



Project Rehabilitation Plan

Bussell Highway Duplication Project – Stage 2

*We're working for
Western Australia.*

CPS 9168/1

State Forest No. 2 - Sites 1 and 3

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1 BACKGROUND AND INTRODUCTION

1.1 Purpose of the Plan

The overall purpose of this Project Rehabilitation Plan (the Plan) is to create self-sustaining vegetation that provides habitat for Western Ringtail Possum¹ (WRP) and three species of threatened Black Cockatoos² and includes an area that is representative of the Tuart Woodland Threatened Ecological Community (Tuart TEC)³.

Specifically, the Plan aims to guide implementation of actions to address Condition 20, and to meet the requirements of Condition 21, of CPS 9168/1 (Appendix 1). The Plan has been developed in accordance with “A Guide to Preparing Revegetation Plans for Clearing Permits” (DWER 2018).

1.2 Project and Environmental Background

To improve road safety along this road and to reduce congestion, Main Roads Western Australia (Main Roads) constructed a second carriageway along a 12.8 km section of the Bussell Highway between Hutton Road and the Sabina River bridge (Figure 1) (31.15 - 44.0 SLK) in the Shire of Capel and City of Busselton, approximately 200 km south of Perth.

1.3 Environmental Approvals and Offset Requirements

Main Roads sought a Purpose Clearing Permit for the Project under the WA *Environmental Protection Act 1986* (EP Act) through the Department of Water and Environmental Regulation (DWER). DWER issued a clearing permit (CPS 9168/1) for the Project in July 2021. Condition 20 of CPS 9168/1 (Appendix 1) relates to the provision of an environmental rehabilitation offset and requires that:

- a) The Permit Holder must rehabilitate 60.26 hectares of native vegetation in a degraded (Keighery, 1994) condition in Ludlow State Forest No. 2 within the area cross-hatched orange in Figure 3 of Schedule 2 of this Permit, of which:
 - i. 60.26 hectares must contain species which provide suitable foraging, breeding and roosting habitat for *Pseudocheirus occidentalis* (western ringtail possum) as identified in the western ringtail possum recovery plan
 - ii. 47.51 hectares must contain species which provide suitable foraging, breeding and roosting habitat for *Calyptorhynchus latirostris*² (Carnaby’s Cockatoo), *Calyptorhynchus banksia subsp. naso*² (Forest Red-tailed Black Cockatoo) and *Calyptorhynchus baudinii* (Baudin’s Cockatoo)² as identified in the Black Cockatoo recovery plan
 - iii. 8.95 hectares must contain species commonly found in ‘Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain’ ecological community as described in the Approved Conservation Advice.
- b) The rehabilitation required under condition 20(a) of this Permit, must be undertaken in accordance with the Project Rehabilitation Plan prepared under condition 21 of this Permit.

An amendment to condition 20a and Figure 3 of Schedule 2 of CPS 9168/1 is being submitted concurrently with this Plan to allow for changes to offset rehabilitation areas required by condition 20. Given the significant revegetation offsets required for the approved Bunbury Outer Ring Road (BORR) Southern Section Project (MS 1191), the area shown in Figure 3 of Schedule 2 of

¹ Western Ringtail Possum (*Pseudocheirus occidentalis*)

² Carnaby’s Cockatoo (*Zanda latirostris*), Baudin’s Cockatoo (*Zanda baudinii*) and Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*)

³ Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community.

CPS 9168/1 (identified as Offset Site 7) was reallocated to fulfill the requirements of MS 1191. As a result, in the amendment to CPS 9168/1 it is proposed that Offset Site 1 (14.90 ha) and Offset Site 3 (52.73 ha) replace Offset Site 7 to meet the requirements of Condition 20 (Figure 1). Offset Sites 1, 3 and 7 are all located within the Ludlow State Forest, with Offset Sites 1 and 3 located closer to the approved clearing along Bussell Highway. The Plan demonstrates the suitability of Offset Site 1 and Offset Site 3 to meet offset requirements.

Condition 21(c) relates to the preparation of a Project Rehabilitation Plan, and states:

- c) The Project Rehabilitation Plan must include the following:
- i. site preparation
 - ii. weed control
 - iii. a vegetation establishment period
 - iv. revegetation success completion criteria shall include but not be limited to target weed cover, target vegetation condition, target density, species richness, bare ground cover and target structure
 - v. revegetation success completion criteria must be consistent with:
 - reference site 1 for the rehabilitation area required under condition 20(a)(i) and 20(a)(ii) of this Permit; and
 - reference site 2 for the rehabilitation area required under condition 20(a)(iii) of this Permit.
 - vi. regeneration, direct seeding or planting, at an optimal time in accordance with a defined species list. Species must include suitable foraging, breeding and roosting habitat for *Pseudocheirus occidentalis* (western ringtail possum), *Calyptorhynchus latirostris*² (Carnaby's cockatoo), *Calyptorhynchus banksii* subsp. *naso* (Forest Red-tailed Black Cockatoo) and *Calyptorhynchus baudinii*² (Baudin's Cockatoo) and species which are commonly found in the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community as described in Approved Conservation Advice.
 - vii. contingency actions to be undertaken if completion criteria are not met
 - viii. ongoing maintenance and monitoring of the areas required to be revegetated and rehabilitated
 - ix. timeframes for completion of the activities
 - x. management commitments that will be achieved
 - xi. The Permit Holder shall implement the Project Rehabilitation Plan as approved by the CEO and the Director General of the Department of Biodiversity, Conservation and Attractions.

This Plan addresses Condition 21c) of CPS 9168/1, and has been prepared in accordance with

- *A Guide to Preparing Revegetation Plans for Clearing Permits* (DWER 2018)
- *Guidance Statement No. 6 Rehabilitation of Terrestrial Ecosystems* (EPA 2006)

A completed checklist in accordance with DWER (2018) is included in Appendix 2.

1.4 Offset Calculator Value Justification

In its decision report for CPS 9168/1, DWER confirmed the offset values that were input into the State Offset Calculator for residual significant impacts to remnant vegetation, Tuart TEC, Black Cockatoos, and WRP. These scores are summarised in Table 1 below and include a starting quality score of "two" at Offset Site 7, consistent with DWER (2022) guidance. The justification for this score was based on the site being described as degraded, comprising isolated scattered Tuart, Peppermint, and Marri trees, with a mid-storey of scattered Acacia and Bull Banksia, and an understorey dominated by weeds with isolated patches of sedges and rushes.

The proposal to replace Offset Site 7 with Offset Sites 1 and 3 is considered suitable and highly comparable to what was previously approved by DWER under CPS 9168/1. Both Offset Site 1 and

Offset Site 3 are described as degraded, supporting scattered remnant native trees over a weed-dominated understorey, with species including Peppermint, Marri, Tuart, and Jarrah. Given the very similar condition of Offset Sites 1 and 3, both located within the Ludlow State Forest, and Main Roads' ongoing commitment to achieving the revegetation objectives required under CPS 9168/1, no changes to the offset metrics presented in Table 1 are considered necessary and the current metric values are considered appropriate and consistent with those previously approved.

On this basis, the offset areas achieved through substituting Offset Sites 1 and 3 for the previously approved Offset Site 7 are considered equivalent, maintaining the total offset area (60.26 ha) and required offsets for Black Cockatoos (47.51 ha), WRP (41.12 ha), and the Tuart TEC (8.95 ha). These requirements have been accommodated across Offset Site 1 (total area 14.90 ha) and Offset Site 3 (total area 55.44 ha), equating to a combined total of 70.34 ha. The additional 10.08 ha provides a conservative buffer to account for firebreaks, access tracks, and other necessary management requirements. The additional area also includes a 2.71 ha area consisting of a vegetation community associated with a seasonal wetland (within the fence of Site 3) which is not part of the offset revegetation area.

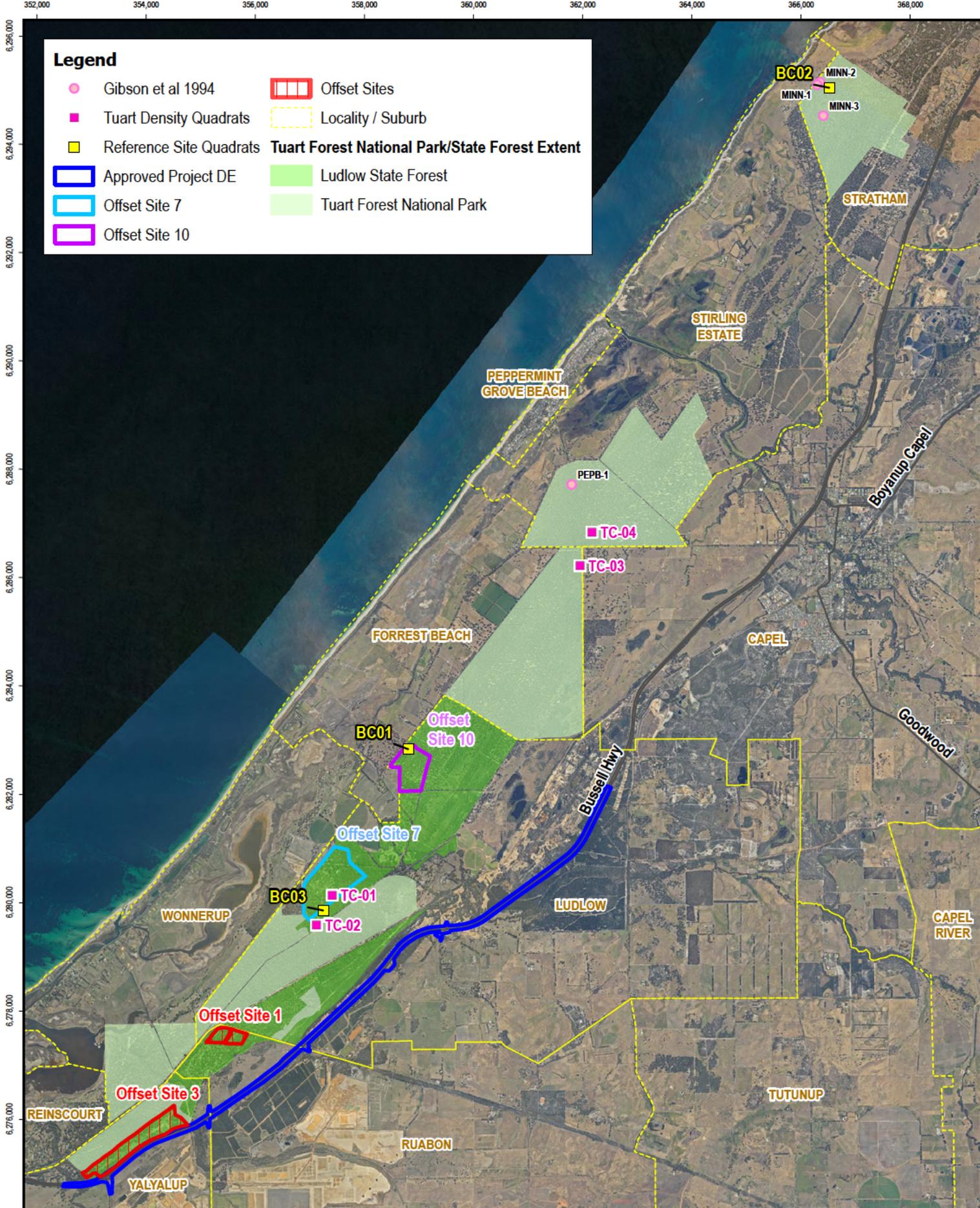
Further detailed information on Offset Sites 1 and 3, including existing biological values, is provided in Sections 3.2.1 and 3.2.2.

Table 1: Agreed Offset Calculator Inputs for Offset Site 7

Attribute	Remnant Vegetation	Tuart TEC	Black Cockatoo	WRP
IUCN Criteria	0.0	6.8	1.2	6.8
Area of impact	27.3	2.0	20.8	24.0
Quality of impacted area	5.0	5.0	6.0	6.0
Time over which loss is averted	20.0	20.0	20.0	20.0
Time until ecological benefit	10.0	10.0	10.0	10.0
Start area	60.26	8.95	47.51	41.12
Start quality	2.0	2.0	2.0	2.0
Future quality without offset	2.0	2.0	2.0	2.0
Future quality with offset	5.0	5.0	6.0	6.0
Risk of loss (%) without offset	15.0	15.0	15.0	15.0
Risk of loss (%) with offset	10.0	10.0	10.0	10.0
Confidence in result (%) risk of loss	90.0	90.0	90.0	90.0
Confidence in result (%) habitat quality	80.0	80.0	80.0	80.0
% of impact	100.0	100.0	100.0	42.3

1.5 Contacts

This Plan was prepared by a Main Roads Senior Environment Officer who holds a Bachelor of Science in Environmental Management, and who has more than 20 years' experience in environmental management in south west Western Australia. Enquires regarding this Plan can be made to Martine Scheltema (Director Environment and Heritage – Main Roads) on 9323 4616.



Legend

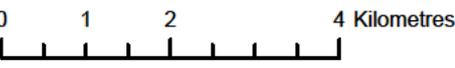
- Gibson et al 1994
- Tuart Density Quadrats
- Reference Site Quadrats
- Approved Project DE
- Offset Site 7
- Offset Site 10
- Offset Sites
- Locality / Suburb
- Tuart Forest National Park/State Forest Extent**
- Ludlow State Forest
- Tuart Forest National Park

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 Created Date: 28/11/2025
 Author: C11025

Bussell Highway Duplication Stage 2

Figure 1: Bussell Highway Duplication State 2 – Offset and Reference Sites

Figure 1



2 IMPACT SITE

2.1 Vegetation

The Project required the approval of clearing of up to 27.3 ha of mixed remnant and planted vegetation. While the floristic diversity within the Clearing Area was high in some locations, the majority consisted of a highly disturbed environment. Most of the vegetation was established as part of landscaping for the existing highway or historic mine site rehabilitation, or has been previously cleared for road construction or agricultural purposes.

Approximately one quarter (24.9%) of the proposed Clearing Area vegetation was rated as Good or Very Good condition, where the original vegetation structure was intact and native plant species dominated (Ecoedge 2019, Ecoedge 2020a). Areas categorised as Degraded or worse (75.1%) were largely revegetated mining areas or areas previously cleared for agricultural or road construction purposes. These had a mix of planted species, many of which are not locally native, and regeneration of locally native species, notably the shrub *Kunzea glabrescens*.

The Clearing Area contained 1.5 ha of the DBCA-listed Priority 3 PEC 'Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands (floristic community type (FCT) 30b)' which also forms part of the Tuart TEC vegetation community (Ecoedge 2020b) which is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as a Priority 3 ecological community (PEC) at the state level by DBCA.

The Clearing Area also contained the Priority 1 PEC '*Eucalyptus cornuta*, *Agonis flexuosa* and *Eucalyptus decipiens* forest on deep yellow-brown siliceous sands over limestone' ('Busselton Yate PEC'), although some of the individuals of *Eucalyptus cornuta* within this occurrence were planted, as indicated by the presence of furrows and ridges from which the trees are growing (Ecoedge 2020a, Ecoedge 2020b). It is also considered to represent an occurrence of the P3 PEC floristic community type 30b. The Project was approved to clear up to 0.6 ha of the Busselton Yate PEC.

In total, the Project required the approved clearing of up to 2.0 ha of the Tuart Woodlands TEC/PEC.

Six taxa classified as Priority flora by DBCA were recorded within the Clearing Area (Ecoedge 2020a):

- *Acacia flagelliformis* (P4) – 52 individuals within the area to be cleared, one individual to be retained;
- *Eucalyptus rudis* subsp. *cratyantha* (P4) – 10 individuals within the area to be cleared, two to be retained;
- *Calothamnus quadrifidus* subsp. *teretifolius* (P4) – 6 individuals within area to be cleared,
- *Synaphea hians* (P3) – 5 individuals within the area to be cleared, five to be retained;
- *Synaphea petiolaris* subsp. *simplex* (P3) – two individuals within the area to be cleared, one to be retained; and
- *Verticordia attenuata* (P3) – 2,896 individuals within the area to be cleared, 26 to be retained.

2.2 Fauna habitat

The Clearing Area was not identified as having a high level of faunal diversity, with surveys recording only two notably similar habitat types, one comprising native vegetation, the other comprising a mix of planted and regrowth vegetation (360 Environmental 2017).

Most (24 ha, 87.9%) of the vegetation present within the Clearing Area represented potential WRP habitat and the species was found at a number of locations within the survey areas of all three

surveys conducted for the Project (360 Environmental 2017). The majority (20.8 ha, 76%) of vegetation in the Clearing Area (including both habitat types) represented Black Cockatoo foraging and/or potential nesting habitat (360 Environmental 2017).

