level 8 Arborist with minimum 5 years consulting experience.

Suitably Qualified Ecologist – means a person who has professional qualifications and

- at least three (3) years of work experience assessing the condition and quality of Regional Ecosystems and the habitat of protected matters
- has implemented and reported on management plans for the habitat of protected matters, and can demonstrate the implementation of those plans achieved the required environmental quality for protected matters
- can give authoritative assessment, advice and analysis on whether the condition and quality of Regional Ecosystems and the habitat of protected matters meets requirements of these conditions using the relevant protocols, standards, methods and/or literature.

Voluntary Declaration (**VDec**) – means the enduring protection mechanism to provide ongoing conservation protection, inscribed on the title of the land, under the Vegetation Management Act 1999 (Qld).

1. Background and Purpose of this Report

1.1 Purpose

Maclean Estates Pty Ltd (**Approval Holder**) has been granted an approval under Section 133(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) to construct an industrial development at North Maclean, Southeast Queensland (**Proposed Action**). The Proposed Action was assessed under EPBC Act referral number 2022/09304.

The Preliminary Documentation report (**PD Report**) supporting the Proposed Action described how the Approval Holder would mitigate potential hollow loss for the Greater Glider (*Petauroides volans*) at the North Maclean development site by constructing artificial hollows for this species at the Rosewood Offset Site (**Offset Site**). For context the bounds of the Offset Site are shown by **Figure 1**.

The Department of Climate Change, Energy, the Environment and Water (**DCCEEW**) accepted the proposed mitigation and included a requirement to prepare a *Greater Glider hollow monitoring and maintenance plan* as condition 23 of its condition package (**Attachment 1**). The condition required the plan to be approved by the **Minister** before the Proposed Action commences. This **Greater Glider Habitat Management and Monitoring Plan** (**GGHMMP**) addresses the requirements of Condition 23 in accordance with commitments made in the **Offset Management Plan**[1] (**OMP**) Action 6: Development of Artificial Greater Glider Denning Habitat (Table 11).

Condition 22 of approval mandated all monitoring to be undertaken as described in the Offset Management Plan utilising a combination of assessment methods, and with sufficient intensity for the life of the offset (20 years from the **Commencement of the Action**) to demonstrate presence / absence and abundance. As the requirements of both Conditions are enmeshed, this Report has been prepared in consideration of the additional requirements contained in Condition 22 in accordance with commitments made in the Offset Management Plan, Action 6: Development of Artificial Greater Glider Denning Habitat (Table 11).

1.2 Reference table for approval conditions response

Table 1 provides the key approval conditions issued by the Department on 16 February 2024, and where the response to the condition is contained within this GGHMMP.

Table 1: Reference Table for Information Request Response

Requested Information	Response Section
22. The approval holder must undertake Greater Glider monitoring as described in the Offset Management Plan and also monitor:	
a) using a combination of methods described in the Greater Glider listing on the SPRAT database.	**Section 4.1 and 4.2**
b) with sufficient intensity and duration to sufficiently demonstrate presence/absence and abundance of the Greater Glider within the Rosewood Offset Site.	**Sections 4.4-4.5**
23. The approval holder must submit a Greater Glider Hollow Monitoring and Maintenance Plan for the Rosewood Offset Site prepared by a Suitably Qualified Ecologist to the department for the Minister's approval. The approval holder must not commence the Action unless the Minister has approved the Greater Glider	

[1] means the Draft Offset Area Management Plan V.3, and all associated attachments, written by M. Barnett published as an attachment to the 2022/09304 Proposed Industrial Development at North Maclean Preliminary Documentation on 17 November 2023, or a subsequent version currently approved by the Minister. The Offset Management Plan is to be in effect until Year 20.

Requested Information		Response Section
Hollow Monitoring and Maintenance Plan in writing. The Greater Glider Hollow Monitoring and Maintenance Plan must include:		
a)	Details of methods for inspecting the condition of all Greater Glider artificial hollows, conducted at least once every 12 months to check if they remain suitable for use by Greater Gliders.	**Section 4.2.1**
b)	Details of the methods that will be implemented to monitor utilisation of hollows, including existing hollows and all Greater Glider artificial hollows, by target, competitor and pest species every 3 months for the first 12 months immediately following the installation of the Greater Glider artificial hollows and, thereafter, at least once annually for the duration of the Offset Management Plan.	**Section 4.2.2**
c)	Clear commitments that, and details of how, the approval holder will promptly report the findings of inspections and monitoring to the Department.	**Sections 4.4** and **4.5**
d)	Specified triggers for corrective measures, details of the corrective measures that will be implemented if triggers are detected and the timelines for their completion.	**Sections 3.3.4** and **4.6**
e)	Justification that the proposed inspection and monitoring methods, timing and effort provide the greatest likelihood of detecting damage to Greater Glider artificial hollows, utilisation of hollows by target, competitor and pest species and the occurrence of any specified triggers	**Sections 4.1 – 4.5** and **Section 5**
f)	The approval holder must implement the Greater Glider Hollow Monitoring and Maintenance Plan as approved by the Minister for the duration of the Offset Management Plan	**Section 6**

2. Objectives

2.1 Background

During May 2023, the Greater Glider Expert undertook and assessment of foraging habitat, presence and abundance of Greater Glider at both the Impact and the Offset Sites. The report outlining the findings of that assessment also undertook a literature review and provided guidance on architecture of **Naturally Occurring Suitable Hollows** for Greater Glider (**Attachment 2**). The purpose of that analysis was to facilitate further **Climbing Arborist** assessment of denning habitat presence and suitability on the Offset Site. Naturally Occurring Suitable Hollows are described as:

- live tree
- potential den opening of 80-350 mm diameter (mean of 181 mm)
- minimum wall thickness around the hollow void of 50 mm
- hollow void of 0.5 m – 5.0 m
- if hollow is a branch, the entrance may be formed by live or dead tissue
- greater than 6 m above ground level.

Dead trees (stags) and branches with an absence of live cambrium tissue around the chamber are specifically excluded due to their limited thermal qualities not being suitable for Greater Glider. Trees containing potential hollows (identified by tree survey undertaken early 2023) were inspected by climbing arborists 29 August - 7 September 2023. Hollow data were collected in line with the attributes for determining suitability of hollows[2][3]. Data were post processed and analysed in accordance with the preferred architecture (see above) to determine the number of Naturally Occurring Suitable Hollows, Amendably Suitable Hollows, and unsuitable hollows.

To achieve the required thermal qualities and maintain some structural integrity to support the regrowth, the branches or trunk must be a minimum of 375 mm in diameter to achieve the internal void requirements. For overall tree health to be maintained, it is recommended that foliage loss to create the branch end hollow must not exceed 30% of the total crown foliage. This is to ensure the tree has sufficient photosynthetic material remaining to generate carbohydrates (energy) for continuing cell function and a sufficient to supply of energy for the active defence of decay, secondary thickening (cell division from the cambium) and foliage regeneration around the hollow.

Baseline assessments of natural Greater Glider hollows identified the presence of 143 Naturally Occurring Suitable Hollows with 88 naturally occurring hollows with **Ecological Context**[4] occurring within an area of regrowth open forest vegetation in western portions of the site (~40% of the site area) and 55 naturally occurring hollows without Ecological Context occurring within an area of pastural grassy open woodland in eastern portions of the site (~60% of the site area).

The PD Report, **OMP** and the **Offset Rehabilitation Plan** (**ORP**), reference the areas of 'with Ecological Context' and 'without Ecological Context' with a number of descriptors relevant to these documents. To avoid confusion, the relationships between descriptors is outlined as **Table 2**.

[2] where hollows could not be inspected for safety reasons, data was estimated from a safe vantage point io the canopy of the tree.

[3] data collected included, tree species, diameter at breast height, height of tree, type of hollow (branch / trunk), height of hollow above ground, orientation of the opening, health status of the chamber and opening, hollow diameter, hollow depth and wall thickness.

[4] Ecological Context means the ability for fauna to survive and persist on account of suitable forage and shelter habitat to facilitate ongoing occupation or movement through an area.

Table 2: Equivalencies of Descriptors Used in the Report[5]

Ecological Context	PD Report	Offset Management Plan	Offset Rehabilitation Plan	Area (ha)	Naturally Occurring Suitable Hollows
Area with existing ecological context	Category C (High Value Regrowth)	Assessment Units AU 1-4	Management Unit (MU) 1	45.58 (40.2% of site area)	88 (68 branch, 20 trunk)
Area without ecological context	Category X (Non-remnant)	Assessment Unit AU 5	Management Unit (MU) 2	67.60 (59.8% of site area)	55 (28 branch, 27 trunk)
Total					143 (96 branch, 47 trunk

Areas with and without Ecological Context are identified in **Figure 2**. The OMP described two strategic commitments to achieve a lasting habitat gain for Greater Glider, one relating to denning habitat, and a second, reinstatement of foraging habitat through ecological restoration to reinstate Ecological Context and achieve a lasting habitat gain for Greater Glider. The location of Naturally Occurring Suitable Hollows is shown in **Figure 3**.

2.2 Provision of Ecological Context through Restoration

Rehabilitation of the eastern portion of the site presently considered non-remnant vegetation (refer **Table 2**) through ecological restoration of Regional Ecosystem 12.3.3 Queensland Blue Gum (*Eucalyptus tereticornis*) woodland on alluvium (a recognised regional ecosystem occupied by Greater Glider), will provide both foraging habitat and bring Ecological Context to 55 existing Naturally Occurring Suitable Hollows presently unusable by Greater Glider on account of their isolation. Reinstatement of Ecological Context is not expected until at least until vegetation matures in the final quarter of the 20-year offset period.

2.3 Provision of Artificial Denning Habitat

The Greater Glider Artificial Hollow (**GGAH**) strategy identified by the OMP commits the Approval Holder to the installation of 100 new branch and trunk hollows or amendments to presently unsuitable branch and trunk hollows.

These are additional to the provision of Ecological Context to 28 naturally occurring suitable branch (and 27 naturally occurring suitable trunk hollows) without Ecological Context occurring in the eastern portion of the Offset Site.

The OMP identifies seven (7) overarching establishment criteria ('checklist') to optimise the effectiveness of GGAH. To a very significant extent these checklist items have been resolved through actions already undertaken to refine the Approval Holders obligations with respect to GGAH deployment. The seven 'checklist' criteria outlined in the OMP and a response to where and how they have been / are being addressed is contained in **Table 3**.

[5] Approval notice of 14 February 2024, Part C - Definitions **Greater Glider Artificial Hollows** (reproduced in Definitions Section) does not require existing trunk hollows to be monitored, however they will be assessed by this GGHMMP.

Table 3: 'Checklist' for Establishment of GGAH (OMP Section 8.10)

Establishment criteria	Where, how and when addressed
1) Mimic Natural Characteristics: Ensure that the artificial hollows closely mimic the characteristics of natural tree hollows. This includes size, shape, entrance dimensions, and internal features. The goal is to make them as appealing and suitable for the greater glider as possible.	During May 2023, the Greater Glider Expert undertook a literature review to provide guidance on architecture of Naturally Occurring Suitable Hollows for Greater Glider (see **Attachment 2**). During August 2023, climbing arborists undertook in canopy assessments of all hollows and collected data on branch and trunk hollow dimensions to determine the presence of suitable hollows. This assessment also identified that there were a number of hollow present that were not presently suitable, but which could be modified by either modifying the hollow entrance or chamber depth so that hollows were suitable with respect to the attributes identified by the Greater Glider Expert. This assessment identified that there were a total of 48 amendably suitable branch / trunk hollow. During September of 2023, the Suitably Qualified Consulting Arborist undertook an assessment of trees on the offset site to determine the adequacy of trees to support the development of GGAH by Chainsaw Cut Hollow and Hollow Hog Hollow (**Attachment 3**) methodologies. The assessment considered the suitability of trees to host artificially developed (ie. naturalistic hollows) of the dimensions identified by the Greater Glider Expert and ensure their long-term viability based on arboricultural principles. That report (**Attachment 3**) identified the potential development of 66 new branch and trunk hollows.
2) Use Suitable Materials: If other materials are to be used, choose materials that are durable, weather-resistant, and safe for wildlife. The artificial hollows should withstand environmental conditions and provide a secure and stable habitat.	No artificial denning boxes will be deployed. All hollows will be developed by modifications to the wood of existing live trees. If any other than that sourced from trees selected to host GGAH is used, it will be raw (untreated) hardwood. No plyboard or chemically pressure treated timber will be used.
3) Install in Suitable Locations: Identify and select appropriate locations for artificial hollow installation. Consider factors such as tree species, height, and proximity to preferred foraging areas. Place the hollows where gliders are likely to find and use them.	In preparing the Arboricultural Technical Paper on GGAH construction, deployment and location, the Suitably Qualified Consulting Arborist prepared the in consultation with advice from the Greater Glider Expert and discussion with a Suitably Qualified Ecologist to identify suitability of habitat, tree species, height and hollow architecture. Predominantly, hollow development has been proposed for the western parts of the site where there presently is ecological context with that area affording foraging and denning habitat opportunities. Additionally, hollow GGAH development is identified for areas in the east of the offset site where relict mature and overmature trees (mainly *Eucalyptus tereticornis* (Queensland blue gum), do not have ecological context on account of an absence of foraging habitat. This area will be progressive restored ecologically so that context will be reinstated and Greater Glider will be able to utilise natural and artificial hollows in this area.

Establishment criteria	Where, how and when addressed
4) Consider Tree Species: Mimic the tree species that greater gliders prefer for nesting. Some gliders may show a preference for specific tree species, so using similar wood for the artificial hollows can enhance their attractiveness.	The purpose of selecting Chainsaw Cut Hollow and Hollow Hog Hollows and exiting natural hollows which are amendable to meet requirements of the Greater Glider, is that they are naturalistic hollows which utilise thermal regulation properties of live trees to maintain uniform temperature within hollows. Four tree species have been selected for development of GGAH: ▪ Queensland Blue Gum (*Eucalyptus tereticornis*), 88% of all hollows deployed ▪ Silver Leaved Ironbark (*Eucalyptus melanophloia*), 4% of all hollows deployed ▪ Swamp Mahogany (*Lophostemon suaveolens*), 4% of all hollows deployed ▪ Moreton Bay Ash (*Corymbia tessellaris*), 2% of all hollows deployed ▪ Narrow Leaved Ironbark (*Eucalyptus crebra*), 2% of all hollows deployed All tree species selected to host GGAH are species known to be species characterising Greater Glider habitat in Queensland (after Eyre *at al*., 2022). The significant weighting of GGAH deployment to *Eucalyptus tereticornis* (88%) results from this species forming the predominant canopy species (pre-clear RE12.3.3[6] and to a small extent 12.3.19 (formerly 12.3.3b)[7]) with the greatest number of trees of a size capable of supporting Chainsaw Cut Hollows and Hollow and Hollow Hog Hollows
5) Provide Multiple Options: Install a variety of artificial hollows in different locations and tree types to provide the greater gliders with options. This increases the chances of them finding a suitable nesting site.	100 GGAH will be deployed. A variety of GGAH types in a variety of tree species (limited by abundance and distribution of canopy species – refer Establishment criteria 4), is built into the strategy: ▪ Chainsaw Cut Hollows comprising 39% of hollows deployed ▪ Hollow and Hollow Hog Hollows comprising 27% of hollows deployed ▪ Amendably Suitable Hollows comprising 34% of hollows deployed
6) Monitor and Adapt: Implement a monitoring program to assess the effectiveness of the artificial hollows. Regularly check for occupancy, observe glider behaviour, and make adjustments based on observations and feedback from the monitoring program.	A monitoring program which assesses annually, the effectiveness of the artificial hollows is built into this GGHMMP and is described in **Section 4** of this document. Evaluation, Reporting, Maintenance and Corrective Actions and maintenance tracking are described in of this GGHMMP section.

[6] *Eucalyptus tereticornis* woodland. *Eucalyptus crebra* and *E. moluccana* are sometimes present and may be relatively abundant in places, especially on edges of plains and higher-level alluvium. Other species that may be present as scattered individuals or clumps include *Angophora subvelutina* or *A. floribunda*, *Corymbia clarksoniana*, *Corymbia intermedia*, *Corymbia tessellaris, Lophostemon suaveolens* and *Eucalyptus melanophloia*. NB. underligned species are species identified for deployment of GGAH.

[7] Open forest to woodland of *Eucalyptus moluccana* and/or *Eucalyptus tereticornis* and *Eucalyptus crebra*. NB. underligned species are species identified for deployment of GGAH.

Establishment criteria	Where, how and when addressed
7) Implement Maintenance Protocols: Establish a maintenance schedule to ensure the ongoing suitability and safety of the artificial hollows. Regular inspections can identify and address issues such as degradation, wear, or damage.	Protocols for reporting, identification of maintenance, prioritisation and tracking are described in **Sections 4.4 – 4.7** of the report.

2.3.1 New branch and trunk hollows

Two methods for the creation of new artificial denning habitat are approved; **Chainsaw Cut Hollows** (**CCH**) and **Hollow Hog Hollows** (**HHH**). Both methods are discussed further in the document *Arboriculture Impact Assessment and Artificial Hollow Construction Report* (**Attachment 3**). CCH and HHH branch hollows will be installed with reference to the parameters outlined by dot points in **Section 2.1** of this GGHMMP. CCH and with reference to the parameters outlined by dot points in **Section 2.1** of this GGHMMP with the modified height requirement of installation of at least *a minimum of 10 m above natural ground* (after Hoffman et al (2022) as cited in Appendix N.2 of the final Preliminary Documentation dated 17 November 2023 approved by the Approval Notice from the Department 14 February 2024).**Table 4** outlines the type, number and location of new hollow deployment. The number of new hollows are reflective of the initial assessment work undertaken for the Preliminary Documentation Report by Arbor Australis Consulting (**Attachment 3**).

Table 4: New branch and trunk hollows

Ecological Context	Chainsaw Cut Hollows		Hollow Hog Hollows		Total
	Branch	Trunk	Branch	Trunk	
Area with Existing Contex *HVR (AUs1-4)*	33	5	2	15	55 (35 branch / 20 trunk)
Area without Context *non-remnant (AU5)*	0	1	3	7	11 (3 branch / 8 trunk)
Total	33	6	5	22	**66** (38 branch / 28 trunk)

The location of proposed new GGAH is presented as **Figure 4**. These locations and trees were assessed by Arbor Australis Consulting and described in the document *Arboricultural Technical Advice – Artificial Hollow Creation, October 2023,* which appeared as Attachment 2, to **Appendix N.2 - Greater Glider denning habitat and offset investigations technical note** to EPBC 2022/09304 Proposed Industrial Development at North Maclean Preliminary Documentation dated 17 November 2023. The *Arboricultural Technical Advice* is attached to this GGHMMP (**Attachment 3**).

As the location of new branch hollows has been field assessed by a **Suitably Qualified Consulting Arborist** a high reliability is placed on these hollows being installed at the location identified by **Figure 4**.

2.3.2 Amendments to branch and trunk hollows

Amendably Suitable Hollows are naturally occurring hollows that can be artificially manipulated (amended) to make them suitable for Greater Glider in line with the architectural / fabric parameters of Naturally Occurring Suitable Hollows. Amendments would include[8]:

- live cambrium around chamber[9]
- hollow opening too small but expanding into a larger suitable chamber
- hollow opening too large but could be reduced to an acceptable size by attaching a face plate with a smaller entrance
- chamber depth too shallow but could be expanded using a chainsaw or 'Hollow Hog" drilling technique.

Table 5 outlines the type, number and location of Amendably Suitable Hollows. These hollows were identified through desk-top analysis ('filtering') of collected data to confirm hollows with the above characteristics. The location of amendably suitable GGAH is presented as **Figure 5**.

Table 5: Amendably suitable live branch and trunk hollows

Ecological Context	Amendments		Total
	Branch	Trunk	
Area with Existing Context *HVR (AUs 1-4)*	23	12	35
Area without Context *non-remnant (AU5)*	7	6	13
Total	30	18	**48**

The Amendably Suitable Hollows identified above *have not* been field inspected at this point and further inspection and determination of suitability by the **Suitably Qualified Consulting Arborist** and **Climbing Arborist** is necessary prior to hollow installation.

A fourth category of Amendably Suitable Hollows exist; being hollow opening is acceptable, however chamber depth is too long, but which could be shortened by installation of a 'plug'. There are a further 10 hollows in this category. These potential Amendably Suitable Hollows will be kept in reserve in the event 34 suitable hollows cannot be created from the 48 identified in **Table 4** (represented by **Figure 5**).

2.3.3 Performance against approved OMP commitments

The approval condition commits the Approval Holder deploying 100 new and amended GGAH (in addition to bringing context to hollows in locations where Greater Glider have no capacity to reach). New GGAH identified within this GGHMMP commit to establishment of 66 new branch and trunk CCH and HHH. The shortfall of 34 GGAH will be met by modifications to Amendably Suitable Hollows to make them utilisable by Greater Glider.

[8] Previous iterations of the GGHMMP and indeed the Preliminary Documentation Report and supporting material (version 7.0 dated 17 November 2023), identified an additional category of Amendably Suitable Hollows being a naturally occurring hollow where the den chamber is too long but which could be shortened through installation of a 'plug'. There are 10 such hollows across the Offset Site. The use of these hollows has now been avoided on account of the potential intervention necessary to install the baffles.

[9] Hollows with suitable dimensions but which do not have live cambrium (providing thermal regulation) surrounding the chamber were excluded.

A total of 48 Amendably Suitable Hollows (refer **Table 5**) have been identified as a pool from which to select the required 34. Inspection of **Table 5** and project data collected at the time of the suitable habitat survey (August 2023, referenced in **Table 3**) reveals that the 34 required may (subject to further assessment by the Suitably Qualified Consulting Arborist), be deployed within the Ecological Context area. This area also contains the greatest proportion of branch end hollows.

2.3.4 Monitoring, reporting and adaptive management principles

Repetitive monitoring and survey replication, annual reporting and corrective action triggers is a feature of this GGHMMP to ensure adaptive management changes are made as soon as identified and throughout the life of the offset. These measures are outlined in **Sections 4.1-4.5** correct action are outlined in **Section 4.6**, auditing and review of the GGHMMP is documented in **Section 4.8** and corrective actions are described in **Section 4.7**.

2.3.5 References

Eyre TJ, Smith GC, Venz MF, Mathieson MT, Hogan LD, Starr, C, Winter, J and McDonald, K (2022). *Guide to greater glider habitat in Queensland*. Report prepared for the Department of Agriculture, Water and the Environment, Canberra. Department of Environment and Science, Queensland Government, Brisbane.

Hoffman M, Mikac K, and Gracinim A (2022). *Greater glider (Petauroides volans) den tree and hollow characteristics*. ***Australian Mammalogy*** 45(2) 127-137.

3. Commencement and Installation – Year 1

This section of the GGHMMP specifically responds to the 'Action Timing' components of OMP Table 11 – Management Actions for development of artificial Greater Glider denning habitat (**Text Box 1**). Actions 1 through 5 are described below.

Action Timing: When and how will the action / task be implemented, started, completed?	**Year 1** 1) Greater glider expert to provide formal description of hollow attributes and orientation of entrances and development of hollow utilisation monitoring program report. 2) Consulting arborist to conduct pre-works investigations to verify continued adequacy of trees previously selected by the arborist. 3) Climbing arborist will construct chainsaw cut hollows. 4) 'Hollow Hog' arborist will inspect and excavate hollows. 5) A suitably qualified ecologist is to prepare a baseline report and monitoring and maintenance plan of constructed hollows. The report must include: a) Photos of each hollow at the time of creation, and subsequent annual reporting of Hollow structural features relevant to the host tree (location on site and tree, facing, height from ground etc.) be mapped; and b) Hollows have an ID that can be reported against for the life of the offset.

Text Box 1 – Table 11 OMP Extract

3.1 Action 1 – Greater Glider Technical Paper

The Greater Glider Expert Dr David Sharpe has already undertaken a review of attributes suitable for Greater Glider (**Attachment 2**). The content of that document was been used to assess the presence and location of Naturally Occurring Suitable Hollows and Amendably Suitable Hollows, and the architecture of suitable hollows utilised for development of CCH described by the Suitably Qualified Consulting Arborist (**Attachment 3**).

Notwithstanding, following approval of this GGHMMP by DCCEEW, the Greater Glider Expert will review the proposed GGAH strategy (as identified by this GGHMMP), the Arboricultural Technical Advice (**Attachment 3**), and prepare a highly focussed **Greater Glider Expert Technical Note** to fully refine desired hollow attributes and hollow orientation for use by the Suitably Qualified Consulting Arborist when undertaking pre-works investigations to verify continued adequacy of trees previously selected by **Attachment 3**.

3.2 Action 2 – Pre-works Verification Investigation

Following approval of this GGHMMP by DCCEEW the Suitably Qualified Consulting Arborist will, informed by the finalised Greater Glider Expert Technical Paper (viz. document arising from Action 1 above), conduct a final pre-works inspection of proposed host trees / branches to assess ongoing suitability or determine new locations, and to conduct inspections of the pool of Amendably Suitable Hollows to identify a further 34 presently unsuitable hollows to be amended. A climbing arborist shall inspect hollows to identify suitable candidates and identify methods of modification.

New hollows are preferred in this instance on account of the ease of construction, comparative with modification of existing hollows and potential complications associated with fauna resident within Amendably Suitable Hollows.

Final deployment of hollows will be prioritised in the following order until 100 hollows are deployed:

- area with context new GGAH by CCH and HHH, presently 55 in number (**Figure 4**)
- area without context new GGAH CCH and HHH, presently 11 in number (**Figure 4**)

and 34 of the most suitable hollows drawn from the following pool:

- area with context amended GGAH, presently 35 in number (**Figure 5**)
- area without context amended GGAH, presently 13 in number (**Figure 6**).

At the time of field inspection the Suitably Qualified Consulting Arborist will tag the location of all trees proposed to support GGAH and collect geospatial data. A short technical note outlining the findings of the inspection, the continued suitability or replacement locations for new CCH / HHH (n=66), suitability and methods of modification for Amendably Suitable Hollows (n=34) and their location.

The technical paper will be supplied to the Suitably Qualified Ecologist overseeing the project and will form the supporting material to the Baseline GGAH Report, which will provide details and attributes of each hollow (refer **Section 3.4**). The report will also form the basis of briefing material for the Climbing Arborist and the Hollow Hog Arborists commissioned to undertake the work.

3.3 Action 3 – Installation of Hollows

Installation of GGAH within areas of the site, presently without context will only occur *immediately prior* to the area achieving ecological context through habitat restoration. Ecological Context is considered to be achieve when canopy height and cover is sufficient to facilitate movement of Greater Gliders between trees and afford high quality foraging habitat. This is expected to occur at year 15, based upon projected foraging habitat benchmarks are achieved. (see **Section 4.3**). The nominal deployment of hollows within parts of the site with Ecological Context and Without Ecological Context, hinges around **Table 6** and final pre-installation assessment by the Suitably Qualified Consulting Arborist (as described by Action 2). 100 GGAH are conditioned by the approval. For example, if 90 GGAH hollows can be deployed in the area *with* Ecological Context, only 10 will need to be deployed in the area *without* Ecological Context.

New and amended GGAH will be installed within the area presently without ecological context immediately prior to context being realised. This will be determined by actual monitoring at year 10 of the Offset with forward projections applied to determine whether Ecological Context will be achieved (benchmark targets are being met) by Year 15. Nominally GGAH will be installed at Year 14. Without Ecological Context Greater Gliders cannot reach any Naturally Occurring Suitable Hollows or GGAH.

In addition, further support for this strategy arises in the form of, potential learnings and continual improvements to arising from installation and 13 years of prior monitoring maintenance of GGAH within the eastern part of the Offset Site and potential development of new / improved methods of artificial habitat creation, refinements of present techniques, not only from this this Offset but other offsets where Greater Glider denning habitat is offset.

3.3.1 New hollows

This applies to the area presently with Ecological Context at Year 1, and area without Ecological Context at Year 14.

Under the supervision of the Suitably Qualified Consulting Arborist, the Climbing Arborist and Hollow Hog Arborist shall construct new branch and trunk hollows broadly conforming to the methods articulated in the *Arboricultural Technical Advice*[10] (**Attachment 3**). The orientation of den openings will be in line with guidance contained within Greater Glider Expert Technical Paper (**Action 1**).

To achieve and meet new branch hollow requirements, the branch needs to be a minimum of 375 mm in diameter. This achieves 47% of retained cross-section and 66% of the outer circumference undamaged, ensuring sap flow, living branch structure, and providing opportunity for response growth. However, maintaining acceptable levels of structure at the site of hollow generation is essential to avoid failures that would compromise the habitat created. For this reason, end weight reduction or branch removal will be required to reduce load.

[10] no two hollows will be identical and the methodologies outlined in the technical report provide options for hollow creation. The climbing arborist creating the hollows will have scope for flexibility to ensure specific hollows are created in response to host tree and site conditions. The Hollowhog carving method is a recent innovation and there may be some limitation in achieving the upper range of the void lengths identified for Greater Glider, from the constructed entry point.

Felled branches will either be stockpiled at the location for later collection and use, or immediately deployed as coarse woody debris throughout the area of ecological restoration.

GGAH will be installed in Category C (High Value Regrowth) areas of the site, those with existing Ecological Context, at Year 1.

GGAH within Category X (non-remnant areas of the site, those without Ecological Context, and comprising isolated paddock trees which Greater Glider cannot reach, will be constructed at Year 14 ahead of the anticipated achievement of Ecological Context.

The completion criteria identify that achievement of Ecological Context through habitat restoration is not anticipated until year 15 of the offset when tree canopy height and cover, and foraging quality benchmarks are achieved. This is identified in the habitat completion targets for year 15, contained in **Attachment 5**.

During the construction of the hollow, photographs will be captured by the arborist to demonstrate the progression of the construction techniques

3.3.2 Amended hollows

This applies to the area presently with Ecological Context at Year 1, and area without Ecological Context at Year 14.

Existing hollows not presently considered to be suitable for Greater Glider, may provide habitat for other species and therefore occupancy will need to be established at the time of the proposed installation. Owing to the temporal and spatial variability of species utilisation, this determination best occurs at the time of the proposed installation.

Owing to possible interference with animal breeding place provisions of the *Nature Conservation Act 1992* (Qld), avoidance of occupied hollows is preferred. Modification of hollows may be postponed until evident occupation of hollows for breeding has ceased, or animals may be relocated. For this reason hollows must be inspected by a suitably qualified and experienced spotter catcher prior to work commencing.

Hollows will be amended by CCH or HHH as identified by the Pre-works Verification Investigation (**Action 2**).

During amendments to hollows, photographs will be captured by the arborist to demonstrate the progression of the construction techniques

3.3.3 Timber felled to accommodate hollows

This applies to the area presently with Ecological Context at Year 1, and area without Ecological Context at Year 14.

Timber (branches) felled in the establishment of branch hollows will be collected and stockpiled for reuse onsite as Coarse Woody Debris (CWD), in accordance with ***Action 7: Distributing Coarse Woody Debris*** of the OMP.

3.3.4 Artificial hollow details to be recorded

This applies to the area presently with Ecological Context at Year 1, and area without Ecological Context at Year 14 for:

- 55 GGAH developed by CCH and HHH methodologies within the ecological context area
- 34 Amendably Suitable Hollows within the ecological context area
- 11 GGAH developed by CCH and HHH methodologies within the area without ecological context.

Baseline Data will be collected by the Suitably Qualified Consulting Arborist and / or the Suitably Qualified Ecologist. The following hollow specific details shall be recorded at the time of hollow installation / modification:

- Hollow number – each GGAH shall be assigned a unique identifying number from 1 to 100.
- Host tree details – Species and tree number assigned from tree survey undertaken for the PD Report (as referenced by final Preliminary Documentation dated 17 November 2023, Figures 53-55, and maintained by 28 South as part of the project geospatial database).

- GPS coordinates of the hollow.
- Hollow details – location (branch with side entrance or end entrance; trunk), artificial hollow status (new or amended), if new the construction method (CCH or HHH) and if amended, the methods of modification.
- Photo-point monitoring establishment - photo points must record 1). the overall position in the host tree, 2). Photograph of the exposed chamber prior to installation of face plate (CCH prepared hollows only), 3). the hollow with entrance and architecture clearly visible in the photographs, 4). Interior of chamber photographed with Snake Eye Camera or similar.

A semi-quantitative, scaled condition rating will be developed following installation and retrospectively applied to all hollows within the post GGAH installation. Its purpose is to form a baseline condition for each hollow monitoring and auditing throughout the life of the offset (years 1-20), and to provide for corrective action triggers and planning.

Therefore, conditions within the GGAH pool shall be comparatively assessed and graded 1 (best) to 5 (unusable). It is not anticipated the deployment of GGAH would result in the establishment of hollows of marginal or dubious benefit to Greater Glider. Rather, classes 4 and 5 are expected to come into play in later years as hollow condition further deteriorates and / or are damaged by tree/limb failure, lightning strike, further deterioration of (amended) natural hollows from normal (natural) pathogenic processes, bushfire etc.

As natural hollows develop from wounding and pathogenic decay (bacterial and fungal) arises from increased moisture ingress into the trees heartwood, continued deterioration is expected because these decay processes are already in train. CCH / HHH methodologies bypass the pathogenesis component of hollows and are therefore (on a balance of probability) are likely to last longer. This is not to suggest that pathogenic decay processes present in natural hollows would not establish in CCH / HHH, rather hollow establishment has bypassed the decay component pathway driving hollow evolution would take longer to establish and take hold (decay progresses relatively slowly as fugal hyphae exude enzymes that break down cellulose and lignin), to a point they were influencing hollow architecture.

In the interest of developing an initial grading, the following condition classes (**Table 6**) would apply.

Table 6: Nominal GGAH condition classes and corrective actions

Features and parameters	Corrective actions
Class 1 - Utility and design parameters mostly intact	
Hollow remains in condition mostly similar to its condition at installation; without defects; hollow entrance diameter measured by calliper mostly unchanged, no water ingress (if end cut hollow), face plate with structural integrity and intact.	None required.
Class 2 - Limited / insignificant impairment of utility	
Live tissue growth / thickening around entrance of hollow. Hollow otherwise structurally sound and within normal hollow design parameters.	Measurement of opening diameter. If diameter is less than 100 mm, intervention is required. Hole saw to be used to redevelop hole to installation diameter.
Class 3 - Moderate impairment of utility	
Face plate fixing screws missing or loosened.	Intervention (maintenance) required; replace screws by drilling new pilot holes and installation of fixing screws.
Face plate warped and or splitting.	Intervention (maintenance) required; replace plate with new timber sourced from a trunk / branch of similar diameter tree.

Features and parameters	Corrective actions
Water ingress into end entrance hollow makes hollow unusable.	Intervention (maintenance) required; install entrance plate with greater overhang to the entrance with new green cut hard-wood timber from on-site trees. Drill pilot holes and install fixing screws
Foliage regeneration around hollow.	Remove foliage.
Modified natural hollows – branch splitting allowing weather ingress / continued live tissue die-back.	Consult Suitably Qualified Consulting Arborist, repair damage if possible otherwise commence planning for replacement GGAH.
Class 4 - Compromised utility (>75% reduction)	
Branch or tree hollow damaged by storm damage.	Consult Suitably Qualified Consulting Arborist, repair damage if possible, commence planning for replacement GGAH.
Tree struck by lightning.	GGAH replacement hollow/s to be developed in live trees
Tree health suffering and does not appear to be recovering post installation (wounding by CCH/HHH). Continued suitability of use in short term.	Consult Suitably Qualified Consulting Arborist, commence planning for replacement GGAH.
Branch containing hollow at imminent risk of failure as a result of biotic agents / abiotic factors.	Consult Suitably Qualified Consulting Arborist, commence planning for replacement GGAH.
Class 5 - Unusable	
Tree dead (variety of causes). Loss of thermal modulation attributes. Undesirable / unusable by Greater Glider.	GGAH replacement hollow/s to be developed in live trees

3.4 Action 4 – GGAH Baseline Report

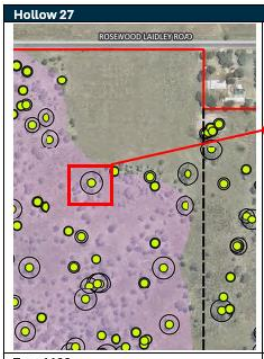
This applies to the area presently with Ecological Context at Year 1, and area without Ecological Context at Year 14.

Data capture will be led by the Suitably Qualified Ecologist, supported by the Suitably Qualified Consulting Arborist, Climbing Arborist and Drone Operator as follows: Condition 23(a) requires details on the methods for monitoring the condition of the hollows. The Approval Holder intends to establish this baseline (or reference) condition through in tree photography by climbing arborist (of the hollow chamber *before* the face plate is attached), and by drone (of the context of the hollow, branch and tree from a height which clearly shows the hollow entrance.

The Approval Holder intends to establish this baseline (or reference) condition through preparation of a GGAH Baseline Report. The GGAH Baseline Report will be prepared by the Suitably Qualified Ecologist for the purposes of auditing occupancy, continued utility of GGAH throughout the life of the offset, and for identifying corrective actions should GGAH become unusable. The Baseline report will be supplied to the Department within one month of the final GGAH being installed. The GGAH Baseline Report will provide a full summary of activities undertaken prior to and during GGAH installation (Arboricultural and Greater Glider technical papers will be appended) and will provide a pictorial reference providing baseline conditions for interior architecture and exterior of each GGAH.

In addition to a pictorial reference of the architecture and construction / modification of hollows by the Suitably Qualified Consulting Arborist and Climbing Arborist, a high-quality -quality drone-mounted camera will photograph all new and amended GGAH including a 1m radius around the entry point of hollows. Photography will be captured in light conditions that allow tree characteristics to be clearly seen (e.g., between 9 am and 3 pm, and under full sun conditions). **Text Box 2** provides a sample layout of hollow data for each GGAH may be presented. Data presented is the minimum requirement.

Hollow 27



Tree 1196
- located in HVR
- Constructed 14/6/2024
- Overmature tree, health is good
- Lindenmeyer class 3

- *Eucalyptus tereticornis*
- 890mm DBH
- 31 m height

- Branch hollow hollow
- Hollow hog construction
- Entrance facing south east
- Condition Class: 1
- Opening: 130mm
- 8 m above ground level
- GDA2020 lat/long:
  - -27.65375, 152.54847

- Interior architecture
- Chamber depth: 0.7m
- Chamber diameter: 250mm
- Chamber interior tree mud and detritis

Text Box 2 – Sample baseline GGAH reporting format

4. Monitoring and Maintenance Years 1-20

The monitoring and maintenance component of the GGHMMP details actions to be undertaken for the remainder of the offset (years 2-20). It comprises of five components:

1. Annual monitoring of the presence and absence of the Greater Glider within the offset area generally.

2. Annual monitoring of condition of all 100 CCH, HHH and Amendably Suitable Hollows and corrective actions if hollow condition has deteriorated and action triggers are met.

3. Annual monitoring of utilisation of all 100 CCH, HHH and Amendably Suitable hollows (ie the GGAH), for occupancy by Greater Glider, competitor species and pest species and occupancy exceeds corrective action triggers for pests and competitors.

4. Annual sample monitoring of the utilisation of 143 Naturally Occurring Suitable Hollows by Greater Glider, competitor species and pest species.

5. Monitoring of foraging habitat regeneration / restoration at years 5, 10, 15 and 20.

4.1 Presence / Absence of Greater Glider within Offset

This section deals with the area-based analysis of presence utilising established survey techniques. This assessment is complimentary to the denning habitat occupation and hollow condition assessments. It applies to the area presently with Ecological Context from Year 1, and area without Ecological Context at Year 15.

The hollow investigations completed in 2023 involved close examination of each naturally occurring, potentially suitable Greater Glider hollow, including measuring the internal dimensions of the hollows in a way that is anticipated to have displaced any Greater Glider occupying the hollow[11]. This, combined with a lack of spotlighting observations suggests that Greater Glider does not presently use the Offset Site.

Notwithstanding, establishment of presence on the site is an important component in establishing that the offset was successful for the protected matter.

Concurrent to the monitoring of hollows, assessments of the broader area of the Offset Site will be undertaken through spotlighting searches along pre-set, (timed) line transects of nominal duration and standardised length (refer Review of Methods **Section 4.1.1**). The Abundance measures (distance sampling and spatial capture – recapture) will be utilised to gauge site abundance. Ground-based spotlighting survey may be supplemented with drone survey and a pilot of this approach will be conducted to validate the application.

4.1.1 Review of methods

The *Conservation Advice for Petauroides volans (greater glider (southern and central)* (DCCEEW, 2022) conducts a situational review of studies, methods and results detecting Greater Glider presence in Queensland, New South Wales and Victoria. There is a paucity in the standardisation of sample technique, either timed or distance related. Some standardised transect lengths (in New South Wales and Victoria) are described, but there is no readily identifiable standard technique established which would allow a reliable comparative presence / abundance assessment between years at the Offset Site.