Two species recorded within the Clearing Area (WRP and Carnaby's Cockatoo) are listed under both the EPBC and BC Acts, and one, the Southern Brown Bandicoot, is listed as Priority 4 by DBCA.

3 REHABILITATION PLAN

3.1 Revegetation Commitments and Objectives

The purpose and intent of this Plan is to create self-sustaining vegetation that provides habitat for WRP and three species of threatened Black Cockatoos and includes an area that is representative of the Tuart TEC.

The objectives for the revegetation offset project are:

- to create 60.26 ha of foraging and breeding habitat for WRP that is representative of WRP habitat as identified in the *Western Ringtail Possum Recovery Plan* (DPaW 2017)
- to create 47.51 ha of foraging, breeding and roosting habitat for Black Cockatoos that is representative of Black Cockatoo habitat identified in Black Cockatoo recovery plans (DEC 2008 and DPaW 2013)
- to create 8.95 ha of Tuart Woodland TEC vegetation that is representative of the Tuart woodland vegetation described in the Approved Conservation Advice (TSSC 2019).

3.2 Revegetation Sites

Two revegetation sites comprise the rehabilitation offset for the Project, these are referred to as Site 1 and Site 3 and are shown in Figure 1. As discussed in Section 1.3, these sites are not referenced in Schedule 2 of CPS 9168/1. An amendment to condition 20a and Figure 3 of Schedule 2 of CPS 9168/1 is being submitted concurrently with this Plan to allow for changes to offset rehabilitation areas required by condition 20. The proposed sites are located within State Forest No. 2 (SF No. 2), also known as the Ludlow State Forest, on Crown land that is managed by DBCA under the *Conservation and Land Management Act 1984*. Accordingly, the offset areas have long term tenure protection. DBCA has also advised that the sites are available to Main Roads for use as an offset towards the Project (Appendix 3).

An MoU between Main Roads and DBCA is yet to be finalised, although revegetation works have commenced with agreement of DBCA. The MoU will detail the agreed ongoing management parameters, the provision of funding for ongoing management costs, as well as the terms for handover of the site to DBCA once the completion criteria are met. Main Roads will fund and manage the Offset Sites 1 and 3 for the purposes of conservation until expiry of the clearing permit (August 2036), or until such time as the completion criteria are met, whichever occurs first.

Main Roads commits to ensuring that the MoU is executed by July 2026, and will update this Plan if required to reflect any additional commitments agreed between DBCA and Main Roads.

3.2.1 Site 1

Site 1 comprises a 14.90 ha degraded portion of State Forest No. 2, located north of Layman Road and approximately 9.5 km east of the Busselton town centre. The site is bounded to the northwest by Tuart Drive and the historic railway easement, to the northeast by an access track, and on the remaining boundaries by scattered remnant and/or planted vegetation within State Forest No. 2. The site previously supported plantation timber (*Pinus* spp.), which was harvested between approximately mid-2001 and mid-2003.

Vegetation within the site is predominantly comprised of scattered remnant *Agonis flexuosa* (Peppermint) and *Eucalyptus gomphocephala* (Tuart) over a weedy understorey.

Contiguous and directly south of Site 1 is another Main Roads rehabilitation offset site allocated to the BORR project. Baseline rehabilitation monitoring of that area was undertaken by Biota (2025), who mapped the 40.3 ha site as Tuart–Peppermint Woodland with occasional *Corymbia calophylla* (Marri) over predominantly weeds, with vegetation condition ranging from Degraded to Completely Degraded (EPA 2016).

In alignment with Biota (2025), Offset Site 1 (Figure 2) was inspected by Main Roads botanists and similarly characterised as Tuart–Peppermint Woodland over weeds in Degraded to Completely Degraded condition (EPA 2016). A reconnaissance survey of Offset Site 1 is scheduled for spring 2025 to establish a baseline for future rehabilitation activities.

The site is located at the southern end of the Swan Coastal Plain and is within the Spearwood Dune landform system on the Ludlow Flats soil phase (SpLD1). The soil type is characterised by flats and very low dunes underlain by deep sands (DPIRD, 2025). The site has low relief and does not contain any watercourses or surface water bodies. The nearest mapped wetland is a multiple use sumpland located approximately 330 m east of the site boundary. The closest watercourse is the Abba River, situated approximately 900 m to the south-west (Figure 3).

Site 1 occurs within Ecosystem Management Zone 2a (FMP ID 124) which is defined in the Tuart Forest National Park Management Plan (TFNPMP) (DPaW 2014) as 'Cleared plantation and former freehold land'. The proposed rehabilitation works are congruent with the objectives of the TFNPMP within Ecosystem Management Zone 2a, which are to:

- Protect and enhance the eastern wetland/tall Tuart community transition zone
- Protect and enhance the proposed Busselton yate TEC
- Protect and increase habitat for fauna that are highly represented in zones 5 and 6 (for example, western ringtail possum and brushtail possum)
- Enhance resilience of this zone to disturbance and threatening processes.

Proposed management actions within the TFNPMP to achieve these objectives include:

- Undertake experimental trials in rehabilitation of the tall Tuart communities to address knowledge deficits
- Re-establish native vegetation in cleared areas, adapting management according to results of experimental trials (DPaW 2014).

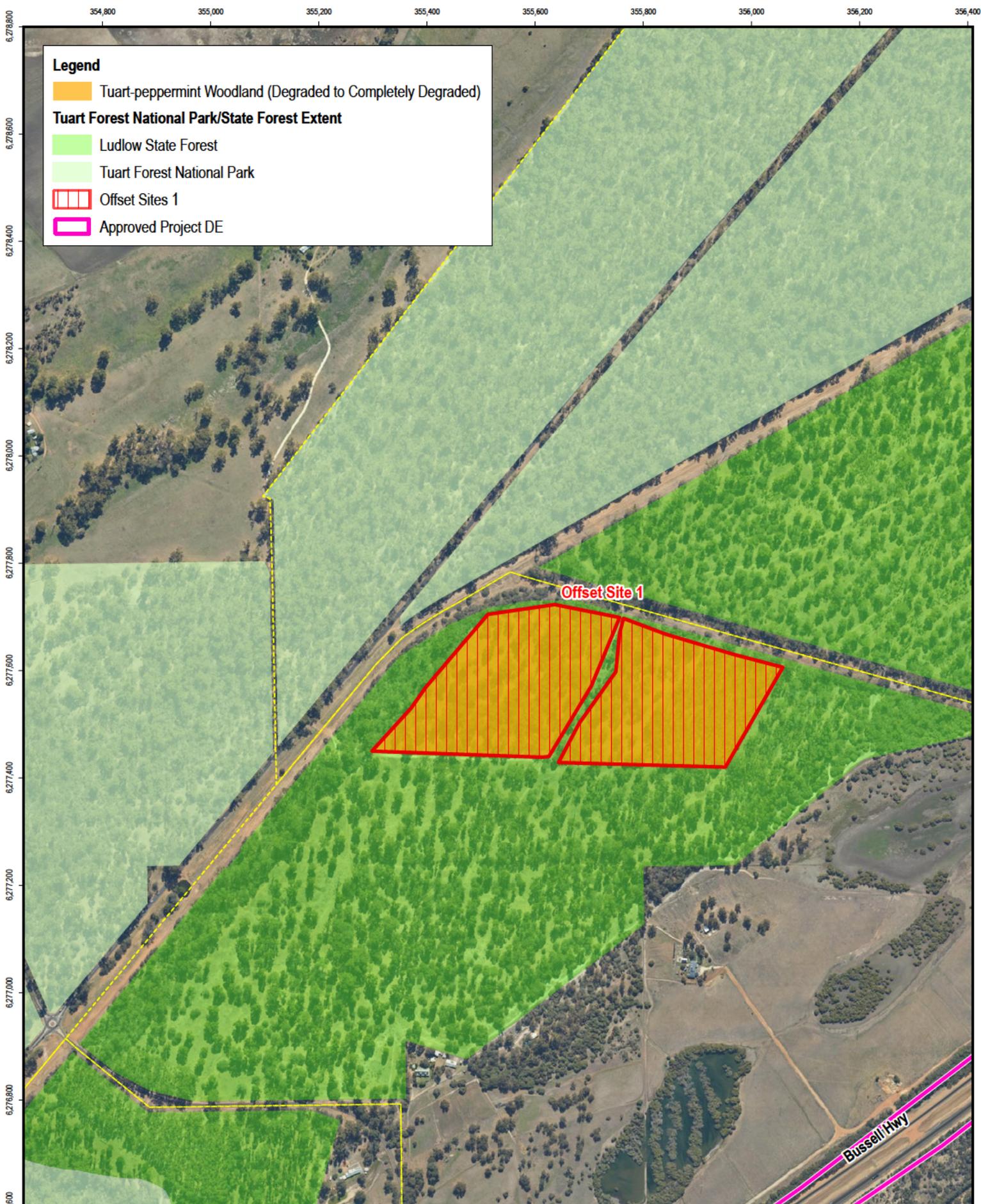
Representative photos of Site 1 are shown in Plate 1 and Plate 2 below illustrating a degraded vegetation community which is comprised of scattered remnant Peppermint and Tuart over weeds.



Plate 1

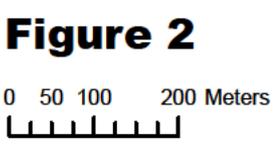


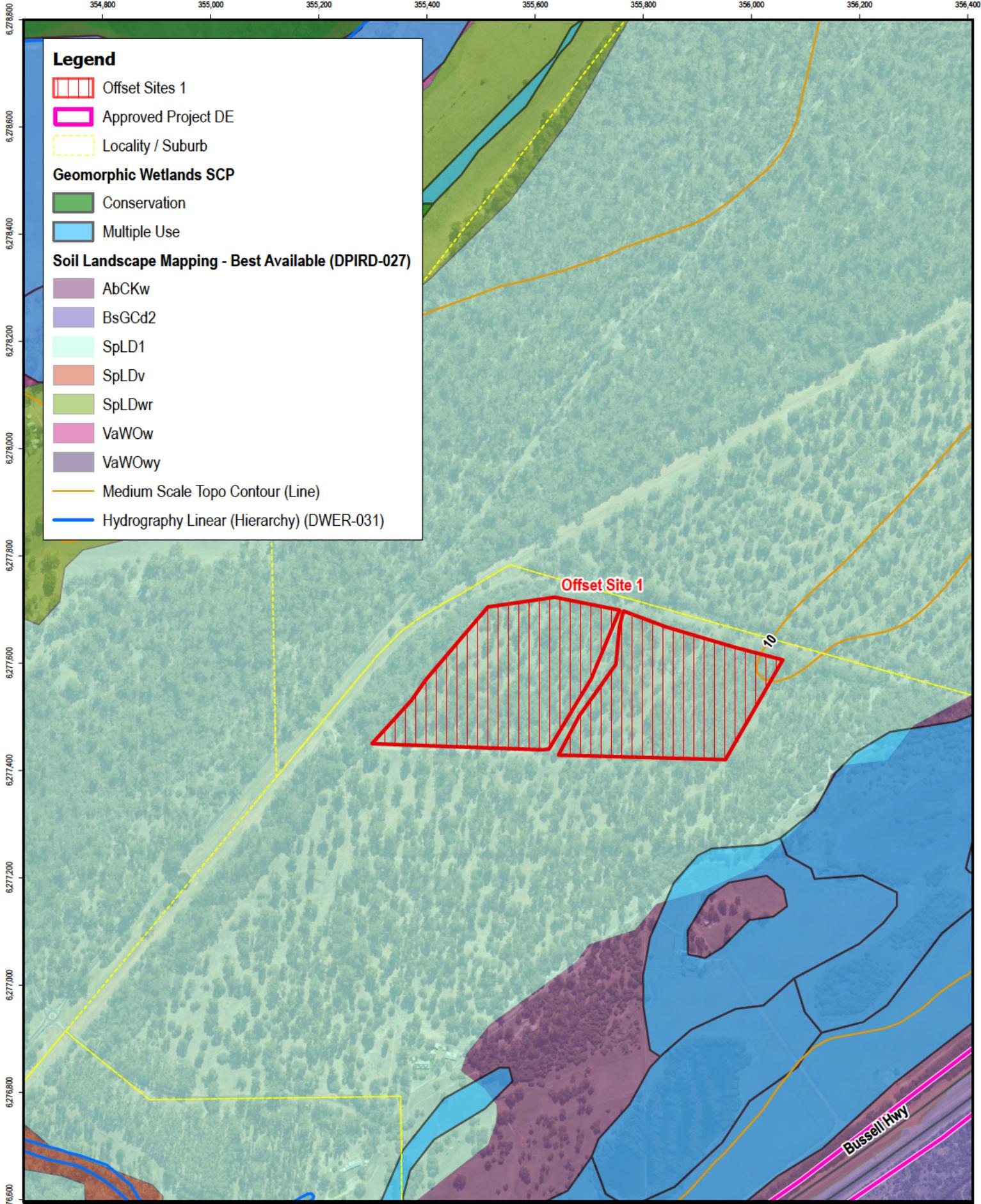
Plate 2



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 Author: C11025

Bussell Highway Duplication Stage 2
 Figure 2: Offset Site 1 Vegetation Type, and Condition





- Legend**
- Offset Sites 1
 - Approved Project DE
 - Locality / Suburb
- Geomorphic Wetlands SCP**
- Conservation
 - Multiple Use
- Soil Landscape Mapping - Best Available (DPIRD-027)**
- AbCKw
 - BsGCd2
 - SpLD1
 - SpLDv
 - SpLDwr
 - VaWOw
 - VaWOwy
- Medium Scale Topo Contour (Line)
 - Hydrography Linear (Hierarchy) (DWER-031)

Offset Site 1

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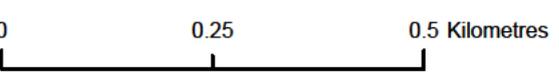
Bussell Hwy

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 Author: C11025

Bussell Highway Duplication Stage 2

Figure 3 – Offset Site 1 Topography, Soil Landscape and Surface Water

Figure 3



3.2.2 Site 3

Site 3 comprises a degraded portion of SF No. 2 and is located approximately 7 km east of the Busselton town centre. It is 55.43 ha in size, is contained within the Ludlow State Forest, and is bounded by the Tuart Forest National Park (TFNP) to the north, Abba River to the east, Bussell Highway to the south and Sabina River to the west. Site 3 is located 1.3 km southwest of Site 1 and is also within the Spearwood Dune landform system (Figure 1).

The site previously supported plantation timber (*Pinus* spp.) which has recently been harvested, with the stumps and pine debris removed and burnt on-site. There are scattered Peppermint, Marri, Tuart and Jarrah trees throughout the site. A portion of a degraded seasonally inundated wetland is located in the south-western portion of the site. This is dominated by overstorey species of Peppermint, *Eucalyptus rudis* (Flooded Gum) and *Melaleuca raphiophylla* (Swamp Paperbark) with an understorey consisting of weed species and isolated clumps of *Baumea juncea* (Bare Twig Rush). The site vegetation was assessed from a site reconnaissance survey (Ecoedge 2022) and review of aerial photography, and is largely Degraded to Completely degraded in condition (EPA 2016). The wetland area (2.71 ha) in the south-western portion of the site and a small pocket of vegetation (0.69 ha) in the north east portion of the site were assessed in Good condition (Ecoedge 2022). Given the objectives for revegetation under this Plan (which do not require wetland revegetation) and following consultation with DBCA, it was decided that the 2.71 ha seasonally inundated wetland within the site (Melaleuca-Peppermint Low Closed Forest) would be excluded from revegetation activities. Vegetation type and condition are summarised in Table 2 and illustrated in Figure 4.

Table 2. Site 3 - Vegetation Associations and Condition

Vegetation Association	Condition	Area (ha)
Tuart-Peppermint Woodland	Good	0.69
Tuart-Peppermint Woodland	Degraded	8.99
Tuart Woodland	Completely Degraded	43.05
Sub-total		52.73
*Melaleuca-Peppermint Low Closed Forest	Good	2.71
Total		55.44

*Vegetation community within fence boundary but not subject to revegetation activities.

Offset Site 3 is predominantly located on the Ludlow Flats soil phase (SpLD1), which is characterised by flats and very low dunes underlain by deep sands (DPIRD, 2025). Where the seasonally inundated wetland occurs the soil type changes to a Ludlow vales phase (SpLDv) which is characterised by sandy alluvial soils associated with narrow floodplains in small depressions along creeks. The site is largely flat with the depression associated with the seasonal wetland the only change in relief. There are no watercourse or permanent surface waterbodies. The nearest mapped wetland is a multiple use sumpland which is adjacent, but largely located on the south side of Bussell Highway. The closest watercourses are the Abba River approximately 80 m east and Sabina River, approximately 200 m to the west of the site (Figure 5).

The site occurs within Ecosystem Management Zone 2b (FMP ID 124) as defined in the TFNPMP (DPaW 2014). The proposed rehabilitation works are congruent with the objectives of the TFNPMP within Ecosystem Management Zone 2b which, after removal of remaining pines, are to:

- Protect and enhance the eastern wetland/tall Tuart community transition zone.
- Protect and increase habitat for fauna that are highly represented in zones 5 and 6 (for example, western ringtail possum and brushtail possum).
- Enhance the resilience of this zone to disturbance and threatening processes.

Proposed management actions within the TFNPMP to achieve these objectives include:

- Retain and avoid damaging individual Tuart trees that occur in these areas during pine harvesting
- Following tree harvesting, management actions will be the same as Zone 2a (DPaW 2014).

Representative photos of the majority of Site 3 subject to revegetation activities (52.73 ha) are shown in and Plate 3 and Plate 4 illustrating a degraded vegetation community which is comprised of scattered Tuart, Peppermint with occasional Jarrah trees over weeds. In agreement with DBCA, the 2.71 ha seasonally inundated wetland will be excluded from revegetation activities and therefore does not form part of the offset.



Plate 3

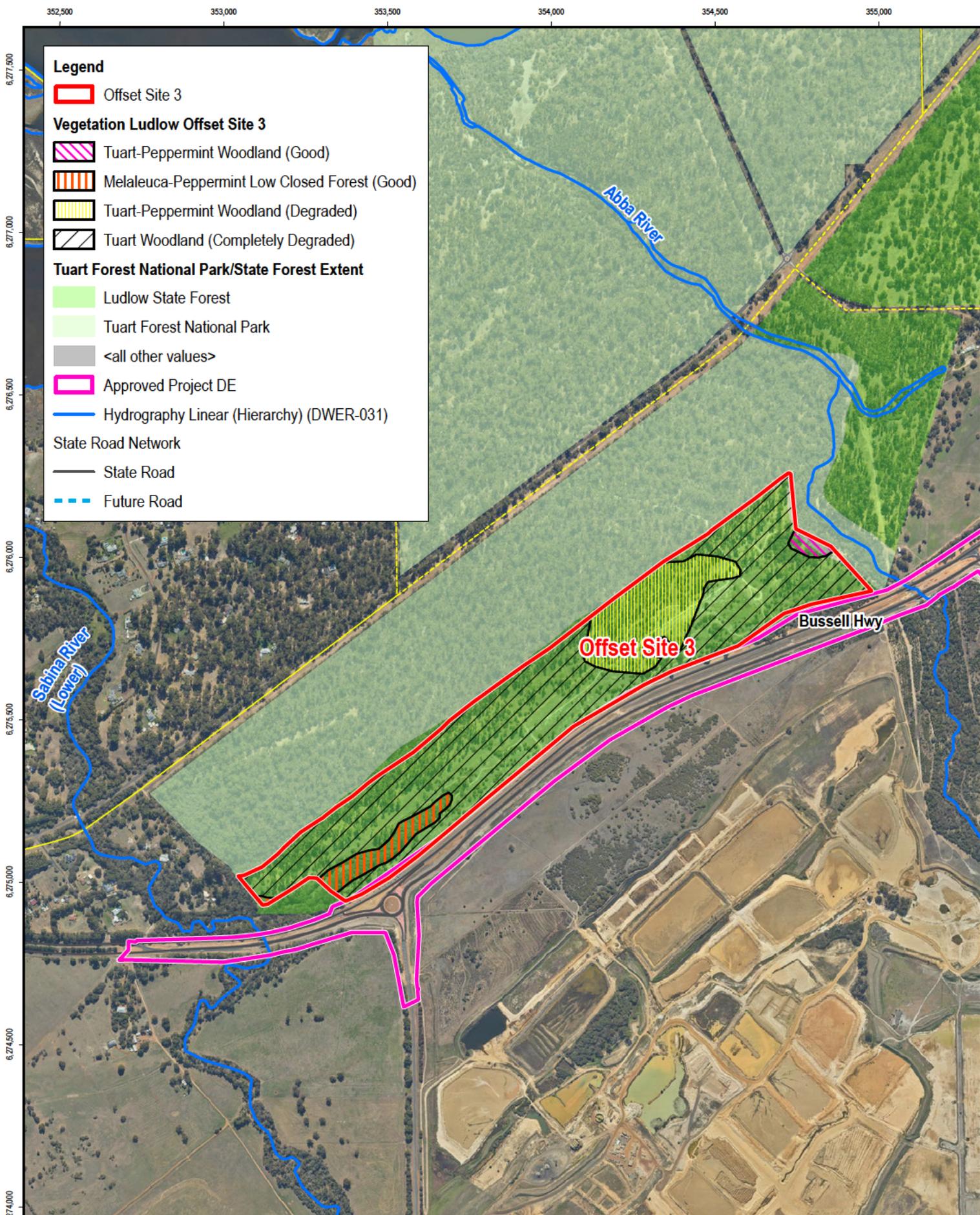


Plate 4

3.2.3 Current Disturbances and Threats

Historically both Site 1 and Site 3 supported plantation timber (*Pinus* spp.) which has now been harvested with only the stumps and pine debris removed and burnt on-site at Site 3. As a result, the key current disturbances and threats at both sites have included herbivore grazing, weed invasion and unrestricted access. The understorey at both sites is dominated by a variety of seasonal weed species, primarily *Zantedeschia aethiopica* (Arum Lily). A small amount of rubbish is also present. Given previous timber plantation land uses and recent removal of pine trees using earth movement equipment there are also likely to be areas of soil compaction present that will need to be ripped to aerate the soil profile prior to rehabilitation.

Given the poor condition of the vegetation and general lack of indicator species, dieback status at both sites is considered uninterpretable however sporadic indicator species both within and surrounding the sites show no evidence of *Phytophthora* attack. The sites will be treated as dieback free and Main Roads will implement its standard management practices for dieback for all management, maintenance and monitoring activities (Section 6.2).

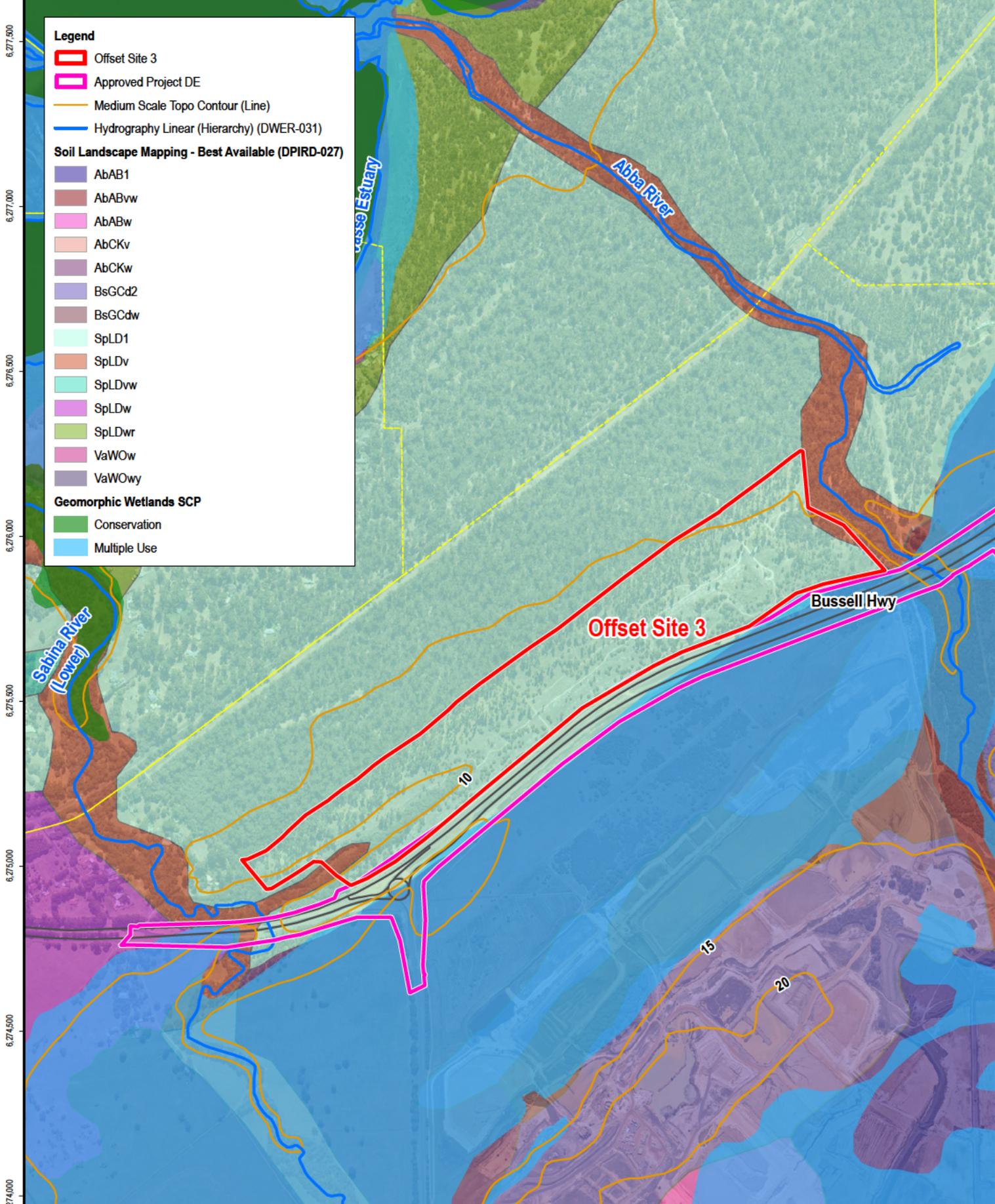


Bussell Highway Duplication Stage 2
 Figure 4 – Offset Site 3 Vegetation Type and Condition

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 Created Date: 1/12/2025
 Author: C11025

Figure 4

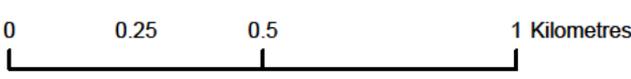




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 Coordinate System: GDA2020 PCG2020
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 Created Date: 1/12/2025
 Author: C11025

Bussell Highway Duplication Stage 2
 Figure 5 – Offset Site 3 Topography, Soil Landscape and Surface Water

Figure 5



4 REFERENCE SITES

Condition 21(c)(v) of CPS 9168/1 requires the identification of reference sites. Reference sites are defined in CPS 9168/1 as meaning "...nearby sites used to provide baseline data for planning a revegetation project. Measurements from fixed reference points or plots where biodiversity components are measured are used to set measurable completion criteria for revegetation projects". According to the definitions in CPS 9168/1:

Reference Site 1 must contain native vegetation which provides the following values:

- provides suitable habitat for *Pseudocheirus occidentalis* (western ringtail possum)
- provides suitable foraging habitat for *Calyptorhynchus latirostris*² (Carnaby's Cockatoo), *Calyptorhynchus banksia* subsp. *naso* (Forest Red-tailed Black Cockatoo) and *Calyptorhynchus baudinii*² (Baudin's Cockatoo)
- accurately represents the surrounding vegetation in Ludlow State Forest No. 2
- is in Good (Keighery, 1994) or better condition

Reference Site 2 must contain the following values:

- Native vegetation which represents the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain' State listed priority ecological community.

Furthermore, DWER (2018) guidance requires the development of completion criteria for revegetation by establishing control sites within Good or better condition vegetation.

Main Roads has undertaken extensive scoping for reference sites within the TFNP in order to meet the above requirements including:

- Consultation with DBCA, specifically the Parks and Wildlife Service's South West Region
- Reference site and quadrat installation and analysis
- Tuart tree density investigation
- Baseline flora and vegetation surveys (Stream 2022 and 2023)

4.1 DBCA Consultation

Consultation with Mr. Andrew Webb at DBCA was undertaken to assist with scoping for suitable reference sites within Ludlow State Forest No. 2 (Webb, A. 2023). DBCA advised that vegetation within the Minninup Forest Block (Minninup) contained the best condition vegetation throughout the TFNP. DBCA further recommended that Main Roads review quadrat data from a study by Gibson et al. (1994) which had four quadrats in the TFNP, with three in the Minninup Forest Block (MINN-1, MINN-2, MINN-3) and one further south (PEPB-1). DBCA have also conducted fencing trials in Minninup with the aim to exclude herbivore grazing (Webb 2017).

4.2 Quadrat Installation and Analysis

Following consultation with DBCA, scoping by Main Roads botanists for reference sites was undertaken within the TFNP, specifically within Ludlow State Forest No. 2 (Ludlow) and Minninup Forest Block (Minninup). One 10 x 10 m quadrat (BC02 – Figure 1) was placed at Minninup, close to but outside the exclusion fencing, on 5 September 2023. Two 10 x 10 m reference quadrats (BC01 and BC03) were installed in Ludlow on 5 and 12 September 2023, within Main Roads' BORR Offset Site 10 and adjacent to BORR Offset Site 7 respectively (Figure 1). All three quadrats were marked with permanent fence droppers in each corner. All species were recorded within the quadrat, including notes on foliage cover (%), evidence of disease and grazing where applicable. Photos were taken in a NW-SW-SE-NE order. Additional species opportunistically recorded outside but adjacent to the quadrats were also noted. The 10 x 10 m quadrats were expanded to 20 x 20 m to record further data on trees (species, density, canopy cover).

Data from Gibson et al. (1994) quadrats in the TFNP were also reviewed. All Gibson et al. (1994) species names were updated to current nomenclature according to the Western Australian Herbarium (1998-). Main Roads quadrat data is provided as Appendix 4 and the total number of species recorded by Main Roads and the four Gibson et al. (1994) quadrats is located in Appendix 5. This data is further discussed in Section 4.2.1 and 4.2.2.

4.2.1 Quadrat Data

The Minninup Forest Block was inspected by Main Roads botanists and it was visually apparent that fencing had resulted in higher species richness, particularly in the ground and herb layers. Whilst the vegetation at Minninup is largely Tuart, Peppermint and *Banksia attenuata*, both Tuart and Peppermint are not as dominant as in Ludlow, reflecting the position of the site closer to the coast and on a sand dune (compared to Ludlow sites on sandy flat close to groundwater table). Further work on the density of Tuart trees is discussed in Section 4.3.

The BC02 10 x 10 m quadrat was tentatively placed at Minninup close to, but outside the exclusion fencing, however it was later determined that the vegetation and position in the landscape was not comparable to the Ludlow Offset Sites 1 and 3 for the Project. Minninup is located on the Spearwood S2a soil phase (211Sp__S2a) which represents the lower slopes of a sand dune ridge while Sites 1 and 3 are located on the Ludlow flats soil phase (211SpLD1) which are characterised by flats and very low dunes on deep sands (DPIRD 2025). The Minninup quadrat was therefore not a representative analogue site for the development of revegetation completion criteria.

Ludlow was extensively scoped for reference sites, however finding suitable sites in Good or better condition was challenging. Ludlow is almost completely in degraded to completely degraded condition, consisting largely of Tuart and Peppermint over weeds, and in some patches almost entirely dominated by declared pest plant Arum lily in the ground layer. As described above, two 10 x 10 m reference quadrats (BC01 and BC03) were installed in Ludlow, in small pockets of Good condition vegetation identified during survey scoping within Main Roads BORR Offset Site 10 (BC01) and adjacent to BORR Offset Site 7 (BC03) (Figure 1).

BC01 and BC03 supported a similar number of species with an average species richness of 27.5 per 100 m². However, excluding weeds (introduced species), the species richness dropped to an average of 13.5 species per 100 m² (Table 3). In comparison, BC02 in Minninup had a total of 23 species, 15 of which were native. The total number of species recorded across the three quadrats and opportunistically was 58, of which 37 were native (Appendix 4).

Table 3. Total Species for Reference Quadrats Including and Excluding Weed Species

Quadrat	Total Species	Weeds	Native Species Only
BC01	27	13	14
BC03	28	15	13
Average	27.5	14	13.5

Data for Gibson et al. (1994) quadrats in the TFNP were also reviewed. All Gibson et al. (1994) species names were updated to current nomenclature according to the Western Australian Herbarium (1998-). Gibson et al. (1994) had four quadrats in the TFNP, with three (MINN-1, MINN-2, MINN-3) in the Minninup block and one (PEPB-1) further south as shown in Figure 1. As previously discussed, vegetation in the Minninup block is not considered an appropriate analogue for Offset Sites 1 and 3.