The method implemented will be an adaptation of spotlighting standards for Queensland described in Eyre et al (2022), Australia's threatened Mammals described by DSEWPAC (2004) and will involve the adoption of a standardise survey method developed and described by DELWP (2019). These are approved pre-logging survey techniques considered adequate to detect presence of Greater Glider in Victorian forestry coupes.

[11] Note: several Common brushtail possums evacuated hollows when these measurements were undertaken.

For spotlighting, the requirement to cover a total distance of as close to 1 km as possible per transect was targeted at a pace of 10 minutes per 100m, as outlined within DELWP (2020, 2022)[12].

In Queensland both animal ethics approval under the *Animal Care and Protection Act 2001* and scientific purposes under the *Nature Conservation Act 1992* is needed for research, survey and/or monitoring involving vertebrates where activities such as trapping, census leading to disturbance of animals (such as spotlighting or call play-back), abnormal interruption of behaviour or marking/tagging are involved. Ecologists will oversee all assessment work, will be suitably qualified and experienced, and will be able to demonstrate necessary permits to undertake the work.

4.1.2 Monitoring to be undertaken

The western portion of the site (denoted by Category C (HVR) vegetation) retains Ecological Context and Greater Gliders, though presently not believed to be present, do have the potential to reach that part of the Offset Site. The eastern portion of the site (denoted by Category X (non-remnant) vegetation) comprises grassy open woodland, does not have Ecological Context and Greater Gliders presently cannot reach and disperse into this area.

Ecological restoration of the site will result in the eastern portions of the site gaining Ecological Context though this is unlikely to occur until the vegetation in this area achieves sufficient height to disperse into and through the area from the west. It is anticipated that this would occur ca. year 15 of the offset. Refer also to **Section 4.3**.

4.1.2.1 Area with Ecological Context

Abundance assessments will occur annually from year two and occur until year 20. The width of the Offset Site is approximately 1 km (between Laidley Rosewood Road) and the southern site boundary. The area of existing Ecological Context (HVR) is approximately 600 m from the western boundary. Six transects ca.100 m apart, the first paralleling and 50 m into the offset site from the western boundary, will be established for annual walked spotlighting campaigns (refer **Figure 6**). Two ecologists walking travelling at a pace of 10 minutes per 100m will survey two transects per night, one either side of the direction of travel over a three-night period. All animals encountered or heard from vocalisations will be recorded.

As the location of Naturally Occurring Suitable Hollows and GGAH are known, stag watching will be conducted thirty minutes either side of sunset and randomly selected potential denning hollow to determine whether Glider Glider (and other fauna) emerge. This approach meets DSEWPAC (2011) guidelines.

4.1.2.2 Area without Ecological Context

Transect spotlighting assessments within the area without Ecological Context will commence in year 15 and continue until year 20. Four transects ca.100 m apart, the first paralleling and 100 m into the area without context parallelling the last transect within the area with context, will be established for annual spotlighting campaigns (refer **Figure 6**). Two personnel travelling at a pace of 10 minutes per 100m will survey two transects per night over a two night period. All animals encountered or heard from vocalisations will be recorded.

4.1.2.3 Seasonal and Climatic Considerations

Weather conditions are also known to influence the success of spotlight surveys as extreme temperatures (both hot and cold), rainfall or wind can reduce animal activity and also make it more difficult for an observer to see fauna (DSEWPAC 2011, Eyre et al 2022). Spotlighting if coinciding with such conditions shall result in the postponement of the survey. Spotlighting shall avoid one week either side of full moon (to account for possible behavioural changes) and be conducted at different times of the year across a range of seasons (where possible).

[12] DELWP 2022 report as number of Greater Glider individuals per spotlight kilometre.

4.1.3 Novel survey methods to be trialled

There is conjecture regarding the effectiveness of spotlighting in assessing Greater Glider presence (eg. Lindenmeyer et al 2002), and so supplementary methods are also proposed.

Concurrent to the traversed spotlighting searches, thermal drone imaging along a similar transect route will be undertaken at the time of spotlighting. Although proposed as an initial complimentary survey method, should the technique prove more effective and reliable than walked transects, approval to continue with thermal drone survey may be sought from the Minister.

Initial trials with the drone will take the form of a scouting role ahead of the field ecologists, with ecologists called over to verify any potential findings, trailing assessments sweeping the area behind the survey to determine whether any animals were overlooked and the drone independently surveying along transects not scheduled for ecologist traverse (ie. both techniques applied to the two sets of two transects on alternate nights). The potential for the drone to 'spook' Greater Gliders and other animals will also be assessed.

Camera trapping at a subset of GGAH is also proposed annually to bolster reliability of results. This is effectively an automated version of 'stagwatching' with the camera's able to be deployed over extended periods (several nights to weeks in duration). This is discussed below in **Section 4.2.2.3**.

Survey dogs are becoming increasingly used to assist with survey for mammals. They are especially useful for surveying large areas / habitats with low densities of animals in a cost-effective manner. The dogs are trained to detect scats of the target animal. Survey dogs have been used reliably to detect Koala's for a number of years and dogs are now being trained to detect Greater Glider.

Whilst detection dog assessment is good for detecting presence / absence, aggregations of scats at a tree containing hollows may be indicative of hollow utilisation. If detected, trees would be subjected to stagwatching or camera trapping. Greater Glider detection dogs will be used every 5 years from years.

4.1.4 Data collection

Data will be collected on standardised field data forms. All species encountered; observed (by field ecologists or drone) or heard (field ecologists) will be notated. Points of MNES encountered will be recorded.

4.1.5 References

Department of Climate Change, Environment, Energy and Water (DCCEEW) (2022). *Conservation Advice for Petauroides volans (greater glider (southern and central)), In effect under the Environment Protection and Biodiversity Conservation Act 1999 from 5 July 2022*. Australian Government.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011). *Survey Guidelines for Australia's threatened mammals*. Guidelines for detecting mammals listed as threatened under the Environmental Protection and Biodiversity Conservation Act 1999.

Department of Environment, Land, Water and Planning (DELWP) (2019). *Approved Survey Standards: Greater Glider Petauroides volans (Version 1)*. Victorian Government.

Department of Environment, Land, Water and Planning (DELWP) (2020). *Forest Protection Survey Program. Survey Guidelines – Spotlighting and Call Playback (V4.1)*. Victorian Government.

Department of Environment, Land, Water and Planning (DELWP) (2022). *Guidance Note – Reporting detections of Southern Greater Gliders. Conservation Regulator*. Victorian Government.

Eyre TJ, Ferguson DJ, Smith GC, Mathieson MT, Venz MF, Hogan, LD, Hourigan CL, Kelly, AL & Rowland, J. (2022). *Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland, Version 4.0*. Brisbane: Department of Environment and Science, Queensland Government.

Lindenmayer, DB, Cunningham, RB, Donnelly, CF, Incoll, RD, Pope, ML, Tibolet, CR, Viggers, KL and Welsh, AH (2001). How effective is spotlighting for detecting the greater glider (Petauroides volans). Wildlife Research 28: 105-109.

4.2 Monitoring Hollow Condition and Utilisation

This section details the requirements of Condition 23(a). This applies to the area presently with Ecological Context from Year 2, and area without Ecological Context from Year 15.

Data capture will be led by the Suitably Qualified Ecologist, supported by the Suitably Qualified Consulting Arborist, Climbing Arborist and Drone Operator to satisfy Condition 23(a) which requires details on the methods for monitoring the condition of the hollows. The Approval Holder intends to undertake annual assessment of external condition of each GGAH by drone, and utilisation (occupation) and internal condition of each GGAH by climbing arborist.

4.2.1 Monitoring of condition

Condition monitoring of the 100 CCH, HHH and Amendably Suitable Hollows (GGAH) is dependent upon the data collected and detailed in the GGAH Baseline Report. Inspections will monitor all GGAH annually and report against GGAH condition classes, and other in field attributes to determine whether deterioration of habitat features has occurred. The Approval Holder will re-inspect the hollows using a high-quality drone-mounted camera on an annual basis. Inspections will be undertaken annually for the duration of the OMP. Tabulated hollow attribute data contained within the GGAH Baseline Report will be added to on an annual basis to produce a rolling condition status with trends in condition changes graphed and reported against such that long term changes may be tracked.

The use of this method is also considered a safety measure to identify active European Honeybee hives, should they have established, so that the climbing arborist undertaking hollow occupation assessments is not unduly exposed.

Results of the drone assessment will inform corrective actions for damage / loss of individual GGAH, relocation / destruction of European Honeybees, more detailed condition assessments by the climbing arborist if suspected structural damage is detected but it cannot be readily assessed by the drone.

4.2.2 Monitoring of hollow utilisation

This applies to the area presently with Ecological Context at Year 1, and area without Ecological Context from Year 15.

This section responds to the requirements of Condition 23(b) and details the monitoring program to be deployed to assess hollow utilisation by Greater Glider, native competitor species and pests, and in relation to competitors and pests, the risks posed to Greater Glider and corrective measures proposed.

Condition (assessed against GGHMMP Baseline), utilisation and uptake of hollows by competitor and pest species will be monitored annually and managed. Results indicating loss or deterioration of hollows to unrecoverable status, utilisation of the hollows by European Honeybee (*Apis mellifera*), or occupancy by native fauna will result measures to repair / replace hollows, remove / eradicate feral pests, and relocate native arboreal mammals.

Annual monitoring is necessary to ensure hollows do not become inundated with pest species or become unattainable/unusable if the hollows need maintenance and thereby reduce the time hollows are potentially unavailable to Greater Glider.

The Suitably Qualified Ecologist will oversee the Monitoring and Maintenance of hollows on behalf of the Approval Holder. The Suitably Qualified Ecologist will enlist assistance as necessary to address non-conformances:

- Drone Operator[13]
- Suitably Qualified Consulting Arborist
- Climbing Arborist
- Suitably qualified and experienced spotter catcher
- Hollow Hog Arborist
- Offset Provider.

4.2.2.1 Monitoring

The condition requires monitoring of the 143 existing hollows (**Figure 3**) and the 66 proposed constructed hollows (**Figure 4**) and 34 of the Amendably Suitable Hollows identified on **Figure 5** for target, competitor and pest species. All new and amended GGAH (n=100) will be monitored annually (by climbing arborist supported by camera trapping, and by the results of the condition assessment undertaken by the drone) to assess condition and presence / absence of pest species or endemic species competing for hollow. Existing Naturally Occurring Suyitablke Hollows (both branch and trunk) will be sampled on a revolving basis. Refer **Section 4.4.2** for details of the schedule.

However, as the eastern (non-remnant) parts of the site would not have Ecological Context through restoration of foraging habitat until ca. year 15 (at which time Greater Glider could potentially utilise hollows) GGAH would only be installed at year 14 and monitoring of GGAH in the area without Ecological Context would only occur from year 15 through to year 20. In contrast, monitoring of Naturally Occurring Suitable Hollows in the area without Ecological Context will start at year 1.

4.2.2.2 Presence / absence and occupancy of hollows - Climbing

There is no standard method for the assessment of hollows that is identified by the Conservation Advice[14]. A Climbing Arborist will be employed to undertake annual inspections of hollows for occupation by Greater Gliders, other arboreal mammals and invertebrate pests (ie. European Honeybees). Inspections will take the form of assessing occupancy by use of a snake eye camera.

4.2.2.3 Presence / absence and occupancy of hollows – Camera trapping

There is no standard method for the assessment of hollows that is identified by the Conservation Advice[8]. Cotsell and Vernes (2016)[15] used canopy-located camera traps to determine tree hollow use by vertebrate fauna in the Coffs Harbor Local Government Area. The study area was located approximately 350 km south of the Offset Site and is a comparable ecological setting. Their study found that canopy-located camera traps can provide "a *wealth of data*" that "*can add substantially to our understanding of arboreal wildlife*." The strength of this observation suggests that canopy-located camera traps are the most appropriate means of detecting use of the natural and constructed hollows.

It is proposed that hollows are monitored for two weeks in any given year, such that all hollows identified for assessment, as identified in **Section 4.4** (Monitoring Schedule) are sampled. A reputable and tested camera system will be used,[16] and preference will be given to camera units with Bluetooth capability to ensure that photos captured can be assessed in real-time. Consideration will also be given to camera placement to ensure SD card

[13] Nominally, Ripper Corp (Jamie Holyoak). Photography and videography of arboreal mammals and hollows, shot by Ripper Corp Drones can be found here: Greater Glider Monitoring and Maintenance plan

[14] DCCEEW (2022) Conservation Advice for *Petauroides volans* (greater glider (southern and central)). Australian Government, Canberra.

[15] Cotsell N and Vernes K (2021). *Camera traps in the canopy: surveying wildlife at tree hollow entrances*. Pacific Conservation Biology.

[16] 28 South Environmental has found the Recoynx HF2X HyperFire2 system to be reliable for the detection of ground fauna and expect no limitation to its use in the tree canopy.

space is not wasted by false stimuli.[17] Cameras will be set to normal sensitivity and programmed to record three successive still images two seconds apart after each 'trigger event'. Image quality will be set at the highest resolution. Data will be downloaded and collated weekly.

4.2.2.4 Competitor and pest species

The only native competitor species identified by the Greater Glider conservation advice (DCCEEW (2022))[18] is Sulphur-crested Cockatoo (*Cacatua galerita*). This species has been observed infrequently at the Offset Site and was not identified in any of the assessed hollows. It is not considered an imminent threat to occupation of the Offset Site's hollows by Greater Glider, but vigilance will be maintained for an increase in numbers. Common Brushtail Possum (*Trichosurus vulpecula) was* encountered in several potentially suitable Greater Glider hollows, but not in numbers that would prevent colonisation by Greater Glider. Spotlighting survey also failed to record high densities of this species. Monitoring undertaken to detect the presence of Greater Glider will also detect occupation of hollows by the native competitor species.

The European Honeybee (*Apis mellifera*) is an invasive species that displaces endemic wildlife from tree hollows[19]. The threat the European Honeybee poses is more formally recognised in NSW, where "*Competition from feral honeybees'* is recognised as a key threatening process under the *Biodiversity Conservation Act 2016* [20]. The threat to conservation-significant species such as Greater Gliders arises from the bees' colonial occupation (and aggressive exclusion) of native species that would otherwise occupy the tree hollows. However, other studies (Saunders *et al*. 2021)[21] suggest that permanent displacement of fauna by European Honeybee may be *rare* and occupancy of tree hollows *typically low.* Further, multi-year studies showed that most colonies occupied tree cavities only temporarily because *wild colonies generally only survive a few years and swarm frequently*.

Saunders *et al.* (2021) note that further that studies documenting nest-site characteristics of wild honeybee colonies suggest that they may prefer large internal cavities – often in large old trees with small or narrow nest entrances that are mostly too constricted for most birds and mammals to enter. These two factors suggest that the artificial hollows proposed for construction would be unsuitable for colonisation by European Honeybee because: (i) their small internal dimension potentially support only a small collective of bees; and (ii) the entry portal will be larger than the narrow slit or small round entrance typically preferred by the bees.

There is greater potential for European Honeybee to occupy existing (natural) hollows, particularly where they extend continuously down the branch into a trunk cavity; these hollows are presently not considered by this GGHMMP.

4.2.2.5 Target species

Assessment of site presence, and hollow use will confirm whether the site is used for foraging, or foraging and denning.

4.2.2.6 Seasonal and Climatic Considerations

Surveys will be diurnal and as Greater Gliders are nocturnal, their presence should be readily detectable. However, weather conditions are also known to influence the success detecting animals (not necessarily those denning), and extreme temperatures (both hot and cold) may result in animals retreating to the depth of the hollow for temperature regulation making detection potentially less likely. Hollow assessments therefore will not, unless necessary for

[17] Cotsell and Vernes (2021) found that considerable wasted SD card space arose from false stimuli (leaves waving in front of the camera trigger). As a result, some cards lasted less than a day and yielded no images of target fauna.

[18] DCCEEW. 2022. Conservation Advice for *Petauroides volans* (Greater glider) (southern and central). Australian Government

[19] DCCEEW. 2024. European honeybee (Apis mellifera) https://www.dcceew.gov.au/environment/invasive-species/insects-and-other-invertebrates/invasive-bees

[20] NSW Scientific Committee. 2024. Competition from feral honeybees - key threatening process listing (NSW Scientific Committee – Final Determination. NSW Government.

[21] Saunders, M.E. Goodwin, E.K. Santos, K. Sonter, C and Rader, R. 2021. *Cavity occupancy by wild honey bee: need for evidence of ecological impact*. Frontiers in Ecology and the Environment.

meeting monitoring and reporting timelines, occur during heat waves or during unseasonably cold diurnal conditions.

4.2.3 Corrective actions

4.2.3.1 Native competitor species

If monitoring detects that more than 10% of suitable Greater Glider hollows are occupied by native competitor species, an application will be made to the Queensland Department of Environment Science and Innovation for a Species Management Program issued under the *Nature Conservation Act 1992* that allows native competitor species to be captured and relocated (with opportunities for artificial hollow habitats such as nest box deployment) such that less than 5% of hollows are occupied. This level is subjective and no literature which justifies a level of tolerable co-occupancy has been detected. An occupancy target of 0% is unreasonable and is expected to result in protected native animals being dislocated from hollows annually.

4.2.3.2 European honeybees

If monitoring detects that more than 10% of suitable Greater Glider hollows are occupied by colonies of European honeybee, an appropriately qualified specialist will be engaged to remove colonies to ensure that no more than 5% of hollows are occupied.

4.2.3.3 Camera traps

If more than 30% of camera trap images arise from false stimuli, the camera trap will be redeployed for a further week.

4.2.3.4 Failure of hollows

The condition GGAH will be assessed annually against **Table 8**, which contains action triggers and corrective actions including requirements for the replacement of failed GGAH. Failure of GGAH hollows will require the construction of a new hollow. The unique identifier of the lost hollow will be retired and a new sequential number assigned to the replacement hollow. Tree hollow details of the new hollow will be recorded per **Section 3.4** of this GGHMMP.

Failure of Naturally Occurring Suitable Hollows (e.g. through storms) will not generate the requirement for the establishment of a replacement branch hollow because the loss occurs through ‘natural attrition’. The natural loss of such hollows will be compensated through the natural accrual of new hollows in regenerating vegetation elsewhereta on the offset site.

4.2.4 References

Cotsell N and Vernes K. (2021). *Camera traps in the canopy: surveying wildlife at tree hollow entrances*. Pacific Conservation Biology

Department of Climate Change, Environment, Energy and Water (DCCEEW) (2024). *European honeybee (Apis mellifera)* https://www.dcceew.gov.au/environment/invasive-species/insects-and-other-invertebrates/invasive-bees

Department of Climate Change, Environment, Energy and Water (DCCEEW) (2022). *Conservation Advice for Petauroides volans (greater glider (southern and central*)). Australian Government, Canberra.

NSW Scientific Committee (2024). *Competition from feral honeybees - key threatening process listing (NSW Scientific Committee – Final Determination*. NSW Government.

Saunders ME, Goodwin EK, Santos K, Sonter C and Rader R (2021). *Cavity occupancy by wild honeybee: need for evidence of ecological impact*. Frontiers in Ecology and the Environment.

4.3 Foraging Habitat Restoration

4.3.1 Targets and objectives

The completion of the GGAH denning habitat in the eastern part of the offset site is reliant on the foraging habitat being established and growing to sufficient advanced status that it connects the 55 Naturally Occurring Suitable Hollows (28 branch, 27 trunk) and up to 10 new / amended hollows in the east to the habitat in the west of the offset site. Ecological context therefore is dependent upon may be dependent on foraging habitat establishment and growth.

The OMP and the ORP[22] describe methods and completion targets (5, 10, 15 and 20 year) for achieving conservation gains, across the offset and in particular Ecological Context to the eastern portion of the Offset Site. There is a strong degree of overlap between the habitats that Koala and Greater Glider occupy and so the Department determined habitat completion criteria for Koala are applicable to Greater Glider. Completion Criteria (for Koala) approved in the approvals package is attached (**Attachment 5**).

4.3.2 Suitability of the ecologically restored area as Greater Glider Habitat

Four pre-clear Regional Ecosystems (**RE**) comprise the vegetation communities present at the 113.18 ha Offset Site. The offset strategy is to ecologically restore the Offset Site to pre-clear RE extent. REs and the spatial pre-clear extent they occupy on the Offset Site are:

- RE12.3.3 Queensland Blue Gum (*Eucalyptus tereticornis*) woodland. Narrow-leaved Ironbark (*Eucalyptus crebra*) and Gum-topped Box (*Eucalyptus moluccana*) are sometimes present and may be relatively abundant in places, especially on edges of plains and higher level alluvium. Other species that may be present as scattered individuals or clumps include Broad-leaved Apple (*Angophora subvelutina*) or Rough-barked Apple (*Angophora floribunda*), Clarkson's Bloodwood (*Corymbia clarksoniana*), Pink Bloodwood (*Corymbia intermedia*), Moreton Bay Ash (*Corymbia tessellaris*), Swamp Mahogany (*Lophostemon suaveolens*) and Silver-leaved Ironbark (*Eucalyptus melanophloia*). Comprises 92.3% of Offset Site.

- RE12.3.18 Swamp Tea-tree (*Melaleuca irbyana*) low open forest or thicket. Emergent Gum-topped Box (*Eucalyptus moluccana*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Queensland Blue Gum (*Eucalyptus tereticornis*) or Spotted Gum (*Corymbia citriodora* subsp. *variegata*) may be present. Comprises 1.1% of the Offset Site.

- RE12.3.19 Gum-topped Box (*Eucalyptus moluccana*) and/or Queensland Blue Gum (*Eucalyptus tereticornis*) and Narrow-leaved Ironbark (*Eucalyptus crebra*) open forest to woodland, with a sparse to mid-dense understorey of Swamp Tea-tree (*Melaleuca irbyana*) on alluvial plains. Comprises 3.6% of the Offset Site.

- RE12.9-10.7 Narrow-leaved Ironbark (*Eucalyptus crebra*) +/- Queensland Blue Gum (*Eucalyptus tereticornis*), Moreton Bay Ash (*Corymbia tessellaris*), Rusty Gum (*Angophora leiocarpa*), Silver-leaved Ironbark (*Eucalyptus melanophloia*) woodland. Occurs on Cainozoic and Mesozoic sediments. Comprises 3.0% of the Offset Site.

All dominant and sub-dominant tree species tree species within the REs (present and restored) of the Offset Area are tree species known to be species characterising Greater Glider habitat in Queensland (after Eyre *at al*., 2022, Appendix B). Eyre *et al*. (2022) compiled a list of species associated with Greater Glider use from a variety of sources (*ibid.* Table 4, p20).

Data were synthesised to identify feed tree, den trees and unspecified when Greater Glider was recorded in a tree but its use was not specified. Tree presence within the pre-clear REs identified on the Offset Site has been cross-referenced against the data collated by Eyre *et al.* (2022). **Table 7** compiles a list these species.

[22] Both the OMP and the ORP were approved by DCCEEW as attachments to the final Preliminary Documentation dated 17 November 2023 approved by the Approval Notice from the Department 14 February 2024. The approved ORP is reproduced in this GGHMMP as **Attachment 4**.

Table 7: Records of tree use of tree by Greater Gliders in Queensland (after Eyre *et al.* 2022)

Binomial name	Common name	Feed tree	Den tree	Unspecified use tree
Angophora floribunda	**Rough-barked Apple**	Yes	n/a	Yes
Angophora leiocarpa	Rusty Gum	n/a	Yes	Yes
Angophora subvelutina	Broad-leaved Apple	n/a	n/a	n/a
Corymbia citriodora subsp. *variegata*	Spotted Gum	Yes	Yes	Yes
Corymbia clarksoniana	**Clarkson's Bloodwood**	n/a	n/a	Yes
Corymbia intermedia	**Pink Bloodwood**	Yes	Yes	Yes
Corymbia tessellaris	**Moreton Bay Ash**	Yes	n/a	Yes
Eucalyptus crebra	**Narrow-leaved Ironbark**	Yes	Yes	Yes
Eucalyptus melanophloia	**Silver-leaved Ironbark**	Yes	n/a	Yes
Eucalyptus moluccana	**Gum-topped Box**	Yes	Yes	Yes
Eucalyptus tereticornis	**Qld Blue Gum**	Yes	Yes	Yes
Lophostemon suaveolens	**Swamp Mahogany**	Yes	n/a	Yes
Melaleuca quinquenervia	**Broad-leaved Tea-tree**	n/a	n/a	Yes

Notes: n/a not applicable, emboldened text denotes canopy species present in RE12.3.3

Eyre *et al.* (2022) identified six tree species as dominant or co-dominant species to the majority of Greater Glider habitat. These six species each have a broad distribution throughout the geographic range of Queensland's greater glider species. In descending order of extent, these were Spotted Gum (*Corymbia citriodora*), Gum-topped Box (*Eucalyptus moluccana*), Queensland Blue Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Pink Bloodwood (*Corymbia intermedia*) and White Mahogany (*Eucalyptus portuensis*). *Ibid,* further identified that most of these species as preferentially selected for foraging 4by greater gliders in Queensland. Five of the six species are known to be present at the Offset Site and with the exception of *Corymbia citriodora,* all will feature in Ecological Restoration.

The eastern portion of the site which presently lacks ecological context is comprised of *Eucalyptus tereticornis* dominated RE12.3.3. This area post restoration will be abundantly suitable as both forage and den habitat.

4.3.3 Offset Rehabilitation Plan

The ORP was approved by DCCEEW as attachments to the final Preliminary Documentation dated 17 November 2023 by the Approval Notice issued by the Department on 14 February 2024. The approved ORP is reproduced in this GGHMMP as **Attachment 4.** The approved plan outlines the management units and the planting schedules for Ecological Restoration within the Offset Site. Canopy and subcanopy species prescribed in the planting palettes for infill planting within the parts of the Offset Site presently *with* and *without* ecological context and their status as Greater Glider habitat tree species are identified as **Table 8**.

Table 8: Greater Glider status of canopy and subcanopy trees species used in Ecological Restoration planting palettes

Binomial name	REs and Management Units – Ecological Restoration					Already present onsite	Greater Glider Species
	12.3.3 AU5 67.6ha	12.3.3 AU4 36.9ha	12.3.18 AU3 1.2	12.3.19 AU2 4.1ha	12.9-10.7 AU1 3.4ha		
Angophora leiocarpa	✓	✓	n/a	✓	✓	✓	✓
Corymbia c. variegata	n/a	n/a	n/a	n/a	✓	✓	✓
Corymbia intermedia	✓	n/a	n/a	✓	n/a	✓	✓
Corymbia tessellaris	n/a	n/a	n/a	✓	✓	✓	✓
Eucalyptus crebra	✓	✓	✓	✓	✓	✓	✓
Eucalyptus melanophloia	n/a	n/a	n/a	n/a	n/a	✓	✓
Eucalyptus tereticornis	✓	✓	✓	✓	✓	✓	✓
Lophostemon suaveolens	✓	✓	n/a	n/a	n/a	✓	✓
Melaleuca quinquenervia	✓	n/a	n/a	n/a	n/a	n/a	✓

Notes: present on site – (✓); not applicable – (n/a); refer to Tables 1-5 of Attachment 4 for details of planting density and dominance.

4.3.4 Functional achievement of Ecological Context

For the purposes of monitoring attainment of ecological functionality, Completion Criteria for Koala habitat will act as a surrogate for Greater Glider habitat. Completion targets (KPIs) for koala are therefore presented as **Attachment 5**. Completion criteria identify that achievement of Ecological Context is not anticipated until year 15 of the offset when tree canopy height and cover, and foraging quality benchmarks are such that Greater Glider will be able to forage and move through the area if present onsite.

Monitoring of growth is conditioned by the approval at Years 5, 10, 15 and 20 from commencement of the Action. Reporting schedules outlined in **Table 13** of this GGHMMP identify that reporting of rehabilitation performance occurs in the same reporting year as the monitoring.

4.3.5 Reporting and corrective actions

Approval conditions for attainment of benchmark scoring, monitoring and reporting identified by Approval Conditions 17-19 which require reporting and identification of corrective actions at 5, 10, 15 and 20 to be supplied to the Department. However, a summary will be provided within GGAH Annual Reporting supplied to the department at the same interval.

4.4 Monitoring Schedule

The total number of hollow subjected to assessment by the GGHMMP is outlined in **Table 9**.

Table 9: Total number of hollows to be monitored

Ecological Context	Naturally occurring suitable hollows (Figure 3)	Newly deployed hollows (Figure 4)	Amended hollows (Figure 5)
Area with Context	88	55	34
Area without Context	55	11*	n/a
Total	**143**	**66**	**34**

Notes: year 15 onwards – (*); not applicable – (n/a)

4.4.1 Year 1

Utilisation of existing suitable hollows and all deployed GGAH by target, competitor and pest species, within the area with Ecological Context, will be monitored once in the first 12 months, immediately following the installation of the Greater Glider artificial hollows.

Table 10 provides a summary of monitoring activities to be undertaken to assess exiting suitable and GGAH by Greater Glider, pests and competitor species, and GGAH condition assessments.

Table 10: Monitoring schedule year 1 (sampling every 3 months for first year following installation)

Hollow type	Number of hollows	Methods of assessment*			Notes
		Utilisation of hollows	Utilisation of habitat	Condition	
Area with context					
Naturally occurring hollows with ecological context	88	1,2,3	4,5,6,7	n/a	refer **Figure 3**
Artificial hollows – *CCH / HHH*	55	1,2,3	4,5,6,7	1,3	refer **Figure 4**
Artificial hollows – *amended*	34	1,2,3	4,5,6,7	1,3	refer **Figure 5**
Area without context					
Naturally occurring suitable hollows without ecological context	55	1,2,3	n/a	n/a	refer **Figure 3**

* Methods of assessment: drone monitoring of external hollow condition - (1), revolving camera trapping of hollows - (2), climbing and physical inspection - (3), drone inspections - (4), detection dog - (5), walked spotlighting transect - (6), drone thermal imaging - (7).

4.4.2 Years 2-20 – Naturally Occurring Suitable Hollows

Table 11 provides a summary of monitoring activities to be undertaken to inspect the 143 Naturally Occurring Suitable Hollows (96 branch and 47 trunk) for presence of Greater Glider, pests and competitor species. The total number of hollows intensity is based upon a rolling program of:

- Annually, sample 25% of all (branch and trunk) hollows (36 hollows)
- Bi-annually, sample 25% of all (branch and trunk) hollows (36 hollows)
- Four yearly, sample 50% of all (branch and trunk) hollows (71 hollows).

The representation of hollows assessed in the area *with* and *without* ecological context is based on the proportional representation of Naturally Occurring Suitable Hollows across the Offset Site; 62% within the area of ecological context and 38% in the area without ecological context. Thus, 25% of 143 hollows is 36. The proportional representation for the area with ecological context (36 x 0.62) is 22.

Table 11: Annual Monitoring Schedule Year 2-20 within Naturally Occurring Suitable Hollows

Sampling Intensity	Number of hollows sampled by context area		Methods	Location
	Area with Context	Area without context		
Annually	22	14	1,2,3	refer **Figure 7**
Bi-annually*	22	14	1,2,3	refer **Figure 8**
Every four years	44	27	1,2,3	refer **Figure 9**

* every two years; **Methods of assessment: drone monitoring of external hollow condition - (1), camera trapping of each hollows - (2), climbing and physical inspection – (3)

On the basis of this schedule, the annualised sampling of Naturally Occurring Suitable Hollows is:

- Years 1, 5, 9, 13 and 17 – 36 hollows
- Years 2, 6, 10, 14 and 18 – 72 hollows
- Years 3, 7, 11, 15 and 19 – 36 hollows
- Years 4, 8, 12, 16 and 20 – 143 hollows.

4.4.3 Years 2-20 – Greater Glider Artificial Hollows

Table 12 (Greater Glider Artificial Hollows) provides a summary of annual monitoring activities to be undertaken to assess GGAH by Greater Glider, pests and competitor species, and condition assessments annually for years 2-20.

Table 12: Annual Monitoring Schedule Year 2-20 within GGAH

Hollow type	Number of hollows	Methods of assessment*			Notes
		Utilisation of hollows	Utilisation of habitat	Condition	
Area with context (Years 1-20)					
Artificial hollows – *CCH / HHH*	55	1,3	4,5,6,7	1,3	refer **Figure 4**
Artificial hollows – *amended*	34	1,3,	4,5,6,7	1,3	refer **Figure 5**
Area without context (Year 15-20)					
Artificial hollows – *CCH / HHH*	11	1,3	n/a	n/a	refer **Figure 3**

* Methods of assessment: drone monitoring of external hollow condition - (1), revolving camera trapping of all hollows annually - (2), climbing and physical inspection - (3), drone inspections - (4), detection dog, year 5, 10 and 15 - (5), walked spotlighting transect (6), drone thermal imaging (7).

4.4.4 Summary of Monitoring Activity

So that seasonal variations in the occupancy / use of Naturally Occurring Suitable Hollows and GGAH (by Greater Gliders, pests and competitor species) may be detected, sampling will be conducted seasonally. The schedule of seasonality has been set so that the 'total hollows sampled' is sampled at least once in each season, and that sampling occurs and all seasons are sampled five times each (4 seasons by 5 events = 20 years). The Schedule of hollows assessed on an annual basis is outlined by **Table 13**.

Table 13: Hollow Sampling Intensity Years 1-20

Years	Sampling season	Number of hollows sampled		Total hollows sampled
		Naturally Occurring	GGAH	
1	Spring	36	89	125
2	Summer	72	89	161
3	Autumn	36	89	125
4	Winter	143	89	232
5	Summer	36	89	125
6	Autumn	72	89	161
7	Winter	36	89	125
8	Spring	143	89	232
9	Autumn	36	89	125

Years	Sampling season	Number of hollows sampled		Total hollows sampled
		Naturally Occurring	GGAH	
10	Winter	72	89	161
11	Spring	36	89	125
12	Summer	143	89	232
13	Winter	36	89	125
14	Spring	72	89	161
15	Summer	36	100	136
16	Autumn	143	100	243
17	Spring	36	100	136
18	Summer	72	100	172
19	Autumn	36	100	136
20	Winter	143	100	243

4.5 Summary Reporting Schedule

Table 14 provides a summary of reporting activities to be undertaken to assess GGAH condition and utilisation, and foraging habitat restoration.

Table 14: Annual Key Actions, Monitoring and Reporting Commitments

Year	Action / Report	Responsibility	Supply to Department
1	Preparation of Technical Paper by Greater Glider Expert	Greater Glider Expert under direction of the Suitably Qualified Arborist	No, but rolled into Baseline GGAH Report as Attachment
	Preparation of Suitability Report by Suitably Qualified Arborist	Suitably Qualified Arborist under direction of Suitably Qualified Arborist	No, but rolled into Baseline GGAH Report as Attachment
	Installation of GGAH in Ecological Context Area	Suitably Qualified Arborist supported by Climbing Arborist and Hollow Hog Arborist, under direction of Suitably Qualified Arborist	No, action is installation
	Baseline GGAH Installation Report	Offset Provider (Cherish the Environment) and the Suitably Qualified Ecologist, assisted by the Suitably Qualified Consulting Arborist	Yes, within 15 Business days of the anniversary of **Voluntary Declaration** (**VDec**) being registered on Title. Shapefile of locations to be added as a data supply.

Year	Action / Report	Responsibility	Supply to Department
	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
2	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
3	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
4	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
5	Monitoring and Maintenance Report Biocondition Assessment of Ecological Restoration and reporting against Completion Criteria	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
6	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
7	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
8	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
9	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
10	Monitoring and Maintenance Report Biocondition Assessment of Ecological Restoration and reporting against Completion Criteria	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
11	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
12	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
13	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title

Year	Action / Report	Responsibility	Supply to Department
14	Preparation of Technical Paper by Greater Glider Expert for area presently without ecological context	Greater Glider Expert under direction of the Suitably Qualified Arborist	No, but rolled into Baseline GGAH Report as Attachment
	Preparation of Suitability Report by Suitably Qualified Arborist for area presently without ecological context	Suitably Qualified Arborist under direction of Suitably Qualified Arborist	No, but rolled into Baseline GGAH Report as Attachment
	Installation of GGAH in area presently without ecological context	Suitably Qualified Arborist supported by Climbing Arborist and Hollow Hog Arborist, under direction of Suitably Qualified Arborist	No, action is installation
	Baseline GGAH Installation Report for area presently without ecological context	Offset Provider (Cherish the Environment) and the Suitably Qualified Ecologist, assisted by the Suitably Qualified Consulting Arborist	Yes – rolled into GGAH Annual Monitoring Report for year 14
	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
15	Monitoring and Maintenance Report Biocondition Assessment of Ecological Restoration and reporting against Completion Criteria	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
16	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
17	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
18	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
19	Monitoring and Maintenance Report	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title
20	Monitoring and Maintenance Report Biocondition Assessment of Ecological Restoration and reporting against Completion Criteria	Offset Provider and the Suitably Qualified Ecologist,	Yes, within 15 Business days of the anniversary of VDec being registered on Title

4.6 Corrective Actions and Tracking

Table 15 outlines a number of triggers and corrective actions and timing which are to be implemented in instances of non-compliance or the lack of success toward the gradual achievement of GGAH, as reported in the GGAH Annual Monitoring Report.

Table 15: Risk triggers, Corrective Actions and Timeframes

Triggers	Corrective Actions	Timeframes
Pest species occupying new and amended GGAH	▪ Review all monitoring reports for observations of use ▪ Incidental observation of utilisation of hollows ▪ Occupancy of greater than 10% of hollows results in the removal/destruction of pest species, maintenance of hollow and reinstatement of hollow availability.	▪ Removal of pest species within 40 business days of detection ▪ Maintenance/repair and reinstatement of hollow availability performed within 50 business days.
Native arboreal mammals occupying of new and amended GGAH	▪ Review all monitoring reports for observations of use ▪ Incidental observation of utilisation of hollows ▪ Occupancy of greater than 10% of hollows results in removal/destruction of pest species, maintenance of hollow and reinstatement of hollow availability.	▪ Removal of native arboreal species within 40 business days of detection ▪ Maintenance/repair and reinstatement of hollow availability performed within 50 business days.
Loss of new and amended artificial hollows arising from stochastic events, bushfire, failure of limbs at point of CCH / HHH	▪ While such events (e.g. fire, flood, drought, vandalism etc) are rare and can be managed by the contractor, where events take place, restoration works are to replace losses and reporting to the DCCEEW is required. ▪ Evidence of impacts and rectification measures are to be issued to the DCCEEW within 30 business days.	▪ Replacement within three months of the event ▪ Within 15 days of a bushfire event that is more severe than a groundcover fire (i.e., scorching > 2m up tree trunks), a stocktake of hollows and fauna infrastructure to be completed and submitted to the Department with a rectification plan that sees hollows recreated/installed/repaired within 40 business days of the event. ▪ Extended drought may cause limb drop. In years where rainfall is < 75% of mean annual rainfall, the monitoring report provides comments on the health of trees containing hollows. ▪ Storms may result in lightning strike, storms and cyclones may cause limb drop. Cause to be ascertained and GGAH replaced. ▪ If limb failure at CCH / HHH, investigate retained cross section met design requirements of 47% of retained cross-section and 66% of the outer circumference

Triggers	Corrective Actions	Timeframes
		undamaged. Modify future use of technique.
GGAH deterioration during life of offset	▪ Inspections show hollows have deteriorated and are unusable. ▪ Evidence of impacts and rectification measures are to be issued to the DCCEEW within 30 business days.	▪ Replacement within three months of the event
Growth rates in restoration management units not performing as expected / Plant failure	▪ Engage a suitably qualified professional to review the plantings and advise on methods to increase growth rates through other interventions. ▪ Undertake soil testing to determine what rate of soil ameliorants or fertilizers may be required to improve the chemical balance of the soils for improved plant growth. ▪ Revise management actions for offset. ▪ Adaptive management developments to the OAMP to be submit to Minister for the Environment for approval via Annual Compliance Reporting.	▪ Within three months of detection ▪ Within three months of detection ▪ Within 12 months of detection ▪ Within 24 months of detection if the corrective actions have not amended the slowing growth rates

The GGHMMP will establish a Register of Corrective Actions applicable to GGAH at the offset site. Each item will be assigned a unique number, the non-conformance described, agreed timeframe entered against it (if an item is an unforeseen non-conformance, an appropriate timeframe will be identified). Non-conformance tracking and completion will be described in GGAH Annual Reporting.

4.6.1 Risk assessment

4.6.1.1 Likelihood, consequence and risk ratings

Each environmental risk is given a rating in terms of likelihood and consequence using the criteria in **Table 16** and **Table 17**, respectively. These ratings are then combined to derive risk scores, as shown in **Table 18**.

Table 16: Description of likelihood definitions

Triggers	Corrective Actions
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Table 17: Description of consequence definitions

Triggers	Corrective Actions
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive efforts
Major	Major loss of environmental amenity and real danger of continuing
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

Table 18: Description of consequence definitions

Likelihood	Consequence				
	Minor	Moderate	High	Major	**Critical**
Highly Likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

4.6.1.2 GGAH Risk Assessment

To maximize the effectiveness of the habitat monitoring and maintenance plan for Greater Glider, it is important to maintain the schedules of inspections and corrective actions identified in Table 8. Pre-mitigation risks and post mitigation residual risks are assessed as **Table 19**.

Table 19: GGAH Risk Assessment of effect on Greater Glider occupancy

Triggers	Mitigation State	Likelihood	Consequence	Risk Rating
Pest species occupying of new and amended GGAH	Pre-mitigation	Likely	High	High
	Post-mitigation	Likely	Moderate	Medium
Native arboreal mammals occupying >5% of new and amended GGAH	Pre-mitigation	Likely	High	High
	Post-mitigation	Likely	Moderate	Medium
Loss of new and amended artificial hollows arising from stochastic events, bushfire, and limb failure at point of CCH / HHH	Pre-mitigation	Likely	High	High
	Post-mitigation	Likely	Moderate	Medium

Triggers	Mitigation State	Likelihood	Consequence	Risk Rating
GGAH deterioration during life of offset	Pre-mitigation	Likely	High	High
	Post-mitigation	Likely	Moderate	Medium
Growth rates in restoration management units not performing as expected / Plant failure	Pre-mitigation	Possible	Moderate	Medium
	Post-mitigation	Possible	Minor	Low

4.7 Adaptive Management

This GGHMP adopts a number of 'adaptive management' procedures both as a governing principle and within specific corrective actions.

Most management actions incorporate detailed baseline survey and data collection to be periodically repeated through the offset period and utilised for iterative changes to management implementation, particularly for stochastic habitat risks and threats. The primary purpose of adaptive management procedures is to allow on-ground monitoring and experiences on the most effective measures to feed into amendments to the GGHMMP which focus on best return GGAH denning habitat outcomes. The structured decision-making process that is a by-product of adaptive management is shown in **Inset 1**. The adaptive management approach will be formally applied to GGAH Annual Reporting (see **Section 4.9**).

Inset 1 – Adaptive management process

4.8 Auditing of the GGHMMP

Section 2.3.4 notes that repetitive monitoring and survey replication, annual reporting and corrective action triggers is a feature of this GGHMMP to ensure adaptive management changes are made as soon as identified and throughout the life of the offset. In line with this principle a review of the continued suitability of the methods and approach to deploying and managing the GGAH, including whether the Plan is adequate to meet the goals of the

offset will be assessed at the time the GGAH Annual Report is prepared, and a recommendation made as to whether it remains unamended or whether amendments are required and Ministerial Approval of the updated plan necessary. A summary of this assessment and recommendation will be described within the Annual Report.

4.9 GGAH Annual Reporting

Condition 23(c) requires detail on how the results of monitoring will be reported to DCCEEW. We propose to submit an annual report with the following headings:

1. Background and Purpose of this Monitoring Report
2. Summary of Actions Undertaken on the Offset Site and Significant Events in Previous 12 Month Period
3. Presence / Absence and Abundance Monitoring
    - 3.1 Monitoring Undertaken
    - 3.2 Temporal, Seasonal and Weather Conditions at time of sampling
    - 3.3 Results
    - 3.4 Discussion and Observations
    - 3.5 Recommendations for Future Monitoring Event Improvements
4. Outcome of Hollow Condition Monitoring
    - 4.1 Monitoring Undertaken
    - 4.2 Temporal Seasonal and Weather Conditions at time of sampling
    - 4.3 Results
    - 4.4 Discussion and Observations
    - 4.5 Actioning Risk Triggers
    - 4.6 Recommendations for Future Monitoring Event Improvements
5. Outcome of Hollow Use Monitoring
    - 5.1 Monitoring Undertaken
    - 5.2 Seasonal and Weather Conditions at time of sampling
    - 5.3 Results
    - 5.4 Discussion and Observations
    - 5.5 Actioning Risk Triggers
    - 5.6 Recommendations for Future Monitoring Event Improvements
6. Non-conformance and Corrective Actions
    - 6.1 Undertaken as a result of previous reporting

6.2 Required

7. Auditing and review of GGHMMP adequacy

8. Other Matters

9. Summary and Conclusions

A template for reporting is appended as **Attachment 6** with further explanation of the information and data that will be provided under each heading.

4.10 References

Eyre TJ, Smith GC, Venz MF, Mathieson MT, Hogan LD, Starr, C, Winter, J and McDonald, K (2022). *Guide to greater glider habitat in Queensland*. Report prepared for the Department of Agriculture, Water and the Environment, Canberra. Department of Environment and Science, Queensland Government, Brisbane

5. Justification of Schedule and Methods of Inspection

This section details the requirements of Condition 23(e).

The methods proposed to identify hollow condition, monitor utilisation of hollow by Greater Glider and hollow resource competitors and pest species are tested, well known, cost effective, reliable and provide a high level of confidence with respect to the outcome. Corrective measures and timeframes are identified to ensure that any GGAH that are identified by monitoring as unavailable to Greater Glider, are attended to in a timely manner (replaced, repaired, pests / competitors removed).

Standardised, known assessment techniques are employed, and novel / emerging technologies (drone infrared transect survey, drone GGAH condition monitoring, Greater Glider detection dog) will be employed to bolster monitoring rigour and effectiveness.

Each GGAH will be inspected by drone to asses condition and through visual inspection by climbing arborist to assess utilisation and internal conditions, on an annual basis. Where selective sampling of features is proposed (camera trapping), it is done so to allow a realistic sampling effort to be achieved. The rotational sampling period allows features to be assessed on no less than 4 occasions over the life of the offset.

The use of drones and detection dogs in faunal survey for nocturnal arboreal mammals is demonstrably more efficient on account of area covered, detection rates and more stealthy assessment that afforded by standard walked survey methods by a team of ecologists.

6. Implementation of the Monitoring and Management Plan

This section details the requirements of Condition 23(f).

The Approval Holder is committed through its environmental consultants and approved offset provider to implement this Greater Glider Hollow Monitoring and Maintenance Plan, for the duration of the period of the Offset Management Plan. The Approval Holder guarantees that sufficient funds are available as part of the execution of the Offset Management Plan to implement the Greater Glider Hollow Monitoring and Maintenance Plan in full. The landscape context of the Offset Site and its existing notable qualities (e.g., the occurrence of significant hollow-bearing trees) provide strong opportunities for immigration and use of the site by Greater Glider.

7. Summary and Conclusion

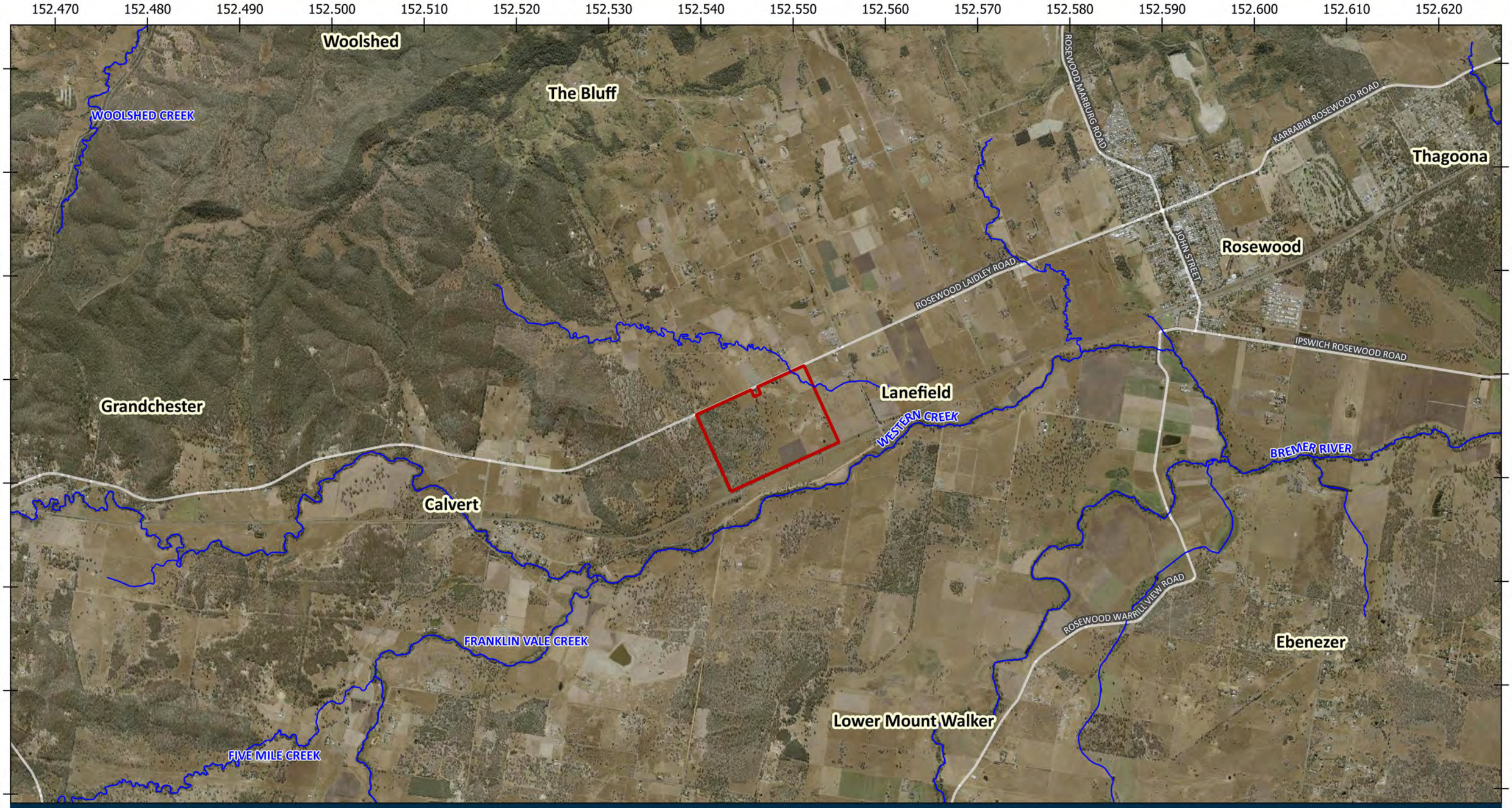
On the 14 February 2024, DCCEEW issues its approval to the Approval Holder to construct an industrial development at North Maclean, Southeast Queensland (EPBC 2022/09304). Condition 23 of the approval mandates the preparation of a Greater Glider Hollow Monitoring and Maintenance Plan for the Offset Site to be prepared by a Suitably Qualified Ecologist and submitted to the department for the Minister's approval.

This monitoring and maintenance plan has been authored by Wayne Moffitt, with secondary input by Dr David Sharp. Both are suitably qualified with respect to Approval Conditions Part C definition for a Suitably Qualified Person.

This monitoring and maintenance plan has synergies with Condition 22 of approval insofar as it responds to the OMP and presents a combination of methods for the assessment of hollow utilisation by Greater Glider, vertebrate competitors and pests and the monitoring proposed has sufficient intensity and duration to demonstrate presence/absence and abundance of Greater Glider and the durability and utility of the artificial hollows deployed, over the Offset Management Period.

The methods proposed to monitor presence / absence of Greater Glider (and competitor species and pests) is contemporary and best practice.

Figures



Maclean Estates, North Maclean

Legend

- Offset Receiving Site Boundary
- Road
- Waterway

Figure 1 – Bounds of offset receiving site

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

The spatial data referenced within this map has been obtained from a variety of verified and licensed sources, as follows: Relevant local government data portals, DoR's QSpatial data catalogue, 28 South Environmental, clients and associates. Aerial imagery is sourced from NearMap, Google Satellite and the DoR repositories QImagery and QGlobe.

Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

Issue Date	Dwg No.	Author
21-03-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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N

152.532 152.535 152.538 152.541 152.544 152.547 152.550 152.553 152.556 152.559 152.562

-27.648 -27.651 -27.654 -27.657 -27.660 -27.663

ROSEWOOD LAIDLEY ROAD ROSEWOOD LAIDLEY ROAD

BUNNEY ROAD

LANE ROAD LANE ROAD

OLD GRANDCHESTER ROAD

WATERS ROAD WATERS ROAD

Floodplain wetland

Hollow-bearing paddock trees without ecological context

Hollow-bearing trees in a regenerating forest setting - trees have ecological context

Maclean Estates, North Maclean

Figure 2 – Ecological Contexts of the ORS

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

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28ºS ENVIRONMENTAL

Legend

- Offset Receiving Site Boundary
- Road
- Rail Network
- Maintenance and Equipment Area
- Washdown Area
- GG Habitat Tree ≥500mm DBH [442]
- GG Habitat Tree 300-499mm DBH [784]
- Remnant Vegetation
- High Value Regrowth Vegetation

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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Maclean Estates, North Maclean

Figure 3 - Naturally Occurring Suitable GG Hollows

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

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Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

Legend

- Offset Receiving Site Boundary
- Rail Network
- Road
- Area with Ecological Context: Category C (HVR) Regulated Vegetation [88 hollows]
- Area without Ecological Context: Category X (Non-rem) Regulated Vegetation [55 hollows]
- Area with Ecological Context: Category B (Rem) Regulated Vegetation

T = Trunk Hollow
B = Branch Hollow

- Naturally Occurring Suitable GG Hollow Tree
- Maintenance and Equipment Area
- Washdown Area
- Existing Maintenance Track
- Proposed Maintenance Track
- Existing Access Gate
- Newly Proposed Access Gate

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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152.535 152.538 152.541 152.544 152.547 152.550 152.553 152.556 152.559

-27.651 -27.654 -27.657 -27.660

ROSEWOOD LAIDLEY ROAD ROSEWOOD LAIDLEY ROAD

BUNNEY ROAD

LANE ROAD LANE ROAD

WATERS ROAD WATERS ROAD

WESTERN CREEK

180 (3T)
531 (1T)
536 (1B)
259 (1T)
189 (1B)
456 (1T)
171 (1T)
339 (1T)
697 (2T3B)
431 (1B)
503 (1T)
508 (1T)
234 (1B)
581 (1B)
215 (1T)
507 (1B)
283 (1T)
414 (1B)
417 (3B)
691 (1B)
702 (1B)
501 (1B)
415 (3B)
301 (1T)
309 (3B)
937 (1T)
656 (1B)
632 (1T1B)
646 (1T)
380 (1T)
943 (1B)
1245 (1B)
1270 (1T)
1249 (1T)
715 (1T1B)
718 (1T)
902 (1B)
1302 (1T)
899 (1B)
1326 (1B)
1319 (1T)
953 (1T)
1439 (1B)
1046 (1B)
1052 (1T)
976 (1B)
959 (3B)
966 (2B)

Maclean Estates, North Maclean

Figure 4 - Proposed New Artificial GG Hollows

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

The spatial data referenced within this map has been obtained from a variety of verified and licensed sources, as follows: Relevant local government data portals, DoR's QSpatial data catalogue, 28 South Environmental, clients and associates. Aerial imagery is sourced from NearMap, Google Satellite and the DoR repositories QImagery and QGlobe.

Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

Legend

- Offset Receiving Site Boundary
- Road
- Rail Network
- Area with Ecological Context: Category C (HVR) Regulated Vegetation [55 hollows]
- Area without Ecological Context: Category X (Non-rem) Regulated Vegetation [11 hollows]
- Area with Ecological Context: Category B (Rem) Regulated Vegetation
- Existing Access Gate
- Newly Proposed Access Gate
- Proposed Chainsaw cut GG hollow tree [ArborAustralis]
- Proposed Hollowhog cut GG hollow tree [ArborAustralis]
- Maintenance and Equipment Area
- Washdown Area
- Existing Maintenance Track
- Proposed Maintenance Track

T = Trunk Hollow
B = Branch Hollow

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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152.535 152.538 152.541 152.544 152.547 152.550 152.553 152.556 152.559

-27.651 -27.654 -27.657 -27.660

ROSEWOOD LAIDLEY ROAD ROSEWOOD LAIDLEY ROAD

BUNNEY ROAD

LANE ROAD LANE ROAD

WATERS ROAD WATERS ROAD

178 (1T1B)
531 (1T)
472 (1T1B)
456 (2T)
481 (1T)
554 (1B)
342 (1B)
1450 (1T1B)
339 (1T)
1445 (2T)
1459 (1B)
1463 (1T)
1466 (3B)
581 (1T)
575 (1T)
212 (1T)
215 (1T)
418 (1T2B)
422 (1T)
689 (1B)
576 (1T)
414 (3B)
664 (2B)
309 (2B)
944 (2B)
1309 (2T1B)
903 (1T2B)
1302 (1B)
1281 (1B)
959 (4B)

Maclean Estates, North Maclean

Legend

Figure 5 - Amendably Suitable GG Hollows

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

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Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

- Offset Receiving Site Boundary
- Road
- Rail Network
- Area with Ecological Context: Category C (HVR) Regulated Vegetation [37 hollows]
- Area without Ecological Context: Category X (Non-rem) Regulated Vegetation [14 hollows]
- Area with Ecological Context: Category B (Rem) Regulated Vegetation
- Existing Access Gate
- Newly Proposed Access Gate
- GG tree with amendably suitable hollows in HVR vegetation
- GG tree with amendably suitable hollows in Category X vegetation
- Maintenance and Equipment Area
- Washdown Area
- Existing Maintenance Track
- Proposed Maintenance Track

T = Trunk Hollow
B = Branch Hollow

NOTE: Location for new hollows is indicative only. Final selection to be based on field conditions.

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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152.535 152.538 152.541 152.544 152.547 152.550 152.553 152.556 152.559

-27.651 -27.654 -27.657 -27.660

ROSEWOOD LAIDLEY ROAD ROSEWOOD LAIDLEY ROAD

BUNNEY ROAD

LANE ROAD LANE ROAD

WATERS ROAD WATERS ROAD

Transect 1 Transect 2 Transect 3 Transect 4 Transect 5 Transect 6 Transect 7 Transect 8 Transect 9 Transect 10 Transect 11 Transect 12

Maclean Estates, North Maclean

Figure 6 - Walked Spotlighting Transects (Years 2-20)

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

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Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

Legend

- Offset Receiving Site Boundary
- Road
- Rail Network
- Area with Ecological Context: Category C (HVR) Regulated Vegetation [37 hollows]
- Area without Ecological Context: Category X (Non-rem) Regulated Vegetation [14 hollows]
- Area with Ecological Context: Category B (Rem) Regulated Vegetation
- Existing Access Gate
- Newly Proposed Access Gate
- Walked spotlighting transect (ecological context area) (year 2-20)
- Walked spotlighting transect (area without ecological context) (year 15-20)
- Maintenance and Equipment Area
- Washdown Area
- Existing Maintenance Track
- Proposed Maintenance Track

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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152.535 152.538 152.541 152.544 152.547 152.550 152.553 152.556 152.559

-27.651 -27.654 -27.657 -27.660

ROSEWOOD LAIDLEY ROAD ROSEWOOD LAIDLEY ROAD
BUNNEY ROAD
LANE ROAD LANE ROAD
OLD GRANDCHESTER ROAD
WATERS ROAD WATERS ROAD

1458B1
178B5 178B3 178B4
532B1
612T1 613B1 342B2
1450B1
1449T1
481T1
339T2
1445T2
431T1
215B1
576B1
415B3 422B3
409B2 409B1
689B2
1466T1
309B2
664B7 664B5
664B11 664B10
1254T1 1254B1
944B4 943B1
944B5 944B2 1309B1
1302B1
1216T1

Maclean Estates, North Maclean

Legend

Figure 7 - Annual Monitoring of Naturally Occurring Suitable GG Hollows

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Maclean No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

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Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

- Offset Receiving Site Boundary
- Rail Network
- Road
- Area with Ecological Context: Category C (HVR) Regulated Vegetation [88 hollows]
- Area without Ecological Context: Category X (Non-rem) Regulated Vegetation [55 hollows]
- Area with Ecological Context: Category B (Rem) Regulated Vegetation

T = Trunk Hollow
B = Branch Hollow

- Naturally Occuring Suitable GG Hollow (Monitored Annualy) [36]
- Maintenance and Equipment Area
- Washdown Area
- Existing Access Gate
- Newly Proposed Access Gate
- Existing Maintenance Track
- Proposed Maintenance Track

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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N

152.535 152.538 152.541 152.544 152.547 152.550 152.553 152.556 152.559

-27.651 -27.654 -27.657 -27.660

ROSEWOOD LAIDLEY ROAD ROSEWOOD LAIDLEY ROAD
BUNNEY ROAD
LANE ROAD LANE ROAD
OLD GRANDCHESTER ROAD
WATERS ROAD WATERS ROAD

460B1 456B1 481B1 581T1 581B1 339B1 339T3 178T1 178T3 178B1 178B2 532B6 532B7 263T1 263B1 614T1 613B2 342T2 342B1 342T3 1458T1 1451T1 1445T5 1445T6 1445T3 1445B1 1459B1 1462T1 1466B1 1464T1 422B1 365B1 415B2 414B4 414B2 691T1 691T2 702T1 689B3 689B1 689B4 410T1 409B4 409B3 568T1 309B1 380T1 664B6 664T1 664B2 664B4 1254B2 944B6 944B7 944B8 1309B2 1302B2 1270B1 1270T1 1358T1 1319B1 1355B2 1281B2

Maclean Estates, North Maclean

Figure 8 - Biannual Monitoring of Naturally Occurring Suitable GG Hollows

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

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Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

Legend

- Offset Receiving Site Boundary
- Rail Network
- Road
- Area with Ecological Context: Category C (HVR) Regulated Vegetation [88 hollows]
- Area without Ecological Context: Category X (Non-rem) Regulated Vegetation [55 hollows]
- Area with Ecological Context: Category B (Rem) Regulated Vegetation

T = Trunk Hollow
B = Branch Hollow

- Naturally Occuring Suitable GG Hollow (Monitored Biannualy) [36]
- Maintenance and Equipment Area
- Washdown Area
- Existing Access Gate
- Newly Proposed Access Gate
- Existing Maintenance Track
- Proposed Maintenance Track

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

GDA2020 MGA 56
1:7,000
0 100 200 m
N

Maclean Estates, North Maclean

Figure 9 - 4 Yearly Monitoring of Naturally Occurring Suitable GG Hollows

28 South Project Ref: 2022-033

Source: C:\Users\Mitch\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS\North Maclean No. 2 (Analysis of Potential GG den trees) (OFFSET).qgz

The spatial data referenced within this map has been obtained from a variety of verified and licensed sources, as follows: Relevant local government data portals, DoR's QSpatial data catalogue, 28 South Environmental, clients and associates. Aerial imagery is sourced from NearMap, Google Satellite and the DoR repositories QImagery and QGlobe.

Links to data sources can be provided upon request.

28ºS ENVIRONMENTAL

Legend

- Offset Receiving Site Boundary
- Rail Network
- Road
- Area with Ecological Context: Category C (HVR) Regulated Vegetation [88 hollows]
- Area without Ecological Context: Category X (Non-rem) Regulated Vegetation [55 hollows]
- Area with Ecological Context: Category B (Rem) Regulated Vegetation

T = Trunk Hollow
B = Branch Hollow

- Naturally Occuring Suitable GG Hollow (Monitored 4 Yearly) [71]
- Maintenance and Equipment Area
- Washdown Area
- Existing Access Gate
- Newly Proposed Access Gate
- Existing Maintenance Track
- Proposed Maintenance Track

Issue Date	Dwg No.	Author
19-04-2024		MO
Approved	**Revision Note**	
AD		

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28ºS ENVIRONMENTAL

Attachment 1

EPBC Approval

Australian Government
Department of Climate Change, Energy, the Environment and Water

Notification of approval

Proposed Industrial Development at North MacLean, 4653 - 4691 Mount Lindesay Highway, North Maclean, Queensland (EPBC ref 2022/09304)

This decision is made under section 133(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Note that section 134(1A) of the EPBC Act applies to this approval. That provision provides, in general terms, that if the approval holder authorises another person to undertake any part of the Action, the approval holder must take all reasonable steps to ensure that the other person is informed of any conditions attached to this approval, and that the other person complies with any such conditions.

Approved Action

person to whom the approval is granted (approval holder)	Maclean Estates Pty Ltd
ACN of approval holder	653 978 646
Action	To undertake an industrial development at 4653 - 4691 Mount Lindesay Highway, North Maclean, Queensland (See EPBC Act referral 2022/09304).

Approval decision

Approval decision	My decision on whether or not to approve the taking of the Action for the purposes of the controlling provision for the Action is as follows.	
	Controlling Provision	**Decision**
	Listed threatened species and communities (section 18 and section 18A)	Approved
period for which the approval has effect	This approval has effect until 19 February 2052.	
conditions of approval	The approval is subject to conditions under the EPBC Act as set out in Annexure A.	

Person authorised to make decision

name and position	Declan O'Connor-Cox Branch Head Environment Assessments QLD
signature	
date of decision	14 February 2024

Annexure A

Note: Words appearing in **bold** have the meaning assigned to them at PART C – DEFINITIONS.

Part A – Operational Conditions

ACTION AREA

1. To avoid and mitigate **harm** to **protected matters**, the approval holder must not take the **Action** outside the **Action Area.**
2. To avoid and mitigate **harm** to **protected matters**, the approval holder must not **clear** more than:
    a) 20.15 hectares (ha) of **Koala habitat**
    b) 20.15 ha of **Grey-headed Flying-fox Habitat**
    c) 20.15 ha of **Greater Glider Habitat**.
3. To avoid and mitigate **harm** to **protected matters**, the approval holder must not **clear** or **construct** in the **Environmental Protection Zone**.

CLEARING AND CONSTRUCTION

4. The approval holder must not undertake **clearing** between the hours of 6 PM to 6 AM AEST.
5. To avoid and mitigate **harm** to **protected matters**, the approval holder must ensure that no **protected matters** are killed or **harmed** as a result of **clearing** or **construction**.
6. To mitigate **harm** to **protected matters**, the approval holder must immediately arrange for veterinary care or assistance from a **Suitably Qualified Ecologist** if any **protected matter** individual is found **harmed**:
    a) within the **Action area** during **clearing** or **construction,**
    b) within 50 metres of the **Action area** during **clearing** or **construction**.
7. To avoid and mitigate **harm** to **protected matters**, the approval holder must:
    a) **clear** only in accordance with the **Sequential Clearing Conditions**
    b) ensure a **Fauna Spotter Catcher** is present within the **Action area** during all **clearing**,
    c) give the **Fauna Spotter Catcher** authority to delay and cease **clearing** and related **construction** for a period of time as specified by the **Fauna Spotter Catcher** to ensure **protected matters** have safely vacated the area of works to enter **suitable habitat**.
    d) ensure that any **clearing** or **construction** within 50 meters of a **Grey-headed Flying-fox Camp** is conducted consistently with the **Grey-headed Flying-fox Mitigation Standards**,
8. To avoid and mitigate **harm** to **Koala** during **clearing** and **construction**, the approval holder must prohibit all people associated with **clearing** and **construction** from bringing any dog into the **Action area**.

TRAFFIC MANAGEMENT AND KOALA EXCLUSION FENCING

9. To avoid and mitigate **harm** to **Koala** as a result of vehicle traffic, the approval holder must:

a) design and **construct** all roads in accordance with **Fauna Sensitive Road Design** and the **Koala Sensitive Design Guidelines**

b) ensure that the speed of all vehicles on roads in the **Action Area** during **clearing** and **construction** is no greater than 40 km/h at any time; and

c) install prominent **Koala** awareness signage consistent with the **Koala Conservation Strategic Plan** or **Koala Sensitive Design Guidelines** on any road that interfaces with **Koala habitat**.

ENVIRONMENTAL PROTECTION ZONE / REHABILITATION MANAGEMENT PLAN

10. To avoid **harm** to **protected matters** in the **Environmental Protection Zone** during **clearing** and **construction**, the approval holder must ensure that:

    a) from the **commencement of the Action** until transfer of the ownership of the **Environmental Protection Zone** to Logan City Council, unauthorised persons do not enter the **Environmental Protection Zone**.

    b) from the **commencement of the Action** until transfer of the ownership of the **Environmental Protection Zone** to Logan City Council, rubbish, unauthorised vehicles and domestic animals are not introduced into the **Environmental Protection Zone**, and

    c) **koala exclusion fencing** is installed within 12 months of the **commencement of the Action** and the **koala exclusion fencing** is then maintained until the expiry of this approval.

11. The approval holder must commence implementation of the **Rehabilitation Management Plan** prior to **commencement of the Action** and continue to implement the **Rehabilitation Management Plan** at least until the expiry of this approval unless ownership of the **Environmental Protection Zone is transferred** to the Logan City Council, in which case the approval holder must continue to implement the **Rehabilitation Management Plan** at least until the outcomes required under condition 12 have been achieved.

12. The approval holder must achieve the following rehabilitation outcomes, as specified in the **Rehabilitation Management Plan**, in the **Environmental Protection Zone** within 20 years of the **commencement of the Action**:

    a) establish 16.27 ha of **Koala habitat,** 16.27 ha of **Greater Glider habitat** and 16.27 ha of **Grey-headed Flying-fox habitat** and

    b) remove all **Weeds of National Significance** and weed species listed under the *Biosecurity Act 2014* (Qld) and thereafter keep the **Environmental Protection Zone** free of these weeds.

13. The approval holder must not transfer ownership of the **Environmental Protection Zone** to any entity other than the Logan City Council. The approval holder may transfer ownership of the **Environmental Protection Zone** to the Logan City Council after the requirements of condition 12 have been met, in fee simple, at no cost the Logan City Council.

ENVIRONMENTAL OFFSET REQUIREMENTS

*Offset Site for the **Koala, Greater Glider** and **Grey-headed Flying-fox***

14. To compensate for the loss of 20.15 ha of **Koala Habitat**, **Greater Glider Habitat** and **Grey-headed Flying-fox Habitat**, the approval holder must:

    a) not undertake any **clearing** at the **Action area** until such time as the **Rosewood Offset Site** has been **legally secured** under a **Voluntary Declaration**,
    b) within 5 **business days** of **legally securing** the **Rosewood Offset Site** under a **Voluntary Declaration**, provide the **department** with written evidence demonstrating the **Rosewood Offset Site** has been placed under a **Voluntary Declaration**,
    c) within 12 months of **commencement of the Action**, **legally secure** the **Rosewood Offset Site** under a **Covenant** or a suitable alternate mechanism providing protection of the **Rosewood Offset Site** in perpetuity and which is approved by the **Minister** in writing,
    d) within five 5 **business days** of having the **Rosewood Offset Site placed** under a **Covenant** or other mechanism as approved in accordance with Condition 14(c), provide the **department** with written evidence demonstrating the **Rosewood Offset Site** has been **legally secured**, and submit **Shapefiles** and offset attributes of the **Rosewood Offset Site** to the **department**.

OFFSET MANAGEMENT PLAN

15. The approval holder must commence implementing the **Offset Management Plan** prior to **commencement of the Action** and continue to implement it until the expiry date of this approval. Within 5 **business days** of commencing implementation of the **Offset Management Plan** the approval holder must notify the **department** in writing of the date on which it commenced implementing the **Offset Management Plan**.

16. The approval holder must complete all management measures as described in the **Offset Management Plan** by the end of **Year 20**.

17. The approval holder must ensure that each of the improvements to habitat quality that the **Offset Management Plan** specifies will have been achieved by each of **year 5**, **year 10**, **year 15** and **year 20** are achieved within the particular specified timeframe.

18. The approval holder must, by the end of each of **Year 5**, **Year 10**, **Year 15** and **Year 20**, meet the **Benchmark Scores** for the **Koala** specified in Attachment 1(a) and Attachment 1(b) and the **Benchmark Scores** for the **Grey-headed Flying-fox** in Attachment 2(a) and Attachment 2(b) in respect of the corresponding time period.

MONITORING

19. Within 30 days prior to the end of each of **Year 5**, **Year 10** and **Year 15**, the approval holder must have an **independent Suitably Qualified Ecologist** undertake an assessment as to whether the outcomes required in conditions 17 and 18 have been or have not been achieved in the **Rosewood Offset Site**. The approval holder must publish the findings of each assessment on the **website** within six months of the date by which this condition requires that assessment be undertaken, submit a copy of the assessment to the **department** within five **business days** of it

first being published and keep the findings of each assessment published on the **website** for the remainder of the duration of the **Offset Management Plan**.

20. The approval holder must undertake **Koala** monitoring as described in the **Offset Management Plan** and also monitor:
    a) using monitoring methods that comprise a combination of two or more **Koala Habitat Assessment Criteria and Methods**.
    b) with sufficient intensity and effort to sufficiently demonstrate presence/absence and abundance of the **Koala** within the **Rosewood Offset Site.**
    c) over a period of at least three consecutive months during spring and summer, chosen to coincide with when **Koala** is most mobile and active in the landscape.

21. The approval holder must undertake **Grey-headed Flying-fox** monitoring as described in the **Offset Management Plan** and also monitor:
    a) using a combination of monitoring methods described in the **Grey-headed Flying-fox** entry on the **SPRAT database**.
    b) with sufficient intensity and effort to sufficiently demonstrate presence/absence and abundance of the **Grey-headed Flying-fox** within the **Rosewood Offset Site.**
    c) over a period of at least three consecutive months during winter and autumn, chosen to coincide with when the winter flowering and fruiting plants within the **Rosewood Offset Site** are in flower or fruit.

22. The approval holder must undertake **Greater Glider** monitoring as described in the **Offset Management Plan** and also monitor:
    a) using a combination of methods described in the **Greater Glider** listing on the **SPRAT database**.
    b) with sufficient intensity and duration to sufficiently demonstrate presence/absence and abundance of the **Greater Glider** within the **Rosewood Offset Site.**

23. The approval holder must submit a Greater Glider Hollow Monitoring and Maintenance Plan for the **Rosewood Offset Site** prepared by a **Suitably Qualified Ecologist** to the **department** for the **Minister**'s approval. The approval holder must not **commence the Action** unless the **Minister** has approved the Greater Glider Hollow Monitoring and Maintenance Plan in writing. The Greater Glider Hollow Monitoring and Maintenance Plan must include:

    a) Details of methods for inspecting the condition of all **Greater Glider artificial hollows**, conducted at least once every 12 months to check if they remain suitable for use by **Greater Gliders**.

    b) Details of the methods that will be implemented to monitor utilisation of hollows, including existing hollows and all **Greater Glider artificial hollows,** by target, competitor and pest species every 3 months for the first 12 months immediately following the installation of the **Greater Glider artificial hollows** and, thereafter, at least once annually for the duration of the **Offset Management Plan**.
    c) Clear commitments that, and details of how, the approval holder will promptly report the findings of inspections and monitoring to the **Department**.

d) Specified triggers for corrective measures, details of the corrective measures that will be implemented if triggers are detected and the timelines for their completion.

e) Justification that the proposed inspection and monitoring methods, timing and effort provide the greatest likelihood of detecting damage to **Greater Glider artificial hollows**, utilisation of hollows by target, competitor and pest species and the occurrence of any specified triggers.

f) The approval holder must implement the Greater Glider Hollow Monitoring and Maintenance Plan as approved by the **Minister** for the duration of the **Offset Management Plan**.

Part B – Administrative conditions

REVISION OF ACTION MANAGEMENT PLANS

24. The approval holder may, at any time, apply to the **Minister** for a variation to an action management plan approved by the **Minister** or as subsequently revised in accordance with the following conditions, by submitting an application in accordance with the requirements of section 143A of the **EPBC Act**. If the **Minister** approves a revised action management plan (**RAMP**) then, from the date specified, the approval holder must implement the **RAMP** in place of the previous action management plan.

SUBMISSION AND PUBLICATION OF PLANS

25. The approval holder must submit all **plans** required by these conditions electronically to the **department**.

26. Unless otherwise agreed to in writing by the **Minister**, the approval holder must publish each **plan** on the **website** within 15 **business days** of the date:

    a) of this approval, if the version of the **plan** to be implemented is specified in these conditions, or

    b) the **plan** is approved by the **Minister** in writing, if the **plan** requires the approval of the **Minister**, or

    c) the **plan** is submitted to the **department** in accordance with a requirement of these conditions, if the **plan** does not require the approval of the **Minister**, or

    d) the **plan** is approved by a state or territory government official required under a state or territory government condition which must be complied with in accordance with these **EPBC Act** conditions.

27. The approval holder must keep all **plans** required by these conditions published on the **website** until the expiry date of this approval.

28. The approval holder is required to exclude or redact **sensitive ecological data** from **plans** published on the **website** or otherwise provided to a member of the public. If **sensitive ecological data** is excluded or redacted from a **plan**, the approval holder must notify the

department in writing what exclusions and redactions have been made in the version published on the **website**.

NOTIFICATION OF DATE OF COMMENCEMENT OF THE ACTION

29. The approval holder must notify the **department** electronically of the date of **commencement of the Action**, within five (5) **business days** following **commencement of the action**.

30. The approval holder must not **commence the Action** later than five (5) years after the date of this approval decision.

COMPLIANCE RECORDS

31. The approval holder must maintain accurate and complete **compliance records**.

32. If the **department** makes a request in writing, the approval holder must provide electronic copies of **compliance records** to the **department** within the timeframe specified in the request.

Note: Compliance records may be subject to audit by the **department**, or by an independent auditor in accordance with section 458 of the **EPBC Act**, and/or be used to verify compliance with the conditions. Summaries of the results of an audit may be published on the **Department's** website or through the general media.

33. The approval holder must ensure that any **monitoring data** (including **sensitive ecological data**), surveys, maps, and other spatial and metadata required under the conditions of this approval are prepared in accordance with the Guidelines for biological survey and mapped data, Commonwealth of Australia 2018, or as otherwise specified by the **Minister** in writing.

34. The approval holder must ensure that any **monitoring data** (including **sensitive ecological data**), surveys, maps, and other spatial and metadata required under the conditions of this approval are prepared in accordance with the *Guide to providing maps and boundary data for EPBC Act projects*, Commonwealth of Australia 2021, or as otherwise specified by the **Minister** in writing.

35. The approval holder must submit all **monitoring data** (including **sensitive ecological data**), surveys, maps, other spatial and metadata and all species occurrence record data (sightings and evidence of presence) electronically to the **department** within accordance with the requirements of the **Offset Management Plan.**

ANNUAL COMPLIANCE REPORTING

36. The approval holder must prepare a **compliance report** for each 12-month period following the date of this approval decision (or as otherwise agreed to in writing by the **Minister**).

37. Each **compliance report** must be consistent with the *Annual Compliance Report Guidelines*, Commonwealth of Australia 2023.

38. Each **compliance report** must include:

    a) Accurate and complete details of compliance and any non-compliance with the conditions and the **plans**, and any **incidents**.

b) One or more **shapefile** showing all **clearing** of **protected matters**, and/or their habitat, undertaken within the 12-month period at the end of which that **compliance report** is prepared.

c) A schedule of all **plans** in existence in relation to these conditions and accurate and complete details of how each **plan** is being implemented.

39. The approval holder must:

a) Publish each **compliance report** on the **website** within 60 **business days** following the end of the 12-month period for which that **compliance report** is required.

b) Notify the **department** electronically, within 5 **business days** of the date of publication that a **Compliance Report** has been published on the **website**.

c) Provide the weblink for the **compliance report** in the notification to the **department**.

d) Keep all published **compliance reports** required by these conditions on the **website** until the expiry date of this approval.

e) Exclude or redact **sensitive ecological data** from **compliance reports** published on the **website** or otherwise provided to a member of the public.

f) If **sensitive ecological data** is excluded or redacted from the published version, submit the full **compliance report** to the **department** within 5 **business days** of its publication on the **website** and notify the **department** in writing what exclusions and redactions have been made in the version published on the **website**.

Note: compliance reports may be published on the **department's** website.

REPORTING NON-COMPLIANCE

40. The approval holder must notify the **department** electronically, within 2 **business days** of becoming aware of any **incident** and/or potential non-compliance and/or actual non-compliance with the conditions or commitments made in a **plan**.

41. The approval holder must specify in the notification:

a) Any condition or commitment made in a **plan** which has been or may have been breached.

b) A short description of the **incident** and/or potential non-compliance and/or actual non-compliance.

c) The location (including co-ordinates), date and time of the **incident** and/or potential non-compliance and/or actual non-compliance.

Note: If the exact information cannot be provided, the approval holder must provide the best information available.

42. The approval holder must provide to the **department** in writing, within 12 **business days** of becoming aware of any **incident** and/or potential non-compliance and/or actual non-compliance, the details of that **incident** and/or potential non-compliance and/or actual non-compliance with the conditions or commitments made in a **plan**. The approval holder must specify:

a) Any corrective action or investigation which the approval holder has already taken.

b) The potential impacts of the **incident** and/or non-compliance.

c) The method and timing of any corrective action that will be undertaken by the approval holder.