Overall, there was correlation in the dominant species between the Gibson et al. (1994) data and the reference quadrats surveyed in 2023, but the species richness was far greater in the Gibson et al. (1994) quadrats. Species richness in the Gibson quadrats varied from 37 to 60, with average richness of 50 species per 100 m², dropping to 33.8 species per 100 m² if excluding weeds. It

appears that the condition of TFNP has deteriorated significantly since Gibson et al. (1994) scored the quadrats almost 30 years ago. Gradual deterioration in vegetation condition has been acknowledged as something that is likely to occur in the TFNP without appropriate management, due to rabbit and kangaroo grazing pressure and significant weed infestation (DPaW 2014). The total number of species recorded across the four Gibson et al. (1994) and the 2023 reference quadrat survey was 125, of which 84 were native (Appendix 5).

4.2.2 Reference Criteria

Reference Site 1 under CPS 9168/1 is to contain native vegetation which provides suitable habitat for WRP and Black Cockatoos. WRP habitat within BC01 and BC03 is largely provided by Peppermint and Tuart trees. All of the reference quadrats and quadrats surveyed by Gibson et al. (1994) are also considered to provide suitable habitat for WRPs. BC01 and BC03 meet the criteria for Reference Site 1, however besides Tuart, most other species remaining within the reference sites and surrounding Ludlow area, other than the occasional *Banksia attenuata* and Jarrah, do not provide high habitat value for Black Cockatoos.

BC01 and BC03 are representative of Tuart TEC (TSSC 2019) and therefore meet the criteria for Reference Site 2 as required by CPS 9168/1. The vegetation within the quadrats is consistent with the key diagnostic characteristics of the TEC, with Tuart the dominant overstorey species and the vegetation part of a large continuous patch well in excess of 5 ha. Both quadrats were assessed as being in Good condition (EPA 2016) and both sites contained significant weeds, although a range of natives persisted among patches of *Lepidosperma* species.

Despite the difficulty in identifying suitable reference sites in Ludlow, both BC01 and BC03 meet the criteria for Reference Site 1 and Reference Site 2. Main Roads does however acknowledge that completion criteria can be elevated to improve vegetation condition and habitat value for Black Cockatoos and this is further detailed in Section 5.

4.3 Tuart Density Investigation

In order to achieve vegetation that is analogous with the surrounding remnant woodlands and forests, Main Roads undertook an investigation into the density of Tuart trees within TFNP. The investigation largely focussed on sites within Ludlow, however Minnip was also considered.

To determine the average Tuart density and to guide rehabilitation efforts, six 20 x 20 m quadrats (including BC01, BC02 and BC03) were installed in Ludlow and one quadrat was installed in Minnip. Sites are detailed in and shown in Figure 1. The recorded Tuart density at Ludlow ranged from 50 to 475 stems/ha. The Minnip quadrat had the lowest Tuart density at 25 stems/ha. Including Minnip, the average density was 200 stems/ha. Excluding Minnip, the average density for Ludlow was 229 stems/ha. Main Roads therefore concluded that revegetation works for Ludlow should aim to establish approximately 230 Tuart stems/ha on average, up to a maximum of 475 stems/ha in order to achieve vegetation that is analogous with the surrounding remnant woodland and forests. These represent long-term target densities (for mature trees) rather than planting densities. Initial planting and/or seeding densities will take into consideration the expected mortality rates, and infill planting or selective thinning may be required to achieve the long-term targets.

Table 4. Tuart Density Sites within Ludlow

Site	Location	Trees/400m ²	Tree/ha
TC01	Good veg, Site 7	8	200
TC02	Near Teresa Road	13	325
TC03	Off Higgins Road	19	475
TC04	Site 12	6	150
BC01	Site 10	7	175
BC02	Minninup	1	25
BC03	Adjacent to Site 7	2	50
Total Average Density			200

4.4 Baseline Flora and Vegetation Surveys

As previously discussed, reference quadrats (BC01 and BC03) were installed in Ludlow, within Main Roads' BORR Offset Site 10 and adjacent to BORR Offset Site 7. These sites, which are about 3 km apart, were assessed in spring 2021 (Stream 2023) and spring 2022 (Stream 2022) respectively. While the majority of both sites were considered to be in Degraded or worse condition, both contain a small portion in Good condition vegetation. BC01 was located in the vegetation mapped as Good condition in Offset Site 10, whilst BC03 was located just outside Offset Site 7 within an area assessed as Good by Main Roads' botanists. This quadrat was placed in vegetation considered to be in better condition than the area mapped as Good condition within Site 7.

Vegetation in Site 7 was described by Stream (2022) as "Tall open woodland of *Eucalyptus gomphocephala* and *Corymbia calophylla* over open woodland of *Agonis flexuosa* over mixed shrubland/grassland of *Briza maxima*, *Zantedeschia aethiopica* and ?*Dichopogon* sp". The field survey recorded 52 taxa of vascular plants from 28 families (Appendix 6). Twenty three of the 52 taxa were introduced. The most common families by number of taxa were Asteraceae (6 taxa), Poaceae (5 taxa) and Fabaceae and Orchidaceae (both with 4 taxa). The prevalence of taxa from Asteraceae and Poaceae (predominantly weed species) is related to the level of disturbance and the generally poor condition of vegetation in that site.

Vegetation in Site 10 was described as "Open woodland of *Eucalyptus gomphocephala* over low woodland of *Agonis flexuosa* over open shrubland of *Hibbertia cuneiformis* over *Lepidosperma ? longitudinale* over weedy grasses (Stream 2023). The field survey recorded 51 taxa of vascular plants from 24 families (Appendix 6). Twenty four of the 51 taxa are introduced. Five species are planted in a small section that appeared to have been partially rehabilitated with infill planting. The most common families by number of taxa were Poaceae (9 taxa), Fabaceae and Asparagaceae (both with 5 taxa). The prevalence of taxa from Poaceae (predominantly weed species) is related to the level of disturbance and the generally poor condition of vegetation in that site.

Dieback surveys have not been conducted at reference sites as these sites are considered to be uninterpretable due their very poor condition and general lack of indicator species. It is also noted that the sites are situated on calcareous soils, and as such it is highly unlikely that dieback is present. Main Roads implements standard management practices for dieback for all management, maintenance and monitoring activities including clean on entry, clean on exit management measures.

5 TARGETS AND COMPLETION CRITERIA

Completion criteria for the revegetation areas are detailed in Table 5. The completion criteria address the requirements of Condition 21 in CPS 9168/1 and are consistent with existing criteria for other revegetation offset sites in the local area undertaken for Main Roads' other projects.

Table 5. SF No. 2 (Sites 1 and 3) – Completion Criteria

Objective	Target	Completion Criteria
Counterbalance significant residual impacts to habitat supporting WRP, and Black Cockatoos and Tuart Woodlands TEC/PEC	Create and manage 60.26 ha of WRP habitat, incorporating 47.51 ha of Black Cockatoo habitat and 8.95 ha of Tuart Woodland TEC/PEC	<p>The Offset Sites will meet the following completion criteria, averaged across the two offset sites:</p> <p><u>General criteria:</u></p> <ul style="list-style-type: none"> Return of dominant tree species present at reference quadrats (BC01 and BC03). Species richness to meet or exceed 8 native species (based on reference quadrats (BC01 and BC03)) per 100 m². Average vegetation condition across the site is Good or better according to the scale of Keighery (EPA 2016). Achieve a canopy cover of >40%, consisting of >15 % overstorey canopy cover and >10 % mid-storey cover. Average weed cover within the revegetation areas does not exceed more than 30%. Average bare ground cover within the revegetation area does not exceed 30% <p><u>WRP habitat specific criteria:</u></p> <ul style="list-style-type: none"> WRP habitat consists of understorey, midstorey and canopy vegetation comprising Peppermint (<i>Agonis flexuosa</i>) and other native species identified as foraging and denning habitat for WRP in Appendix 7. <p><u>Black Cockatoo habitat specific criteria:</u></p> <ul style="list-style-type: none"> Black Cockatoo habitat consists of species known to provide foraging and potential nesting habitat, as identified in Appendix 7. <p><u>Tuart Woodland TEC/PEC specific criteria:</u></p> <ul style="list-style-type: none"> Average of 230 Tuart stems/ha, up to a maximum of 475 stems/ha.

Species richness completion criteria for both WRP and Black Cockatoo habitat, as well as TEC/PEC targets is to meet or exceed 8 native species per 100 m² overall. These metrics have been determined based on the following:

- Topsoil from which annuals could be introduced is not available for use in the revegetation.
- Of the 14 native species recorded within the BC01 quadrat, only 6 (43%) are commercially available in seedling form for use in revegetation.
- Of the 13 native species recorded within BC03, only 4 (31%) are commercially available in seedling form for use in revegetation (overlapping with of those in BC01).
- Native species richness in both BC01 and BC03 was 14 and 13 respectively (averaging 13.5).

Revegetation of both WRP and Black Cockatoo habitat, as well as TEC/PEC vegetation will include additional species from the indicative revegetation species list presented in Appendix 7. This list is a sub-set of the DBCA-approved list prepared for Main Roads' proposed revegetation at Ludlow (for the BORR and Bussell Highway Duplication projects), and is based on species generally expected to be commercially available. It includes both upland and wetland species to be used as appropriate. A minimum of 8 species from this list will be used in the revegetation.

Additional species from the broader DBCA-approved list may also be used in seed form where site conditions are conducive to direct seeding.

6 MANAGEMENT AND REHABILITATION ACTIONS AND TIMEFRAMES

6.1 Approach

The following section summarises the proposed methodology and timing for the revegetation works. The revegetation methods will:

- Improve connectivity between existing remnant native upper-storey species with seedling plantings
- Include infill planting around native remnant vegetation patches to augment existing patches and increase native species cover generally
- Encourage natural regeneration through weed and herbivore control in existing native vegetation patches.

The site preparation and revegetation methodology applied at Sites 1 and 3 will be the same as that used at all other Main Roads revegetation sites in the Ludlow State Forest with minor variation as required dependant on site conditions. Aspects comprising this approach are outlined below.

6.2 Management Actions

The following specific management actions will be undertaken at Sites 1 and 3. Table 6 details management actions required to achieve the proposed revegetation outcomes. An adaptive management approach will be taken based on on-going monitoring of the revegetation works and site specific lessons learned to achieve the completion criteria.

Fencing requirements. Access to offset area revegetation sites have been restricted through the installation of fencing to fauna fence standards, including 1.5 m high fence with a 300 mm rabbit wire apron to reduce burrowing animals from entering the sites. A minimum of two fauna escape gates have been installed at each site. The aim of the fauna fence is to minimise further degradation of native vegetation and maximise success of revegetation efforts by limiting macropod (and rabbit) grazing pressure. The minimisation of grazing pressure will create favourable conditions for both revegetation and natural regeneration. DBCA have requested that public access to all sites is maintained. As such, all fences will have gates enabling access for when rehabilitation works are stabilised.

Fencing for Offset Site 1 was completed in October 2025 and Offset Site 3 was completed in the winter of 2024. Both sites contain vehicle access and at least two fauna escape gates as specified.

Pest control. Pest animal control will be undertaken on an as-required basis based on site observations of rabbit grazing pressure impacting revegetation / natural regeneration, or of predation impacts on WRPs. If required, rabbit baiting using Rabbit Haemorrhagic Disease Virus (RHDV), Pindone or 1080 (sodium fluoroacetate), in consultation with DBCA, would be undertaken from spring through to late autumn. If required, fox baiting using 1080 would be undertaken during late winter through to autumn. Pest animal control at both Offset Sites will be ongoing and undertaken as required until expiry of the clearing permit (August 2036), or until such time as the completion criteria are met, whichever occurs first.

Weed control. Initial weed control commenced in Offset Site 3 in 2024 and Site 1 in October 2025. Further works are planned for 2026 and beyond. Weed control at both Offset Sites will be ongoing and undertaken annually as required based on site observations of weeds impacting achievement of stated completion criteria (Section 5) until expiry of the clearing permit (August 2036), or until such time as the completion criteria are met, whichever occurs first.

Dieback management. Dieback surveys have not been conducted at either site as these sites are expected to be uninterpretable due to their very poor condition and general lack of indicator species. It is also noted that the sites are situated on calcareous soils, and as such it is highly unlikely that *Phytophthora cinnamomi* is present.

Dieback management measures shall include:

- Prior to arrival on site all plant, machinery, equipment and tools are to be cleaned and
- Prior to departure from the project site all plant, machinery, equipment and tools are to be cleaned.

Rubbish removal. Control over access has been established via the installation of fencing, any remaining domestic and or commercial waste within the Offset Sites will be removed off-site and disposed of at an approved waste disposal site.

Fire management. Fire has the potential to have a significant negative impact on the revegetation works. Main Roads has installed 3.6 m wide gates for access to rehabilitation areas to enable the entry of firefighting units. Main Roads will maintain a 3 m firebreak around the revegetation areas until expiry of the clearing permit (August 2036), or until such time as the completion criteria are met, whichever occurs first.

6.3 Rehabilitation Actions

Activities associated with the on-ground management for rehabilitating the Sites are set out below and Table 6. These are directly linked to the stated completion criteria (see Table 5) to ensure that the completion criteria will be achieved. Detail on the methodologies to be implemented are included in Appendix 9.

Rehabilitation works will consist of site preparation (ripping/furrow-lining, auguring of seedling planting holes and pest control), seeding/planting and ongoing management. These are described below.

Staging. To minimise risk of losses and maximise resource availability, the strategy to revegetate Sites 1 and 3 requires a staged approach. Initial weed control treatments commenced at Site 3 in 2024 and further works were conducted at both sites in 2025. Subsequent fencing, ripping / furrow-lining, auguring and revegetation works will be staged between the sites as outlined in Table 6.

6.3.1 Site preparation

Rip / furrow preparation works to occur when seasonal conditions are optimal and soil moisture is suitable for planting. Some thinning of Tuarts may be required in some areas. Manual auger planting is to occur in areas where access is reduced or where lower impact site works is deemed appropriate.

All planting areas will require routine maintenance access. Informal tracks are to be established to enable efficient access (where possible). More permanent internal tracks may be required such as including suitable materials at gateways to enable fire access. Vehicle access tracks may also serve as firebreaks on the internal boundary fences.

6.3.2 Vegetation Establishment

Species selection. Species used in the revegetation have been selected in consultation with DBCA based on the general site parameters and on:

- Species detailed in the Tuart Woodlands TEC approved conservation advice (TSSC 2019).
- Species known to provide foraging and potential nesting habitat for Black Cockatoos as per the species' recovery plans and approved conservation advice (DEC 2008, DEWHA 2009, DPaW 2009, DPaW 2013).

- Species known provide foraging and potential nesting habitat for WRP (DPaW 2017, TSSC 2018).
- Additional advice from DBCA Parks and Wildlife Service (A. Webb, pers comm).

The revegetation will include a variety of species within each structural layer to provide native vegetation cover. The indicative revegetation species list, which is a sub-set of the DBCA-approved list prepared based on species generally expected to be commercially available, is presented in Appendix 7. A minimum of 8 species from this list will be used in the revegetation. Additional species from the broader DBCA-approved list may also be used in seed form where site conditions are conducive to direct seeding.

Seed and material sourcing. Licensed seed collectors will be engaged to collect native seed over several years until sufficient seed is collected. Collected seed will be used for both propagation of seedlings and for direct seeding in select areas. Vegetative material such as cuttings and material obtained by division may also be collected. All seed and vegetative material will be local provenance as defined by CPS 9168/1, being within 100 km of the offset sites and within the Swan Coastal Plain IBRA Region.

Seedling propagation. Collected seed and vegetative material will be provided to nurseries that meet the Nursery and Garden Industry Western Australia certification to ensure appropriate hygiene protocols are observed. Alternative nurseries may be considered as potential suppliers if the plants can be supplied to the required standards and conditions. Seedlings may also be sourced directly from commercial nurseries as long as they meet the definition of local provenance.

Seeding / seedlings. Both Sites 1 and 3 contain a significant weed burden. The presence of weeds may limit the option to undertake direct seeding in some areas. Direct seeding and / or seedling planting will occur once project sites are prepared (weed control, pest control, fencing). Seedlings may be planted with slow release native fertiliser tablets.

Planting density. A minimum of 3,000 stems per hectare will be planted. Planting densities will be managed to maximise canopy connectivity and resource availability for WRP and foraging species for Black Cockatoos (where required). Planting density will also aim to minimise bare ground and maximise canopy cover (in accordance with the completion criteria presented in Section 5) and long-term viability of the established vegetation. Where provision of Tuart Woodlands TEC/PEC is included in the revegetation areas, Tuart canopy cover will be established to align with requirements for Tuart Woodlands TEC/PEC as per the conservation advice (TSSC 2019) and Tuart stem density outlined in the completion criteria in Section 5.

Monitoring. As detailed in Section 7, regular monitoring will be undertaken to assess plant health and monitor against achievement of completion criteria. Where seedling survival rates are not sufficient, or pests or other issues are detected, appropriate treatments will be applied. Any applied treatments will be recorded.

6.4 Maintenance and Contingency Measures

Contingency actions shall be implemented if monitoring indicates that the revegetation trajectory is not trending towards achievement of the completion criteria within required timeframes.

Contingency actions which may be implemented include:

- Additional weed control
- Supplementary in-fill planting of seedlings
- Supplementary direct seeding
- Additional pest control
- Application of fertilisers, soil conditioners and / or wetting agents
- Erosion mitigation

Where monitoring indicates that the completion criteria are unlikely to be met or are not being met, contingency actions will be implemented. This may include the following:

- If the target species richness and plant density criteria are not met, then infill planting / seeding will occur during the next planting season
- If plant composition criteria including species richness and density are not met, then specific species will be infill planted / seeded during the next planting season
- If weed presence or weed cover requirements are not met, then herbicide will be applied to affected areas at the appropriate time of year for the weed species present
- If erosion is present, mitigation methods such as mulching, contouring and/or establishment of groundcover will be undertaken
- If, by the end of Year 8, the trend in the revegetation does not indicate that target vegetation condition will be achieved, then weed control measures will be reviewed and additional infill planting and / or seeding may be undertaken as appropriate
- If, by the end of Year 8, vegetation growth does not indicate that the target vegetation structure will be achieved, additional infill planting and / or seeding of appropriate species will be undertaken

6.5 Schedule and Budget

A work plan has been developed outlining the actions that will be undertaken and the timing of those actions, including revegetation actions (Table 6) and monitoring and contingency actions (Table 7).

Main Roads will be responsible for the implementation of revegetation works and ongoing management and will fund and manage Offset sites 1 and 3 for the purposes of conservation until 2036, or until such time as the completion criteria are met, whichever occurs first. Indicative budget and costings are provided in Table 8.

Table 6. Offset area revegetation actions and timeframes

Activity	Actions	Timeframe and Frequency	Status
Fencing	<ul style="list-style-type: none"> - Construction of revegetation area fence to fauna fence specification, including fauna gates - Fence locations surveyed to obtain accurate calculation of Offset Area <p>Ensure fence position provides for fauna access and ongoing fire break maintenance.</p>	Fencing for Offset Site 1 was completed in October 2025 and Offset Site 3 was completed in the winter of 2024.	Site 1 – Completed Site 3 – Completed
Weed control	Define weed control requirements.	Baseline and initial weed control commenced in Site 3 in 2024.	Commenced at Site 3
	<ul style="list-style-type: none"> - Conduct weed control prior to planting and / or direct seeding - Implement weed control as required to achieve completion criteria. 	Initial weed control at Site 1 and Site 3 has been undertaken and further works are planned for 2026 and beyond based on site observations.	Ongoing
Feral animal control	Implement feral animal control for rabbits and foxes as required in order to meet completion criteria	As required based on scheduled and opportunistic site observations.	Commencing 2026
Rubbish removal	Rubbish removal as required	As required based on scheduled and opportunistic site observations.	Ongoing
Revegetation – seed collection / propagation.	<ul style="list-style-type: none"> - Maintain existing seed collections - Order seedlings - Seedling propagation. 	Seedlings ordered annually as required based on monitoring results to enable achievement of completion criteria.	Commencing 2026
Revegetation – site preparation	<ul style="list-style-type: none"> - Rip and furrow-line throughout open areas and / or hand augur in amongst existing vegetation in preparation for planting. 	Site preparation works to commence in 2026 and ongoing as required to meet completion criteria.	Commencing in 2026
Revegetation – planting and seeding	<ul style="list-style-type: none"> - Direct seeding of areas with low weed burden - Rip / furrow planting with seedlings - Targeted planting required for areas of remnant vegetation - Infill planting as required. 	<ul style="list-style-type: none"> - Planting to commence in winter 2027 and be completed in winter 2031 (5-year revegetation program) - Post 2031, infill planting will be undertaken annually as required. 	Commencing in 2027

Table 7. Offset Area monitoring and contingency program

Parameter	Performance indicator	Methodology	Frequency and timing	Trigger value	Corrective action	Reporting
Access						
Fencing	Presence and condition of fencing	Visual inspection of fence	Annually commencing 2025	Fence not intact or to specifications	<ul style="list-style-type: none"> Investigate cause Implement corrective actions which may include: <ul style="list-style-type: none"> Review practicality of fencing design and structure Undertake repair/modification of fence as required Improve personnel training and education Review monitoring frequency and method Monitor outcomes. 	Report annually as part of annual compliance reporting
Firebreaks	Condition of firebreaks	Visual inspection of firebreaks	Annually commencing 2025	Firebreaks not to specified standard		
Pest animals (rabbits, foxes)	Evidence of recent (<2 months old) fox or rabbit presence	Field survey for visual evidence of fox presence (tracks, scats) or of rabbit grazing impacts	Annually in spring to late autumn commencing 2026, or as required, based on site observations of rabbit grazing impacting revegetation / natural regeneration	Visual evidence of recent fox or rabbit activity impacting success of revegetation/natural regeneration		
Revegetation						
Condition	Condition of vegetation assessed against EPA (2016)	Floristic quadrats and visual inspection - Installation and assessment of 10 m x10 m floristic quadrats and visual inspection	Annually in Years 1-3 then three yearly for the life of the permit	At year 8 or later condition is Degraded or worse.	<ul style="list-style-type: none"> Investigate cause Implement corrective actions which may include: <ul style="list-style-type: none"> Review practicality of fencing design and structure Undertake repair/modification of fence as required Improve personnel training and education Review monitoring frequency and method Monitor outcomes. 	Report annually as part of annual compliance reporting
Weed cover	Weed species cover by area averaged across quadrats			At year 8 or later average weed species cover by area is $\geq 30\%$ Weeds impacting success of revegetation/natural regeneration		

Parameter	Performance indicator	Methodology	Frequency and timing	Trigger value	Corrective action	Reporting
Revegetation continued						
Vegetation structure, species diversity and density.	Averaged across quadrats, vegetation structure, species richness and density reflect completion criteria.	Floristic quadrats and visual inspection - Installation and assessment of 10 m x10 m floristic quadrats and visual inspection	Annually in Years 1-3 then three yearly for the life of the permit.	At year 8 or later vegetation structure, species richness or density are not reflective of completion criteria or trending to be so.	<ul style="list-style-type: none"> Investigate cause Implement corrective actions which may include: <ul style="list-style-type: none"> Review practicality of fencing design and structure Undertake repair/modification of fence as required Improve personnel training and education Review monitoring frequency and method Monitor outcomes. 	Report annually as part of annual compliance reporting
Native cover	Bare ground cover averaged across quadrats reflect completion criteria.			At year 8 of later average bare ground cover is not reflective of completion criteria or trending to be so.		
Tuart Woodlands TEC	Averaged across quadrats: <ul style="list-style-type: none"> vegetation condition (TSSC, 2019) Tuart stems/ha reflects completion criteria 			At year 8 or later condition is Degraded or worse or Tuart density is not reflective of completion criteria or trending to be so.		

Parameter	Performance indicator	Methodology	Frequency and timing	Trigger value	Corrective action	Reporting
Revegetation continued						
WRP habitat	Averaged across quadrats, under-, mid- and upper-storey strata comprise Peppermint (<i>Agonis flexuosa</i>) and other native species identified as WRP foraging habitat.	Floristic quadrats and visual inspection - Installation and assessment of 10 m x10 m floristic quadrats and visual inspection	Annually in Years 1-3 then three yearly for the life of the permit.	At year 8 or later, understorey and midstorey vegetation does not comprise Peppermint (<i>Agonis flexuosa</i>) and other native species provided in in Appendix 7.	<ul style="list-style-type: none"> Investigate cause report Implement corrective actions which may include: <ul style="list-style-type: none"> Review practicality of fencing design and structure Undertake repair/modification of fence as required Improve personnel training and education Review monitoring frequency and method Monitor outcomes. 	Report annually as part of annual compliance reporting
	Average native canopy cover	Aerial or drone footage (3D imagery)	2027 and then every three years thereafter.	At year 8 or later, average canopy connectivity is less than 30%		
Black Cockatoo habitat	Averaged across quadrats, Black Cockatoo habitat consists of species known to provide foraging and potential nesting habitat.	Floristic quadrats and visual inspection - Installation and assessment of 10 m x10 m floristic quadrats and visual inspection	Annually in Years 1-3 then three yearly for the life of the permit.	<p>Eight years after commencement of revegetation, averaged across 10 m x 10 m monitoring quadrats:</p> <ul style="list-style-type: none"> Plant survival is not occurring at a rate sufficient to achieve the stated criteria. Projected foliage cover of suitable foraging species for Black Cockatoos is <20% consisting of 10% of overstorey and <5% midstorey. 		

Table 8. Offset Area Indicative Budget Estimate

Stage/Activity	Total Estimated Costs (to 2036)
Revegetation (site prep, initial weed control, planting/seeding and infill for 68 ha)	\$2M
Ongoing management (pest and weed control, fence and firebreak maintenance)	\$1.5M
Monitoring (field-based and aerial or drone)	\$0.5M
Reporting and monitoring	\$0.25M
TOTAL ESTIMATED COST (15 years)	\$4.25M over 15 years

7 PROPOSED MONITORING PROGRAM

Main Roads will monitor the progress of the revegetation works in order to assess progress towards achieving the completion criteria.

Although on ground works have commenced on the site, for monitoring purposes, year 0 for the SF No 2. Offset Area is considered to be 2027, which is when revegetation works are planned to commence.

Monitoring will comprise assessment of aerial / drone imagery and data collected from quadrats and photopoints, as described below. The monitoring program has been designed in accordance with recommendations included in Table 1 from A Guide to Preparing Revegetation Plans for Clearing Permits (DWER 2018). A monitoring recording sheet template is included in Appendix 10.

Drive/traverse . To check fences and opportunistically survey for evidence of herbivore damage and weed invasion. To be undertaken annually.

Aerial imagery. High resolution aerial imagery captured by aerial survey will be used to assess canopy cover, canopy connectivity and vegetation structure. Aerial imagery will be captured annually from 2027 then every three years thereafter.

Quadrats. Fifteen (15) monitoring quadrats measuring 10 m x 10 m will be established in Site 3. Three monitoring quadrats measuring 10 m x 10 m will be established in Site 1. The quadrats will be randomly located within these sites (or vegetation types), ensuring representation across the rehabilitation areas. Each quadrat shall be clearly marked with fence droppers or similar, and the corner of the quadrat GPS marked. Quadrats will be assessed in annually in Years 1, 2 and 3 then three yearly for the life of the permit.

The 10 m x 10 m quadrats will be used to assess:

- vegetation structure including vegetation in each stratum
- Species richness (No), including weeds
- vegetation condition (Keighery)
- average weed cover by area (%)
- average bare ground cover by area (%)
- average Tuart stem density (No.)

For the purposes of assessing tree species richness and tree density, six quadrats will be expanded to 20 m x 20 m. The number and species richness of trees within these expanded quadrats will be recorded to provide an indication of tree cover across the sites.

Photopoints. Photopoints will be established at the northwest corner of each quadrat. Photos will be taken on the southeast/northwest axis (i.e. lining up with the southeast corner of the quadrat) facing away from the quadrat. Photopoints will also be established at either end of the transects, with photos taken towards the opposite end of the transect. Photopoint monitoring will be conducted annually in Years 1, 2 and 3 then three yearly for the life of the permit.

Data analysis. Monitoring of the rehabilitation site will incorporate appropriate analysis to assess progress towards completion criteria. Analysis methods will be employed in order to evaluate changes in the overall vegetation composition across years, allowing for comparison between the revegetation site and established reference sites based on species richness (presence/absence) and species density (stems/ha), and to track changes in key individual species or structural attributes, such as stem density of *Eucalyptus gomphocephala*. All data analysis will be documented to ensure consistency, repeatability, and clarity in interpreting rehabilitation outcomes.

A monitoring and contingency program for the revegetation works to be undertaken is detailed in Table 7.

8 REPORTING REQUIREMENTS

In accordance with Condition 23 of CPS 9168/1, on or before June 30 each year Main Roads will provide an annual report to the CEO of DWER detailing the revegetation activities undertaken during the period 1 January and 31 December of the preceding calendar year.

Prior to 1 May 2036, Main Roads will provide the CEO of DWER a written report of any unreported activities in relation to this Rehabilitation Plan.

8.1 Responsibilities

This Plan identifies the environmental management activities to be undertaken by Main Roads or its delegate in the implementation of the offset Proposal. Main Roads acknowledges that the environmental management actions contained within this Plan are legal requirements to be met by Main Roads.

Main Roads' Director Environment and Heritage will maintain responsibility for implementation of the management actions specified in this Plan, on behalf of Main Roads Managing Director. Management actions may be undertaken by employees and / or contractors of Main Roads on behalf of the Managing Director.

Where management actions are undertaken by employees and / or contractors of Main Roads, these will be communicated and documented to the relevant personnel through relevant environmental training and contractual arrangements.

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10 APPENDICES

Appendix	Title
Appendix 1	Clearing Permit CPS 9168/1
Appendix 2	A Guide to Preparing Revegetation Plans for Clearing Permits - Checklist
Appendix 3	DBCA Letter for Offsets at State Forest No.2 (Ludlow Tuart Forest)
Appendix 4	Main Roads Reference Site Quadrat Data
Appendix 5	Total Species - Main Roads and Gibson et al (1994) Quadrats
Appendix 6	Total Species - Reference Site Baseline Surveys
Appendix 7	Indicative Revegetation Species List
Appendix 8	Offset Site Fencing
Appendix 9	Revegetation Planting and Seeding Procedures
Appendix 10	Monitoring Record Form

Appendix 1: Clearing Permit CPS 9168/1



CLEARING PERMIT

Granted under section 51E of the Environmental Protection Act 1986

Purpose Permit number:	CPS 9168/1
Permit Holder:	Commissioner of Main Roads Western Australia
Duration of Permit:	From 1 August 2021 to 1 August 2036

ADVICE NOTE:

In relation to condition 19 of this Permit, it is noted that 11.86 hectares of Lot 201 on Deposited Plan 409860, Manjimup, will be attributed to the offset for this project. The remaining balance of the property (approximately 6.14 hectares) may be used as a banked offset for other projects. The nominated 11.86 hectare area contains western ringtail possum(s) (*Pseudocheirus occidentalis*) habitat, in addition to other environmental values.

The Permit Holder is authorised to clear native vegetation subject to the following conditions of this Permit.

PART I – CLEARING AUTHORISED

1. Clearing authorised (purpose)

The Permit Holder is authorised to clear *native vegetation* for the purpose of the construction of a second carriageway along Bussell Highway and associated infrastructure.

2. Land on which clearing is to be done

The Permit Holder is authorised to clear *native vegetation* within the properties described in Table 3 of Schedule 1 of this Permit.

3. Clearing authorised

The Permit Holder must not clear more than 27.3 hectares of *native vegetation* within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2.

4. Type of clearing authorised

This Permit authorises the Permit Holder to clear *native vegetation* for the activities described in condition 1 of this Permit to the extent that the Permit Holder has the power to carry out work involving clearing for those activities under the *Main Roads Act 1930* or any other written law.

5. Period during which clearing is authorised

The Permit Holder must not clear any *native vegetation* after 1 August 2026.

PART II – MANAGEMENT CONDITIONS

6. Avoid, minimise, and reduce impacts and extent of clearing

In determining the *native vegetation* authorised to be cleared under this Permit, the Permit Holder must apply the following principles, set out in descending order of preference:

- (a) avoid the clearing of *native vegetation*;
- (b) minimise the amount of *native vegetation* to be cleared; and
- (c) reduce the impact of clearing on any environmental value by implementing:

7. Weed and dieback management

When undertaking any clearing authorised under this Permit, the Permit Holder must take the following measures to minimise the risk of introduction and spread of *weeds* and *dieback*:

- (a) clean earth-moving machinery of soil and vegetation prior to entering and leaving the area to be cleared;
- (b) ensure that no known *dieback* or *weed*-affected soil, *mulch*, *fill*, or other material is brought into the area to be cleared;
- (c) restrict the movement of machines and other vehicles to the limits of the areas to be cleared.