INDEPENDENT AUDIT

43. The approval holder must ensure that an **independent audit** of compliance with the conditions is conducted for every 3-year period following the **commencement of the action** until this approval expires or until the **Minister** confirms in writing that the requirement of conditions 17 and 18 have been met.

44. For each **independent audit**, the approval holder must:

a) Provide the name and qualifications of the nominated **independent** auditor, the draft audit criteria, and proposed timeframe for submitting the **audit report** to the **department** prior to commencing the **independent audit**.

b) Only commence the **Independent Audit** once the nominated **independent** auditor, audit criteria and timeframe for submitting the **audit report** have been approved in writing by the **department**.

c) Submit the **audit report** to the **department** for approval within the timeframe specified and approved in writing by the **department**.

d) Publish each **audit report** on the **website** within 15 **business days** of the date of the **department's** approval of the **audit report**.

e) Keep every **audit report** published on the **website** until this approval expires.

45. Each **audit report** must report for the 3-year period preceding that audit report.

46. Each **audit report** must be completed to the satisfaction of the **minister** and be consistent with the *Environment Protection and Biodiversity Conservation Act 1999 Independent Audit and Audit Report Guidelines*, Commonwealth of Australia 2019.

COMPLETION OF THE ACTION

47. The approval holder must notify the **department** electronically 60 **business days** prior to the expiry date of this approval, that the approval is due to expire.

48. Within 20 **business days** after the **completion of the action**, and, in any event, before this approval expires, the approval holder must notify the **department** electronically of the date of **completion of the action** and provide **completion data**. The approval holder must submit any spatial data that comprises **completion data** as a **shapefile**.

Part C – Definitions

In these conditions any bolded use of a word or term refers to the below definition of that word or term:

Action Area means the location of the Action, represented in Attachment 3 by the zone enclosed by the solid black line labelled 'Site Boundary'.

Audit report means a written report of compliance and fulfilment of the conditions attached to this approval, objectively evaluated against the audit criteria approved by the **department**.

Benchmark Scores means the 'average scores from **MHQA**' specified in Attachments 1 and 2 in the particular column headed either "**Year 5** Score", "**Year 10** Score", "**Year 15** Score" or "**Year 20** Score".

Business day means a day that is not a Saturday, a Sunday or a public holiday in Queensland.

Clear, **cleared** or **clearing** means the cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting, or burning of vegetation.

Commence the Action or **Commencement of the Action** means the date on which the first instance of any on-site Clearing, Construction or other physical activity associated with the Action is undertaken, but does not include minor physical disturbance necessary to:

a) Undertake pre-clearance surveys or monitoring programs.

b) Install signage and/or temporary fencing to prevent unapproved use of the **Action area**, so long as the signage and/or temporary fencing is located where it does not **Harm** any **Protected Matter**.

c) Protect environmental and property assets from fire, weeds, and feral animals, including use of existing surface access tracks.

d) Install temporary site facilities for persons undertaking pre-commencement activities so long as these facilities are located where they do not **Harm** any **Protected Matter**.

Completion data means an environmental report and spatial data clearly detailing how the conditions of this approval have been met.

Completion of the Action means the date on which all activities associated with this approval have permanently ceased and/or been completed.

Compliance records means all documentation or other material in whatever form required to demonstrate compliance with the conditions of approval (including compliance with commitments made in **plans**) in the approval holder's possession, or that are within the approval holder's power to obtain lawfully.

Compliance report means a written report of compliance with, and fulfilment of, the conditions attached to the approval.

Construction or **Construct** means:

a) the erection of a building or structure that is, or is to be, fixed to the ground and wholly or partially fabricated on-site,

b) the alteration, maintenance, repair or demolition of any building or structure,

c) any work which involves breaking of the ground (including pile driving) or bulk earthworks,

d) the laying of pipes and other prefabricated materials in the ground, and

e) any associated excavation works.

Note: Construction does not include the installation of temporary fences and signage.

Covenant means the enduring protection mechanism to provide ongoing conservation protection, on the title of the land under Chapter 6 Part 4 Division 8A of the *Land Act 1994* (Qld).

Department means the Australian Government agency responsible for administering the **EPBC Act**.

Development footprint means the location of all **Clearing** and **Construction Activities** within the **Action area**, represented in Attachment 3 by the pink shaded area labelled 'Disturbance Footprint [20.15].'

Environmental Management Plan Guidelines means the *Environmental Management Plan Guidelines*, Commonwealth of Australia 2014.

Environmental Protection Zone means the location of area to be designated for conservation, represented in Attachment 3 by the green shaded zone designated 'Avoidance footprint [16.27 ha].

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

Fauna Sensitive Road Design means Fauna Sensitive Road Design, Volume 1 and 2. Queensland Department of Main Roads, Planning, Design and Environmental Division. Brisbane, 2000.

Fauna Spotter Catcher means a person holding an appropriate license issued under the *Queensland Nature Conservation Act 1992* to detect, capture, care for, assess and release wildlife disturbed by vegetation **clearance** activities who has at least three years' experience undertaking this work with **protected matters**.

Greater Glider refers to the **EPBC Act** listed threatened species *Petauroides volans*.

Greater Glider artificial hollows – means amendably suitable branch hollows, existing suitable branch hollows and amendably suitable branch hollows being provided with ecological context, amendably suitable trunk hollows, and new canopy trunk hollows as described in the final Preliminary Documentation dated 17 November 2023.

Greater Glider habitat means any area that provides habitat suitable for the **Greater Glider** as described in Department of Climate Change, Energy, the Environment and Water (2022). *Conservation Advice for Petauroides volans (greater glider (southern and central))*. Canberra: Department of Climate Change, Energy, the Environment and Water. In effect under the EPBC Act from 05-Jul-2022. At the date of this approval decision this plan can be accessed at: https://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-05072022.pdf. **Greater Glider habitat** occupies the entire **Action area**.

Grey-headed Flying-fox refers to the **EPBC Act** listed threatened species *Pteropus poliocephalus*.

Grey-headed Flying-fox Camp means any area that provides roosting requirements of the **Grey-headed Flying-fox**, as described in *National Recovery Plan for the Grey-headed Flying-fox 'Pteropus poliocephalus', Department of Agriculture, Water and the Environment, Canberra 2021.* At the date of this approval decision this plan can be accessed at: https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/grey-headed-flying-fox

Grey-headed Flying-fox habitat means any area that provides or is likely to provide foraging and roosting habitat of the **Grey-headed Flying-fox**, as described in Department of Agriculture, Water and the Environment (2021). *National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus*. Canberra: Commonwealth of Australia. At the date of this approval decision this plan can be accessed at: https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/grey-headed-flying-fox. **Grey-headed Flying-fox habitat** occupies the entire **Action area**.

Grey-headed Flying-fox Mitigation Standards means the mitigation standards listed in *Referral guideline for management actions in grey-headed and spectacled flying-fox camps*, Commonwealth of Australia 2015' (2015) At the date of this approval decision this guideline can be accessed at: https://www.dcceew.gov.au/environment/biodiversity/threatened/species/flying-fox-policy-statement.

Harm means to cause any measurable direct or indirect disturbance or deleterious change as a result of any activity associated with the **Action**.

Incident means any event which has the potential to, or does, **Harm** any **Protected Matter**.

Independent means a person or firm who does not have any individual, financial*, employment* or family affiliation or any conflicting interests with the Action, the approval holder or the approval holder's staff, representatives, or associated persons.

*Other than for the purpose of undertaking the role for which an **independent** person is required

Independent Audit means an audit conducted by an **Independent** and **Suitably qualified person** as detailed in the *Environment Protection and Biodiversity Conservation Act 1999 Independent Audit and Audit Report Guidelines* 2019 (Cth).

Koala means the **EPBC Act** listed threatened species *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory).

Koala Conservation Strategic Plan means *Koala Conservation Strategic Plan,* City of Logan, 2013 – 2023.

Koala Exclusion Fencing means exclusion fencing as described in Table 4.2 of the *Koala-Sensitive Design Guideline: A guide to koala sensitive designed measures for planning and development activities* 2022 (Qld) and is depicted in Figure RMP001 of appendices A-D of the final Preliminary Documentation dated 17 November 2023 (see Attachment 5). At the date of this approval decision this guideline can be accessed at: https://www.des.qld.gov.au/policies?a=272936:policy_registry/koala-sensitive-design-guideline.pdf

Koala Habitat means any area that provides or is likely to provide the essential life cycle requirements of the **Koala**, including dispersal, foraging and or breeding habitat as described in:

- Conservation Advice for Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory, Commonwealth of Australia 2022, and
- National Recovery Plan for the Koala *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory), Commonwealth of Australia 2022, and
- A review of Koala Habitat assessment criteria and methods, Youngentob, K.N, Marsh, K.F., Skewes, J. 2021.

Koala habitat occupies the entire **Action area**.

Koala Habitat Assessment Criteria and Methods means survey and assessment methods described in the following paper: Youngentob, K.N, Marsh, K.F., Skewes, J., A review of koala habitat assessment criteria and methods, report prepared for the Department of Agriculture, Water and the Environment, Canberra, November 2021. At the date of this approval decision this paper can be accessed at: https://www.agriculture.gov.au/sites/default/files/documents/review-koala-habitat-assessment-criteria-and-methods-2021.pdf

Koala Sensitive Design Guidelines refers to *Koala-Sensitive Design Guideline,* Queensland Department of Environment and Science, 2022. At the date of this approval decision this guideline can be accessed at: https://www.des.qld.gov.au/policies?a=272936:policy_registry/koala-sensitive-design-guideline.pdf

Legally secure/d means to secure a legal agreement under relevant Queensland legislation, in relation to a site, to provide enduring protection for the site against activities incompatible with conservation.

MHQA means the Modified Habitat Quality Assessment, a methodology for determining terrestrial habitat quality derived from the Queensland State Government's following paper: *Guide to determining terrestrial habitat quality. A toolkit for assessing land-based offsets under the Queensland Environmental Offsets Policy Version 1.2 April 2017*. The Queensland Guide (v1.2) should be used subject to the following modifications:

- The species richness scores in Table 2 of the *Guide to determining terrestrial habitat quality* are printed as having three scoring ranges: 2.5 points, 3 points, and 5 points. Instead, those scores should be 0 points, 2.5 points, and 5 points respectively to reflect the *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2* (2015) scoring method.

At the date of this approval decision this paper can be accessed at: https://environment.des.qld.gov.au/data/assets/pdf_file/0015/90312/habitat-quality-assessment-guide.pdf

Minister means the Australian Government Minister administering the **EPBC Act**, including any delegate thereof.

Monitoring Data means the data required to be recorded under the conditions of this approval.

Offset Management Plan means the Draft Offset Area Management Plan V.3, and all associated attachments, written by M. Barnett published as an attachment to the 2022/09304 Proposed Industrial Development at North Maclean Preliminary Documentation on 17 November 2023, or a subsequent version currently approved by the **Minister.** The **Offset Management Plan** is to be in effect until **Year 20.**

Plan means any action management plan or strategy that the approval holder is required by these conditions to implement.

Protected matter means a matter protected under a controlling provision in Part 3 of the **EPBC Act** for which this approval has effect (**Koala, Greater Glider** and **Grey-headed Flying-fox**).

RAMP means Revised Action Management Plan.

Regional Ecosystem means vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil (Sattler and Williams 1999, *Vegetation Management Act 1999*).

Rehabilitation Management Plan means the *Rehabilitation Management Plan,* 28 South Environmental Pty Ltd, Version 1**,** submitted to the **department** as Appendix C.2 of the Preliminary Documentation for the Proposed Industrial Development at North Maclean (2022/09304) dated 17 November 2023.

Rosewood Offset Site means Lot 70 on CH31316 and Lot 2 on RP200424 located at 442-544 Rosewood Laidley Road, Lanefield, QLD shown in Attachment 4 by the zone enclosed by the red line and labelled 'Offset Site Boundary.'

Safe movement solutions means measures to minimise the risk of injury or deaths to **Koalas** from vehicle strike, specifically including **Koala Exclusion Fencing**, fauna underpasses or overpasses, and/or bridges as described in the **Koala-sensitive design guidelines.**

Sensitive Ecological Data means data as defined in the *Sensitive Ecological Data – Access and Management Policy V1.0* 2016 (Cth).

Sequential Clearing Conditions has the same meaning as **'**Sequential Clearing Conditions' in the *Nature Conservation (Koala) Conservation Plan 2017* issued under the *Nature Conservation Act 1992* (Qld) and published by the Queensland Department of Environment and Science. At the date of this approval decision this plan can be accessed at: https://www.legislation.qld.gov.au/view/pdf/inforce/current/sl-2017-0152

Shapefile means location and attribute information about the Action provided in an Esri **Shapefile** format containing:

a) '.shp', '.shx', '.dbf' files,

b) a '.prj' file which specifies the projection or geographic coordinate system used, and

c) an '.xml' metadata file that describes the **shapefile** for discovery and identification purposes.

SPRAT database means the Species Profile and Threats Database including relevant information and associated documents linked on species profiles, Department of Climate Change, Energy, the Environment and Water, Commonwealth Government, available on the date of this approval at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl).

Suitable habitat means habitat no more than 10 km from the **Action area** featuring ecological characteristics that will provide for the safe breeding, feeding, resting and sheltering of the particular **protected matter**.

Suitably Qualified Ecologist means a person who has professional qualifications and

- at least three (3) years of work experience assessing the condition and quality of **Regional Ecosystems** and the habitat of **protected matters**;
- has implemented and reported on management plans for the habitat of **protected matters,** and can demonstrate the implementation of those plans achieved the required environmental quality for **protected matters**; and
- can give authoritative assessment, advice and analysis on whether the condition and quality of **Regional Ecosystems** and the habitat of **protected matters** meets requirements of these conditions using the relevant protocols, standards, methods and/or literature.

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

Voluntary Declaration means the enduring protection mechanism to provide ongoing conservation protection, inscribed on the title of the land, under the *Vegetation Management Act 1999* (Qld).

Website means a set of related web pages located under a single domain name attributed to the approval holder and available to the public.

Weeds of National Significance means Weeds identified as a threat to Australian environments based on their invasiveness, potential for spread, and socioeconomic and environmental impacts; 20 plant species are currently listed as WONS. The list of **Weeds of National Significance** can be found at this link at the date of approval: https://weeds.org.au/weeds-profiles/

Year 1 means the period within 12 months from the date of commencement of implementation of the **Offset Management Plan**.

Year 5 means the period within five years from the date of commencement of implementation of the **Offset Management Plan**.

Year 10 means the period within ten years from the date of commencement of implementation of the **Offset Management Plan**.

Year 15 means the period within fifteen years from the date of commencement of implementation of the **Offset Management Plan**.

Year 20 means the period within twenty years from the date of commencement of implementation of the **Offset Management Plan**.

Attachments

1) Attachment 1(a) – Completion Criteria for **Koala**
2) Attachment 1(b) – Completion Criteria for **Koala**
3) Attachment 2(a) – Completion Criteria for **Grey-headed Flying-fox**
4) Attachment 2(b) - Completion Criteria for **Grey-headed Flying-fox**
5) Attachment 3 – **Action Area**
6) Attachment 4 – **Rosewood Offset Site**
7) Attachment 5 – **Koala Exclusion Fencing**

Australian Government

Department of Climate Change, Energy, the Environment and Water

Completion Criteria for **Koala** – Example outlining how ORS performance will achieve OAMP goals and reach proposed ecological benefit in line with EPBC Offsets Policy.

Key Performance Indicators	Description	Completion Criteria: Baseline (average scores – from MHQA)	Year 5 Score (average scores – from MHQA)	Year 10 Score (average scores – from MHQA)	Year 15 Score (average scores – from MHQA)	Year 20 Score (average scores – from MHQA)
Site Condition (Bio-condition Parameters and KPIs)						
Recruitment of woody perennial species in EDL	Number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).	**3.2/5**	**3.2/5**	**3.2/5**	**4.2/5**	**5.0/5**
Native Species Richness – Trees	Number of native tree species occurring in the monitoring site. This is controlled by the planting palettes within the OMP.	**2.8/5**	**5.0/5**	**5.0/5**	**5.0/5**	**5.0/5**
Native Species Richness – Shrubs	Number of native shrub species occurring in the monitoring site.	**2.8/5**	**5.0/5**	**5.0/5**	**5.0/5**	**5.0/5**
Native Species Richness – Grasses	Number of native grass species occurring in the monitoring site.	**2.3/5**	**2.8/5**	**2.8/5**	**3.3/5**	**4.8/5**
Native Species Richness – Forbes	Number of native forbes species occurring in the monitoring site.	**3.0/5**	**3.0/5**	**3.0/5**	**3.0/5**	**4.8/5**
Tree canopy height	Average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)	**4.0/5**	**4.5/5**	**4.6/5**	**5.0/5**	**5.0/5**
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.	**3.5/5**	**3.7/5**	**3.7/5**	**4.4/5**	**5.0/5**
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.	**2.0/5**	**2.6/5**	**2.6/5**	**4.6/5**	**5.0/5**
Native grass cover	Extent/occurrence pf native grass species	**0.8/5**	**0.8/5**	**0.8/5**	**1.6/5**	**4.6/5**
Organic litter	Extent/occurrence of organic litter (percentage coverage within the monitoring site)	**4.6/5**	**4.6/5**	**4.6/5**	**4.8/5**	**4.8/5**
Large trees	Large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.	**9.0/15**	**9.0/15**	**9.0/15**	**10.5/15**	**10.5/15**
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).	**2.9/5**	**2.9/5**	**2.9/5**	**3.3/5**	**4.7/5**
Non-native plant cover	Extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)	**3.3/10**	**4.7/10**	**4.7/10**	**5.8/10**	**6.6/10**
Quality and availability of food and habitat required for foraging		4.2/10	4.2/10	4.2/10	10.0/10	10.0/10
Quality and availability of habitat required for shelter and breeding		4.2/10	4.2/10	4.2/10	10.0/10	10.0/10
	Site Condition Score (out of 100)	**52.5**	**60.2**	**60.2**	**80.5**	**90.7**
	Site Condition Score (converted out of 3)	**1.57**	**1.80**	**1.81**	**2.41**	**2.7**
Site Context						
Size of Patch		10.0/10	10.0/10	10.0/10	10.0/10	10.0/10

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Attachment 1(a). Completion Criteria for the Koala on the Rosewood Offset Site

Key Performance Indicators	Completion Criteria				
	Baseline (average scores – from MHQA)	Year 5 Score (average scores – from MHQA)	Year 10 Score (average scores – from MHQA)	Year 15 Score (average scores – from MHQA)	Year 20 Score (average scores – from MHQA)
Connectedness	2.0/10	2.0/10	2.0/10	2.0/10	2.0/10
Context	4.0/5	4.0/5	4.0/5	4.0/5	4.0/5
Ecological Corridors	4.0/6	4.0/6	4.0/6	4.0/6	4.0/6
Role of site location to species overall population in the state	1.0/5	1.0/5	1.0/5	1.0/5	1.0/5
Threats to species	7.0/10	7.0/10	7.0/10	7.0/10	7.0/10
Species mobility capacity	7.0/10	7.0/10	7.0/10	7.0/10	10/10
Site Context Score (out of 56)	35.0	35.0	35.0	35.0	38.0
Site Context Score (converted out of 3)	**1.88**	**1.88**	**1.88**	**1.88**	**2.04**
Species Stocking Rate					
Presence detected on or adjoining site	10.0/10	10.0/10	10.0/10	10.0/10	10.0/10
Species Usage (Habitat type & evidence of usage)	10.0/15	10.0/15	10.0/15	10.0/15	15.0/15
Approximate Density	10.0/30	10.0/30	10.0/30	10.0/30	20.0/30
Role/Importance of Species Population on Site	5.0/10	5.0/10	5.0/10	5.0/10	5.0/15
Species Stocking Rate (out of 70)	35.0	35.0	35.0	35.0	50.0
Species Stocking Rate (converted out of 4)	**2.0**	**2.0**	**2.0**	**2.0**	**2.86**
Total Habitat Quality Score (out of 10)	**4.79** Averaged Scores for AUs Round to 5	**5.16** Averaged Scores for AUs Round to 5	**5.16** Averaged Scores for AUs Round to 5	**6.04** Averaged Scores for AUs Round to 6	**7.42** Averaged Scores for AUs Round to 7

Attachment 1(b). Completion Criteria for the Koala on the Rosewood Offset Site

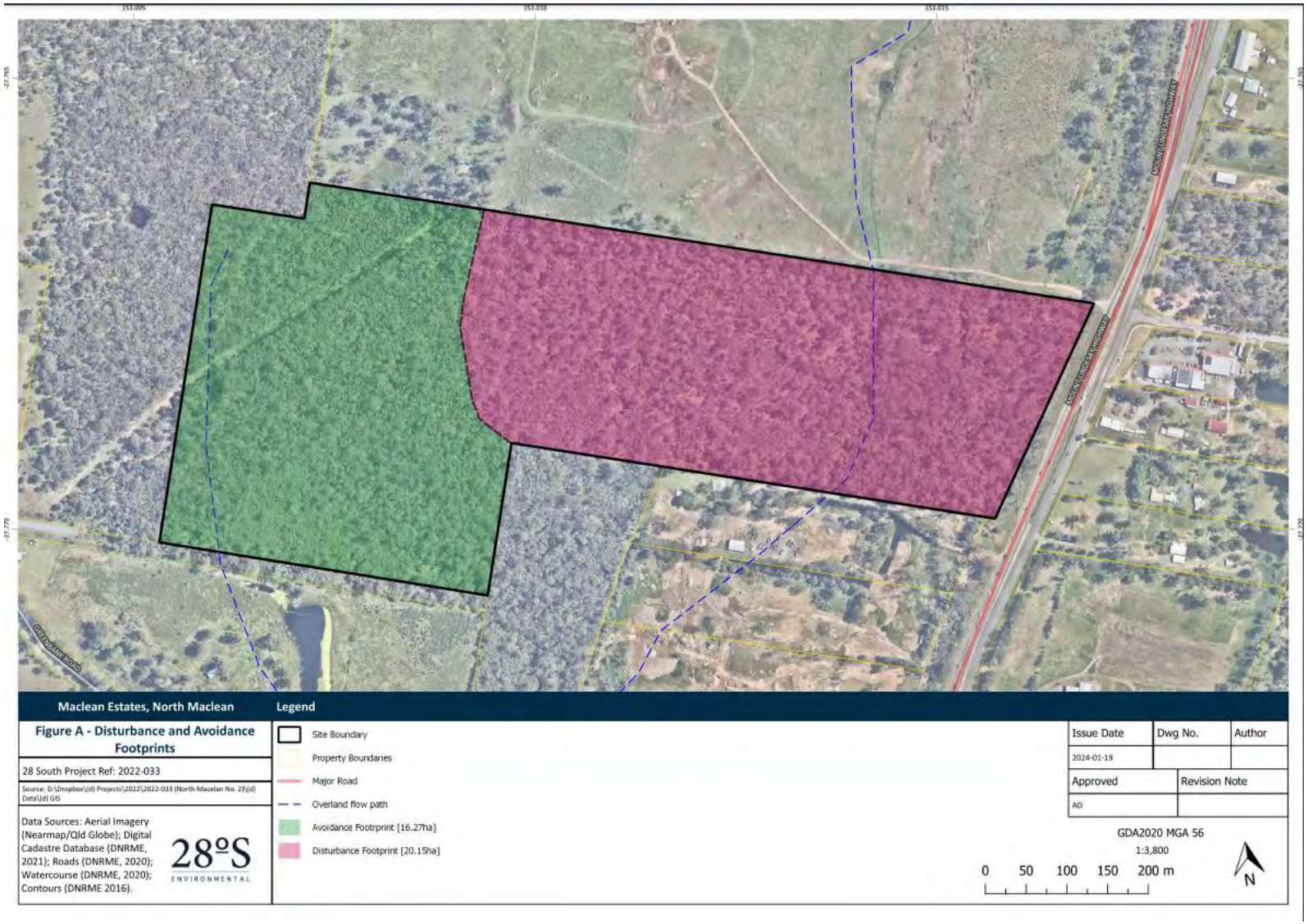
Completion Criteria for **Grey-headed Flying-fox** – Example outlining how ORS performance will achieve OAMP goals and reach proposed ecological benefit in line with EPBC Offsets Policy.

Key Performance Indicators	Description	Completion Criteria				
		Baseline (average scores – from MHQA)	Year 5 Score (average scores – from MHQA)	Year 10 Score (average scores – from MHQA)	Year 15 Score (average scores – from MHQA)	Year 20 Score (average scores – from MHQA)
Site Condition (Bio-condition Parameters and KPIs)						
Recruitment of woody perennial species in EDL	Number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).	**3.2/5**	**3.2/5**	**3.2/5**	**4.2/5**	**5.0/5**
Native Species Richness – Trees	Number of native tree species occurring in the monitoring site. This is controlled by the planting palettes within the OMP.	**2.8/5**	**5.0/5**	**5.0/5**	**5.0/5**	**5.0/5**
Native Species Richness – Shrubs	Number of native shrub species occurring in the monitoring site.	**2.8/5**	**5.0/5**	**5.0/5**	**5.0/5**	**5.0/5**
Native Species Richness – Grasses	Number of native grass species occurring in the monitoring site.	**2.3/5**	**2.8/5**	**2.8/5**	**3.3/5**	**4.8/5**
Native Species Richness – Forbes	Number of native forbes species occurring in the monitoring site.	**3.0/5**	**3.0/5**	**3.0/5**	**3.0/5**	**4.8/5**
Tree canopy height	Average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)	**4.0/5**	**4.5/5**	**4.6/5**	**5.0/5**	**5.0/5**
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.	**4.0/5**	**3.7/5**	**3.7/5**	**4.4/5**	**5.0/5**
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.	**2.0/5**	**2.6/5**	**2.6/5**	**4.6/5**	**5.0/5**
Native grass cover	Extent/occurrence pf native grass species	**0.8/5**	**0.8/5**	**0.8/5**	**1.6/5**	**4.6/5**
Organic litter	Extent/occurrence of organic litter (percentage coverage within the monitoring site)	**4.6/5**	**4.6/5**	**4.6/5**	**4.8/5**	**4.8/5**
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.	**9.0/15**	**9.0/15**	**9.0/15**	**10.5/15**	**10.5/15**
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).	**2.9/5**	**2.9/5**	**2.9/5**	**3.3/5**	**4.7/5**
Non-native plant cover	Extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)	**3.3/10**	**4.7/10**	**4.7/10**	**5.8/10**	**6.6/10**
Quality and availability of food and foraging habitat (/80) Alternative Scoring Method Supplementary Data		35.0/80	43.0/80	48.0/80	48.0/80	58.0/80
Quality and availability of shelter (20) Alternative Scoring Method Supplementary Data		0.0/20	0.0/20	0.0/20	0.0/20	0.0/20
Site Condition Score (out of 180)		**79.6**	**94.8**	**99.8**	**108.5**	**128.7**
Site Condition Score (converted out of 4)		**1.77**	**2.11**	**2.22**	**2.41**	**2.86**
Site Context						
Size of Patch		10.0/10	10.0/10	10.0/10	10.0/10	10.0/10

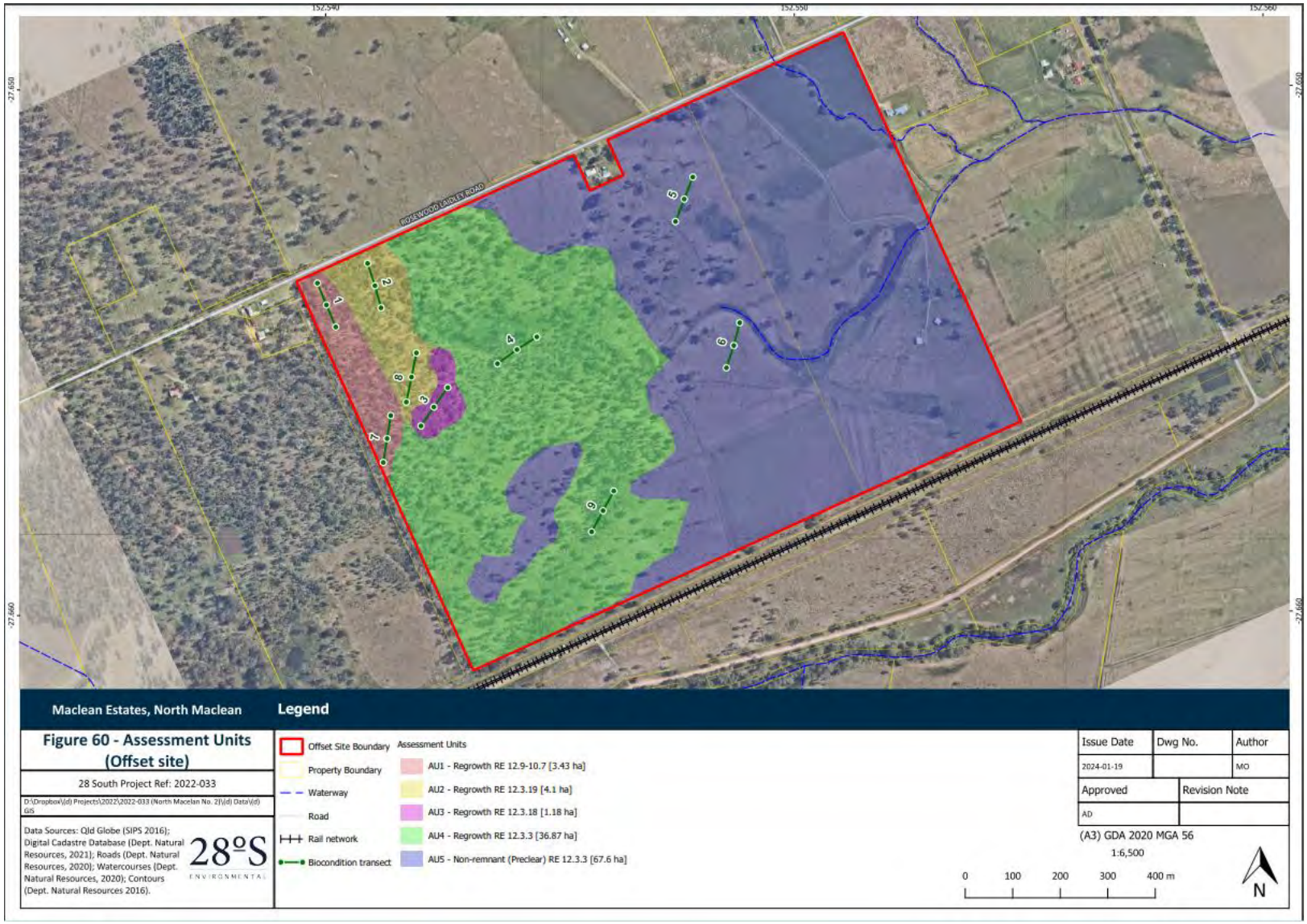
Attachment 2(a). Completion Criteria for the Grey-headed Flying-fox on the Rosewood Offset Site

	Completion Criteria				
Key Performance Indicators	**Baseline** (average scores – from MHQA)	**Year 5 Score** (average scores – from MHQA)	**Year 10 Score** (average scores – from MHQA)	**Year 15 Score** (average scores – from MHQA)	**Year 20 Score** (average scores – from MHQA)
Connectedness	2.0/5	2.0/5	2.0/5	2.0/5	2.0/5
Context	4.0/5	4.0/5	4.0/5	4.0/5	4.0/5
Ecological Corridors	4.0/6	4.0/6	4.0/6	4.0/6	4.0/6
Role of Site location to species overall population in the state	2.0/15	5.0/15	10.0/15	10.0/15	10.0/15
Threats to Species	0.0/15	0.0/15	0.0/15	0.0/15	0.0/15
Species mobility capacity	10.0/10	10.0/10	10.0/10	10.0/10	10.0/10
Site Context Score (out of 96)	32.0	35.0	40.0	40.0	40.0
Site Context Score (converted out of 3)	**1.0**	**1.09**	**1.25**	**1.25**	**1.25**
Species Stocking Rate					
Presence detected on or adjoining site	5.0/10	5.0/10	5.0/10	10.0/10	10.0/10
Species Usage (Habitat type & evidence of usage)	10.0/15	10.0/15	10.0/15	10.0/15	10.0/15
Approximate Density	10.0/30	10.0/30	10.0/30	10.0/30	15.0/30
Role/Importance of Species Population on Site	5.0/15	5.0/15	5.0/15	5.0/15	5.0/15
Species Stocking Rate (out of 70)	30.0	30.0	30.0	35.0	40.0
Species Stocking Rate (converted out of 3)	**1.29**	**1.29**	**1.29**	**1.50**	**1.71**
Total Habitat Quality Score (out of 10)	**3.16** Averaged scores for AUs Round to 3	**3.86** Averaged Scores for AUs Round to 4	**4.12** Averaged Scores for AUs Round to 4	**4.62** Averaged Scores for AUs Round to 5	**5.29** Averaged Scores for AUs Round to 5

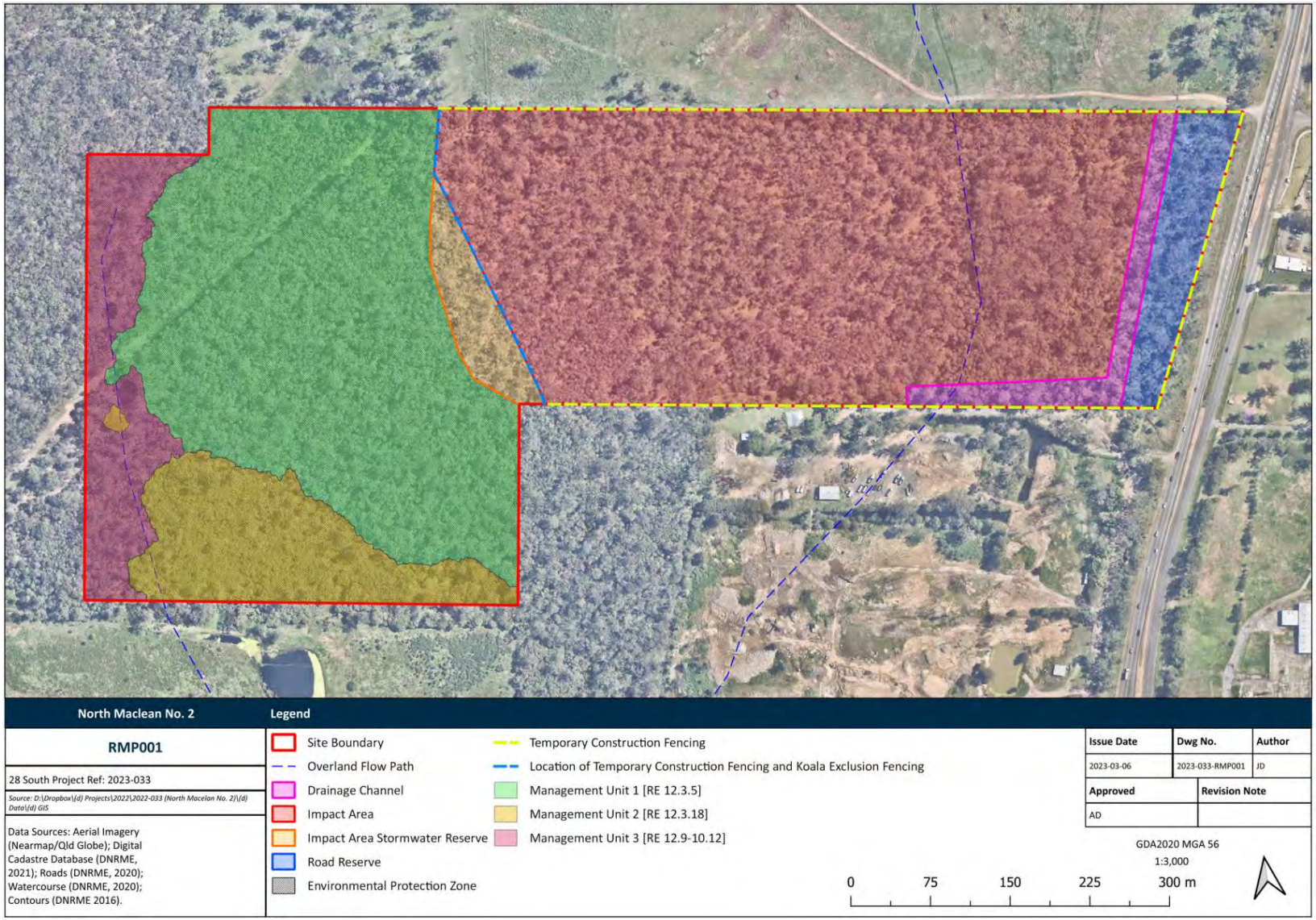
Attachment 2(b). Completion Criteria for the Grey-headed Flying-fox on the Rosewood Offset Site



Attachment 3. Map of the Proposed Industrial Development at North Maclean



Attachment 4. The Proposed Rosewood Offset Site



Attachment 5. Location of Koala Exclusion Fencing

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Attachment 2

Greater Glider Technical Report by Dr David Sharpe

Attachment

Assessment of the Greater Glider at a Proposed Development Site: 4653-4691 Mount Lindesay Highway North Maclean.

Dr David Sharpe

May 2023

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Introduction

The identification and management of development impacts depends on the ability to detect the presence of a threatened species and understand its habitat requirements to determine the nature and intensity of the impacts. This requires the use of the most effective detection methods and understanding the probability of detection should a species be present (Debus 1995; Wintle et al. 2005). False absences are a common problem in ecology (Gu and Swihart 2003; Cunningham and Lindenmeyer 2005). However, it is only possible to estimate the absence of a species probabilistically and a number of site visit are required to achieve reasonable level of confidence (Debus 1995; Kéry 2002).

The Central Greater Glider (*Petauroides armillatus*) (after McGregor et al. 2020) is listed as Endangered in Queensland under the *Nature Conservation Act 1992* and Federally under the *Environment Protection and Biodiversity Conservation Act 1999*. The reason for its EPBC listing is a population decline of over 50% over three generations (21 years), including habitat and population impacts arising from the 2019-20 bushfires. Current threats to Greater Glider species include land clearing, habitat fragmentation, edge effects, bushfires, climate change and forestry. While these impacts are unlikely to have caused a substantial change in its extent of occurrence, the area of occupancy has decreased considerably (DCCEEW 2022).

As such, developments must consider the occurrence of the Central Greater Glider and undertake a Significant Impact Assessment if it is present, with offsets required when a significant impact is concluded. For simplicity, the species will be referred to as the Greater Glider in the rest of this report given most relevant literature was produced prior to the taxonomic changes and it is unclear how the ecology and behaviour varies between the three currently recognised Greater Glider species (McGregor et al. 2020).

The proposed development site located at 4653-4691 Mount Lindesay Highway, North Maclean (Lot 1 on RP113251) (the Site). North Maclean is part of the GFPDA, a State coordinated urban growth area approximately 30km south of Brisbane. The Site is zoned Industrial and Business. It is 36.3 ha in area, of which approximately 20.15 ha is proposed for development and would be totally cleared. The far eastern part of the land is to be resumed for a service road associated with the duplication upgrade of the Mt. Lindsey Hwy, with the balance in the west to be retained as a conservation area. Further details of the site, its landscape context and the development proposal are provided by 28^{o}S Environmental (2022), which should be read in conjunction with this report.

The purpose of this report is to review the detection methods and detection probability for the Greater Glider and determine whether the species is likely to be present on the development site based on survey data. The suitability of a proposed offset site for the Greater Glider is also assessed.

Background

Ecology and Behaviour

The Greater Glider is an arboreal folivore dependent on large tree hollows (Foley 1987; Kavanagh and Lambert 1990; Comport et al. 1996; Eyre 2006; Smith et al. 2007; Jensen et al. 2015; DCCEEW 2022; Hofman et al. 2022). Larger trees within a forest stand are favoured for both foraging (>30 cm DBH) and denning (>50 cm DBH) (Eyre et al. 2022). Thus, Greater Gliders are more likely to occur and reach higher densities where larger trees are more common.

Greater Gliders prefer to eat young leaves as they have a higher nutrient status and lower toxin levels compared to mature leaves, resulting in seasonal changes in tree species selection and habitat

use due to asynchronies in new leaf production (Kavanagh 1984, 1990). Other studies have also demonstrated an effect of leaf nutrient and toxin status and leaf phenology on the species' diet (e.g. Moore et al. 2004; Jensen et al. 2015). This results in preferential use of some tree species within a forest stand (Comport et al. 1996; Kavanagh and Lambert 1990; Eyre et al. 2022) and a patchy distribution through a forested area (Kavanagh and Bamkin 1995; Kavanagh et al. 1995; Wintle et al. 2005; Eyre 2006). In Queensland, Greater Gliders are more common in moist Eucalypt forest compared to drier forest types, which may be due to higher site productivity, higher leaf nutrient status and lower foliar toxin concentrations (Eyre 2006).