8. Flora management

Prior to undertaking any clearing authorised under this Permit, the Permit Holder must:

- (a) Engage an *environmental specialist* to *demarcate* the *priority flora* individuals and the relevant *buffers* that are to be retained, located within the area hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2.
- (b) Ensure that clearing of *Verticordia attenuata* is limited to 1,233 individuals.

9. *Verticordia attenuata* management - Retain and reuse vegetative material and topsoil

- (a) The Permit Holder must retain the vegetative material and topsoil removed by clearing authorised under this Permit from the areas identified as containing *Verticordia attenuata* in the Targeted Flora *Verticordia attenuata* survey (Ecoedge, 2021a).
- (b) Prior to the relocation of the vegetative material and topsoil retained under condition 9(a), the Permit Holder must submit a written proposal to the Department of Biodiversity, Conservation and Attractions which outlines where the soil will be transferred from/to and proposed methods for the minimisation of *weed* and *dieback* introduction and spread.
- (c) The Permit Holder must use the vegetative material and topsoil retained under condition 9(a) within 18 months of its removal.

- (d) The Permit Holder must relocate the vegetative material and topsoil retained under condition 9(a) to a site within the same *Verticordia attenuata* population, as identified during the Targeted Flora *Verticordia attenuata* survey (Ecoedge, 2021a); and:
 - (i) monitor the site annually in spring for two years following the completion of activities to capture any subsequent germination; and
 - (ii) submit a Threatened and Priority Flora Report Form to the Species and Communities Program of the Department of Biodiversity, Conservation and Attractions upon completion of each monitoring event.

10. *Verticordia attenuata* management – seed collection

- (a) The Permit Holder must collect a minimum of 3,000 *Verticordia attenuata* seeds. The Permit Holder must apply the following principles, set out in descending order of preference:
 - (i) Collect seeds from the populations impacted by the clearing activities authorised under this Permit;
 - (ii) Collects seeds from the retained individuals of the populations impacted by the clearing activities authorised under this Permit;
 - (iii) Collects seeds from other plants identified by Ecoedge (2021a) during the targeted *V. attenuata* flora survey.
- (b) The number of seeds required under condition 10(a) must be collected:
 - (i) Prior to clearing, if collected in accordance with conditions 10(a)(i); or
 - (ii) Within 24 months from the commencement of the clearing and no later than 1 August 2023, if collected under condition 10(a)(ii) and 10(a)(iii).
- (c) Prior to the actions required under condition 10(a) of this Permit, the Permit Holder must contact *Threatened Flora Seed Collection* for advice on the collection and submission of seeds.
- (d) The Permit Holder must forward all seeds collected to the WA Seed Centre via *Threatened Flora Seed Collection* with labels detailing collection details for each sample.

11. Priority ecological community management

The Permit Holder must not clear more than two hectares of native vegetation within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2 which represent the ‘Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain’ State listed priority ecological community as identified within the Targeted Vegetation Survey of Threatened and Priority Ecological Communities (Ecoedge, 2021b).

12. Threatened ecological community management

The Permit Holder must not clear native vegetation within the area cross-hatched red in Figure 1e of Schedule 2 which represents the ‘*Corymbia calophylla* woodlands on heavy soils of the southern Swan Coastal Plain’ State listed threatened ecological community.

13. Fauna management – black cockatoo foraging habitat

The Permit Holder must not clear more than 20.8 hectares of native vegetation within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2 that provides foraging habitat for *Calyptorhynchus latirostris* (Carnaby’s cockatoo), *Calyptorhynchus banksia* subsp. *naso* (forest red-tailed black cockatoo), *Calyptorhynchus baudinii* and (Baudin’s cockatoo).

14. Fauna management – black cockatoo habitat

- (a) Prior to undertaking any clearing authorised under this Permit within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2, the Permit Holder must engage a *fauna specialist* to conduct a *fauna survey* of the Permit area to identify *black cockatoo habitat tree/s* being utilised by *black cockatoo species*.
- (b) Where *black cockatoo habitat tree/s* are identified under condition 14(a), the Permit Holder must engage a *fauna specialist* to map *black cockatoo habitat tree/s* within the permit area.
- (c) Each *black cockatoo habitat tree* identified must be inspected by a *fauna specialist* for *evidence* of current or past breeding use by *black cockatoo species*.
- (d) Where a *black cockatoo habitat tree* with no *evidence* of current or past use by *black cockatoo species* is identified in accordance with condition 14(a), that tree must only be cleared immediately after the inspection.
- (e) Where a *black cockatoo habitat tree* is identified within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2, and that tree shows *evidence* of current or past breeding use by *black cockatoo species* under condition 14(c), and clearing of that tree cannot be avoided, that tree must be monitored by a *fauna specialist* to determine when it is no longer in use for that breeding season.
- (f) Any *black cockatoo habitat tree* with *evidence* of current breeding use by *black cockatoo species* must not be cleared whilst it is in use for that breeding season as determined by the *fauna specialist* under condition 14(e).
- (g) For each suitably sized hollow for black cockatoo nesting that cannot be avoided, the Permit Holder must install one artificial black cockatoo nesting hollow.
- (h) Each artificial black cockatoo nesting hollow required by condition 14(g) must be installed prior to commencement of the next black cockatoo breeding season following clearing of the related *black cockatoo habitat tree(s)*.
- (i) The artificial black cockatoo nest hollow(s) required by condition 14(g) of this Permit must:
 - (i) be installed at the location identified by the Department of Biodiversity, Conservation and Attractions within Ludlow State Forest No. 2;

- (ii) be designed and placed in accordance with the specifications details in Schedule 3 of this Permit; and
- (iii) be monitored and maintained in accordance with the specifications detailed in Schedule 4 of this Permit, for a period of at least 10 years.
- (j) Within two months of clearing authorised under this Permit within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2, the Permit Holder must provide the results of the fauna survey in a report to the *CEO*.
- (k) The fauna survey report must include the following;
 - (i) The time(s) and date(s) of inspection(s) by the *fauna specialist*
 - (ii) A description of the *fauna specialist* inspection methods used
 - (iii) the location of the *black cockatoo habitat tree(s)* recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings or decimal degrees
 - (iv) the location of any fauna species listed in condition 14(a), if identified, recorded using a GPS unit set to GDA94, expressing the geographical coordinates in Eastings and Northings or decimal degrees
 - (v) the name and amount of each fauna species identified
 - (vi) whether the *black cockatoo habitat tree/s* identified show current or past use by black cockatoo species
 - (vii) a photo of the *black cockatoo habitat tree(s)* identified; and
 - (viii) a description of the *black cockatoo habitat tree(s)* identified, including the:
 - (A) species of *black cockatoo habitat tree(s)*; and
 - (B) condition of the *black cockatoo habitat tree(s)*
 - (ix) the time and date each *black cockatoo habitat tree* with evidence of current or past breeding use was cleared
 - (x) the location of the artificial black cockatoo nesting hollow installed.

15. Fauna management – western ringtail possums

The Permit Holder must not clear more than 24 hectares of native vegetation within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2 that provides habitat for western ringtail possum(s) (*Pseudocheirus occidentalis*).

16. Fauna management – western ringtail possums

- (a) In relation to the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2, the Permit Holder must engage a *fauna specialist* to inspect that area immediately prior to, and for the duration of clearing activities, for the presence of western ringtail possum(s) (*Pseudocheirus occidentalis*).
- (b) Prior to the clearing authorised under this Permit, the Permit Holder must:
 - (i) define and mark the western ringtail possum assisted dispersal management areas identified within the *Western Ringtail Possum management plan*;
 - (ii) identify and mark western ringtail possum release points within the refuge sites identified within the *Western Ringtail Possum management plan*; and

- (iii) must engage *western ringtail possum specialist* to remove all vacant dreys within the area cross-hatched yellow in Figure 1a, Figure 1b, Figure 1c, Figure 1d, Figure 1e, Figure 1f, Figure 1g and Figure 1h of Schedule 2.
- (c) Clearing activities must cease in any area where fauna referred to in condition 16(a) are identified until either:
 - (i) the western ringtail possum(s) individual has moved on from that area to adjoining *suitable habitat*; or
 - (ii) the western ringtail possum(s) individual has been removed by a *western ringtail possum specialist*.
- (d) Any western ringtail possum(s) individual removed in accordance with condition 16(c)(ii) must be relocated by a *western ringtail possum specialist* to a *suitable habitat* at the western ringtail possum refuge sites identified within the *Western Ringtail Possum management plan*.
- (e) The Permit Holder must not exceed the release point limits identified in the *Western Ringtail Possum management plan*.
- (f) Where fauna is identified under condition 16(a), the Permit Holder must within two months provide the following records to the *CEO*:
 - (i) the number of individuals identified;
 - (ii) the date each individual was identified;
 - (iii) the location where each individual was identified recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings or decimal degrees;
 - (iv) the number of individuals removed and relocated;
 - (v) the relevant qualifications of the *western ringtail possum specialist* undertaking removal and relocation;
 - (vi) the date each individual was removed;
 - (vii) the method of removal;
 - (viii) the date each individual was relocated;
 - (ix) the location where each individual was relocated to, recorded using a GPS unit set to GDA94, expressing the geographical coordinates in Eastings and Northings or decimal degrees; and
 - (x) details pertaining to the circumstances of any death of, or injury sustained by, an individual.

17. Ecological linkage management – rope bridges

- (a) Within 24 months of commencing clearing, in consultation with the Department of Biodiversity, Conservation and Attractions, the Permit Holder must install western ringtail possum (*Pseudocheirus occidentalis*) rope bridges within the area cross-hatched green in Figure 1g and Figure 1h of Schedule 2 to allow the safe movement of western ringtail possum (*Pseudocheirus occidentalis*) rope bridges between remnants of native vegetation.
- (b) The Permit Holder must maintain the rope bridges installed under condition 17(a) for the remaining term of this Permit.

18. Wind erosion management

The Permit Holder must ensure that road widening and associated activities commence within three months of the authorised clearing being undertaken to reduce the risk of soil erosion by minimising the exposure time of soils prior to construction.

19. Offset – Land acquisition

Within 12 months of the commencement of clearing authorized under this Permit and no later than 1 August 2022, the Permit Holder must fund the purchase of native vegetation within the area cross-hatched red in Figure 2 of Schedule 2 (Lot 201 on Deposited Plan 409860, Manjimup) for inclusion of native vegetation into conservation estate managed by the Department of Biodiversity, Conservation and Attractions.

20. Offset – Rehabilitation

- (a) The Permit Holder must rehabilitate 60.26 hectares of native vegetation in a degraded (Keighery, 1994) condition in Ludlow State Forest No. 2 within the area cross-hatched orange in Figure 3 of Schedule 2 of this Permit, of which:
- (i) 60.26 hectares must contain species which provide suitable foraging, breeding and roosting habitat for *Pseudocheirus occidentalis* (western ringtail possum) as identified in the *western ringtail possum recovery plan*
 - (ii) 47.51 hectares must contain species which provide suitable foraging, breeding and roosting habitat for *Calyptorhynchus latirostris* (Carnaby's cockatoo), *Calyptorhynchus banksia* subsp. *naso* (forest red-tailed black cockatoo) and *Calyptorhynchus baudinii* (Baudin's cockatoo) as identified in *black cockatoo recovery plan*
 - (iii) 8.95 hectares must contain species commonly found in 'Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain' ecological community as described in *Approved Conservation Advice*.
- (b) The *rehabilitation* required under condition 20(a) of this Permit, must be undertaken in accordance with the *Project Rehabilitation Plan* prepared under condition 21 of this Permit

21. Project Rehabilitation Plan

- (a) Within 12 months of the commencement of clearing authorized under this Permit, the Permit Holder must submit a *Project Rehabilitation Plan* to the CEO for approval for the areas cross-hatched orange in Figure 3 of Schedule 2, which shall be developed in accordance with *A Guide to Preparing Revegetation Plans for Clearing Permits* (Department, 2018).
- (b) The *Project Rehabilitation Plan* must be prepared by an *environmental specialist*.
- (c) The *Project Rehabilitation Plan* must include the following:
- (i) *site preparation*
 - (ii) *weed control*
 - (iii) *a vegetation establishment period*
 - (iv) *revegetation success completion criteria* shall include but not be limited to target weed cover, target vegetation condition, target density, species richness, bare ground cover and target structure
 - (v) *revegetation success completion criteria* must be consistent with:
 - *reference site 1* for the *rehabilitation* area required under condition 20(a)(i) and 20(a)(ii) of this Permit; and
 - *reference site 2* for the *rehabilitation* area required under condition 20(a)(iii) of this Permit.

- (vi) *regeneration, direct seeding or planting, at an optimal time* in accordance with a defined species list. Species must include suitable foraging, breeding and roosting habitat for *Pseudocheirus occidentalis* (western ringtail possum), *Calyptorhynchus latirostris* (Carnaby's cockatoo), *Calyptorhynchus banksia* subsp. *naso* (forest red-tailed black cockatoo) and *Calyptorhynchus baudinii* (Baudin's cockatoo) and species which are commonly found in the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community as described in *Approved Conservation Advice*.
- (vii) contingency actions to be undertaken if *completion criteria* are not met
- (viii) ongoing maintenance and monitoring of the areas required to be *revegetated* and *rehabilitated*
- (ix) timeframes for completion of the activities
- (x) management commitments that will be achieved
- (xi) The Permit Holder shall implement the *Project Rehabilitation Plan* as approved by the *CEO* and the Director General of the Department of Biodiversity, Conservation and Attractions.

PART III - RECORD KEEPING AND REPORTING

22. Records that must be kept

The Permit Holder must maintain records relating to the listed relevant matters in accordance with the specifications detailed in Table 1.

Table 1: Records that must be kept

No.	Relevant matter	Specifications
1.	In relation to the authorised clearing activities generally	<ul style="list-style-type: none"> (a) the species composition, structure, and density of the cleared area; (b) the location where the clearing occurred, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings; (c) the date that the area was cleared; (d) the size of the area cleared (in hectares); (e) actions taken to avoid, minimise, and reduce the impacts and extent of clearing in accordance with condition 6 of this Permit; (f) actions taken to minimise the risk of the introduction and spread of <i>weeds</i> and <i>dieback</i> in accordance with condition 7 of this Permit; (g) actions taken in accordance with condition 9 of this Permit; (h) actions taken in accordance with condition 10 of this Permit; (i) the size of the Tuart (<i>Eucalyptus gomphocephala</i>) Woodlands and Forests of the Swan Coastal Plain' State listed priority ecological community cleared (in hectares) in accordance with condition 11 of this Permit (j) evidence that no vegetation was cleared in the area cross-hatched red in Figure 1e of Schedule 1 in accordance with condition 12; (k) the size of foraging habitat for <i>Calyptorhynchus latirostris</i> (Carnaby's cockatoo), <i>Calyptorhynchus banksia</i> subsp. <i>naso</i> (forest red-tailed black cockatoo), <i>Calyptorhynchus baudinii</i> and (Baudin's cockatoo) cleared (in hectares) in accordance with condition 13 of this Permit; (l) the size of habitat for <i>Pseudocheirus occidentalis</i> (western ringtail

No.	Relevant matter	Specifications
		<p>possum) cleared (in hectares) in accordance with condition 15 of this Permit;</p> <p>(m) actions taken to minimise the impacts of the clearing authorised under this Permit on western ringtail possum in accordance with condition 16 of this Permit;</p> <p>(n) actions taken to minimise the risk of wind erosion in accordance with condition 18 of this Permit;</p> <p>(o) actions taken to acquire and conserve the area cross-hatched red in Figure 2 of Schedule 2 of this Permit in accordance with condition 19 of this Permit; and</p> <p>(p) actions taken to develop a <i>Project Rehabilitation Plan</i> in accordance with condition 21 of this Permit.</p>
2.	In relation to flora management pursuant to condition 8	<p>(a) the name and location of each <i>threatened flora</i> and/or <i>priority flora</i> species, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;</p> <p>(b) actions taken to demarcate each <i>priority flora</i> species recorded and their relevant buffers;</p> <p>(c) actions taken to avoid the clearing of <i>priority flora</i> species; and</p> <p>(d) the number of priority flora plants cleared in accordance with condition 8(c) of this Permit</p>
3.	In relation to rehabilitation pursuant to condition 20	<p>(a) a description of the <i>revegetation</i> and <i>rehabilitation</i> activities undertaken;</p> <p>(b) the size of the areas <i>revegetated</i> and <i>rehabilitated</i> (in hectares);</p> <p>(c) the date that <i>revegetation</i> and <i>rehabilitation</i> works began;</p> <p>(d) any remediation works undertaken; and</p> <p>(e) the date that <i>completion criteria</i> are considered to be met.</p>

23. Reporting

- (a) The Permit Holder must provide to the *CEO* on or before 30 June of each year, a written report:
- (i) of records required under condition 22 of this Permit; and
 - (ii) concerning activities done by the Permit Holder under this Permit between 1 January and 31 December of the preceding calendar year.
- (b) If no clearing authorised under this Permit was undertaken between 1 January to 31 December of the preceding calendar year, a written report confirming that no clearing under this Permit has been carried out, must be provided to the *CEO* on or before 30 June of each year.
- (c) Prior to 1 May 2036, the Permit holder must provide to the *CEO* a written report of records required under condition 22 of this Permit, where these records have not already been provided under condition 23(a) of this Permit.

DEFINITIONS

In this Permit, the terms in Table have the meanings defined.

Table 2: Definitions

Term	Definition
Approved Conservation Advice	means Approved Conservation Advice for the Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain prepared by the Threatened Species Scientific Committee available at http://www.environment.gov.au/biodiversity/threatened/communities/pubs/153-conservation-advice.pdf
Black cockatoo habitat trees	means trees that have a diameter measured over bark at 130 centimetres from the base of the tree of 50 centimetres or greater (or 30 centimetres or greater for <i>Eucalyptus salmonophloia</i> or <i>Eucalyptus wandoo</i>) that contain hollows suitable for breeding by <i>black cockatoo species</i> .
black cockatoo recovery plan	means: a) A recovery plan prepared by Department of Environment and Conservation (2008) for Forest Black Cockatoo (Baudin's Cockatoo <i>Calyptorhynchus baudinii</i> and Forest Red tailed Black Cockatoo <i>Calyptorhynchus banksii naso</i>) b) A recovery plan prepared by Department of Parks and Wildlife (2013) for Carnaby's cockatoo (<i>Calyptorhynchus latirostris</i>)
Black cockatoo species	means one or more of the following species: a) <i>Calyptorhynchus latirostris</i> (Carnaby's cockatoo); b) <i>Calyptorhynchus baudinii</i> (Baudin's cockatoo); and/or c) <i>Calyptorhynchus banksii naso</i> (forest red-tailed black cockatoo).
Buffer	means 20 metres for <i>priority flora</i>
CEO	Chief Executive Officer of the department or his/her delegates responsible for the administration of the clearing provisions under the <i>Environmental Protection Act 1986</i> .
Clearing	has the meaning given under section 3(1) of the EP Act.
Completion criteria	means a measurable outcome based on suitable <i>reference sites</i> , used to determine revegetation/ <i>rehabilitation success</i>
Condition	a condition to which this clearing permit is subject under section 51H of the EP Act.
Demarcate	means the utilisation of flagging tape or using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings
Department	means the department established under section 35 of the <i>Public Sector Management Act 1994</i> (WA) and designated as responsible for the administration of the EP Act, which includes Part V Division 3.
Dieback	means the effect of <i>Phytophthora</i> species on native vegetation.
Direct seeding	means a method of re-establishing vegetation through establishment of a seed bed and the introduction of seeds of the desired plant species.
Environmental specialist	means a person who holds a tertiary qualification in environmental science or equivalent and has experience relevant to the type of environmental advice that an environmental specialist is required to provide under this Permit, or who is approved by the CEO as a suitable environmental specialist.
Environmental Management Plan	means the plan prepared by the Permit Holder for the purpose of managing native vegetation clearing impacts associated with the Bussell Highway Duplication Stage, Hutton to Sabina project (DWER Ref: A2023688).
EP act	<i>Environmental Protection Act 1986</i> (WA)
Fauna specialist	means a person who holds a tertiary qualification specialising in environmental science or equivalent, and has a minimum of 2 years work experience in fauna identification and surveys of fauna native to the region being inspected or surveyed, or who is approved by the CEO as a suitable fauna specialist for the bioregion, and who holds a valid fauna licence issued under the <i>Biodiversity Conservation Act 2016</i> .
Fill	means material used to increase the ground level, or to fill a depression.
Local provenance	means native vegetation seeds and propagating material from natural sources within 100 kilometres and the same Interim Biogeographic Regionalisation for Australia (IBRA) subregion of the area cleared.
Mulch	means the use of organic matter, wood chips or rocks to slow the movement of

Term	Definition
	water across the soil surface and to reduce evaporation.
Native vegetation	has the meaning given under section 3(1) and section 51A of the EP Act.
Optimal time	means the optimal time for undertaking direct seeding and planting for that region.
Priority flora	means those plant taxa described as priority flora classes 1, 2, 3 or 4 in the <i>Department of Parks and Wildlife's Threatened and Priority Flora List for Western Australia</i> (as amended);
Planting	means the re-establishment of vegetation by creating favourable soil conditions and planting seedlings of the desired species.
Project Rehabilitation Plan	Means plans developed by the Permit Holder for the <i>revegetation</i> and <i>rehabilitation</i> of a site in accordance with condition 22 of this Permit:
Reference site 1	means nearby sites used to provide baseline data for planning a revegetation project. Measurements from fixed reference points or plots where biodiversity components are measured are used to set measurable completion criteria for revegetation projects. The reference sites must contain native vegetation which provides the following values: <ul style="list-style-type: none"> • provides suitable habitat for <i>Pseudocheirus occidentalis</i> (western ringtail possum) • provides suitable foraging habitat for <i>Calyptorhynchus latirostris</i> (Carnaby's cockatoo), <i>Calyptorhynchus banksia</i> subsp. <i>naso</i> (forest red-tailed black cockatoo) and <i>Calyptorhynchus baudinii</i> (Baudin's cockatoo) • accurately represents the surrounding vegetation in Ludlow State Forest No. 2 • is in good (Keighery, 1994) or better condition
Reference site 2	means nearby sites used to provide baseline data for planning a revegetation project. Measurements from fixed reference points or plots where biodiversity components are measured are used to set measurable completion criteria for revegetation projects. The reference sites must contain the following values: <ul style="list-style-type: none"> • Native vegetation which represents the Tuart (<i>Eucalyptus gomphocephala</i>) Woodlands and Forests of the Swan Coastal Plain' State listed priority ecological community.
Regeneration	means revegetation that can be established from in situ seed banks contained either within the topsoil or seed-bearing mulch.
Rehabilitate, rehabilitated and rehabilitation	means actively managing an area containing native vegetation in order to improve the ecological function of that area using methods such as natural <i>regeneration</i> , <i>direct seeding</i> and/or <i>planting</i> , so that the species composition, structure and density is similar to pre-clearing vegetation types in that area.
Revegetate/ed/ion	means the re-establishment of a cover of local provenance native vegetation in an area using methods such as natural regeneration, direct seeding and/or planting, so that the species composition, structure and density is similar to pre-clearing vegetation types in that area
Revegetation area	Means the areas cross-hatched red on Figure 2 of Schedule 1.
Site preparation	means management of existing site topsoil and preparation of the finished soil surface for revegetation, for example by ripping or tilling the soil surface and respreading site topsoil and chipped native vegetation
Suitable habitat (western ringtail possum)	means habitat known to support western ringtail possums (<i>Pseudocheirus occidentalis</i>) within the known current distribution of the species, typically characterised by abundant foliage, presence of suitable nesting structures such as tree hollows, as well as high canopy cover and continuity. Known habitat includes peppermint (<i>Agonis flexuosa</i>) dominated woodlands, jarrah (<i>Eucalyptus marginata</i>) and marri (<i>Corymbia calophylla</i>) forests, riparian vegetation with a canopy of Bullich (<i>Eucalyptus megacarpa</i>) or flooded gum (<i>Eucalyptus rudis</i>), karri (<i>Eucalyptus diversicolor</i>) forests, sheoak (<i>Allocasuarina fraseriana</i>) dominated woodlands, and other stands of myrtaceous trees growing near swamps, watercourses or floodplains
Threatened Flora Seed Collection	means Threatened Flora Seed Collection at the Department of Biodiversity, Conservation and Attractions: Ph. 9219 9063 or email tfsc@dbca.wa.gov.au ,

Term	Definition
Vegetation condition	means the rating given to native vegetation which refers to the impact of disturbance on each of the layers and the ability of the community to regenerate (Keighery 1994)
Vegetation establishment period	means a period of at least two summers after the revegetation during which time replacement and infill revegetation works may be required for areas in which revegetation has been unsuccessful, and involves regular inspections of revegetation sites to monitor the success of revegetation
Weeds	means any plant – (a) that is a declared pest under section 22 of the <i>Biosecurity and Agriculture Management Act 2007</i> ; or (b) published in a Department of Biodiversity, Conservation and Attractions species-led ecological impact and invasiveness ranking summary, regardless of ranking; or (c) not indigenous to the area concerned.
Western ringtail possum recovery plan	means a plan prepared by Department of Parks and Wildlife (2017) to guide recovery actions for the western ringtail possum for the next 10 years.
Western ringtail possum specialist	means a fauna specialist who holds a tertiary qualification specialising in environmental science or equivalent, has a minimum of two years of work experience in western ringtail possum (<i>Pseudocheirus occidentalis</i>) identification, surveys of western ringtail possums and capture and handling of western ringtail possums, and holds a valid fauna licence issued under the Biodiversity Conservation Act 2016.
Western Ringtail Possum Management Plan	means a plan prepared by the Permit Holder and approved by the Department and the Department of Biodiversity, Conservation and Attraction to adequately managed impacts associated with the Bussell Highway Duplication Stage, Hutton to Sabina project on western ringtail possum (DWER Ref: A2021755).

REFERENCES

- Department of Environment and Conservation (2008). Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan. Department of Environment and Conservation, Perth, Western Australia.
- Department of Parks and Wildlife (2013). Carnaby's cockatoo (*Calyptorhynchus latirostris*) Recovery Plan. Department of Parks and Wildlife, Perth, Western Australia
- Department of Parks and Wildlife (2017). Western Ringtail Possum (*Pseudocheirus occidentalis*) Recovery Plan. Wildlife Management Program No. 58. Department of Parks and Wildlife, Perth, WA.
- Ecoedge. (2021a). *Targeted Flora (Verticordia attenuata) Survey. Bussell Highway between Hutton Road and Sabina River*. Flora survey prepared for Main Roads Western Australia for clearing permit application CPS 9168/1. Received by the Department on 9 March 2021. DWER Ref: A1987003
- Ecoedge. (2021b). *Targeted Vegetation Survey of Threatened and Priority Ecological Communities. Hutton Road to Sabina River, Capel*. Biological survey prepared for Main Roads Western Australia for clearing permit application CPS 9168/1. Received by the Department on 23 December 2020. Updated in May 2021. DWER Ref: A2023798.
- Keighery, B.J. (1994) *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*. Wildflower Society of WA (Inc). Nedlands, Western Australia.

END OF CONDITIONS

Michelle Andrews

Chief Executive Officer

DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATION

9 July 2021

Schedule 1

Table 3: List of properties within which the clearing is authorised in accordance with conditions of this Permit.

Property	Property Identification Numbers (PINs)	Locality
Lot 53 on Plan 19312	11422129, 11422128	Yalyalup
Lot 3819 on Plan 410411	12267364	Yalyalup
Lot 500 on Plan 19312	11947243	Yalyalup
Lot 4354 on Plan 209044 (Crown Reserve R 27534)	534514	Yalyalup
Bussell Highway Road reserve	1247124	Yalyalup
Lot 5193 on Plan 21119, Sues Road reserve	11429547	Yalyalup
Lot 5193 on Plan 21119	11429548	Yalyalup
Un-named road	11507305	Ruabon
Sues Road reserve	11380878, 11380823, 11380822	Yalyalup
Lot 100 on Plan 65306	11849853	Yalyalup
Lot 501 on Plan 19312	11947244	Yalyalup
Lot 4411 on Plan 213198	534525	Yalyalup
Lot 52 On Plan 19311	11425078, 11425079	Yalyalup
Lot 4626 on Plan 47033 (Crown reserve R 33734)	534536	Yalyalup
Bussell Highway Road Reserve	11380879	Yalyalup
Layman Road reserve	11507303	Yalyalup/Ruabon
Wannerup South Road	11380879	Yalyalup/Ruabon
Lot 51 on Plan 19311	11425077	Ruabon
Lot 50 on Plan 19311	11425080	Ruabon
Ruabon Road reserve	11551801, 11507306, 11507327	Ruabon/Ludlow
Lot 114 on Plan 236759	11765105	Ruabon/Ludlow
Lot 51 on Plan 18910	11414648	Ruabon/Ludlow
Lot 21 on Plan 402137	12102506	Ludlow
Lot 52 on Plan 18910	11414649	Ludlow
Lot 51 on Plan 18909	11416794, 1416798	Ludlow
Lot 12 on Plan 22029	1200431	Ludlow
Lot 52 on Plan 18909	11416793	Ludlow
Lot 53 on Plan 18909	11416797	Ludlow
Ludlow-Hithergreen Road reserve	11551805	Ludlow
Lot 103 on Plan 49023	11520166	Ludlow
Lot 54 on Plan 18909	11416796	Ludlow
Lot 55 on Plan 18909	11416795	Ludlow
Lot 56 on Plan 18908	11567174	Ludlow
Lot 300 on Plan 18908	11947202	Ludlow
Lot 301 on Plan 18908	11947201	Ludlow
Lot 303 on Plan 18908	11947199	Ludlow
Lot 304 on Plan 18908	11947198	Ludlow
Lot 302 on Plan 18908	11947200	Ludlow

Schedule 2

The boundary of the area authorised to be cleared is shown in the maps below (Figure 1a – 1h).



Figure 1a: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur.