The availability of tree hollows is considered a key limiting resource for the Greater Glider (DCCEEW 2022). Number of hollow-bearing trees varies with forest type (Eyre 2006). It requires at least 2-4 hollows per 2 ha (Eyre 2002). Greater Glider abundance is positively related to the number of live hollow-bearing trees, from 0.7 gliders predicted per 3 ha with one hollow-bearing tree ha^{-1} to 2.3 gliders with 8 hollow-bearing trees ha^{-1} (Eyre 2006). Individual Greater Gliders tend to use multiple tree hollows, with a range of 1 – 20 den trees reported (Kavanagh and Wheeler 2004; Lindenmayer *et al.* 2004; Smith *et al.* 2007) and they are generally located in the core areas of the home-range (Comport *et al.* 1996). Greater Gliders occupy hollows with a mean entrance diameter of 18.1 ± 0.6 cm (range 8 – 35 cm) (Hofman et al. 2022).

Home ranges are usually 1-4 ha in size (Henry 1984; Kehl and Borsboom 1984; Comport et al. 1996; Gibbons and Lindenmayer 2002; Pope et al. 2005); however, in lower productivity forest and more open woodland habitats home ranges can be up to 16 ha (Eyre 2004; Smith et al. 2007).Male home-ranges are larger than for females. There is a high degree of home-range overlap between the sexes but not within the sexes, particularly for males (Comport *et al.* 1996; Kavanagh and Wheeler 2004; Pope *et al.* 2005). Reported population densities range from 0.35 ha^{-1} to 2.3 ha^{-1} (Kehl and Borsboom 1984; Comport *et al.* 1996; Smith and Smith 2018). Larger home-ranges are associated with lower population density (Pope *et al.* 2005).

The number of Greater Gliders declines with increase in percentage of cleared area within 1 km. The smallest forest patch in southern Queensland in which the Greater Glider has been found is 160 ha (Eyre 2006). Due to its patchy use of habitat and limited dispersal ability the Greater Glider may have difficulty persisting in smaller, isolated forest stands. The Greater Glider is negatively affected by forestry activities (Kavanagh and Bamkin 1995; Kavanagh et al. 1995; Eyre 2006; Maclean et al. 2018). It has long recovery times from fire (20 – 30 years for severe fire) due to mortality and low reproductive output but may persist in unburnt areas (van der Ree and Lyon 2002; Lindenmayer *et al.* 2013; Berry *et al.* 2015). The Greater Glider is also threatened by climate change. It appears to poorly tolerate nocturnal temperatures over 20^{o}C, which may have caused it to decline at low elevations in the southern part of its range (Smith and Smith 2018, 2020; Wagner et al. 2020).

Critical Habitat and Important Populations

Habitat critical to the survival of the Greater Glider is defined as (DCCEEW 2022):

- Large contiguous areas of eucalypt forest, which contain mature hollow-bearing trees and a diverse range of the species' preferred food species in a particular region
- Smaller or fragmented habitat patches connected to larger patches of habitat, that can facilitate dispersal of the species and/or that enable recolonization
- Cool microclimate forest/woodland areas (e.g. protected gullies, sheltered high elevation areas, coastal lowland areas, southern slopes)
- Areas identified as refuges under future climate changes scenarios

- Short-term or long-term post-fire refuges (i.e. unburnt habitat within or adjacent to recently burnt landscapes) that allow the species to persist, recover and recolonise burnt areas.

Habitat meeting any one of the criteria above is considered critical irrespective of the current abundance or density of greater gliders or the perceived quality of the site as currently unoccupied habitat may be colonized in the future as hollow-bearing trees become more common as the forest matures (DCCEEW 2022). Given its Endangered status, all populations of the Greater Glider are important for its conservation (DCCEEW 2022).

Greater Glider Habitat in Queensland

The characteristics of Greater Glider habitat in Queensland is described by Eyre et al. (2022). A reliance on habitat characteristics to define potential Greater Glider habitat was adopted due to uncertainty regarding the detection of the Greater Glider and the difficulty of assessing suitable tree hollows from the ground. The report of Eyre et al. (2022) describes the Queensland Regional Ecosystems known or likely to support the Greater Glider, the species and size of foraging trees, and the species and size of hollow-bearing trees used for denning.

Eyre et al. (2022) defined Greater Glider habitat as:

- A Regional ecosystem with confirmed species records
- An area that contains important habitat attributes (live or dead hollow-bearing trees, feed trees, large trees, landscape habitat connectivity).

Eyre et al. (2022), summarising other studies (Comport et al. 1996; Wormington 2003; Smith et al. 2007; Starr et al. 2021), suggest that trees >30 cm DBH are preferred for foraging and trees >50 cm DBH are preferred for denning. Table 4 of this report also provides data on feed and den trees species use by the Greater Glider.

Detection Rate

The survey methods, detection rates and population sizes of the Greater Glider reported in scientific publications are summarised in **Table 1**. The Greater Glider is generally regarded as a relatively easy species to detect due to its bright eyeshine and sedentary behaviour (e.g. Smith and Smith 2018; Gracanin et al. 2022). It shows variation in habitat occupancy and detection rates, which are likely to reflect habitat influences on detectability and different population densities (e.g. understorey density, productivity, availability of hollow-bearing trees). Site occupancy of the Greater Glider is generally low, suggesting populations are patchily distributed within a forest area (**Table 1**).

Henry (1984) detected Greater Gliders on 84% of survey nights in a population of 24 gliders. Using radio-tracking, Lindenmayer et al. (2001a) demonstrated the detection probability for a Greater Glider occurring along a spotlighting transect (and hence available for detection) in their study area was 0.26. In occupied habitat, reported detection rates of the Greater Glider range between 1.58 and 6.61 detections per hour (Kavanagh 1984; Eyre 2006; Goldingay et al. 2022). This suggests that when Greater Gliders are present it is highly likely that the species' presence would be detected given sufficient spotlighting effort.

Table 1: Summary of detectability in studies on the Greater Glider.

Methods	Results	Source
116 ha study area, 43 ha occupied 804 hrs over 227 nights over 41 months Mean 3.54 hrs/night	Detected on 190 nights (83.7%) Mean population size 24 gliders	Henry 1984
100 ha study area 10 transects of 1 km, ~10m/min 120 nights spotlighting 11 sample periods	1211 observations 6.61 detections per hour	Kavanagh 1984
120 nights spotlighting 220km of transect	Mean population size 84	Kavanagh and Lambert 1990
200 sites, surveyed once each 10 min spotlight 1 ha (56.5m radius)	28 records at 13 sites	Kavanagh and Bamkin 1995
291 sites, surveyed twice (winter/summer) 5 min spotlight in variable radius plots	376 records at 149 sites	Kavanagh et al. 1995
		Kavanagh 2000
6 transects (5x600m, 1x400m) 20 gliders radio-collared for reference 5 nights of study Total of 45 passes along transects	Probability of detecting a glider given it was available for detection 26% (9 from 35 opportunities)	Lindenmeyer et al. 2001a
39 patches spotlighted Complete count (once) & transects (3x each) in multiples of 200m	81 detections in 20 patches Observation Nos. consistent across three replicates	Lindenmeyer et al. 2001b
38 sites, 1 km transect with 5 50m square quadrats surveyed more intensively	Detected at 31 sites with 128 observations	Wormington et al. 2002
40 min spotlighting in 80m radius of playback site 50 sites, 8 times each	Recorded at 25 of 50 sites Total 84 detections Single visit detection probability 0.41 (0.34-0.49 95% CI)	Wintle et al. 2005
506 survey sites 300 x 50 m transect, Surveyed once for 1 person-hour	175 detections at 111 sites (i.e. 1.58/hr in occupied habitat 15 of 22 vegetation communities	Eyre 2006
52 spotlight sites Driving transects ~4km at 10 km/hr over 4 hrs Walking transects over 1 hr	Detected at 7 then 3 sites Respective abundance 5.29 then 0.57 Abundance only at sites not cleared 5.8 and 0.7 respectively	Woinarski et al. 2006
40 surveys of 30 min Two observers 200-300m transects	Present at 14% of sites Population density 0.1-0.36 ha^{-1} HRs 10.8 ha M, 6.9 ha F	Smith et al. 2007
Twenty sites with known records	Absent at 35% of sites	Smith and Smith 2018

Methods	Results	Source
10 over and 10 under 500m elevation 1 hr search by two people, 3 times each Transects 480-2210m, mean 880m	Mean 0.35 gliders per ha over 500m 0.05 under 500m	
20-34 survey sites 200 m transect Surveyed 3 times/year for 20 min	118 detections on 77% of transects 4.51/hr in occupied habitat	Goldingay et al. 2022

Site Investigations

Habitat Assessment by 28 South Environmental (2022)

The pre-clearing REs on the Site are RE12.9-10.2/12.9-10.12/12.9-10.7, RE12.3.18 and RE12.3.19. Two small remnant patches and one large patch of RE12.3.19 remain. There is also an area of RE12.3.5 in the south-west of the Site. The high-value regrowth mapped on the site has species consistent with the pre-clearing mapping. These species include trees of recognised importance to the Greater Glider: *Eucalyptus tereticornis*, *E. moluccana*, *E. crebra*, *Corymbia intermedia* and *Melaleuca quinquenervia* (Eyre 2006; Eyre et al. 2022) and are generally common on the Site (28 South Environmental 2023).

28 South Environmental (2023) undertook at tree survey of the Site consistent with Eyre et al. (2022). A total of 1,171 potential forage trees (>300 mm DBH) and 367 habitat trees (>500 mm DBH) were recorded in the development footprint (**Table 2**). Ecosmart Ecology (2022) recorded six trees with hollows >20 cm entrance diameter on the Site. While Greater Gliders used hollows with a mean entrance diameter of 18.1 cm, they can use hollows with entrances as narrow as 8 cm (Hofman et al. 2022). Moreover, it is possible that some large tree hollows were missed. So, there may be more than six potential den trees present. However, despite the number of trees >500 mm present and the difficulty of recognising hollows from the ground, there is clearly a low density of hollow-bearing trees on the Site (personal observations).

Table 2: Greater Glider habitat trees on the Site (after Eyre et al. 2022).
Source: 28 South Environmental (2022).

Species	Number Potential Forage Trees	Number Potential Habitat Trees
Angophora leiocarpa	14	0
Angophora subvelutina	0	0
Corymbia intermedia	31	1
Corymbia tessillaris	9	1
Eucalyptus crebra	23	5
Eucalyptus melanophloia	0	0
Eucalyptus moluccana	160	34
Eucalyptus seeana	209	125
Eucalyptus siderophloia	282	50
Eucalyptus tereticornis	322	98
Lophostemon suaveolens	286	38
Melaleuca quinquenervia	363	15
Melaleuca linariifolia	12	0
Total	**1,711**	**367**

Landscape Connectivity

Historic aerial imagery shows much of the Site was previous cleared, but some remnant vegetation remained (28 South 2022). Previously cleared areas now support regrowth vegetation. The site is moderately connected to the west but land to the north was recently cleared. Mt Lindsey Hwy is to the east, with regrowth and clearing further east (**Figure 1**). The far eastern part of the land is to be resumed for a service road as part of the duplication upgrade of the Mt. Lindsey Hwy. This work would increase the distance across the highway corridor. Land to the south of the site is fragmented and does not provide much additional potential habitat for the Greater Glider and lacks ongoing connectivity.

Thus, the only viable link between the site and additional potential habitat is to the west. While tree cover is relatively continuous to the west along riparian corridors, there is moderate fragmentation, most trees are not ecologically mature and tree hollows are uncommon to rare. These factors suggest connectivity to the west is currently poor but there is clearly recovery potential if there is not further clearing and the existing trees are allowed to mature. As tree hollows generally take decades to form (Mackowski 1984; Gibbons and Lindenmayer 2002), this is the potential recovery time for connectivity to the site to be restored.

Local Records

Since 1990, there have been 148 records of Greater Glider within 25km of the project Site (28 South 2023):

- 148 records within 25 km
- 4 records within 10 km
- 3 records within 5 km
- 0 records within 2 km

The majority of records within 10 km are associated with an area to the northeast of the Site and are suggestive of a resident population. This population is separated from the project Site by a number of significant movement barriers including Mount Lindesay Highway, a high voltage powerline easement (110 m wide) and urban and industrial development. This suggests movement between these areas would be very unlikely.

Spotlight Survey

A Greater Glider survey of the site was undertaken in May 2022 by Ecosmart Ecology (2022). This survey included 10 person-hours of spotlighting, with two observers traversing the entirety of the Site at night. No Greater Gliders were detected (28 South Environmental 2022).

A further two-night spotlighting survey was conducted on 26 and 27 April 2023. This consisted of one observer systematically traversing the development site in an east/west direction one night and north/south on the other for over 2.5 hours per night (**Figure 2**; **Table 3**). Weather during this survey was conducive to spotlighting, with mild temperatures, high humidity and little to no wind (**Table 3**). No Greater Gliders were detected. However, three other arboreal mammal species were found during spotlighting (**Table 3**). The Common Brushtail Possum (*Trichosurus vulpecula*) and Common Ringtail Possum (*Pseudocheirus peregrinus*) may compete with the Greater Glider for hollows.

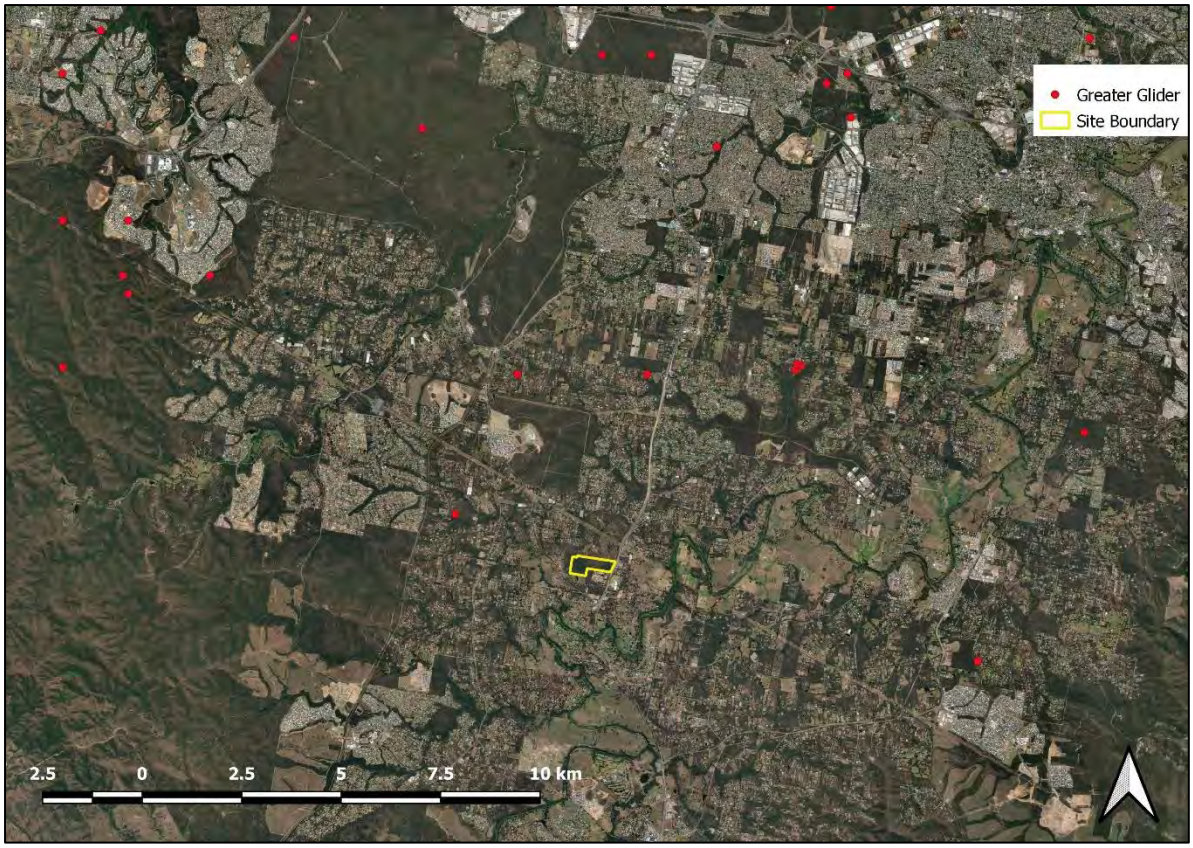


Figure 1: Locality of North Maclean showing the context of the site.

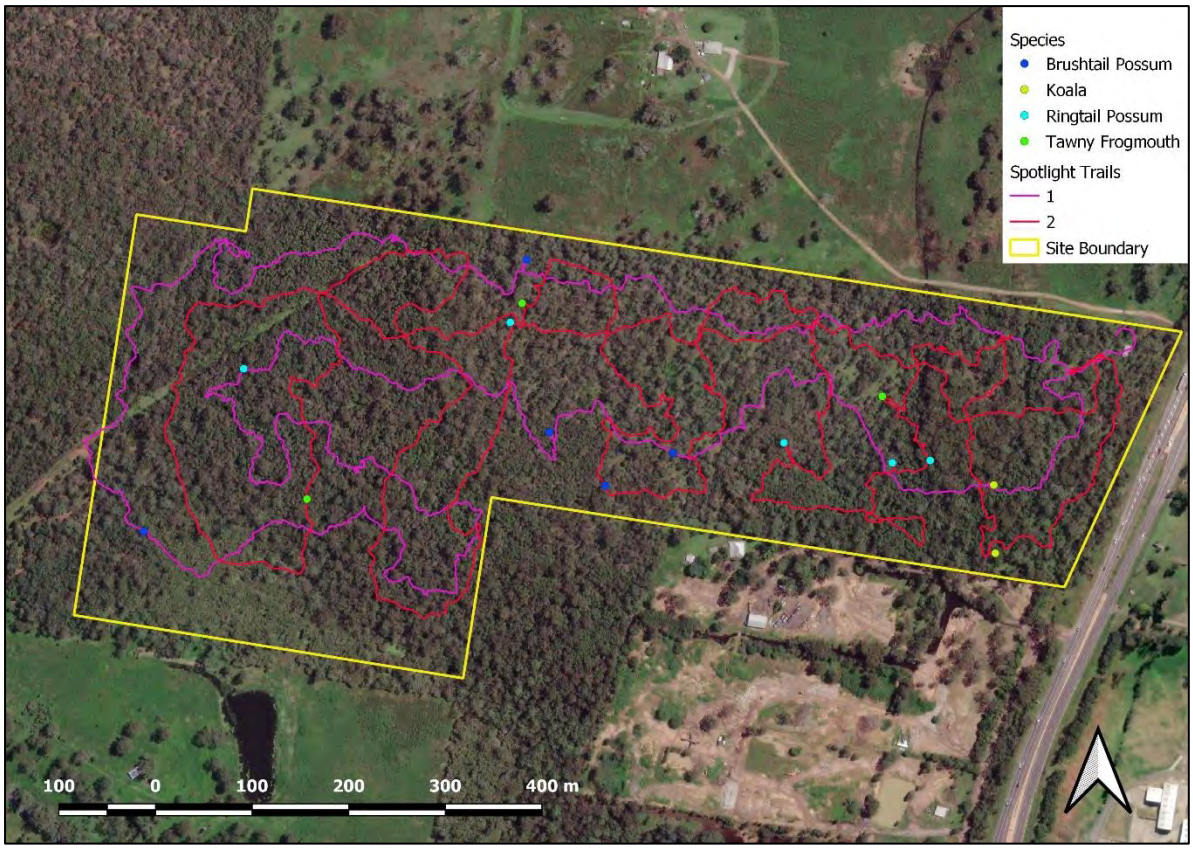


Figure 2: Spotlighting transects and animals records.

Table 3: Timing, weather conditions and results of the spotlighting survey of the Site in April 2023.
CBP = Common Brushtail Possum, CRP = Common Ringtail Possum

	Night	
	1	**2**
Start		
Time	19:05	19:17
Temperature (^{o}C)	19.3	16.9
Wind (direction/khr)	S, 4	-, 0
Relative Humidity (%)	82	99
Finish		
Time	21:48	21:52
Temperature (^{o}C)	17.0	16.5
Wind (direction/khr)	-, 0	-, 0
Relative Humidity (%)	95	100
Duration (hr)	2:43	2:35
Species		
CBP	4	1
CRP	1	4
Koala	1	1
Tawny Frogmouth	0	3

Offset Site

The proposed offset site at Rosewood (Lot 2 RP200424 Rosewood-Laidley Road) was inspected on 28 April 2023. The tree cover gradually becomes less mature to the east and the eastern half of the offset is grassland used for grazing. The Site is mapped as high value regrowth, which include 1,199 trees >30 cm DBH, including 415 trees >50 cm DBH (**Figure 3)**. Hollow-bearing trees are scattered a low density in the western half of the offset site and were recorded mostly in trees >50 cm DBH. Greater Gliders have not been recorded on the offset site.

The following tree species were recorded on the offset site and includes species of known importance to the Greater Glider:

- *Angophora leiocarpa*
- *Angophora floribunda*
- *Angophora subvelutina*
- *Corymbia intermedia*
- *Corymbia tessillaris*
- *Eucalyptus crebra*
- *Eucalyptus melanophloia*
- *Eucalyptus tereticornis*
- *Lophostemon suaveolens.*

The Rosewood offset site is cleared to the north, east and south. The Toowoomba Railway is on the site's southern boundary. Land to the west also supports high value regrowth, which joins to two patches of remnant vegetation. There is further connectivity to north-west where there is a substantial area containing large patches of remnant vegetation joined by smaller areas of high value regrowth. The three nearest Greater Glider records to the offset site are 7.0 – 8.7 km away

(**Table 4**; **Figure 4)**. There is relatively continuous tree cover between these records and the offset site, including large patches of remnant vegetation containing larger trees and hollow-bearing trees. These areas are also potential Greater Glider habitat. Thus, there is potential for the Greater Glider to reach the offset site, at least in the longer-term (i.e. up to several decades) if vegetative cover in the locality is allowed to persist and mature.

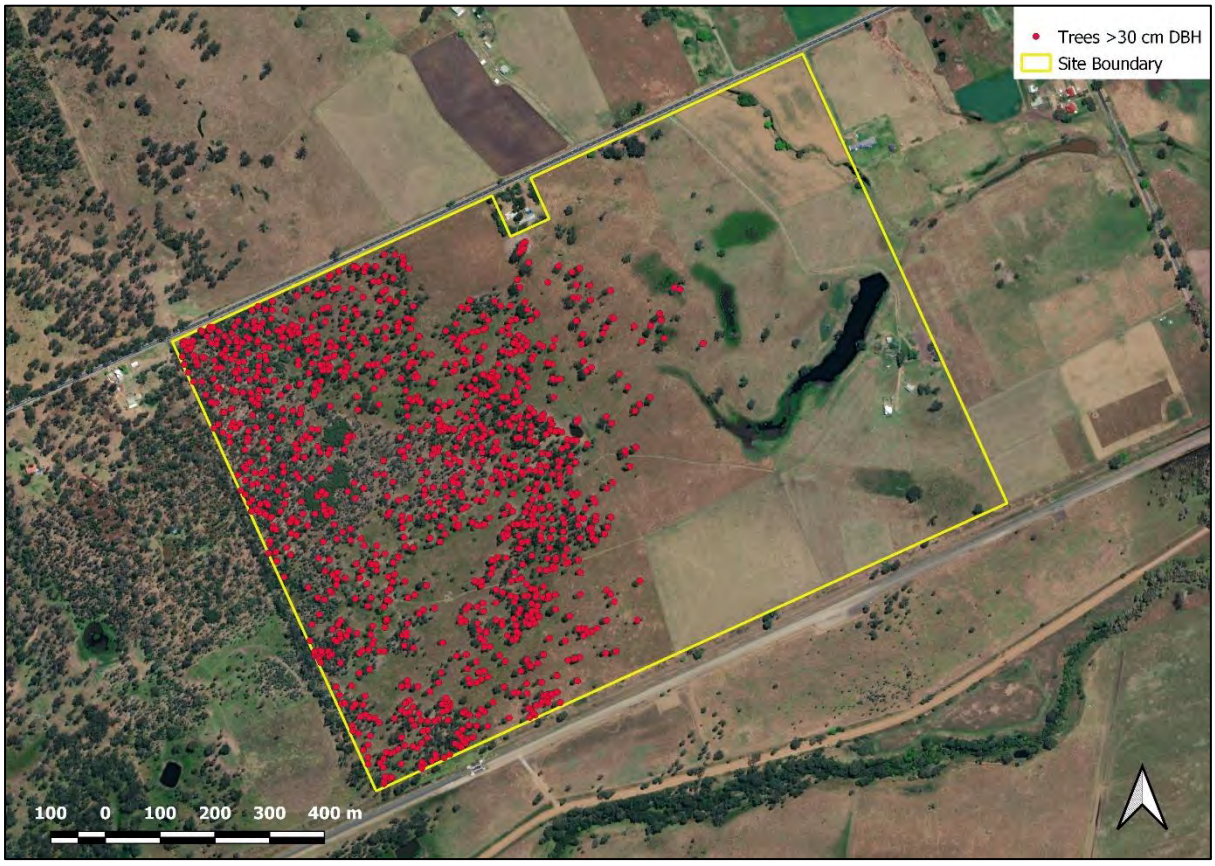


Figure 3: Distribution of large trees on the proposed offset site at Rosewood.

Table 4: Greater Glider records within 10 km of the Rosewood offset site.

Year	Distance (km)	Direction
1993	7.7	NNW
1993	8.7	NNE
2021	7.0	NNW

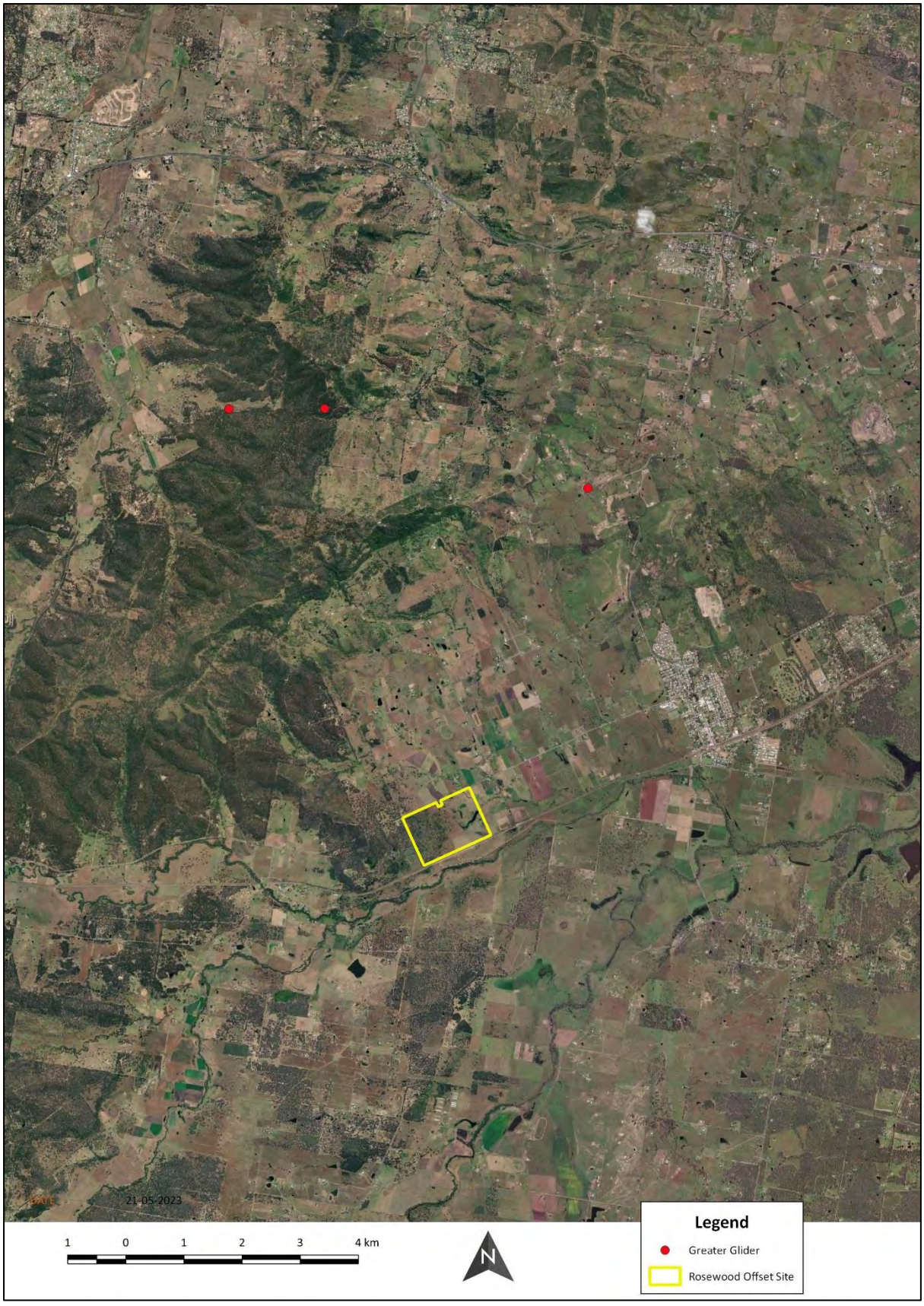


Figure 4: Greater Glider records within 10 km of the Rosewood offset site.

Discussion

Greater Gliders have not been detected on the Site despite 15 hrs of spotlighting in two distinct periods. Spotlighting studies reporting detection rates for the Greater Glider (see above) suggest that there is a very high likelihood it would have been detected on the site were it present. While tree hollows can be difficult to see from the ground, a consistent lack of observable hollows within a stand indicates at least a low abundance. Given that not all hollow-bearing trees would provide hollows suitable for the Greater Glider, the number of potential den trees on the Site must be low. Trees hollows appear to be currently limiting on the Site and in the locality. This is the most likely reason for the apparent current absence of the Greater Glider from the Site.

Regional Ecosystems and analogous High Value Regrowth on the Site are known to be used by the Greater Glider. Furthermore, *Corymbia intermedia*, *Eucalyptus moluccana* and *E. tereticornis* are associated with the Greater Glider in south-east Queensland (Eyre et al. 2022, Table 4). These species are present on the site and are consistent with the preclearing REs. There are 1,711 trees >30 cm DBH and 367 >50 cm DBH (28 South Environmental 2022). This suggests that both feed trees and den trees are present on the Site (after Eyre et al. 2022).

Although the patch size of vegetation mapped as RE and High-value Regrowth in the locality, including the Site, has not been determined, it is large enough to meet the patch size requirements of the Greater Glider given the range of patch sizes occupied (see Eyre et al. 2022, Table 6). There is no potential Greater Glider habitat to the north of the Site due to recent clearing on the adjacent property. To the east is Mt Lindsey Highway, which is likely to be a significant movement barrier to the species. Future duplication of the highway will further inhibit cross highway movement. Unlike Petaurid gliders, the Greater Glider has not been recorded using crossing structures (gliding poles, rope bridges) (e.g. Goldingay et al. 2013), so it is unlikely that this impact could be adequately mitigated. There is potential habitat connectivity to the west, although much of this vegetation is relatively immature and may not currently support Greater Gliders. Thus, colonisation of the project site is possible over the medium to long-term provided the intervening vegetation remains intact and is allowed to mature.

While the Greater Glider is not currently present on the Site, the critical habitat definition includes unoccupied habitat that may be colonized in the future as hollow-bearing trees become more common as the forest matures (DCCEEW 2022). While current landscape connectivity to the Site is likely to be poor due to the low abundance of hollow-bearing trees in the locality, this too would improve over time provided the remaining habitat remains sufficiently intact and is allowed to mature. Thus, habitat critical to the survival of the Greater Glider is present on the Site. While there is future colonisation potential, it may take decades before this occurs due to the length of time generally required for tree hollows to form (Mackowski 1984; Gibbons and Lindenmayer 2002). Given the development that is occurring in the locality of the project site, there is uncertainty regarding the long-term quantity and quality of habitat in the locality and whether site colonisation would ultimately occur.

The offset site at Rosewood does not currently support the Greater Glider, but potential habitat is present. Tree cover occurs in the western half of the offset site and includes tree species of known value to the Greater Glider. There are also a large number of large trees (1,199 >30 cm DBH, including 415 >50 cm DBH). The offset site also has a significant capacity to improve habitat quality for the Greater Glider over time by revegetation of cleared areas and the maturity of existing and future vegetation.

The offset site is linked to a large area of remnant and regrowth forest where there are two Greater Gliders records, one from 2021. While these records are over 7 km away, the intervening habitat provides continuous tree cover and large patches of remnant vegetation that contains large and hollow-bearing trees. Areas meeting these requirements are also potential habitat and it is possible that additional Greater Gliders may occur closer to the offset site. Thus, there is potential for the Greater Glider to colonise the offset site in the medium-term (10 – 20 years). Given the rural location of the offset site, there is likely to be greater long-term habitat security both on the offset site and in the surrounding locality relative to the North Maclean project site. The presence of regulated (remnant) vegetation in the offset locality also provides some long-term habitat security under State legislation. As such, the offset site may provide a better location for the recovery of the Greater Glider.

Significant Impact Assessment

A significant impact assessment for the Endangered Greater Glider is provided in **Table 5**.

Table 5: Significant impact assessment for the Endangered Greater Glider.

Criterion	Response
Lead to a long-term decrease in the size of a population	The Site does not currently appear to support the Greater Glider. Although there is future colonisation potential, the current situation implies that the proposal would not lead to a long-term decrease in the size of a Greater Glider population.
Reduce the area of occupancy of the species	The Site does not currently appear to support the Greater Glider. Although there is future colonisation potential, the current situation implies that the proposal would not reduce the area of occupancy of the Greater Glider.
Fragment an existing population into two or more populations	Mt Lindsey Highway forms the eastern boundary of the Site. Land to the north of the Site was recently cleared and there is only limited habitat to the south. The main potential habitat connection is therefore to the west. Habitat in the western third of the Site would be retained and remain connected to the west. Thus, the proposal would not fragment an existing Greater Glider population.
Adversely affect habitat critical to the survival of a species	Despite the apparent absence of the Greater Glider from the Site, it was determined that habitat critical to its survival is present as 1) the habitat characteristics suggest that potential habitat is present and 2) there is future colonisation potential provided adequate connectivity to the Site is maintained. The proposal would remove 20.15 ha of potential habitat. This constitutes an adverse impact to critical habitat for the Greater Glider.
Disrupt the breeding cycle of a population	The Site does not currently appear to support the Greater Glider. Thus, the proposal would

	not disrupt the breeding cycle of a Greater Glider population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal would not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Greater Glider is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposal is unlikely to introduce or exacerbate invasive species that are harmful to the Greater Glider or its habitat.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that is harmful to the Greater Glider.
Interfere with the recovery of the species	Recovery of the Greater Glider will include the rehabilitation of potential habitat that will enable colonisation to expand populations. This will be particularly important in fragmented habitat, such as the Site locality. By removing potential Greater Glider habitat, which would prevent future colonisation, the proposal may interfere with the recovery of the Greater Glider.

Conclusion

The proposed development site at North Maclean was assessed for its current and future potential to support the Greater Glider. Although the site possesses characteristics of Greater Glider habitat, spotlighting surveys have failed to locate the species. However, the proposed development would adversely affect habitat critical to the survival of the Greater Glider and may interfere with its recovery by preventing future colonisation of potential habitat. Therefore, the proposal would have a significant impact on the Greater Glider.

An offset site at Rosewood has been proposed and it currently supports some low quality foraging and denning habitat. The offset site is potentially linked to habitat with known Greater Glider records in the locality, but the quality of the link is not known. However, there is potential for the Greater Glider to colonised the offset over the course of up to several decades.

References

28 South Environmental (2022) Proposed Industrial Development at North Maclean Terrestrial Ecological Assessment Report Supporting a Controlled Action Referral to the Commonwealth Regulator, and a Development Application to Economic Development Queensland. Unpublished report by 28^{o}S Environmental, Fortitude Valley.

Berry, L.E., Driscoll, D.A., Banks, S.C. and Lindenmayer, D.B. (2015) The use of topographic fire refuges by the greater glider (*Petauroides volans*) and the mountain brushtail possum (*Trichosurus cunninghami*) following a landscape-scale fire. *Australian Mammalogy* **37**: 39-45.

Comport, S.S., Ward, S.J. and Foley W.J. (1996) Home ranges, time budgets and food-tree use in a high-density tropical population of Greater Gliders, *Petauroides volans minor* (Pseudocheiridae: Marsupialia). *Wildlife Research* **23**, 401-19.

Cunningham, R.B. and Lindenmayer, D.B. (2005) Modeling count data of rare species: some statistical issues. *Ecology* **86**, 1135-42.

DCCEEW (2022) Conservation Advice for Petauroides volans (Greater Glider (southern and central)). Department of Climate Change, Energy, the Environment and Water, Canberra.

Debus, S.J.S. (1995) Surveys of large forest owls in northern New South Wales: methodology, calling behaviour and owl responses. *Corella* **19**, 38-50.

Eyre T.J. (2002) Habitat preferences and management of large gliding possums in southern Queensland. PhD Thesis. Southern Cross University, Lismore, NSW.

Ecosmart Ecology (2022) Fauna Survey of Lot 1, RP 113251, North Maclean. Unpublished report to 23 South Environmental, Fortitude Valley Qld.

Eyre T.J. (2006) Regional habitat selection of large gliding possums at forest stand and landscape scales in southern Queensland, Australia: I. Greater glider (*Petauroides volans*). *Forest Ecology and Management* **235**, 270-82.

Eyre, T.J., Smith, G.C., Venz, M.F., Mathieson, M.T., Hogan, L.D., Starr, C., Winter, J. and McDonald K. (2022) *Guide to Greater Glider Habitat in Queensland*. Department of Agriculture, Water and the Environment, Canberra. Department of Environment and Science, Queensland Government, Brisbane.

Foley, W.J. (1987) Digestion and energy metabolism in a small arboreal marsupial, the greater glider (*Petauroides volans*), fed high-terpene *Eucalyptus* foliage. *Journal of Comparative Physiology B* **157**, 355-62.

Foley, W.J., Kehl, J.C., Nagy, K.A., Kaplan, I.R. and Borsboom, A.C. (1990) Energy and water metabolism in free-living greater gliders, *Petauroides volans*. *Australian Journal of Zoology* **38**, 1-9.

Gibbons, P. and Lindenmayer, D. (2002) *Tree Hollows and Wildlife Conservation in Australia*. CSIRO, Melbourne.

Goldingay, R.L., Rohweder, D. and Taylor, B.D. (2013) Will arboreal mammals use rope-bridges across a highway in eastern Australia? *Australian Mammalogy* **35**, 30-8.

Goldingay R.L., McHugh D. and Parkyn J.L. (2022) Multiyear monitoring of threatened iconic arboreal mammals in a mid-elevation conservation reserve in eastern Australia. *Ecology and Evolution* **12**, e8935.

Gracanin A., Pearce A., Hofman M., Knipler M. and Mikac K.M. (2022) Greater glider (*Petauroides volans*) live capture methods. *Australian Mammalogy* **44**, 280-6.

Gu, W. and Swihart, R.K. (2003) Absent or undetected? Effects of non-detection of species occurrence on wildlife-habitat models. *Biological Conservation* **116**, 195-203.

Henry, S.R. (1984) Social organisation of the greater glider (*Petauroides volans*) in Victoria. In: *Possums and Gliders* (eds A. P. Smith and I. D. Hume) pp. 221-8. Surrey Beatty & Sons, Sydney.

Hofman M., Gracanin, A. and Mikac, K.M. (2022) Greater glider (*Petauroides volans*) den tree and hollow characteristics *Australian Mammalogy*, A-K.

Jensen L. M., Wallis I. R. and Foley W.J. (2015) The relative concentrations of nutrients and toxins dictate feeding by a vertebrate browser, the greater glider *Petauroides volans*. *PLOS ONE* **10**, e0121584.

Kavanagh, R.P. (1984) Seasonal changes in habitat use by gliders and possums in southeastern New South Wales. In: *Possums and Gliders* (eds A. P. Smith and I. D. Hume) pp. 527-43. Surrey Beatty & Sons, Sydney.

Kavanagh, R.P. and Lambert, M.J. (1990) Food selection by the Greater Glider, *Petauroides volans* - Is foliar nitrogen a determinant of habitat quality? *Wildlife Research* **17**, 285-99.

Kavanagh, R.P. and Bamkin, K.L. (1995) Distribution of nocturnal forest birds and mammals in relation to the logging mosaic in south-eastern New South Wales, Australia. *Biological Conservation* **71**, 41-53.

Kavanagh, R.P., Debus, S., Tweedie, T. and Webster, R. (1995) Distribution of nocturnal forest birds and mammals in north-eastern New South Wales: relationships with environmental variables and management history. *Wildlife Research* **22**, 359-77.

Kéry, M. (2002) Inferring the absence of a species - a case study of snakes. *Journal of Wildlife Management* **66**, 330-8.

Lindenmayer D.B., Cunningham R.B., Donnelly C.F., Incoll R.D., Pope M.L., Tribolet C.R., Viggers K.L. and Welsh A.H. (2001a) How effective is spotlighting for detecting the greater glider (*Petauroides volans*)? *Wildlife Research* **28**, 105-9.

Lindenmayer D.B., Ball I., Possingham H.P., McCarthy M.A. and Pope M.L. (2001b) A landscape-scale test of the predictive ability of a spatially explicit model for population viability analysis. *Journal of Applied Ecology* **38**, 36-48.

Lindenmayer, D.B., Pope, M.L. and Cunningham, R.B. (2004) Patch use by the greater glider (*Petauroides volans*) in a fragmented forest ecosystem. II. Characteristics of den trees and preliminary data on den-use patterns. *Wildlife Research* **31**, 569-77.

Lindenmayer, D.B., Blanchard, W., McBurney, L., Blair, D., Banks, S.C., Driscoll, D., Smith, A.L. and Gill, A.M. (2013) Fire severity and landscape context effects on arboreal marsupials. *Biological Conservation* **167**: 137-48.

Mackowski, C.M. (1984) The ontogeny of hollows in blackbutt (*Eucalyptus pilularis*) and its relevance to the management of forests for possums, gliders and timber. In: *Possums and Gliders* (eds Smith, A.P., Hume and I.D.) pp. 553-67. Surrey Betty & Sons, Sydney.

McGregor D. C., Padovan A., Georges A., Krockenberger A., Yoon H.-J. and Youngentob K.N. (2020) Genetic evidence supports three previously described species of greater glider, *Petauroides volans*, *P. minor*, and *P. armillatus*. *Scientific Reports* **10**, 19284.

Moore, B. D., Wallis,, I.R., Mars,h K.J. and Foley, W.J. (2004) The role of nutrition in the conservation of the marsupial folivores of eucalypt forests. In: *Conservation of Australia's Forest Fauna, 2nd Edition* (ed D. Lunney) pp. 549-75. Royal Zoological Society of New South Wales, Mosman, NSW.

Smith, P. and Smith, J. (2018) Decline of the greater glider (*Petauroides volans*) in the lower Blue Mountains, New South Wales. *Australian Journal of Zoology* **66**, 103-14.

Smith, G.C., Mathieson, M. and Hogan, L. (2007) Home range and habitat use of a low-density population of greater gliders, *Petauriodes volans* (Pseudocheiridae: Marsupialia), in a hollow-limiting environment. *Wildlife Research* **34**, 472-83.

Starr C.R., Hughes R.T., Hemmings M.S., Coase J.F. and Jess M.D. (2021) Field studies of a high elevation population of northern greater glider *Petauroides volans minor* in the Bluff State Forest, Far North Queensland. *Australian Zoologist*.

van der Ree, R. and Loyn, R.H. (2002) The influence of time since fire and distance from fire boundary on the distribution and abundance of arboreal marsupials in *Eucalyptus regnans*-dominated forest in the Central Highlands of Victoria. *Wildlife Research* **29** 151-58.

Wagner, B., Baker, P.J., Stewart, S.B., Lumsden, L.F., Nelson, J.L., Cripps, J.K., Durkin, L.K., Scroggie, M.P. and Nitschke, C.R. (2020) Climate change drives habitat contraction of a nocturnal arboreal marsupial at its physiological limits. *Ecosphere* **11**, e03262.

Wintle, B.A., Kavanagh, R.P., McCarthy, M.A. and Burgman, M.A. (2005) Estimating and dealing with detectability in occupancy surveys for forest owls and arboreal marsupials. *Journal of Wildlife Management* **69**, 905-17.

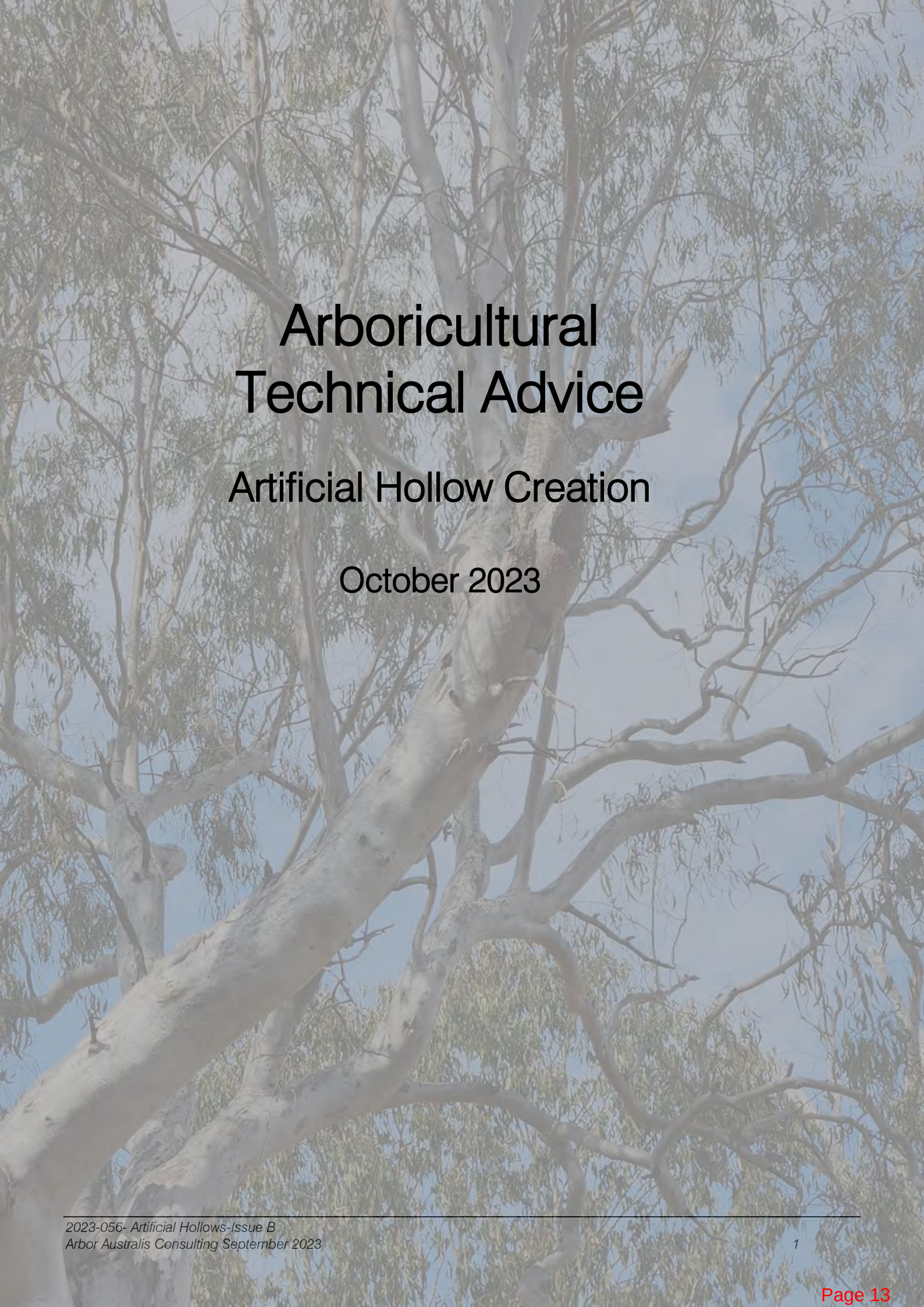
Woinarski, J., McCosker, J., Gordon, G., Lawrie, B., James, C., Augusteyn, J., Slater, L. and Danvers, T. (2006) Monitoring change in the vertebrate fauna of central Queensland, Australia, over a period of broad-scale vegetation clearance, 1973—2002. *Wildlife Research* **33**, 263-274.

Wormington K., Lamb D., McCallum,, H. and Moloney D.J. (2002) Habitat requirements for the conservation of arboreal marsupials in dry sclerophyll forests of Southeast Queensland, Australia. *Forest Science* **48**, 217-27.

28°S ENVIRONMENTAL

Attachment 3

Arboricultural Impact Assessment and Artificial Hollow Construction Reporting



Arboricultural Technical Advice

Artificial Hollow Creation

October 2023

ARBOR AUSTRALIS
CONSULTING

20th October 2023

Attention: Wayne Moffitt
Director – 28 South Environmental

28 South Environmental
11/43 Martin Street
Fortitude Valley
QLD 4006

Dear Wayne,

Re: Artificial Hollow Creation, Arboricultural Technical Advice.

I am pleased to submit our assessment and advice on the potential of Chainsaw Cut and Hollowhog carved hollows as artificial habitat design locations for *Petauroides spp,* (Greater Gliders) within the offset site.

I trust that you find this assessment both satisfactory and helpful. Should you wish to discuss any of its recommendations or arrange for them to be implemented, please contact me on 07 3379 7793.

Yours sincerely,

Jeremy Young
Managing Director
Cert Arb (UK) | Adv Dip Hort (Arb) | Dip Arb
Certified Arborist AU-0011A
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Document Control

Document:

Project Name: Maclean Estates Offset Site
Report Name: Technical Advice, Chainsaw Cut Hollows

Contact:

Contact Name: Wayne Moffitt
Contact Position: Director
Contact Organisation: 28 South Environmental

This document has been prepared by: Arbor Australis Consulting (AAC)

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Revision History

Version	Date	Details	Author	Reviewed	Authorised
Issue A	05/09/2023	Arboricultural Technical Advice	Jeremy Young	JB	JY
Issue B	20/10/2023	Updated to Include Hollow Hog Hollows	Jeremy Young	JB	JY

Assessment Team:

Tree Survey: Jeremy Young (AQF 6).
Technical Advice: Jeremy Young.

Author Qualification and Experience Summary:

- Jeremy Young
- AQF level 6 (Arboriculture).
- 35 Years of industry experience.
- Arboriculture Australia, Approved Consultant.
- Queensland Arboricultural Association, Approved Consultant.
- Brisbane City Council, Panel of Providers, Arboricultural Consultant.

Arboricultural Impact Assessment. Experience in over 1400 projects in the past eight years, ranging from small developments to major infrastructure development.

Table of Contents:

1. Scope:

Assessment of existing trees to identify opportunities to artificially develop or introduce hollows through the relatively new practice of chainsaw cut hollows (CCH) and Hollowhog carved hollows(HHH). The target fauna species for which the hollows are to be developed is the *Petauroides spp*, Greater Glider.

The Greater Glider requires larger hollows with good thermal qualities. No documentation sets out a CCH or HHH methodology specifically for this species, and limited research has been conducted on the success of CCH or HHH for Greater Gliders. However, recent research provided in the technical advice provided by 28 South Environmental (Insert 5) has indicated positive results.

Due to the limited information available, this advice aims to propose selection criteria and considerations required to determine trees that may be suitable candidates for CCH or HHH.

2. Offset Site:

454-544 Rosewood-Laidley Road, Lanewood, Qld 4340

Image 1: Offset site indicated approximately by the red polygon.

The offset site is open woodland where cattle currently graze. This grazing has impeded tree regrowth. The trees onsite are predominantly of semi-mature age, with a few mature and over-mature trees. Tree life stage is an essential indicator of the likelihood of hollow development, with hollows typically not present until trees reach the late to over-mature stages of life.

3. Methodology:

Following the initial request for an assessment and advice concerning chainsaw cut hollows to achieve denning opportunities for Greater Glider species, a tree assessment and survey was conducted. This assessment sought opportunities to achieve new artificial habitat design locations without compromising existing tree habitat features.

The survey has been updated (October 2023) to include opportunities for Hollowhog hollows within trees that already have natural hollows present.

All measurements have been estimated, and the assessment for hollow opportunities has been conducted from the ground. Tree location and numbering has been plotted using the GPS coordinates provided by 28 South Environmental, and all tree numbering has been retained to ensure continuity between reports.

The requirements for the Greater Glider hollows have been based on the technical note provided by Dr David Sharp.

4. Natural Hollow Development:

An understanding of hollow development and the tree's natural response to wounding and decay is required to determine the opportunities to impose artificial hollows on trees.

Crown hollow development is primarily a result of decay in over-mature trees that have experienced branch, branch union or stem failures. These failures expose dysfunctional heartwood to the air. This exposure to the air reduces the moisture content in the cells and stimulates the decay pathogens that are latent in the timber. Decay can enter the tree through spores colonising the wound site; however, recent research indicates this is less likely than pathogens already dormant in the wood structure.

Decay progresses relatively slowly as fugal hyphae exude enzymes that break down cellulose and lignin. At the same time, the trees actively try to compartmentalise (resist) the decay pathogen through chemical alteration of cells to create barrier zones. Compartmentalisation occurs in the living tissue of the tree (sapwood), not the heartwood. The basic principle of compartmentalisation is the forming of internal chemical walls or barriers, increasing in effectivity from 1-4:

- Barrier Zone 1 is the longitudinal zone parallel to tree growth, on a trunk this is above and below the wounding site. At the time of wounding, the border pits are altered through a process called tylosis. Barrier zone 1 is the weakest of the barrier zones due to the large sap vessels that allow fungal hyphae movement.

- Barrier Zone 2 is the marginal axial parenchyma (growth rings). At the time of wounding, the tree will chemically alter the cells and create a barrier at the current growth ring. The barrier resists the spread of decay inwards from the wounding site.

- Barrier Zone 3 is the medullary or parenchyma rays which radiate like spokes of a bike wheel from trunk centre. This chemical barrier resists and limits the lateral spread of decay.

- Barrier Zone 4 is laid down at the time of wounding by the area of the cambium that is still functioning at the edge of the wound site. This barrier resists the spread of decay into the new wound wood that develops around the wound site and is the strongest defence against decay.

The rate of decay and speed of hollow development is highly variable. Tree species, vigour, and vitality, play a significant role in the rate of decay that results in hollow development.

Some examples of variations:

Growing Location, Trunk Size Variation:

- A Queensland Blue Gum *(Eucalyptus tereticornis)* growing in an alluvial loam, close to a water supply is unlikely to reach over maturity until the age of 250 years. It may be 2m+ in trunk diameter before hollows start to develop. Trees in this growing environment typically have a higher vitality and energy reserves that can be utilised in defence against decay.
- Whereas a Queensland Blue Gum *(Eucalyptus tereticornis)* growing in poor soil with limited water supply will age quicker and put on less annual increment growth, so over-maturity may be reached in 100 - 150 years. Trees in this growing environment have reduced vitality and, as a result, have less energy reserves that can be utilised for active defence against decay.

Species, Decay Rate Variation:

- A Narrow-leaved Red-Ironbark *(Eucalyptus crebra*) has a dense wood structure with high lignin content. This provides a physical barrier to fungal hyphae movement through the timber and impedes decay, slowing the development of hollows.
- Whereas a Scribbly Gum *(Eucalyptus racemosa)* has a low timber durability rating with low lignin content in its heartwood. This species will typically begin to develop hollows within 30 years.

The examples above are only a snapshot of the variability of hollow development. The tree's trunk diameter/DBH (diameter at breast height) or tree's height has little to no bearing on the likelihood of hollows being present. The tree's life stage because of its growing environment, is by far a better indicator.

5. Hollow Opportunities:

The development of artificial hollows through CCH or HHH methodology needs to consider the fauna requirements it is intended for, the tree structure, the presence of other habitat features and the biological function of the tree. The following is a summary of conditions that collectively need to be satisfied to meet the potential for creating hollows.

Existing Hollows: Trees previously mapped by 28 South Environmental that have existing hollows were initially excluded from consideration; however, as part of the October 2023 update, they have been included as opportunities for HHH. The selection criteria also identify the trees with existing hollows as having the potential for hollow improvement to meet the needs of the Greater Glider. This will need to be weighed against the benefit they currently provide to other species.

Thermal Qualities: Dead trees (stags) have been excluded from the assessment due to their limited thermal qualities not being suitable or preferred by the Greater Gliders.

Hollow Location: Greater Gliders prefer branch-end hollows over vertical trunk hollows. The assessment has focused on the opportunity for branch-end hollow development; however, opportunities have also been listed where a good opportunity exists to position a hollow in a trunk.

Structure: Hollows should not create a significant weakness or a significantly increased probability of failure at the site of the artificial hollow.

Risk: In considering Risk of Harm (RoH) artificial hollows may pose, the risk is acceptable for this site as there is a low probability of people (target) being present should a tree failure occur. The only portion of the site that should be considered as posing a potentially unacceptable risk is adjacent to Rosewood-Laidley Road, where target increases.

However, maintaining acceptable levels of structure at the site of hollow generation is essential to avoid failures that would compromise the habitat created. For this reason, end weight reduction or branch removal will be required to reduce load.

6. Hollow Branch Structure for Greater Glider:

Requirements for denning hollows for greater glider are:

- Den opening of 130mm.
- A 200mm x 200mm hollow void in cross-section.
- A minimum of 50mm in wall thickness around the hollow void.
- The length of the hollow void to be 0.5m – 2.0m

To achieve and meet these requirements and create the branch-end hollows, the branch needs to be a minimum of 375mm in diameter. This achieves 47% of retained cross-section and 66% of the outer circumference undamaged, ensuring sap flow, living branch structure, and providing opportunity for response growth. This may be possible at sites of previous branch failures or by cutting appropriately sized branches.

**Please note:* The Hollowhog carving method is a recently invented innovative system. In reviewing the online information regarding the method & tool, there may be limitations in achieving the required denning depths from the entry point required for the Greater Glider.

Images 2 and 3: Example of hollows created with the Hollowhog carving tool (HHH).

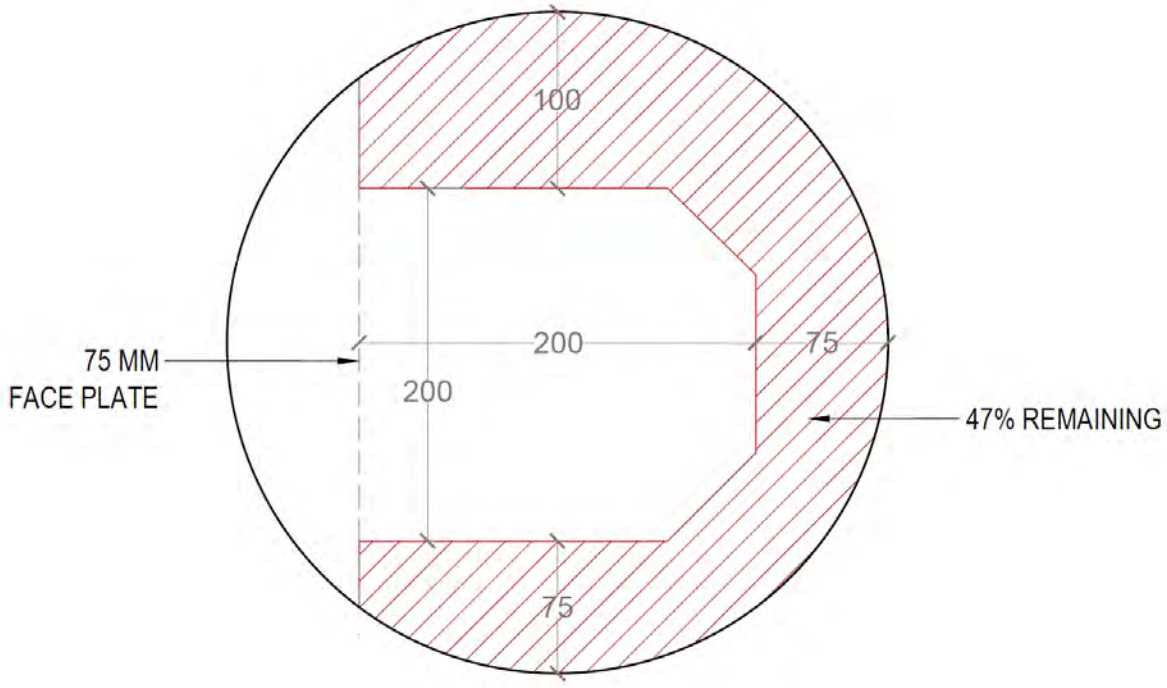


Image 4: Cross section of the proposed branch Chainsaw Cut Hollow (CCH)

Image 5: Example where the red line indicates the pruning point where the branch would be removed to create the chainsaw cut hollow. The branch end removal reduces load on the hollow site.

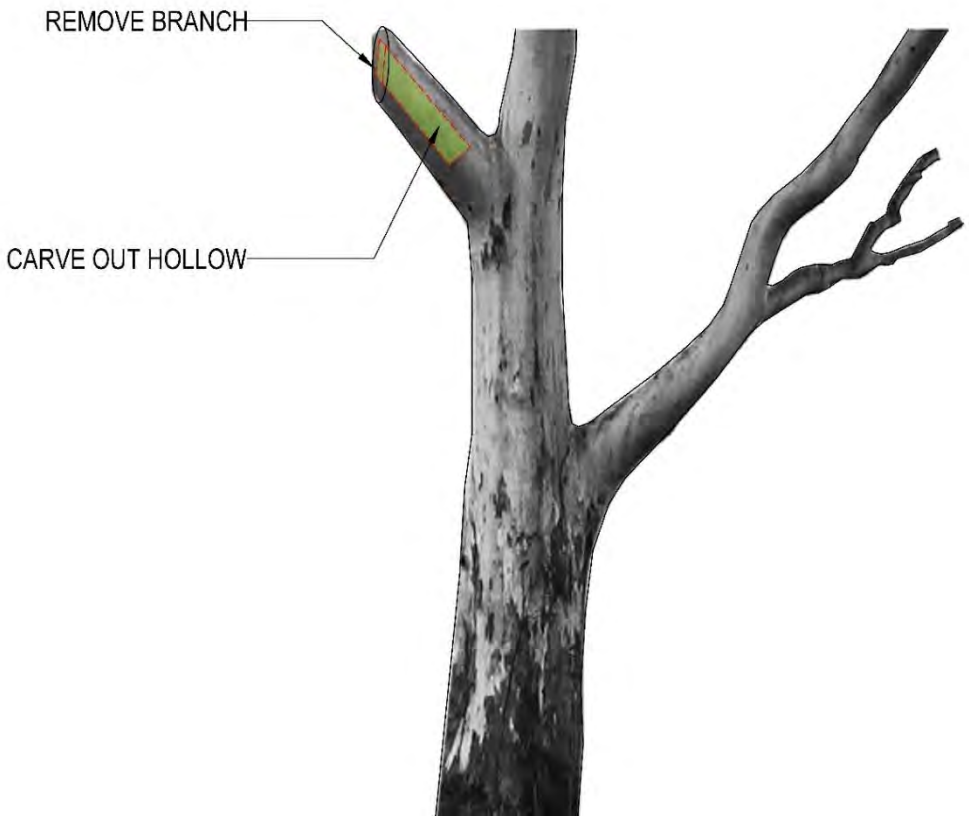


Image 6: Following the removal of the branch, the hollow will be carved into the side of the branch stub.

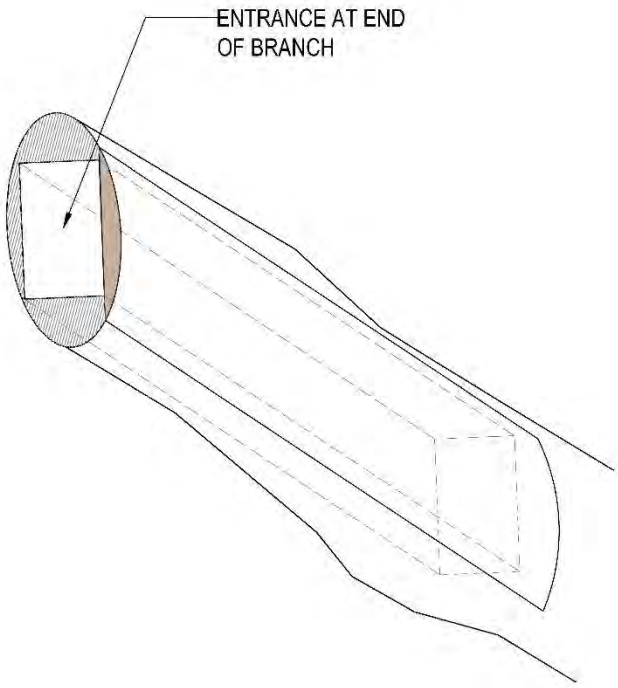


Image 7: The best option for the entrance hole will be determined on a branch-by-branch basis. The sketch above shows the option for an open-ended entrance point.

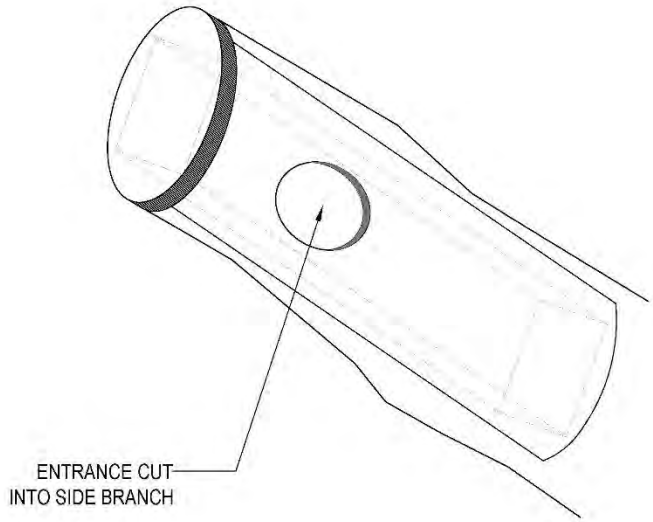
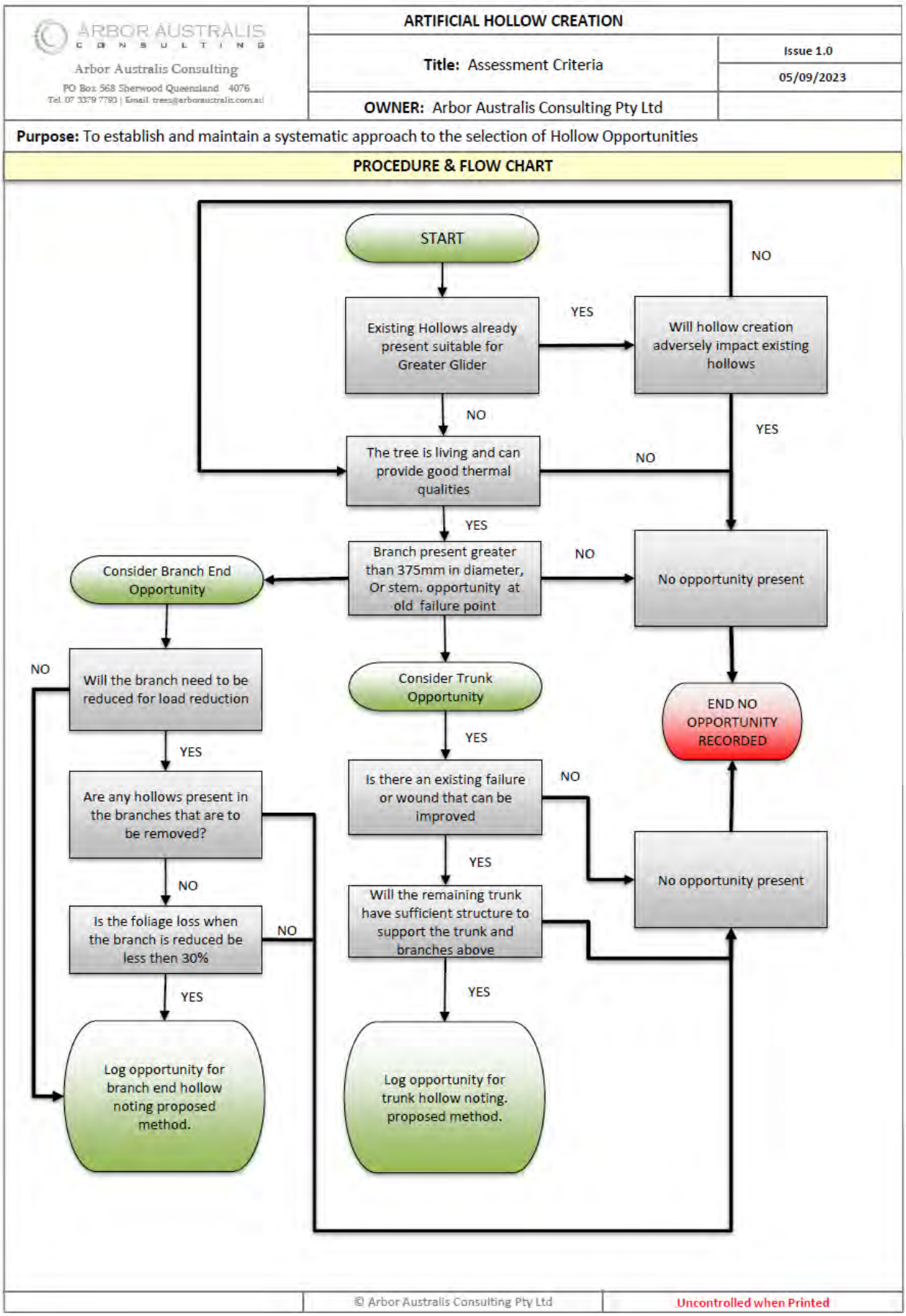


Image 8: Side access entrance holes may be better in more upright hollows.

**NOTE: No two hollows will be identical, and the methodologies outlined in the report provide various options for creating the hollows. The arborist creating the hollows needs to have some scope for flexibility to ensure the hollow is created for the specific location on the tree.*

7. Artificial Hollow, Selection Criteria:



8. Discussion:

Chainsaw Cut Hollows and Hollowhog Hollows are a relatively new approach to creating artificial habitat hollows. These can be sized based on the targeted fauna species by altering position, orientation, and hollow and entrance sizes. The overall success of CCH and HHH for Greater Glider is yet to be proven; however, the benefits of an artificially created hollow in living trees appear to solve the thermal limitation of hollow boxes.

The opportunity for improving denning sites for Greater Gliders through artificial hollows needs to be carefully balanced against the adverse impacts that wounding the trees will have. It is imperative that the tree recovers from the wounding and continues to grow. Living trees with hollows will continue to provide the hollow shelters and dens with good thermal qualities.

The size required for the hollow to suit the Greater Glider is the most significant factor limiting the number of opportunities. To achieve the required thermal qualities and maintain some structural integrity to support the regrowth, the branches or trunk must be a minimum of 375mm in diameter to achieve the internal void requirements.

For overall tree health to be maintained, it is recommended that foliage loss to create the branch end hollow must not exceed 30% of the total crown foliage. This is to ensure the tree has sufficient photosynthetic material remaining to generate carbohydrates (energy) for continuing cell function and a sufficient to supply of energy for the active defence of decay, secondary thickening (cell division from the cambium) and foliage regeneration around the hollow.

A number of trees that had branch structures suitable for branch end hollows were excluded from the opportunities due to smaller habitat hollows present that would have been removed in the process. The creation of artificial hollows should not be at the expense of other habitat features.

Trunk hollow opportunities can be created without the loss of foliage; however, they require greater structural integrity to sustain and support the trunk, branches, and foliage above. The opportunities onsite for this type of hollow, at the size required were on the largest of the trees only. The use of existing features or wounds, on or close to the trunk, allows the introduction of artificial hollows with only limited loss of structure.

From the ground-based review of all trees greater than 500mm DBH, 48 trees have been identified as having opportunities to create artificial hollows for Greater Gliders. Of these 48 opportunities, 28 are located at branch ends, and 20 are located in trunks. Six trees have a structure suitable to achieve multiple hollows; however, these trees have only been counted as one opportunity.

9. Further Consideration

The development of artificial could be supplemented with other environmental arboricultural practices to promote a diversity of hollows and improve the overall biodiversity.

Whilst dead trees (stags) are reported to not have the thermal qualities suitable for Greater Glider, the presence of a hollow provides an opportunity for potential habitat improvement. This could be achieved by planting a Fig Tree (*Ficus spp.*) at the base on the trunk and utilising the root development to encapsulate the dead hollow with living wood.

The potential success of this proposed management is untested, and will take some time to develop the required structure; however, it aims to utilise the hollow assets present.

Trees identified by 28 South as having existing hollows may have hollows that are not currently of a size to be beneficial to Greater Gliders that can be increased in size. A review of the aerial assessment data and further arboricultural advice in relation to the current hollow benefits will help inform this option.

10. Data Table, Maclean Estates, 454-544 Rosewood-Laidley Road, Rosewood:

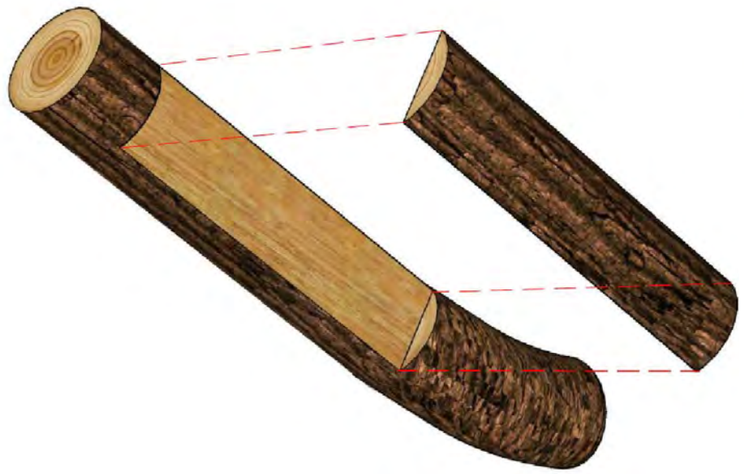
Artificial Hollow Opportunity									
ID	Species	DBH (mm)	Tree Height (m)	CCH Opportunities	Branch Diameter (At Hollow Opp)	Branch Height (At Hollow Opp)	Foliage Loss (%)	Hollow Type	Chainsaw Cut Hollow Note
189	*Eucalyptus tereticornis*	1260	25	CCH	400	10	3	Branch End	Lower branch on Northern side
234	*Eucalyptus tereticornis*	1000	18	CCH	400	10	5	Branch End	Lower branch Northern side
309	*Eucalyptus tereticornis*	1020	20	CCH	400	10	5	Branch End	Multiple opportunities existing branch failures
339	*Eucalyptus tereticornis*	1280	17	CCH	500	20	0	Trunk	In trunk below old limb failure. Eastern side
414	*Eucalyptus tereticornis*	1130	22	CCH	400	12	0	Branch End	Use existing branch failure on eastern side
415	*Eucalyptus tereticornis*	1040	19	CCH	400	8	2	Branch End	Lower branch on northeastern side. Also other opportunities on the tree higher up
417	*Eucalyptus tereticornis*	650	19	CCH	500	10	0	Branch End	Use existing branch failure on western side. Also other opportunities higher in the tree.
431	*Eucalyptus tereticornis*	710	20	CCH	400	10	30	Branch End	Western side main leader
456	*Eucalyptus tereticornis*	990	22	CCH	500	18	0	Trunk	On trunk below old failure
501	*Lophostemon suaveolens*	854	15	CCH	400	15	30	Branch End	Main leader Eastern side
507	*Eucalyptus tereticornis*	1070	19	CCH	400	10	10	Branch End	Lower branch to the south
536	*Eucalyptus tereticornis*	1080	20	CCH	400	12	5	Branch End	Lower branch on Northern side
581	*Eucalyptus tereticornis*	1190	23	CCH	400	18	1	Branch End	Use existing branch failure southern side
646	*Corymbia tessellaris*	570	16	CCH	400	10	0	Trunk	Existing crown failure. Upright hollow
656	*Eucalyptus tereticornis*	1290	22	CCH	400	8	10	Branch End	Lower branch on northern side
691	*Eucalyptus tereticornis*	1210	25	CCH	500	12	0	Branch End	Use existing branch failures. Upright hollow
702	*Eucalyptus tereticornis*	1100	23	CCH	500	10	0	Branch End	Use existing branch failure. Upright hollow southern side
718	*Eucalyptus tereticornis*	850	19	CCH	400	8	30	Trunk	Upright hollow stem to the southeast
899	*Eucalyptus tereticornis*	920	20	CCH	500	400	10	Branch End	Lower branch to the north
902	*Eucalyptus melanophloia*	830	22	CCH	400	15	20	Branch End	Leader on southeastern side. Upright hollow
943	*Eucalyptus tereticornis*	1120	21	CCH	400	12	3	Branch End	Second branch on Northern side
959	*Eucalyptus tereticornis*	510	19	CCH	400	15	5	Branch End	Multiple options check tree number tree is 1300 DBH
966	*Eucalyptus tereticornis*	1070	27	CCH	400	14	5	Branch End	Lower or second branch to the northeast
976	*Eucalyptus tereticornis*	1730	30	CCH	400	10	10	Branch End	Lower branch on the northern side

Artificial Hollow Opportunity									
ID	Species	DBH (mm)	Tree Height (m)	CCH Opportunities	Branch Diameter (At Hollow Opp)	Branch Height (At Hollow Opp)	Foliage Loss (%)	Hollow Type	Chainsaw Cut Hollow Note
1046	*Eucalyptus tereticornis*	1080	32	CCH	400	12	5	Branch End	Lower branch north side
1052	*Eucalyptus tereticornis*	1190	20	CCH	400	10	15	Trunk	Upright hollow on stem on the western side
1245	*Eucalyptus tereticornis*	1060	22	CCH	400	10	5	Branch End	Lowest branch on northern side
1302	*Eucalyptus tereticornis*	930	25	CCH	400	18	2	Trunk	Improve existing limb failure on southern side.
1326	*Eucalyptus tereticornis*	1040	25	CCH	400	18	5	Branch End	Upper branch on southern side
1439	*Eucalyptus tereticornis*	1060	21	CCH	400	8	5	Branch End	Lower branch on northwestern side
380	*Eucalyptus tereticornis*	1590	26	HHH	375	18	0	Trunk	Main stem past dead stub near union
1268	*Eucalyptus tereticornis*	870	24	HHH	375	18	0	Trunk	Main stem, tree height updated
1270	*Eucalyptus tereticornis*	1250	19	HHH	375	14	0	Trunk	Main stem at union
301	*Lophostemon suaveolens*	1280	18	HHH	375	12	0	Trunk	Main stem, height updated
503	*Eucalyptus tereticornis*	1280	26	HHH	375	18	0	Trunk	Main stem
632	*Eucalyptus tereticornis*	620	13	HHH	375	10	0	Trunk	Main stem 10-12m
697	*Eucalyptus tereticornis*	510	16	HHH	375	18	0	Trunk	Main stem
171	*Eucalyptus tereticornis*	900	20	HHH	375	12	0	Trunk & Branch End	Main stem or existing broken branch 12m and 15m 2 opportunities
937	*Eucalyptus tereticornis*	1400	26	HHH	375	20	0	Trunk & Branch End	3 0pportunitie branch end western side 20m, 2 on main stems at 15m
283	*Eucalyptus tereticornis*	1150	28	HHH	375	18	0	Trunk	Main stem
215	*Eucalyptus tereticornis*	1600	23	HHH	375	18	0	Trunk	Main stem
180	*Eucalyptus tereticornis*	880	25	HHH	375	15	0	Trunk	Main stem
715	*Eucalyptus crebra*	770	17	HHH	375	10	0	Trunk	Main stem
953	*Eucalyptus melanophloia*	1220	24	HHH	400	15	0	Trunk	3 stem opportunities
259	*Eucalyptus tereticornis*	710	24	HHH	375	12	2	Trunk & Branch End	Main stem 12m and western side 17m (reduce branch) hollow hog hollows
508	*Eucalyptus tereticornis*	620	18	HHH	375	15	0	Trunk	Main stem 15m, below dead branch
531	*Eucalyptus tereticornis*	950	20	HHH	375	15	0	Trunk	Main stem
508	*Eucalyptus tereticornis*	800	21	HHH	375	13	0	Trunk	Main stem
531	*Eucalyptus tereticornis*	1180	23	HHH	375	16	0	Trunk	Main stem, central leader near union. Height updated

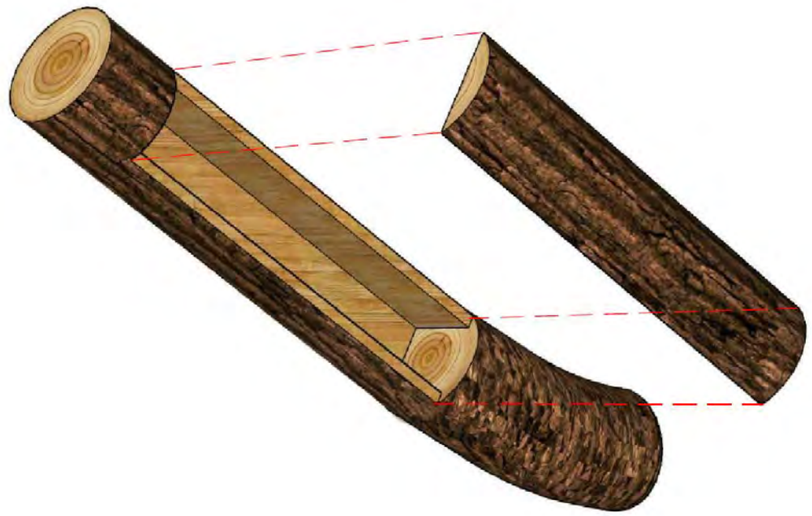
11. Appendix 1: Branch End Hollow with Side Entrance, Creation Methodology

(Chainsaw Cut Hollow) NB: For branches that are more upright and or do not have an existing hollow present. Hollow in trunks will follow a similar methodology.

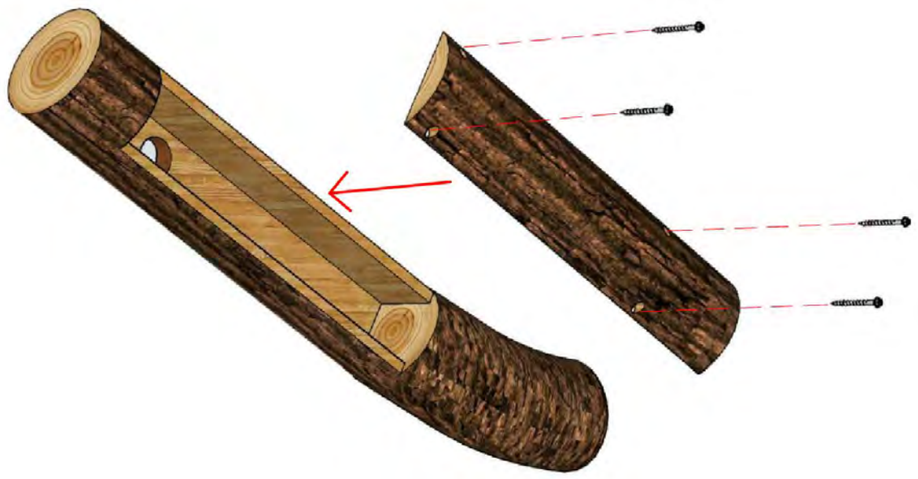
Step 1. *The branch that is selected for a Chainsaw Cut Hollow is cut back to remove weight. Not all branches will need to be cut back to this extent. The arborist will assess the extent of branch reduction required.*



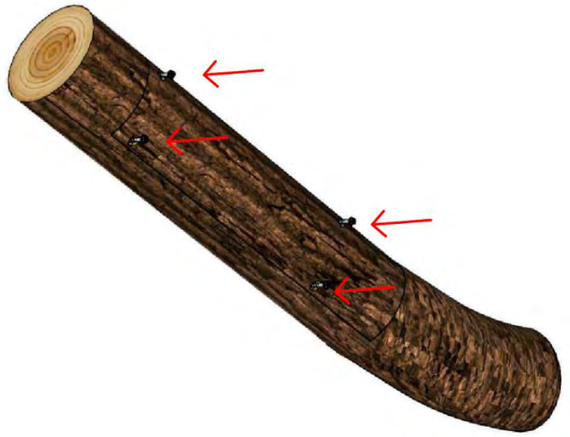
Step 2. *The face plate is removed. This should be a minimum of 75mm in wood thickness.*



Step 3. *The hollow cavity is carved out. The cavity is to be 1.5 – 2.5m long and 200mm x 200mm in cross section.*



Step 4. *An entry hole or 150mm is cut into the cavity toward the upper limit. Pilot holes are drilled in the face plate for fixing screws. Note the number of screws will vary depending on the size of the face plate.*

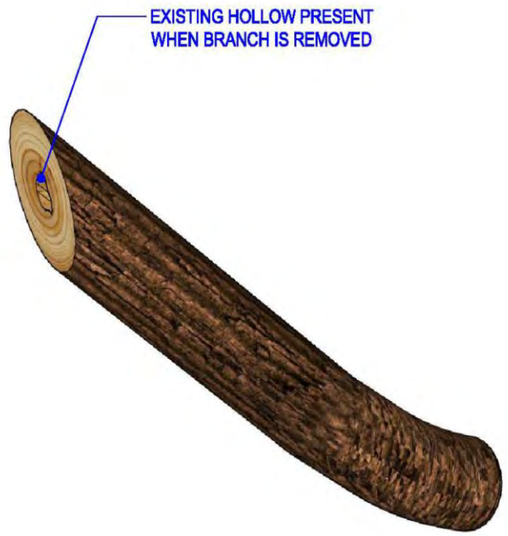


Step 5. *Face plate is returned and screwed on to the Chainsaw Cut Cavity*

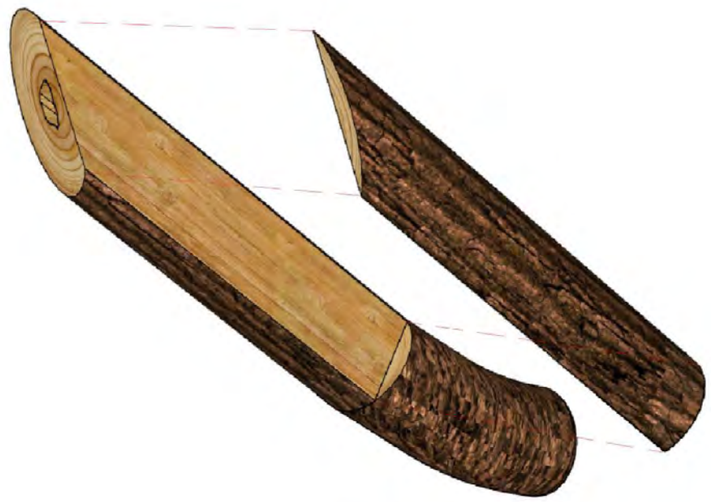
Step 6. *Finished cavity with branch side entrance.*

12. Appendix 1: Branch End Hollow with End Entrance, Creation Methodology

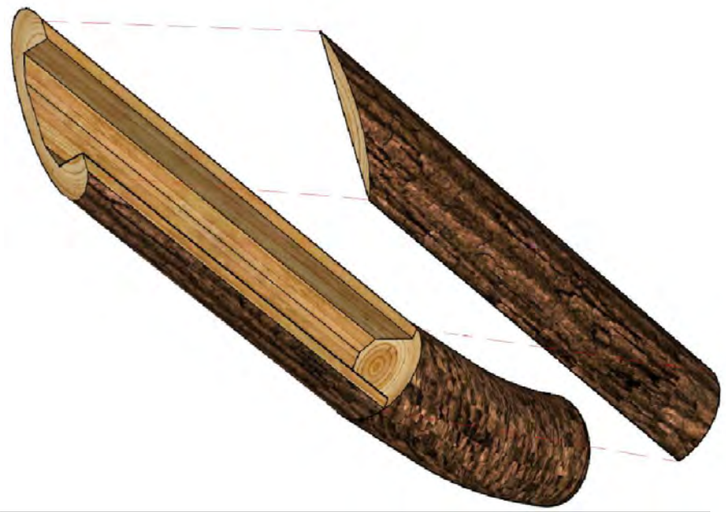
(Chainsaw Cut Hollows)



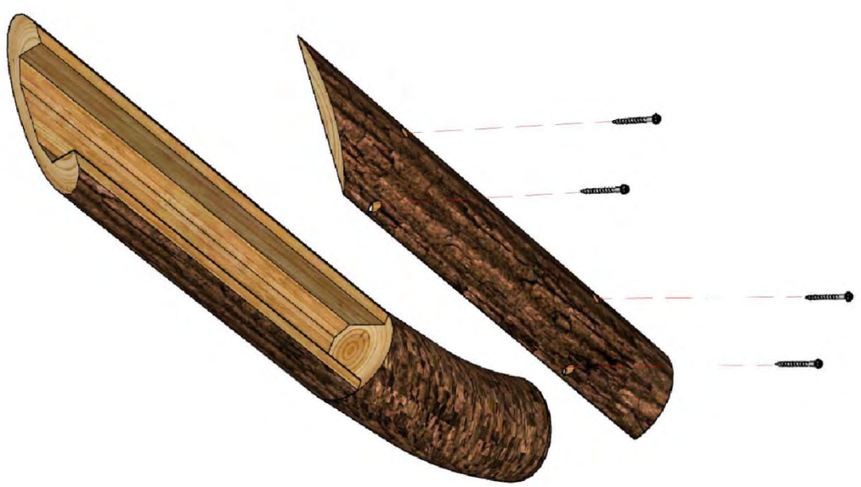
Step 1. *The branch that is selected for a Chainsaw Cut Hollow is cut back to remove weight. An existing hollow present in the heartwood provides an different entrance opportunity.*



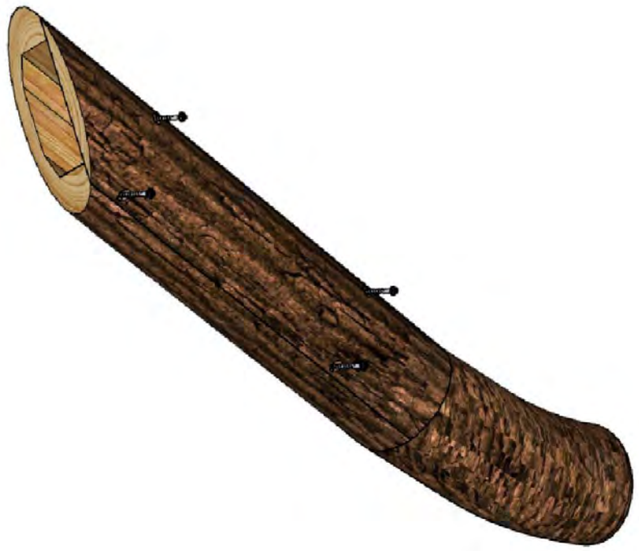
Step 2. *The face plate is removed. This should be a minimum of 75mm in wood thickness.*



Step 3. *The hollow cavity is carved out. The cavity is to be 1.5 – 2.5m long and 200mm x 200mm in cross section.*



Step 4. *Pilot holes are drilled in the face plate for fixing screws. Note the number of screws will vary depending on the size of the face plate.*

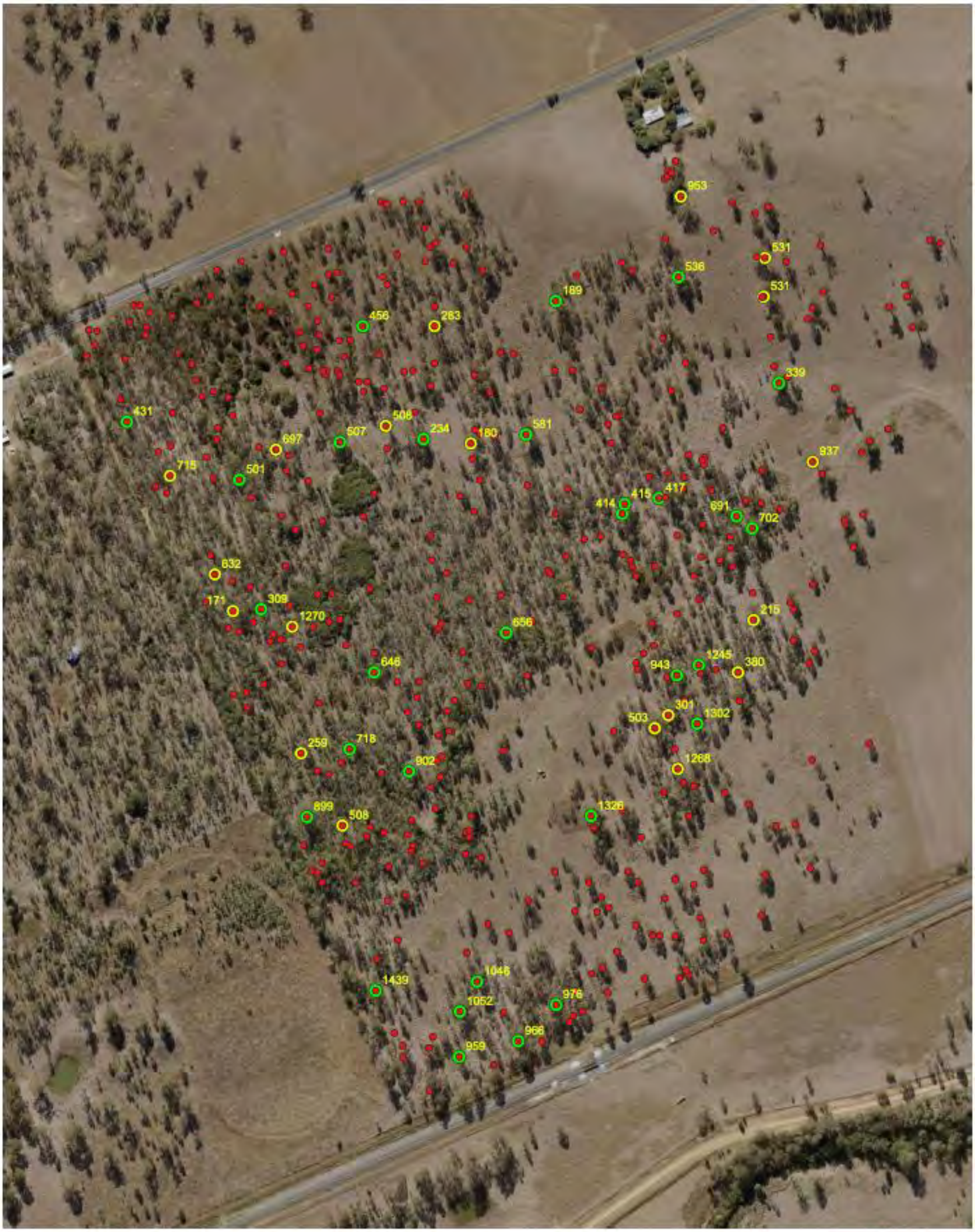


Step 5. *Face plate is returned and screwed to the Chainsaw Cut Cavity*

Step 6. *Finished cavity with branch end entrance.*

13. Appendix 3: Artificial Hollow Opportunity Map

- Green: Chainsaw Cut Hollows
- Yellow Hollowhog Hollows



Site: Rosewood Laidley Road

TITLE: Artificial Hollow Opportunities

DATE: October 2023

Disclaimer: While every reasonable effort has been made to ensure that this document is correct at the time of assessment, Arbor Australis and its agents disclaim any and all liability to any person in respect of anything or the consequences of anything done or omitted to b done using the whole or any part of this documents.

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Author's Statement of Experience

Experience

With 35 years of experience in all aspects of the Arboricultural Industry, I can provide a well-rounded, experienced, and educated approach to arboricultural-related issues in most environments. A commitment to continual professional development has ensured I can provide up-to-date information that will add value and resolve tree issues for most sites.

Memberships

Arboriculture Australia (AA)	Member
Arboricultural Association UK (AAUK)	Member
Queensland Arboricultural Association (QAA)	Approved Consultant
International Society of Arboriculture (ISA)	Member

Educational History:

2018 BSC (Hons) Arboriculture, Myerscough UK, (under completion)
2014 Diploma Arboriculture Upgrade (AQF Level 5 ACH 50510)
2004 Certified Arborist AU 0011-A
2004 Diploma Horticulture (Arb) (AQF 5)
2004 Advanced Diploma of Horticulture (Arb) (AQF level 6)
2003 Timber Pest Certificate
2001 Certificate II Pest control
2001 Certificate IV Work Site Assessor
1992 Certificate of Arboriculture Merrist Wood UK
Various OH&S operational tickets
CPD: Ongoing attendance of National Arboricultural Conferences and training courses.

Licences and Certifications

Australian Arborist Industry Licence AL1204
ISA Certified Arborist AU-0011A
Quantified Tree Risk Assessment (QTRA)
Tree Risk Assessment Qualification (TRAQ)
Cert IV in workplace trainer
Timber Pest Inspector
Construction Safety Blue / White Card

28°S ENVIRONMENTAL

Attachment 4

DCCEEW Approved Offset Rehabilitation Plan

OFFSET REVEGETATION PLAN

Introduction

28 South Environmental Pty Ltd (**28 South**) has prepared this Offset Revegetation Plan (**ORP**) as part of the broader Offset Area Management Plan (**OAMP**) submitted for the North Maclean Industrial Development (the **Proposed Action**) that is being assessed as a Controlled Action and which is progressing through the Preliminary Documentation phase subject to conditions of the Department of Climate Change, Energy, the Environment and Water (**DCCEEW**) under the *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) (DCCEEW Ref: **2022/09304**). For clarity, this ORP has been prepared to guide on-ground restoration works with regard to the on-ground ecological restoration works, their goals and completion criteria. The overarching OAMP provides guidance on how the Offset Site achieves the goals of the DCCEEW Environmental Offsets Policy.

Significant residual impact associated with the Proposed Action will require the Proponent to provide an offset for the significant residual impact to listed threatened species under the EPBC Act, specifically the koala and grey-headed flying-fox. The Proponent owns the land upon which the rehabilitation will occur and will legally secure the offset area (the Offset Receiving Site (**ORS**)) via Voluntary Declaration under the *Vegetation Management Act 1996* and being assigned a Category A area of Regulated Vegetation under the *Planning Act 2017*. Maclean Estates Pty Ltd will commission an approved rehabilitation contractor to undertake the offset works generally in accordance with this ORP and its Environmental Objectives to manage and protect the offset in perpetuity as defined within the OAMP.

As detailed within the overarching OAMP, the ORS will result in a direct conservation outcome for the koala and grey-headed flying-fox in accordance with the EPBC Acts Environment Offset Policy and Environmental Objectives of the OAMP through the restoration of existing habitat, re-establishment/ creation of diverse and functional ecosystems providing greater additionality to adjoining large intact remnants. Further, the ORS will build upon the extent of a state significant biodiverse area immediately to the west at Calvert and the existing Queensland blue gum (noted as a key foraging species for both target matters) dominated vegetation to the west and north. Through this, a consolidated regionally significantly area of important foraging habitat will be established, with the site strategically positioned as a staging point for rehabilitation of broad areas of Queensland blue gum woodland to open forest on the alluvial plains.

Offset Receiving Site

The ORS is situated on a dual property at 454-544 and 418-452 Rosewood Laidley Road, Lanefield (Lot 2 on RP200424 and Lot 70 on CH31316) held in freehold title. The ORS is situated in the centre-west of the Ipswich City Council (**ICC**) Local Government Area (**LGA**) adjoining the Lockyer Valley Regional Council LGA and the Brisbane City Council LGA. The property totals 113.18 ha and the ORS comprises the entirety of the site. This area encompasses approximately 45.58 ha of remnant and high value regrowth vegetation and 67.60 ha of non-remnant vegetation historically cleared for the establishment of pasture.

Purpose of this ORP

The intent of this ORP is to outline the Environmental Objectives of the OAMP and how the ORS will be managed including:

a) The proposed treatments across the ORS such as;

i. The components of the ORS which will be subject to assisted natural regeneration methods where parts of the ORS currently support regrowth native vegetation communities.

ii. The component of the ORS which will be subject to active restoration and infill planting where parts of the ORS currently support some native vegetation, principally native shrubs and canopy elements in the ground layer (noting high levels of native woody recruitment); and

b) How the on-ground progress will be managed, monitored and reported upon.

This ORP has also been prepared in accordance with the requirements of the OAMP prepared for the Action and the South East Queensland Ecological Restoration Framework.

Restoration Area Management Strategies

The ORS and the areas proposed to be restored and managed as part of the Proposed Action's Offset have been illustrated on **ORP001.** A number of Management Units (**MU**) has been identified within the ORS and are derived from existing on-ground condition within these areas. Management measures for each MU have been derived from in-field detailed inspection and prepared in line with the SMART principals (Specific, Measurable, Achievable, Realistic & Timed) to achieve the Environmental Objectives of the OAMP. These management measures have also been prepared in concert with the Offset Land Management Actions and Corrective Actions outlined within the OAMP.

Management measures have also been prepared to ensure that temporal conditions can be reacted to and place greater accountability on the offset provider to utilise the most appropriate measures based on the proposed Environmental Objectives and on-ground temporal conditions (i.e. if good native recruitment is occurring at the time of works, tube stock plantings may not be required or can be significantly reduced, conversely, increasing weed incursion during works may require further weeding and increased tube stock plantings, drought conditions may require increased watering events through irrigation set ups). Specifications encourage the active natural regeneration from the seed bank where possible as this is the best means of establishing a robust, resilient and self-sufficient native ecosystem that is genetically suited to its endemic conditions.

Timing for Commencement of Works

The works outlined within this ORP must commence in concert with the Proposed Action (i.e. clearing and construction works on the Impact Site for the Proposed Action. Following initial establishment of the works, the ORS will be subject to ongoing management for the 20-year maintenance period and monitoring for the life of the Action's Approval (until 2053).

Maclean Estates Residential Development
Offset Revegetation Strategy

ORP001

28 South Project Ref: 2023-033

Source: D:\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS

Data Sources: Aerial Imagery (Nearmap/Qld Globe); Digital Cadastre Database (DNRME, 2021); Roads (DNRME, 2020); Watercourse (DNRME, 2020); Contours (DNRME 2016).

Legend

- Site Boundary
- Planning Cadastre
- Watercourse
- AU1 - Regrowth RE 12.9-10.7 [3.43 ha]
- AU2 - Regrowth RE 12.3.19 [4.10 ha]
- AU3 - Regrowth RE 12.3.18 [1.18 ha]
- AU4 - Regrowth RE 12.3.3 [36.88 ha]
- AU5 - Regrowth RE 12.3.3 [67.60 ha]
- Management Unit 1 [45.58 ha]
- Management Unit 2 [61.80 ha]
- Management Unit 2b [2.56 ha]
- Management Unit 2c [3.24 ha]

Issue Date	Dwg No.	Author
2023-03-07	2023-033-RMP001	JD
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

1:5,000

0 150 300 450 600 m

Management Unit 1 – Management Strategy

Management Unit 1 (**MU 1**) (refer **Inset 1**) encompasses all of the western portion of the ORS apart from a component in the centre southwest which requires more intensive restoration methods. This MU mirrors the State mapped High value regrowth on the ORS and this vegetation reflects the most mature section on the ORS. This area totals 45.58 ha in area and supports a mix of Regional Ecosystem (**RE**) typologies. The MU has been split into sub-units based on the differing Regional Ecosystem typologies - refer to **ORP001**. Within these MUs the ground layer comprises a significant number and coverage of native species; while sporadic occurrences of pest plant species including lantana (*Lantana camara*) and common herbaceous weeds occur scattered throughout; disturbance is minimal with some small evidence of farm tracks throughout the MU. It is expected that continued exclusion of cattle and any other introduced herbivores (i.e. pigs, goats, deer or wild horses) and weed management measures will greatly enhance the MU's ability to naturally regenerate to a fully layered and self-sufficient ecosystem.

Assisted Natural Regeneration Requirements

The Assisted Natural Regeneration (**ANR**) management approach to this MU will take advantage of the emerging natural resilience and functionality of the existing communities, while promoting the regeneration of native vegetation through the removal of stock and exotic weed species. The main focus within this MU is to undertake targeted pest plant treatment and removal to encourage the natural recruitment of endemic native species from the seed bank. Seed of local provenance is key to successfully creating resilient and ultimately self-sufficient ecosystems as the seed is derived from parent plants lineage evolved in a site's microclimates. The commencement of the restoration works will also coincide with de-stocking of the ORS to remove any cattle and commencement of pest fauna management. Limited planting is proposed for most REs of this MU unless regeneration of various other canopy and shrub species are shown to be lacking from the ANR suite of species or weed eradication target areas do not show signs of native recruitment after a short period of time. Planting the area encompassing the Regrowth **RE 12.3.3** is recommended due to its lower density but this should occur after the weed treatment and observed lack of native recruitment. Revegetation should be undertaken utilising native tube stock, derived from locally sourced and grown species. Cherish will work closely with local native nurseries to establish a supply of tube stock to sufficiently support these areas. Seed collection from the ORS should also be considered over the course of management. All plantings are to be derived from the planting palette's analogous with each Sub-Unit RE in **Table 1**, **Table 2, Table 3** and **Table 4**.

Presently, there are no extensive areas of weed development within the MU and so only chemical methods for weed removal are prescribed herein (to avoid machinery impacting any native recruitment); however, it is at the discretion of the restoration contractor to use the most suitable, sensitive and adaptive methods. The engaged contractor will undertake an initial intensive weed management program to identify the pest plants occurring at the time of restoration works. All weed treatment and removal methods should be in accordance with the methods specified in the *South East Queensland Ecological Restoration Framework Manual.*

Assisted Natural Regeneration Management Actions

The primary objectives and performance criteria of ANR efforts proposed for MU 1 include:

- Remove stock and any fencing causing impediment to native fauna movement (i.e. barbed wire fencing)
- Retain and enhance all existing native fauna habitat
- Increase the extent of native vegetation cover over time
- Prior to planting out of the ORS the engaged contractors are to establish a 3 primary bio-condition plots and 3 tertiary site plots for on-going monitoring consistency, demarcated by steal posts or wooden bollards sufficient to last the 20 year monitoring period.
- Where practicable improve habitat connectivity and reduce fragmentation through encouragement of native recruitment
- Reintroduce large woody debris and other habitat features (fabrication of habitat qualities from left over timber elsewhere which would ordinarily go into green waste facilities)
- Weeds of National Significance (WoNS) and weed species listed under the *Biodiversity Act 2014* (**BA**) are not to be present within MU 1
- Evidence of significant reductions in the presence of other exotic species. It is considered appropriate that the following performance criteria be adopted:
    - o all large weed trees and woody weeds are to be removed or treated in-situ (to ensure they will not re-sprout/re-seed)
    - o scattered groundcover weed species may occur in very low densities where they perform important soil retention functions; however, no WoNS or BA weeds are to be present
        - ▪ pastoral grasses which do not impact the ultimate goal (restoring habitat for target MNES) are not considered to be weeds that require removal (however, native grasses/herbs and forbs should be preference)
    - o all weed treatment must be performed in a manner which does not promote erosion or instability of creek banks or soil
- Undertake baseline monitoring for feral predator/herbivore usage and management with ICC
- Bushfire monitoring and management in conjunction with the QFES and ICC
- Routine monitoring of the restoration area must also identify and rectify the following impacts:
    - o litter and/or rubbish dumping
    - o plant theft
    - o fauna impacts
    - o soil compaction
    - o erosion.

Timing assigned to these goals is variable and will be benefited by works being afforded a 20-year life span.

Inset 1: Current condition of Management Unit 1

Management Unit 2 – Management Strategy

Management Unit 2 (**MU 2**) (refer **Inset 2**) encompasses all of the remaining, eastern portion of the ORS and the aforementioned excluded centre southwest segment - refer to **ORP001**. This MU reflects the least mature section on the ORS and supports an eastern running unnamed tributary of Western Creek. This area totals 67.60 ha in area and supports the RE typology **12.3.3** (**Table 4**) with a central, ephemeral wetland area which will be reconstructed to support **RE 12.3.8** (**Table 5**) and three select areas in the north of the Site being the subject to translocated propagules for *Melalueca irbyana* (swamp tea-tree), collected as seeds from the Proposed Actions impact site. The ephemeral wetland areas will be a discrete sub-unit to MU 2, called **MU 2b** with a species planting palette. The areas subject to translocation of propagules will be known as **MU 2c**, with a specific planting palette analogous with **RE 12.3.18** (**Table 3**). MU 2 wholistically displays a pasture ground layer which dominates the stratum with some occurrences of native trees; and there are some incursions of pest plant species and common herbaceous weeds; disturbance is high with large agricultural pastures, ancillary structures and a dwelling dominating within the MU. There are some native trees highly scattered through the MU which will be key veteran trees within the regenerating ecosystem over time. It is expected that continued exclusion of cattle and any other introduced herbivores (i.e. pigs, goats, deer or wild horses) and weed management measures will greatly enhance the MU's ability to regenerate.

Reconstruction Requirements

The Reconstruction management approach to this MU will take advantage of the unchanged site topography (no earthworks required to undertaken reconstruction methods) to promote the regeneration of native vegetation through the removal of stock and exotic weed species and critically, the in-fill planting of species analogous with the ground-truthed **RE 12.3.3**, desired **RE 12.3.18** and the *Melaleuca irbyana* translocation respective to the sub-unit. The first focus within this MU is to undertake targeted pest plant treatment and removal to enable the natural and planted recruitment of native species from the seed bank and planting palette. The commencement of the reconstruction works will also coincide with de-stocking of the ORS to remove any cattle. Revegetation should be undertaken utilising native tube stock, derived from locally sourced and grown species at the rates and densities outlined in **Table 4** and **5**. MU 2b's requirements are largely congruent with that of its parent, with a specific focus on wetland areas and sensitive management around wet areas. MU 2c will be subject to propagated *Melaleuca irbyana* seed collected from the impact site to establish a community homogenous with that of the impact site to compensate for its loss. Cherish will work closely with local native nurseries to establish a supply of tube stock to sufficiently support these areas. All plantings are to be derived from the planting palettes in **Table 4** and **Table 5**. Seed collection from the ORS should also be considered over the course of management. It is noted that not all species may be available at the time of works. Subsequent species listed under the Regional Ecosystem Definition Data (**REDD**) prepared by the Queensland Herbarium must be consulted to identify other appropriate species for planting.

Regular maintenance must be undertaken to ensure plant establishment is successful and any failed plantings can be appropriately replaced to ensure the achievement of 1 plant per 1 m2. Further, regular monitoring must coincide with weed management to remove pest plants that may continue to persist within the MU. Mechanical and chemical methods for weed removal are prescribed and it is at the discretion of the Restoration Contractor to use the most suitable method. All weed treatment and removal methods must be undertaken in accordance with the methods specified in the South East Queensland Ecological Restoration Framework Manual.

Ecological Reconstruction Management Actions for MU 2 and MU 2b

The primary objectives and performance criteria of the Reconstructive efforts proposed for MU 2 include:

- Remove stock and any fencing causing impediment to native fauna movement (i.e. barbed wire fencing)
- Retain and enhance all existing native fauna habitat and existing veteran trees
- Prior to planting out of the ORS the engaged contractors are to establish a 3 primary bio-condition plots and 3 tertiary site plots for on-going monitoring consistency, demarcated by steal posts or wooden bollards sufficient to last the 20 year monitoring period.
- Plant out the ORS utilising tubestock from **Tables 4** and **5** in line with the Landscape treatment sections below
- Water in plantings and closely maintain these for an establishment period of 3 months or longer based on growth success goal attainment.
- Increase the extent of native vegetation cover over time
- Where practicable improve habitat connectivity and reduce fragmentation through encouragement of native recruitment and where possible the installation of nesting boxes in veteran trees.
- Reintroduce large woody debris and other habitat features
- WONS and weed species listed under BA are not to be present within MU 2
- Evidence of significant reductions in the presence of other exotic species. It is considered appropriate that the following performance criteria be adopted:
    - all large weed trees and woody weeds are to be removed or treated in-situ (to ensure they will not re-sprout/re-seed)
    - scattered groundcover weed species may occur in very low densities where they perform important soil retention functions; however, no WoNS or BA weeds are to be present
        - pastoral grasses which do not impact the ultimate goal (restoring habitat for target MNES) are not considered to be weeds that require removal
    - all weed treatment must be performed in a manner which does not promote erosion or instability of creek banks or soil
- Undertake baseline monitoring for feral predator/ herbivore usage and management with ICC
- Bushfire monitoring and management in conjunction with the QFES and ICC
- Routine monitoring of the restoration area must also identify and rectify the following impacts:
    - litter and/or rubbish dumping
    - plant theft
    - fauna impacts
    - soil compaction
    - erosion.

Timing assigned to these goals is variable and will be benefited by works being afforded a 20-year life span.

Ecological Reconstruction Management Actions for MU 2c

A total of 3600 *Melaleuca irbyana* will be propagated from seed collected from the Subject Site, as follows:

- Seed capsules will be collected prior to vegetation clearing.
- Planting will be carried out when the site is relatively dry to allow vehicle and machinery access. This will probably be between August and December but may be changed according to weather conditions. The Translocation Contractor is to determine the most appropriate time of year for planting.
- The corners of four Planting Areas within the Recipient Site will be pegged (e.g. zinc alum star picket painted white) and the coordinates recorded with a GPS.
- Prior to the commencement of planting, pasture and weeds in a circle of radius 50 cm will be sprayed with herbicide and left for 2-3 weeks before planting. Patches with good quality native ground cover should be avoided. All weed management works shall be conducted by suitably experienced Revegetation Contractor or Bush Regenerator with appropriate native and weed species identification skills, under supervision of the Translocation specialist.
- The dense M. irbyana thickets in the impact site have a closed forest structure like rainforest and therefore a rainforest planting model could be used. In rainforest revegetation, tree spacing is typically 1.8 m, so for 1 ha 3000 tubestock are required. To achieve the dense, monospecific stand of M. irbyana, plant spacing will be 2m x 2m, or 2500 per ha.
- A total of 5600 will be planted at the Recipient Site and 1000 kept in reserve for replacements or additional plantings if needed.
- All plants shall be:

- Watered 1 – 2 hours prior to planting;
- Planted with 12-month slow-release fertiliser;
- Watered, on the day of installation until soil is moist to 30 cm in depth.
- Follow-up watering shall be applied to ensure the soil does not become excessively dry.
- Watering is required to be undertaken every 2-3 days for the first two weeks;
- Watering is required once every 4-5 days for the following five weeks; and
- Watering once every 1-2 weeks until the completion of the Establishment Period.

- Where mulch is deemed to be required by the Translocation Contractor, the mulch shall be weed free and installed within three days of the completion of planting, spread to 50 mm and installed at the base of plants and only mulch free of weed seed will be used.

The establishment period (minimum 90 days) will commence after successful planting where the translocation is assessed for health. After the completion of this period, maintenance will be carried out to ensure the plantings remain healthy and actively growing. The timing for each of these periods is variable and greater detail regarding the translocation process can be found in the *Melaleuca irbyana Translocation Plan* found in **Attachment 1**.

Inset 2: Current condition of Management Unit 2

Planting Palette

The species list and target density for planting in **Tables 1, 2, 3, 4 & 5** have been derived from Regional Ecosystem Technical Descriptions (https://www.publications.qld.gov.au/dataset/re-technical-descriptions).

Table 1: Planting palette **RE 12.9-10.7**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
Eucalyptus tereticornis	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (~6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Corymbia tessellaris	Moreton bay ash	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
Acacia disparrima	Southern salwood	10%	
Acacia neriifolia	Oleander wattle	10%	
Corymbia intermedia	Pink bloodwood	10%	
Shrub			
Acacia leiocalyx	Black wattle	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Acacia salicina	Native willow	33%	
Alphitonia excelsa	Red ash	33%	
Groundcover			
Themeda triandra	Kangaroos grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Cymbopogon refractus	Barbed wire grass	30%	
Aristida gracilipes	Three-awn speargrass	20%	
Chloris divaricata	Slender chloris	20%	

Table 2: Planting palette **RE 12.3.19**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
Eucalyptus tereticornis	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (~6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Corymbia tessellaris	Moreton bay ash	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
Acacia disparrima	Southern salwood	10%	
Acacia neriifolia	Oleander wattle	10%	
Corymbia intermedia	Pink bloodwood	10%	
Shrub			
Acacia leiocalyx	Black wattle	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Acacia salicina	Native willow	33%	
Alphitonia excelsa	Red ash	33%	
Groundcover			
Themeda triandra	Kangaroos grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Cymbopogon refractus	Barbed wire grass	30%	
Aristida gracilipes	Three-awn speargrass	20%	
Chloris divaricata	Slender chloris	20%	

Table 3: Planting palette **RE 12.3.18**

Botanical Name	Common Name	Dominance (%)	Density
Canopy			
Eucalyptus tereticornis[1]	Queensland blue gum	45%	Canopy plantings should be established at 1/40m² (6.3m spacing)
Eucalyptus crebra	Narrow-leaved ironbark	10%	
Allocasuarina luehmannii	Bull-oak	10%	
Dockrillia linguiformis	Tounge orchid	5%	
Sub-canopy and Shrub			
Melaleuca irbyana	Swamp tea-tree	15%	Sub-canopy and shrub plantings should be established at 1/36m² (6m spacing)
Acacia leiocalyx subsp. leiocalyx	Black wattle	15%	
Alphitonia excelsa	Red ash	10%	
Alstonia constricta	Quinine bush	10%	
Groundcover			
Paspalidium distans	Shotgrass	10%	Groundcover plantings should be established at 1/1m² (~1m spacing)
Themeda triandra	Kangaroo grass	20%	
Enteropogon unispiceus	Windmill Grass	15%	
Digitaria breviglumis	Short-glumed umbrella grass	15%	

[1] Species denoted with * are winter-flowering species

Table 4: Planting palette **RE 12.3.3**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
Eucalyptus tereticornis[2]	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Lophostemon suaveolens	Swamp box	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
*Melaleuca quinquenervia**	Broad-leaved paperbark	10%	
Acacia disparrima subsp. disparrima	Hickory wattle	10%	
*Banksia integrifolia**	Coast banksia	10%	
Shrub			
*Alphitonia excelsa**	Red ash	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Petalostigma pubescens	Quinine bush	33%	
Jacksonia scoparia	Dogwood	33%	
Groundcover			
Eremochloa bimaculata	Poverty grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Imperata cylindrica	Blady grass	30%	
Heteropogon contortus	Black spear grass	20%	
Themeda triandra	Kangaroo grass	20%	

T

[2] Species denoted with * are winter-flowering species

Table 5: Planting palette **RE 12.3.8 (Management Unit 2b)**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
*Eucalyptus tereticornis**[3]	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Lophostemon suaveolens	Swamp box	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
*Melaleuca quinquenervia**	Broad-leaved paperbark	10%	
Acacia disparrima subsp. disparrima	Hickory wattle	10%	
*Banksia integrifolia**	Coast banksia	10%	
Shrub			
*Alphitonia excelsa**	Red ash	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Petalostigma pubescens	Quinine bush	33%	
Jacksonia scoparia	Dogwood	33%	
Groundcover			
Eremochloa bimaculata	Poverty grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Imperata cylindrica	Blady grass	30%	
Heteropogon contortus	Black spear grass	20%	
Themeda triandra	Kangaroo grass	20%	

[3] Species denoted with * are winter-flowering species

Landscape Specifications

Maintenance

The minimum following maintenance measures are required to be undertaken by the contractor:

- Planting areas are to be regularly watered for a period of 12 weeks or as deemed necessary by the contractor to ensure establishment is successful or until sufficient rainfall is received; and
- Recurrent listed WoNS or BA weeds within regeneration areas are to be removed (weed management measures are outlined within **Table 6**);

Planting Requirements

Table 1-4 identify the appropriate species to be selected for planting as well as the density criteria to be achieved. It is noted that not all species proposed may be available at the time of works. Subsequent species listed under the Regional Ecosystem Definition Data (REDD) prepared by the Queensland Herbarium should be consulted to identify other appropriate species for planting. If all species required for planting are not available, a staged planting may be required. This must be supported in writing from the Assessment Manager/Team.

Site Clean-up & Waste Management

Hazards and wastes are removed from the development site; this includes:

- any wastes as defined in the *Environmental Protection Act 1994*;

- machinery, fencing or equipment left over from past uses and practices; and

- items of rubbish and litter.

It is noted that site surveys did not identify any significant waste material. Contractors should be made aware of any contaminates or waste material prior to undertaking works.

Sediment and Erosion Control

The engaged contractor must install silt control fencing as required on site, to prevent soil material from entering restoration areas or leaving restoration areas. If soil stabilisation measures are required within the MUs to assist in the avoidance, minimisation and mitigation of soil loss, they should be sympathetic to the specific situation and only utilise appropriate measures such as sediment fencing, coir logs or native mulch.

Fire Ant Movement Controls

To prevent the spread of fire ants, the Queensland Government has implemented controls that apply to individuals and commercial operators, to restrict the movement of materials that could carry fire ants including soil, turf, potted plants, mulch, baled hay or straw, animal manures mining or quarry products. Penalties apply for non-compliance with the movement controls. If the engaged contractors are unsure of their obligations under the *Biosecurity Act 2014* they should contact the relevant Queensland State Government Department.

Contractor Requirements

All weed treatment must be safely undertaken by a suitably qualified contractor and utilise appropriate chemicals and all contractors must have Conservation and Land Management Certification 4 or equivalent experience and an ACDC licence.

This RMP has been based on best practices from the SEQ Ecological Restoration Framework and significant practical experience in restoration implementation projects.

Services

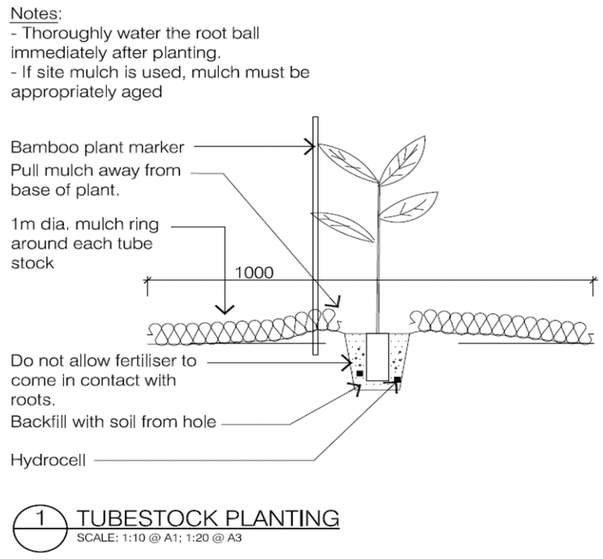
The contractor shall make themselves aware of all underground and overhead services prior to the commencement of works. The contractor shall also be responsible for determining the locations of as-built and to be constructed services during the course of the works. No services have been identified on these drawings.

Controlling Domestic Pets and Wildlife

It is important to exclude domestic pets and wildlife from restoration areas during the formative periods of the restoration efforts. This will help avoid the loss of tube stock or regenerating vegetation from being impacted and or loss through foraging.

Landscape Specification Notes for Planting

1. Ensure all water crystals are thoroughly wetted before application and fertiliser applied at the nominated rate.
2. Compensatory Planting Treatments: remove all weeds and install planting as noted. Provide a bamboo marker at each tube stock location that extends 300mm above the ground and has the top 100mm painted white or pink.
3. Planting is to be undertaken in accordance with the below diagram - Tubestock Planting 1.
4. It is the responsibility of the engaged contractor to determine the final location of each planting. This location should take into account the position of any existing vegetation retained within the Site and the necessary maintenance of the MU.



Each specimen will be watered-in with at least 5 litres of water; fertiliser and water crystals; and surrounding with a 0.5m ring of clean native mulch to a depth of 50mm. Landscape specifications for plants are outlined below and within *Tube Stock Planting Note 1*.

Table 6: Control techniques and herbicide application rates

Common Name	Scientific Name	Application Method	Chemical	Application Rate
Trees				
Camphor laurel	*Cinnamomum camphora*	Stem inject	Glyphosate	
		Cut, scrape and paint	Glyphosate	
		Basal bark (saplings)	Fluroxypyr	
		Spot spray	Glyphosate, Glyphosate + Metsulfron methyl	
Chinese celtis	*Celtis sinensis*	Cut stump and paint, stem injection	Triclopyr 200g /L plus picloram 100 g/L	
		Stem injection, cut stump and paint	Glyphosate 360 g/L	
		Spot spray	Fluroxypyr 200 g/L	
Cadaghi	*Corymbia torelliana*	Spot Spray	Glyphosate	
		Cut, scrape and paint	Glyphosate	
		Stem inject	Glyphosate	
		Basal bark (saplings)	Fluroxypyr	
Umbrella tree	*Schefflera actinophylla*	Spot Spray	Glyphosate + Metsulfron methyl	
		Cut, scrape and paint	Glyphosate	
		Stem inject	Glyphosate	
Giant devils fig and wild tobacco	*Solanum chrysotrichum* and *S. mauritianum*	Spot spray	Glyphosate, Fluroxypyr	
		Cut, scrape and paint	Glyphosate	
		Basal bark (juvenile / mature)	Fluroxypyr	
		Stem inject	Glyphosate	
African tulip tree	*Spathodea campanulata*	Spot spray	Glyphosate	
		Cut, scrape and paint	Glyphosate	
		Stem inject	Glyphosate	
Cocos palm	*Syagrus romanzofffiana*	Stem inject	Glyphosate + Metsulfron methyl	
		Spot spray	Glyphosate + Metsulfron methyl	
Shrubs				
Easter Cassia	*Senna pendula var. glabrata*	Spot Spray	Glyphosate	
		Cut Scrape Paint	Glyphosate	
		Stem Inject	Glyphosate	
Lantana	*Lantana camara*	Cut, Scrape and Paint	Glyphosate	
		Spot-spray	Fluroxypyr	
		Spray (spot spray and	Glyphosate	
Brazilian peppertree	*Schinus terebinthifolius*	Spot spray	Glyphosate	
		Cut scrape paint	Glyphosate + Metsulfuron Methyl	
		Basal barking	Fluroxypyr	
Groundsel	*Baccharis halimifolia*	Spot Spray, Stem Inject, Cut Scrape Paint	Glyphosate	
		Spot Spray	2,4-D	
Yellow bells	*Tecoma stans*	Cut stump method	Triclopyr 200g /L plus picloram 100 g/L	
		Spot spray	Glyphosate	
		Basal barking	Fluroxypyr	
		Stem injection	Glyphosate	
Groundcovers and grasses				
Singapore Daisy	*Sphagneticola trilobata*	Spot-spray	Glyphosate + Metsulfuron Methyl	
			Metsulfuron Methyl	
Pink Lady	*Callisia repens*	Culture burn	Glyphosate	

Herbicides must be applied by appropriately qualified / supervised persons in accordance with the Agricultural Chemicals and Distribution Control Act 1966 at rates as identified on registered product labels, or on an Australian Pesticides and Veterinary Medicines Authority (APVMA) issued permit where applicable. Refer to the South East Queensland Ecological Restoration Framework for addition guidance.

Common Name	Scientific Name	Application Method	Chemical	Application Rate
		Spot Spray		
Blue billy goats weed	*Ageratum houstonianum*	Spot Spray	Glyphosate	
			Metsulfuron Methyl	
Singapore Daisy	*Sphagneticola trilobata*	Spot-spray	Glyphosate + Metsulfuron Methyl	
			Metsulfuron Methyl	
Basket asparagus	*Asparagus aethiopicus*	Spot Spray	Glyphosate + Metsulfuron Methyl	
			Metsulfuron Methyl	
Red Natal, South African Pigeon Grass, Molasses Grass, Para Grass, Rhodes Grass, Guinea Grass, Elephant Grass, Signal Grass	*Melinis repens, Setaria sphacelata, Melinis multiflora, Urochloa mutica, Chloris gayana, Megathyrsus maximus*, *Pennisetum purpureum, Urochloa decumbens*	Spot Spray	Glyphosate	

Monitoring

Monitoring is important to understand the gradual improvement and eventual achievement of the offset obligation, which will ultimately result in the net-benefit for the two listed threatened species (koala and grey-headed flying-fox). It is also noted that the re-establishment of two Threatened Ecological Communities (**TEC**) will be benefited by the proposed ORS. Detailed monitoring will be undertaken throughout the ORS with a minimum of 3 Primary monitoring sites established for each MU (i.e. minimum of 6 primary monitoring sites across the ORS)**.** A further 3, tertiary monitoring sites are also to be established within each MU where tertiary monitoring is to be undertaken as a means of ensuring adequate coverage capturing growth, cover and species richness and assisting in the insurance of goals being met. Monitoring should include the collection of Key Performance Indicators[4] as indicated in **Table 7** below as well as any opportunistic observations of species koala and grey-headed flying-fox. During each monitoring event, photos should be collected in the centre of each monitoring site and taken in cardinal directions. Any other additional photographic evidence of the parameters being monitored should also be collected and recorded where appropriate. Monitoring is to be undertaken once per annum for the first 3 years, biennially until year 10 and then every five years until the expiry of the approval (2052) with audit reporting submitted to DCCEEW following each 5 year milestone. Refer to **Table 9**.

Table 7: Monitoring of Key Performance Indicators (KPIs) for Primary Monitoring Sites

Key Performance Indicators	Description	20+ year Goal
Bio-condition Parameters		
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.	The ultimate goal of all KPIs is to achieve, at a minimum the proposed upswing in Condition Scoring for each individual MU (based on a weighted scoring of Assessment Units described in **Attachment 11** of OAMP).
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)	
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).	
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.	
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.	
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).	
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site.	
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.	
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.	
Native Species Richness – Forbes	Record the number of native forbs species occurring in the monitoring site.	
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)	
Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)	
Additional Restoration Parameters		
Dominant Species	Qualitative description of the floristic structure of the monitoring site for the tree, shrub and ground layers	N/A
Assessment of plant health	Notation of plant health within the monitoring site. Notation of survival rate of plants where they have been established.	
Plant Failure	Notation and number of natural death or illegal removal of established plantings	
Flowering Trees	Monitoring should be focused on periods during late winter to detect the presence of flowering and the relative density for flowering within the MU (and ORS generally)	

Tertiary monitoring sites should be established to provide greater coverage over the ORS to ensure rehabilitation works as a whole are trending towards the ultimate goals and Environment Objectives of the OAMP. Tertiary monitoring aims to track the major KPIs. Failure of the KPIs will trigger a review of management measures and potentially corrective actions (Refer to OAMP). KPIs for the Tertiary monitoring sites are outlined in **Table 7**. Tertiary monitoring sites are based on the Regional Ecosystem Vegetation Structure Assessment (CORVEG)[5]. Tertiary monitoring sites are to be monitored yearly to ensure trends in growth and/or management issues are detected and corrective actions can be immediately actioned where required. **Table 8** includes an auditing report proforma for the monitoring of KPIs. Each KPI for the ORS condition scoring has a significantly different ability to be achieved, particularly noting many are simply a result of the initial planting works or ANR (e.g. species richness, weediness etc.). As such, some KPIs will be achieved and maintained early; while others will require much of the +20 years to achieve.

Table 8: Monitoring of KPIs for tertiary monitoring sites

Key Performance Indicators	Description
Bio-condition Parameters	
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site.
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)
Additional Restoration Parameters	
Dominant Species	Qualitative description of the floristic structure of the monitoring site for the tree, shrub and ground layers
Assessment of plant health	Notation of plant health within the monitoring site. Notation of survival rate of plants where they have been established.
Plant Failure	Notation and number of natural death or illegal removal of established plantings
Flowering Trees	Monitoring should be focused on periods during late winter to detect the presence of flowering and the relative density for flowering within the MU (and ORS generally)

On-ground fauna surveys for koala and grey-headed flying-fox are to be undertaken as part of each major monitoring event (5, 10, 15 and 20 years[6]) and are to be in accordance with the relevant Terrestrial Vertebrate Fauna Survey Guidelines for Queensland as well as Spot Assessment Technical (**SAT**) Surveys for Koala, spot lighting, diurnal bird surveys, incidental records during management activities.

[4] The auditor should develop a performer for the collection of information in Table 6/7 and in accordance with the *Queensland Government Guide to Determining Terrestrial Habitat Quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (Version 1.3 2020).*

[5] Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Addicott, E.P. and Appelman, C.N. (2020) *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1*. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

[6] It is recommended monitoring be undertaken more regularly while rehab staff are on Site to improve the volume of study undertaken.

Table 9: Monitoring Schedule

Monitoring activity	Management needs/questions addressed	Parameter/s measured	Survey/monitoring guidelines	Where	When	Reporting Requirements
Baseline Surveys - Primary Monitoring Site Establishment	Establish an understanding of baseline values/condition of each of the monitoring sites across the ORS for comparison during the 20 year management timeframe and the ongoing auditing until 2050.	Refer to the KPI's in **Table 7/8** and specific completion criteria in **Table 10** and **11.**	KPI's have been adopted from the *Queensland Government Guide to Determining Terrestrial Habitat Quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (Version 1.3 2020).*	At each of the 9 Monitoring Sites to be established across the ORS (a minimum of 3 per Management Unit)	Year 0 - Prior to the commencement of offset works and establishment (2022).	Annual Compliance Reporting
Monitoring of KPIs (9 Primary Monitoring Sites)	Undertake monitoring and auditing reporting for the primary monitoring sites. Report to DAWE on the ORS achievement of the KPIs and Completion Criteria.	Refer to the KPI's in **Table 7/8** and specific completion criteria in **Table 10** and **11.**	KPI's have been adopted from the *Queensland Government Guide to Determining Terrestrial Habitat Quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (Version 1.3 2020).*	At each of the 9 Primary Monitoring Sites to be established across the ORS (a minimum of 3 per Management Unit)	Year 1 (2023)	
					Year 2 (2024)	
					Year 3 (2025)	
					Year 5 (2027)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 8 (2030)	Annual Compliance Reporting
					Year 10 (2032)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 15 (2037)	
					Year 20 (2042)	
					Year 25 (2047)	Annual Compliance Reporting
					Year 28 (2050)	
Monitoring of Secondary Sites (9 additional sites)	Undertake monitoring at the secondary sites.	General floristic structure and composition including the tree canopy heights (growth rates), assessment of plant health and failure, and extent of weed coverage.	Simplified assessment sheet that is based on the CORVEG Proforma and methodology from the *Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (Version 5.1 2020)*	At each of the 9 Secondary Monitoring Sites	Year 1 (2023)	
					Year 2 (2024)	
					Year 3 (2025)	
					Year 5 (2027)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 8 (2030)	Annual Compliance Reporting
					Year 10 (2032)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 15 (2037)	
					Year 20 (2042)	
					Year 25 (2047)	Annual Compliance Reporting
					Year 28 (2050)	
Targeted Fauna Surveys	Understanding of MNES Fauna Species Presence/Usage of the ORS	MNES Fauna Species Presence/Usage	Surveys are to be in accordance with the relevant Terrestrial Vertebrate Fauna Survey Guidelines for Queensland as well as Spot Assessment Technical (SAT) Surveys for Koala, spot lighting, diurnal bird surveys, incidental records during management activities.	At ORS in accordance with the Terrestrial Vertebrate Fauna Survey Guidelines.	**Year 5 (2027)**	
					Year 10 (2032)	
					Year 15 (2037)	
					Year 20 (2042)	

Table 10: Completion Criteria Scoring Table Proforma

Key Performance Indicators	Description	MUXX Benchmark Score	MUXX Baseline Score	MUXX Monitoring Year 5 Score	Increase in Score	MUXX 20+ year Goal	Required Increase to achieve Goal	Trending / Not Trending Towards and Recommendations
Bio-condition Parameters								
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.							
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)							
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).							
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy, sub-canopy and shrub.							
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).							
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site.							
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.							
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.							
Native Species Richness – Forbes	Record the number of native forbes species occurring in the monitoring site.							
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)							
Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)							
Additional Restoration Parameters								
Dominant Species*	Qualitative description of the floristic structure of the monitoring site for the tree, shrub and ground layers	N/A	N/A		N/A			
Assessment of plant health	Notation of plant health within the monitoring site. Notation of survival rate of plants where they have been established.	N/A	N/A		N/A			
Plant Failure	Notation and number of natural death or illegal removal of established plantings	N/A	N/A		N/A			

Completion Criteria

Completion criteria is directly linked to the KPI's listed in **Tables 7** and **8** as well as increases in Context and Species Stocking Rates Scores (which are also derived from the KPIs), with the gradual achievement contributing to the eventual satisfaction and completion of the offset works at the end of the 20-year maintenance period for the ORS. Completion criteria include:

- Achievement of Habitat Quality Scores at year 20.
    - All Habitat Quality Scores, are to be populated by detailed monitoring assessments (i.e. Bio-condition (MHQA) and fauna surveys) for the Offsets Condition scoring (at both East and West areas).
    - Context Scoring is directly linked to the achievement of regrowth and remnant status of the rehabilitation works. As such, achieving 50% (cover) and 70% (height) will attain Remnant Status, *as such achieving the proposed increases in Context scoring- a GIS metric*.
    - Species Stocking Rates will be assessed and accounted for during bio-condition survey efforts.
- Achievement of remnant status under the *Vegetation Management Act 1999*, whereby vegetation meets the 70% of the height and greater than 50% cover relative to the bio-condition benchmarks for targeted RE's. This is demonstrated through the following KPIs; Tree Canopy Height, Tree Canopy Cover, Native Species Richness – Trees and Dominant Species.
- Revegetation works must establish at least 1 koala habitat tree per 40m2 in accordance with the *Queensland Environmental Offsets Policy 2014*;
- No WoNS present and less than 10% coverage of other weeds listed under the BA are present within the ORS; and
- At least 90% survival rate of established plantings

Each audit report should state the progression towards achieving the Completion Criteria and when they have been met. The audit reporting should include the data in tabulated format as illustrated in **Table 9/10** & ultimately final results in **Table 11**. This information should be assessed at an ORS scale (i.e. all scores should be compiled to calculate the weighted total score for ORS MU1 and MU2 (MU2B & MU2C). **Tables 12a-b** illustrate the expected upswing in scores for each koala and grey-headed flying-fox over 5, 10, 15 and 20 years over the Site as an averaged whole.

Table 11: Completion Criteria – Habitat Quality Score Increases for MNES species

Monitoring Completion Criteria	Baseline Score	Year 5 Score	Year 10 Score	Year 15 Score	Year 20 Score
Total Condition Score /3	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)
Site Context Score /3	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)
Species Stocking Rate Score /4	Derived from Fauna Survey Results	Derived from Fauna Survey Results	Derived from Fauna Survey Results	Derived from Fauna Survey Results	Derived from Fauna Survey Results
Total Future Habitat Quality Score With Offset /10	Sum of the above parameters	Sum of the above parameters	Sum of the above parameters	Sum of the above parameters	Sum of the above parameters

Triggers and Corrective Actions

The following Triggers, Corrective Actions and Timing outlined in **Table 12** are to be implemented in instances of non-compliance or a lack of success towards the gradual achievement of the Key Performance Criteria in **Table 6** and **7** and the Completion Criteria Scores at Years 5, 10, 15 and 20 in **Table 9**.

Table 12a: Completion Criteria for Koala – Example outlining how ORS performance will achieve OAMP goals and reach proposed ecological benefit in line with EPBC Offsets Policy.

Key Performance Indicators	Description	Baseline	Year 5 Score	Year 10 Score	Year 15 Score	Year 20 Score
	Site Condition (Bio-condition Parameters and KPIs)					
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.		**5/15** 0-50% of Benchmark	**5/15** 0-50% of Benchmark	**10/15** >50-110% of Benchmark	**10/15** >50-110% of Benchmark
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)		**3/5** >200% of Benchmark	**3/5** >200% of Benchmark	**5/5** >70% of Benchmark	**5/5** >70% of Benchmark
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).		**3/5** >20-75% of Benchmark	**3/5** >20-75% of Benchmark	**5/5** >75% of Benchmark	**5/5** >75% of Benchmark
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.		**3/5** >200% of Benchmark	**3/5** >200% of Benchmark	**4/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.		**3/5** >10%-<50% or >200% of Benchmark	**3/5** >10%-<50% or >200% of Benchmark	**3/5** >10%-<50% or >200% of Benchmark	**5/5** >50-<200% of Benchmark
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).		**2/5** <50% or >200% of Benchmark	**2/5** <50% or >200% of Benchmark	**2/5** <50% or >200% of Benchmark	**5/5** >200% of Benchmark
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site. This is controlled by the planting palettes within the OMP.		**3/5** >25-90% of Benchmark	**3/5** >25-90% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.		**3/5** >25-90% of Benchmark	**3/5** >25-90% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.		**2.5/5** <25% of Benchmark	**2.5/5** <25% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Native Species Richness – Forbes	Record the number of native forbes species occurring in the monitoring site.		**3/5** >25-90% of Benchmark	**3/5** >25-90% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)		**3/10** >25%-50% of Benchmark	**3/10** >25%-50% of Benchmark	**3/10** >5-25% of Benchmark	**5/10** >5-25% of Benchmark
Native grass cover	Note the extent/occurrence pf native grass species		**1/5** >10-50% of Benchmark	**1/5** >10-50% of Benchmark	**3/5** >50-90% of Benchmark	**5/5** >90% of Benchmark

Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)		**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark
Quality and availability of food and habitat required for foraging			**5/10**	**5/10**	**5/10**	**10/10**
Quality and availability of habitat required for shelter and breeding			**5/10**	**5/10**	**5/10**	**10/10**
		Site Condition Score (out of 100)	**52.5 (baseline)**	**49.5**	**49.5**	**70**	**90**
		Site Condition Score (converted out of 3)	**1.57 (baseline)**	**1.49**	**1.49**	**2.1**	**2.7**
	Site Context					
Size of Patch				10/10	10/10	10/10	10/10
Connectedness				2/5	2/5	2/5	2/5
Context				4/5	4/5	4/5	4/5
Ecological Corridors				4/6	4/6	4/6	4/6
Threats to Species				7/15	7/15	7/15	7/15
Quality and availability of habitat required for mobility				5/10	5/10	10/10	10/10
		Site Context Score (out of 56)	35	32	32	37	37
		Site Context Score (converted out of 3)	**1.88**	**1.71**	**1.71**	**1.98**	**1.98**
	Species Stocking Rate					
Presence detected on or adjoining site				10/10	10/10	10/10	10/10
Species Usage (Habitat type & evidence of usage)				10/15	10/15	10/15	10/15
Approximate Density				10/30	10/30	20/30	20/30
Role/Importance of Species Population on Site				5/15	5/15	5/15	5/15
		Species Stocking Rate (out of 70)	35	35	35	45	45
		Species Stocking Rate (converted out of 4)	**2**	**2**	**2**	**2.57**	**2.57**
		Total Habitat Quality Score (out of 10)	**5.45* AU Weighting Factor of 0.809 (5.45*0.809 = 4.41 (Actual MHQA Score)**	**5.2 Averaged Scores for AUs Round to 5**	**5.2 Averaged Scores for AUs Round to 5**	**6.68 Averaged Scores for AUs Round to 7**	**6.68 Averaged Scores for AUs Round to 7**

Table 12b: Completion Criteria for Grey Headed Flying Fox – Example outlining how ORS performance will achieve OAMP goals and reach proposed ecological benefit in line with EPBC Offsets Policy.

Table 11b: Completion Criteria for Grey Headed Flying Fox**Key Performance Indicators**	**Description**	**Baseline (rounded)**	**Year 5 Score**	**Year 10 Score**	**Year 15 Score**	**Year 20 Score**
	Site Condition (Bio-condition Parameters and KPIs)					
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.		**10/15**	**10/15**	**10/15**	**10/15**
			>50-110% of Benchmark	>50-110% of Benchmark	>50-110% of Benchmark	>50-110% of Benchmark
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)		**3/5**	**3/5**	**5/5**	**5/5**
			>200% of Benchmark	>200% of Benchmark	>70% of Benchmark	>70% of Benchmark
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).		**3/5**	**3/5**	**5/5**	**5/5**
			>20-75% of Benchmark	>20-75% of Benchmark	>75% of Benchmark	>75% of Benchmark
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.		**3/5**	**3/5**	**5/5**	**5/5**
			>200% of Benchmark	>200% of Benchmark	>50%-<200% of Benchmark	>50%-<200% of Benchmark
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.		**3/5**	**3/5**	**3/5**	**5/5**
			>10%-<50% or >200% of Benchmark	>10%-<50% or >200% of Benchmark	>10%-<50% or >200% of Benchmark	>50-<200% of Benchmark
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).		**2/5**	**2/5**	**2/5**	**5/5**
			<50% or >200% of Benchmark	<50% or >200% of Benchmark	<50% or >200% of Benchmark	>200% of Benchmark
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site. This is controlled by the planting palettes within the OMP.		**3/5**	**3/5**	**5/5**	**5/5**
			>25-90% of Benchmark	>25-90% of Benchmark	>90% of Benchmark	>90% of Benchmark
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.		**3/5**	**3/5**	**5/5**	**5/5**
			>25-90% of Benchmark	>25-90% of Benchmark	>90% of Benchmark	>90% of Benchmark
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.		**2.5/5**	**2.5/5**	**5/5**	**5/5**
			<25% of Benchmark	<25% of Benchmark	>90% of Benchmark	>90% of Benchmark
Native Species Richness – Forbes	Record the number of native forbes species occurring in the monitoring site.		**3/5**	**3/5**	**5/5**	**5/5**
			>25-90% of Benchmark	>25-90% of Benchmark	>90% of Benchmark	>90% of Benchmark
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)		**3/10**	**3/10**	**3/10**	**5/10**
			>25%-50% of Benchmark	>25%-50% of Benchmark	>25%-50% of Benchmark	>5-25% of Benchmark
Native grass cover	Note the extent/occurrence pf native grass species		**1/5**	**1/5**	**3/5**	**5/5**
			>10-50% of Benchmark	>10-50% of Benchmark	>50-90% of Benchmark	>90% of Benchmark

Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)		**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark
Quality and availability of food and habitat required for foraging			**35/80**	**45/80**	**45/80**	**60/80**
Quality and availability of habitat required for shelter and breeding			**0/20**	**0/20**	**0/20**	**0/20**
	Site Condition Score (out of 190)	**79.6 (Baseline)**	**79.5**	**79.5**	**107**	**128**
	Site Condition Score (converted out of 4)	**1.67 (Baseline)**	**1.67**	**1.67**	**2.25**	**2.69**
Site Context						
Size of Patch		10/10	10/10	10/10	10/10	10/10
Connectedness		2/5	2/5	2/5	2/5	2/5
Context		4/5	4/5	4/5	4/5	4/5
Ecological Corridors		4/6	4/6	4/6	4/6	4/6
Role of Site location to species overall population in the state		2/15	2/15	2/15	7/15	12/15
Threats to Species		0/15	0/15	0/15	0/15	0/15
Quality and availability of habitat required for mobility		10/10	10/10	10/10	10/10	10/10
	Site Context Score (out of 96)	32	32	32	37	42
	Site Context Score (converted out of 3)	**1**	**1**	**1**	**1.15**	**1.31**
Species Stocking Rate						
Presence detected on or adjoining site		5/10	5/10	5/10	10/10	10/10
Species Usage (Habitat type & evidence of usage)		10/15	10/15	10/15	10/15	10/15
Approximate Density		10/30	10/30	10/30	20/30	20/30
Role/Importance of Species Population on Site		5/15	5/15	5/15	5/15	5/15
	Species Stocking Rate (out of 70)	30	30	30	45	45
	Species Stocking Rate (converted out of 3)	**1.29**	**1.29**	**1.29**	**1.93**	**1.93**
	Total Habitat Quality Score (out of 10)	**3.8 * AU Weighting Factor of 0.84 (3.8*0.84 = 3.19 (Actual MHQA Score)**	**3.96 Averaged Scores for AUs Round to 4**	**3.96 Averaged Scores for AUs Round to 4**	**5.33 Averaged Scores for AUs Round to 5**	**5.93 Averaged Scores for AUs Round to 6**

Table 13: Overarching Triggers, Corrective Actions and Timing to Achieve KPIs

Triggers	Corrective Actions	Timeframes
Trees and plantings showing signs of ill health, decline or death.	The restoration contractor will engage a suitably qualified professional to identify the likely cause of health decline Apply recommended mitigation measure/s to improve growing conditions (as recommended by the suitably qualified professional) Remove ill or dead plantings, undertake any remediation works and re-establishment planting	Engage the suitably qualified professional within three months of detection Implement recommended mitigation measures within six months of detection Remove ill or dead plantings and undertake remediation works within six months of detection
Weed re-establishment	Immediately treat all WoNs & BA weeds with delicate methods to avoid impacts to restoration works (mechanically or chemically dependent on circumstances) Undertake an investigation of the potential source point of seeding Additional treatment and removal works are to be followed up during the next potential growth period to avoid any regeneration and potential seeding events	Within three months of detection, noting that treatment during non-growth periods may be ineffective and are best targeted during growth periods for greater effectiveness Within three months of detection Within six months of initial detection
Plant failure (>10% of stock) during the establishment period	Supplementary planting will be undertaken Should the planting fail again, the contractor is to engage a suitably qualified professional to identify the likely cause of plant failure Apply recommended mitigation measure/s to improve growing conditions (as recommended by the suitably qualified professional)	Within six months or the next appropriate planting period (whichever comes first) of detection Within month of detection Apply in alignment with the recommendations made by the suitably qualified professional
Coarse woody debris is failing to become present naturally	The selective removal of limbs, shrubs, or trees (particularly from the shrub layer were forming dense thickets) Importation of felled native timber from known impact areas where it would ordinarily be mulched and sent to land fill	At the 5, 10, 15 and 20 year monitoring events At the 5, 10, 15 and 20 year monitoring events
Growth rates not as expected	Engage a suitably qualified professional to review the plantings and advise on methods to increase growth rates through other interventions Undertake soil testing to determine what rate of soil ameliorants or fertilizers may be required to improve the chemical balance of the soils for improved plant growth Revise management actions for offset Discuss with the Department to negotiate changes to timeframes to meet the completion criteria Revise OAMP and submit to Minister for the Environment for approval	Within three months of detection Within three months of detection Within 12 months of detection Within 24 months of detection if the corrective actions have not amended the slowing growth rates Within 24 months of detection if the corrective actions have not amended the slowing growth rates
Stochastic or nuisance events	While such events (eg. fire, flood, drought, vandalism etc) are rare and can be managed by the contractor, where events take place, restoration works are to replace losses and reporting to the DCCEEW is required Evidence of impacts and rectification measures are to be issued to the DCCEEW within three months	Within six months of the event Within six months of rectification
Ongoing presence of pest fauna (eg. wild dogs/pigs)	Where recurrent pest animal species are detected, reengagement with the surrounding landholders and ICC to re-deploy management measures. Should recurrent pest fauna be observed going forward, revised management measures to include more site-specific measures including targeted baiting and/or trapping	Within three months of continued presence identification
Monitoring and reporting illustrates that KPIs are unlikely to be achieved at the end of the 20 year management timeframe and other corrective actions are failing to progress the achievement of the KPI	Engage a suitably qualified professional to review the plantings and advise on methods to increase growth rates through other interventions Undertake soil testing to determine what rate of soil ameliorants or fertilizers may be required to improve the chemical balance of the soils for improved plant growth The proponent / approval holder will request an extension to the 20 year management timeframe from the Minister Revise the management actions for the offset Extend timeframes to meet completion criteria	Within three months of detection Within three months of detection Within 24 months of detection if corrective actions have not amended the slowing growth rates Within 24 months of detection if corrective actions have not amended the slowing growth rates Within 24 months of detection if corrective actions have not amended the slowing growth rates

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Attachment 5

Habitat Completion Criteria

Table 12a: Habitat Completion Criteria for Koala, Adopted for Greater Glider Habitat Offset, also Showing Deployment of GGAH

Key Performance Indicators	Description	Baseline (average scores – from MHQA)	Year 5 Score (average scores – from MHQA)	Year 10 Score (average scores – from MHQA)	Year 15 Score (average scores – from MHQA)	Year 20 Score (average scores – from MHQA)
Site Condition (Bio-condition Parameters and KPIs)						
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).	**3.2/5**	**3.2/5**	**3.2/5**	**4.2/5**	**5.0/5**
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site. This is controlled by the planting palettes within the OMP.	**2.8/5**	**5.0/5**	**5.0/5**	**5.0/5**	**5.0/5**
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.	**2.8/5**	**5.0/5**	**5.0/5**	**5.0/5**	**5.0/5**
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.	**2.0/5**	**2.8/5**	**2.8/5**	**3.3/5**	**4.8/5**
Native Species Richness – Forbes	Record the number of native forbes species occurring in the monitoring site.	**3.0/5**	**3.0/5**	**3.0/5**	**3.0/5**	**4.8/5**
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)	**4.0/5**	**4.5/5**	**4.6/5**	**5.0/5**	**5.0/5**
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.	**3.5/5**	**3.7/5**	**3.7/5**	**4.4/5**	**5.0/5**
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.	**2.0/5**	**2.6/5**	**2.6/5**	**4.6/5**	**5.0/5**
Native grass cover	Note the extent/occurrence pf native grass species	**0.8/5**	**0.8/5**	**0.8/5**	**1.6/5**	**4.6/5**
Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)	**4.6/5**	**4.6/5**	**4.6/5**	**4.8/5**	**4.8/5**
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.	**9.0/15**	**9.0/15**	**9.0/15**	**10.5/15**	**10.5/15**
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).	**2.9/5**	**2.9/5**	**2.9/5**	**3.3/5**	**4.7/5**
Non-native plant cover	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)	**3.3/10**	**4.7/10**	**4.7/10**	**5.8/10**	**6.6/10**
Quality and availability of food and habitat required for foraging		4.2/10	4.2/10	4.2/10	10.0/10	10.0/10
Quality and availability of habitat required for shelter and breeding		4.2/10	4.2/10	4.2/10	10.0/10	10.0/10
	Site Condition Score (out of 100)	**52.7**	**60.2**	**60.2**	**80.5**	**90.7**
	Site Condition Score (converted out of 3)	**1.58**	**1.80**	**1.81**	**2.41**	**2.7**
Site Context						
Size of Patch		10.0/10	10.0/10	10.0/10	10.0/10	10.0/10
Connectedness		2.0/10	2.0/10	2.0/10	2.0/10	2.0/10
Context		4.0/5	4.0/5	4.0/5	4.0/5	4.0/5
Ecological Corridors		4.0/6	4.0/6	4.0/6	4.0/6	4.0/6
Role of site location to species overall population in the state		1.0/5	1.0/5	1.0/5	1.0/5	1.0/5

Key Performance Indicators	Description	Baseline (average scores – from MHQA)	Year 5 Score (average scores – from MHQA)	Year 10 Score (average scores – from MHQA)	Year 15 Score (average scores – from MHQA)	Year 20 Score (average scores – from MHQA)
Threats to species		7.0/10	7.0/10	7.0/10	7.0/10	7.0/10
Species mobility capacity		7.0/10	7.0/10	7.0/10	7.0/10	7.0/10
	Site Context Score (out of 56)	35.0	35.0	35.0	35.0	38.0
	Site Context Score (converted out of 3)	**1.88**	**1.88**	**1.88**	**1.88**	**2.04**
Species Stocking Rate						
Presence detected on or adjoining site		10.0/10	10.0/10	10.0/10	10.0/10	10.0/10
Species Usage (Habitat type & evidence of usage)		10.0/15	10.0/15	10.0/15	10.0/15	15.0/15
Approximate Density		10.0/30	10.0/30	10.0/30	10.0/30	20.0/30
Role/Importance of Species Population on Site		5.0/10	5.0/10	5.0/10	5.0/10	5.0/15
	Species Stocking Rate (out of 70)	35.0	35.0	35.0	35.0	50.0
	Species Stocking Rate (converted out of 4)	**2.0**	**2.0**	**2.0**	**2.0**	**2.86**
	Total Habitat Quality Score (out of 10)	**4.81** **Averaged Scores for AUs** **Round to 5**	**5.16** **Averaged Scores for AUs** **Round to 5**	**5.16** **Averaged Scores for AUs** **Round to 5**	**6.04** **Averaged Scores for AUs** **Round to 6**	**7.42** **Averaged Scores for AUs** **Round to 7**
Greater Glider Artificial Hollows (100 approved)						
New Branch hollows developed by CCH / HHH		**55**	**55**	**55**	**55**	**55**
New Trunk hollows developed by CCH / HHH		**34**	**34**	**34**	**34**	**34**
Amendably suitable branch hollows					**11**	**11**
	Total GGAH Deployed	**89**	**89**	**89**	**100**	**100**

Attachment 6

Annual Reporting Requirement

Attachment 6 – Annual GGAH Reporting Format

1. **Background and Purpose of this Monitoring Report**

   - Scene setting how this document responds to the Approved GGHMMP.
   - Describes the reporting year.

2. **Summary of Actions Undertaken on the Offset Site and Significant Events in Previous 12 Month Period**

   - An overview of the actions on the Offset Site more broadly, not necessarily directly relevant to Greater Glider Denning Habitat, but foraging habitat more broadly, including but not limited to: rehabilitation / revegetation activities, storms, cyclones, flooding, bushfires and controlled burns, damage / vandalism.

3. **Presence / Absence and Abundance Monitoring**

   3.1 Monitoring Undertaken

   - A comprehensive description of all monitoring undertaken (eg walked transects, drone transect, drone meander, detection dog) will be included.
   - Timing, personnel, and methods shall be described.

   3.2 Temporal, Seasonal and Weather Conditions at time of sampling

   - Description of seasonal, weather and lunar cycle at the time of sampling, for each of the methods employed.
   - Potential limitations arising from conditions at the time of sampling shall be described.

   3.3 Results

   - Tabulation of presence / absence of animals observed for each survey technique.
   - Tabulation of Greater Glider results against standardised measures of abundance (eg, number of observations / km of walked transect, number observations / km of drone transect, number of observations / hour of random search, number of dog detections / km of search.
   - Temporal graphing of results across all sampling years, both by all species recorded and measures of abundance for all years of assessment.

   3.4 Discussion and Observations

   - Trends will be discussed for each method and between methods to assess reliability and effectiveness.
   - Unusual or noteworthy conditions and observations made at the time of the sampling which would have a material effect on detection or presence will be described.

   3.5 Recommendations for Future Monitoring Event Improvements

- Analysis and commentary of the reliability of the results will be discussed with respect to the methods employed, and the temporal, seasonal and lunar cycles at the time of the assessment.
- A comparative analysis of the effectiveness of methods will be conducted with recommendations for methodological / procedural improvements, phasing in / out of techniques.

4. Outcome of Hollow Condition Monitoring

4.1 Monitoring Undertaken

- A comprehensive description of all monitoring undertaken (eg walked transects, drone transect, drone meander, detection dog) will be included.
- Timing, personnel, and methods shall be described.

4.2 Temporal Seasonal and Weather Conditions at time of sampling

- Description of seasonal and weather conditions at the time of sampling, for each of the methods employed.
- Potential limitations arising from conditions at the time of sampling shall be described and discussed.

4.3 Results

- Tabulation of presence / absence of animals observed during drone inspections of hollow condition.
- Photographic index of each hollow , in line with the requirements described in the GGAH Baseline Report (Sections 3.3 and 3.4 of the GGHMMP)
- Tabulation of the results of hollow inspection against condition classes for the period.
- A running tabulation of hollow classes for each hollow across all years of sampling

4.4 Discussion and Observations

- Discussion of the progressive deterioration of hollows and likely failure necessitating action / maintenance.
- Presence of European Honeybees necessitating action.

4.5 Actioning Risk Triggers

- Reporting of field observations against the action triggers contained in Table 8 of the OAMP.
- Corrective action requirements

4.6 Recommendations for Future Monitoring Event Improvements

- Analysis and commentary of the reliability of the results will be discussed with respect to the methods employed, and the temporal, seasonal and lunar cycles at the time of the assessment.
- A comparative analysis of the effectiveness of methods will be conducted with recommendations for methodological / procedural improvements, phasing in / out of techniques in line with Section 4.6 of the GGHMMP.

5. Outcome of Hollow Use Monitoring

5.1 Monitoring Undertaken

- A comprehensive description of all monitoring undertaken (eg camera trapping, climbed inspections) will be included.
- Timing, personnel, and methods shall be described.

5.2 Seasonal and Weather Conditions at time of sampling

- Description of seasonal, weather and lunar cycle at the time of sampling, for each of the methods employed.
- Potential limitations arising from conditions at the time of sampling shall be described.

5.3 Results

- Tabulation of presence / absence of animals observed for each survey technique.
- Tabulation of presence / absence of animals observed for each hollow survey technique for sample period.
- Annualised tabulation of presence / absence of animals observed for each hollow survey technique for offset period.

5.4 Discussion and Observations

- Trends will be discussed for each method and between methods to assess reliability and effectiveness.
- Unusual or noteworthy conditions and observations made at the time of the sampling which would have a material effect on detection or presence will be described.

5.5 Actioning Risk Triggers

- Reporting of field observations against the action triggers contained in Table 8 of the OAMP.
- Corrective action requirements

5.6 Recommendations for Future Monitoring Event Improvements

- Analysis and commentary of the reliability of the results will be discussed with respect to the methods employed, and the temporal, seasonal and lunar cycles at the time of the assessment.
- A comparative analysis of the effectiveness of methods will be conducted with recommendations for methodological / procedural improvements, phasing in / out of techniques in line with Section 4.6 of the GGHMMP.

6. Non-conformance and Corrective Actions

- This section hinges on the preparation of a corrective actions register for the project.

6.1 Undertaken as a result of previous reporting

- The section summarises (with reference to the register) actions arising from previous monitoring.

- It will identify the status of those actions, eg outstanding or actioned, and if actioned, that date actions were undertaken.

6.2 Required

- This section summarises (with reference to specific items identified in Sections 5.5, 4.5) the corrective actions arising from the monitoring.

- It will identify responsibilities (what, where, how, by whom) and timing (when)actions to be undertaken , timing of those actions and by whom.

7. Auditing and review of GGHMMP adequacy

- Section 7 fulfils an annual adaptive management analysis of the effectiveness of the GGHMMP.

- It is a recapping of all of all recommendations for improvement contained in Section 3.5, 4.6 and 5.6, and Controlled Actions in Sections 4.5 and 5.5 and tracking of those matters in Section 6.

- It will assess whether amendments to the plan are necessary, and identify whether changes are minor or major and whether formal change approval by the Minister is necessary.

8. Other Matters

- Summary of any other matters of relevance, including new and or emerging techniques, procedures, practices in relation to Greater Glider management relevance to the GGHMMP that should be followed.

9. Summary and Conclusions