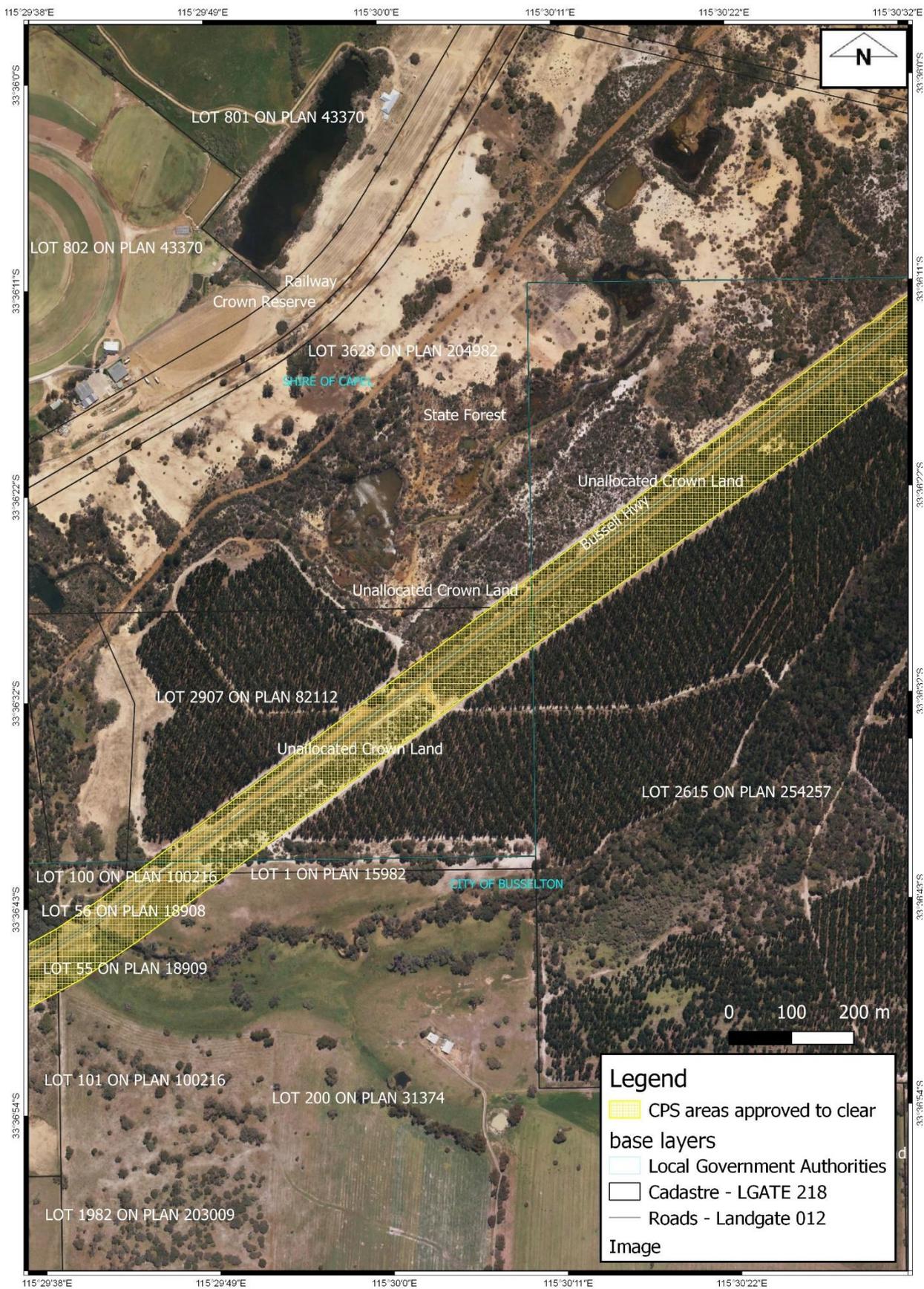


Figure 1b: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur

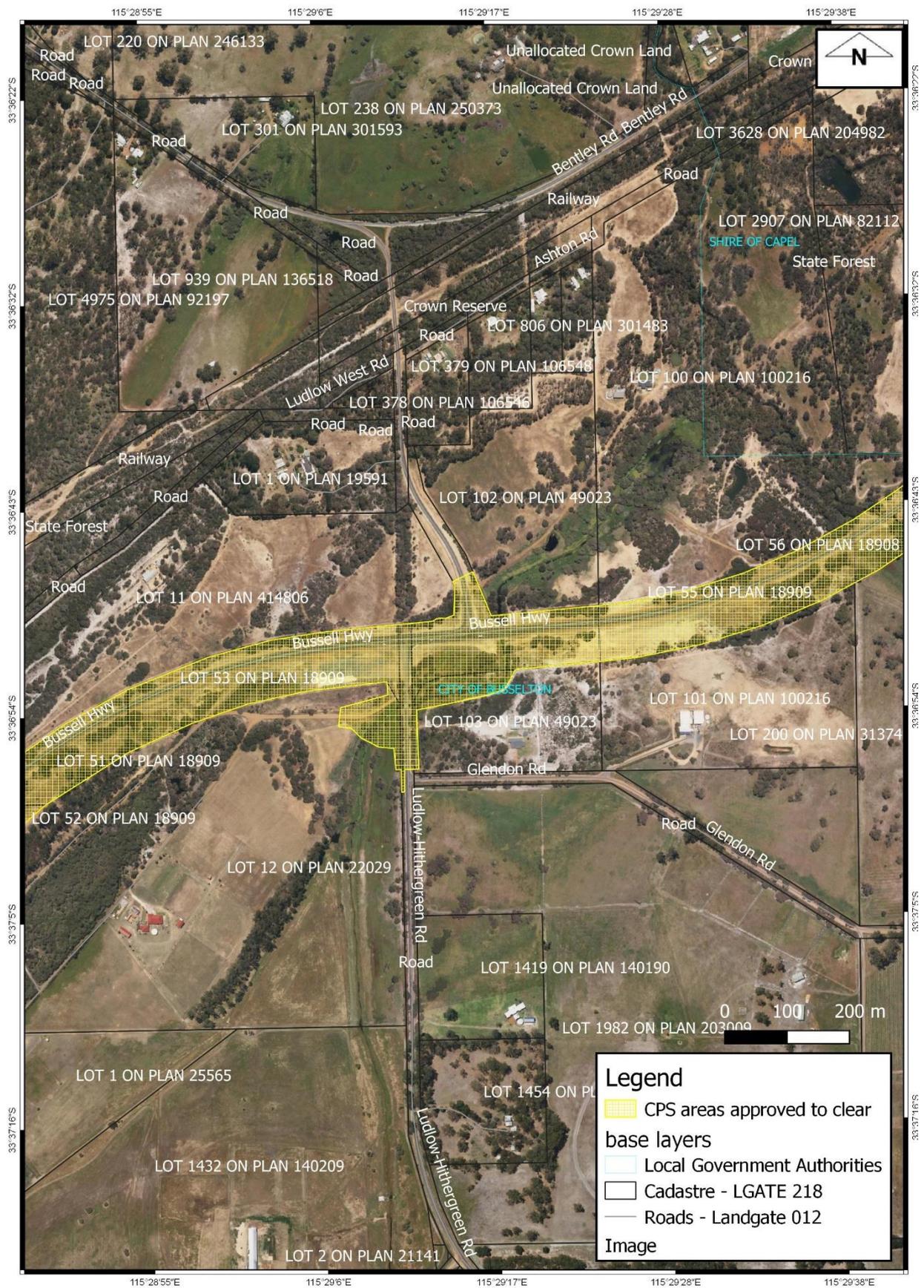


Figure 1c: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur

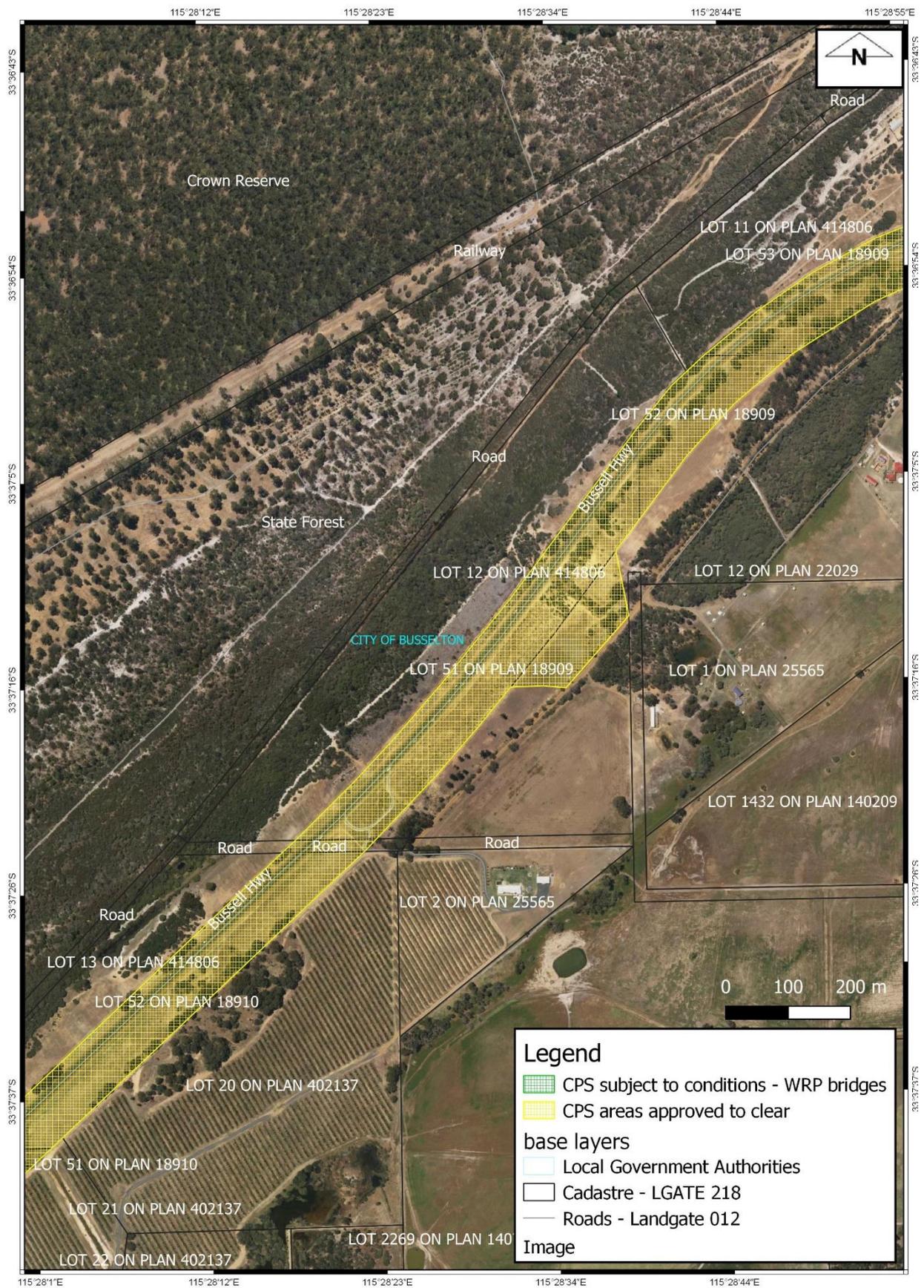


Figure 1d: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur



Figure 1e: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur. The area cross-hatched red indicates the area within which clearing of native vegetation is not authorised in accordance with Condition 12 of this Permit.

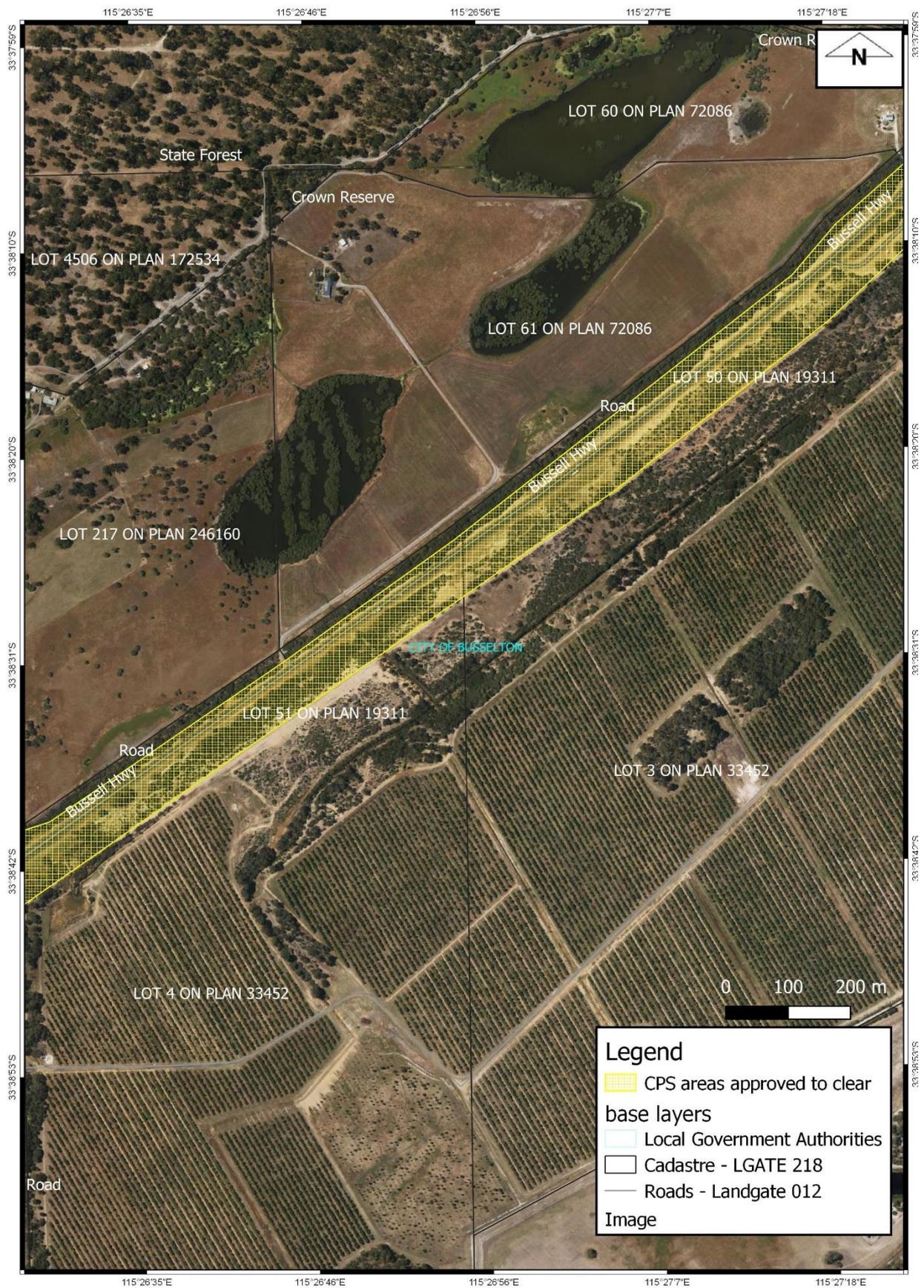


Figure 1f: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur



Figure 1g: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur. The area cross-hatched green indicates the area within which the Permit Holder must install XXX

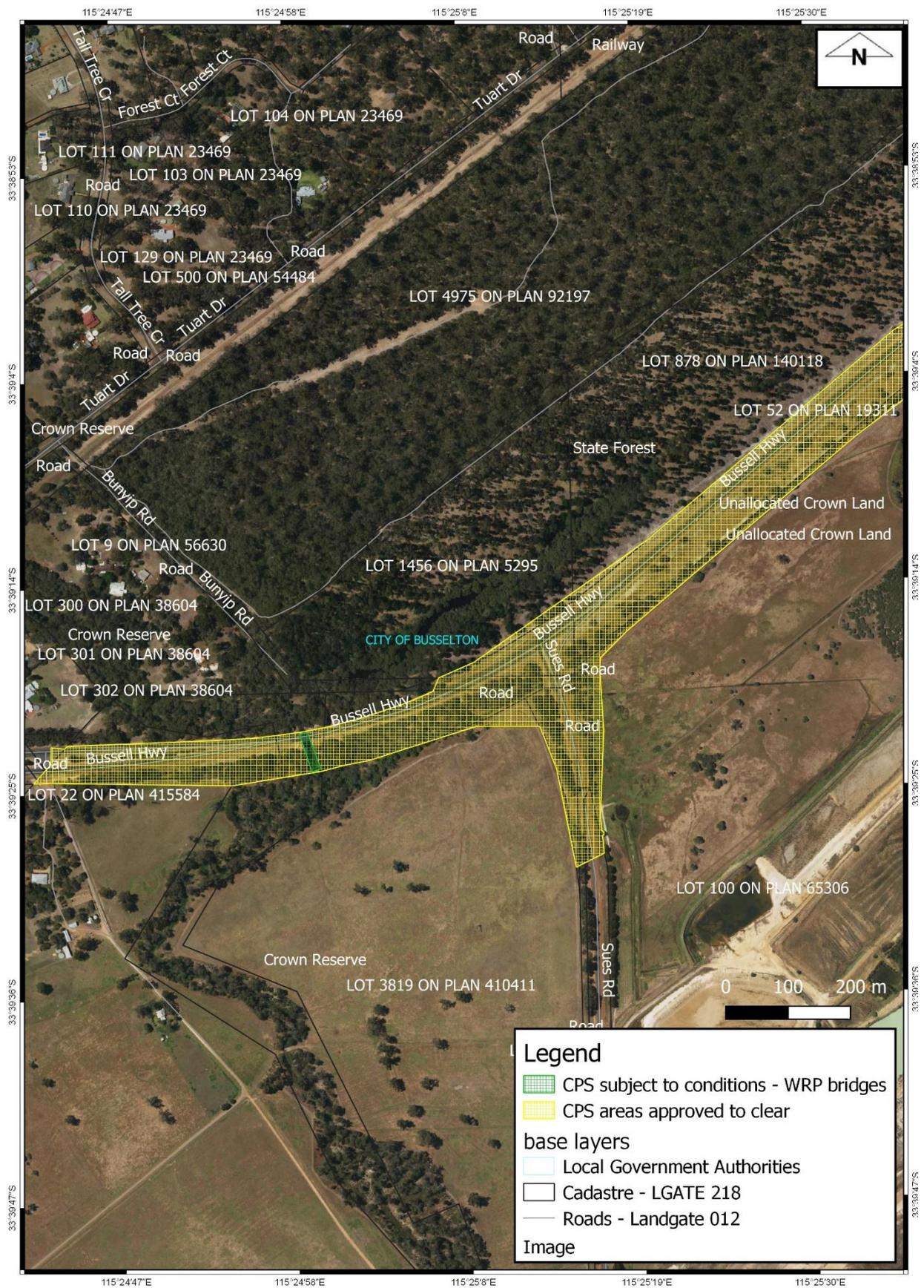


Figure 1h: Map of the boundary of the area (cross-hatched yellow) within which clearing may occur

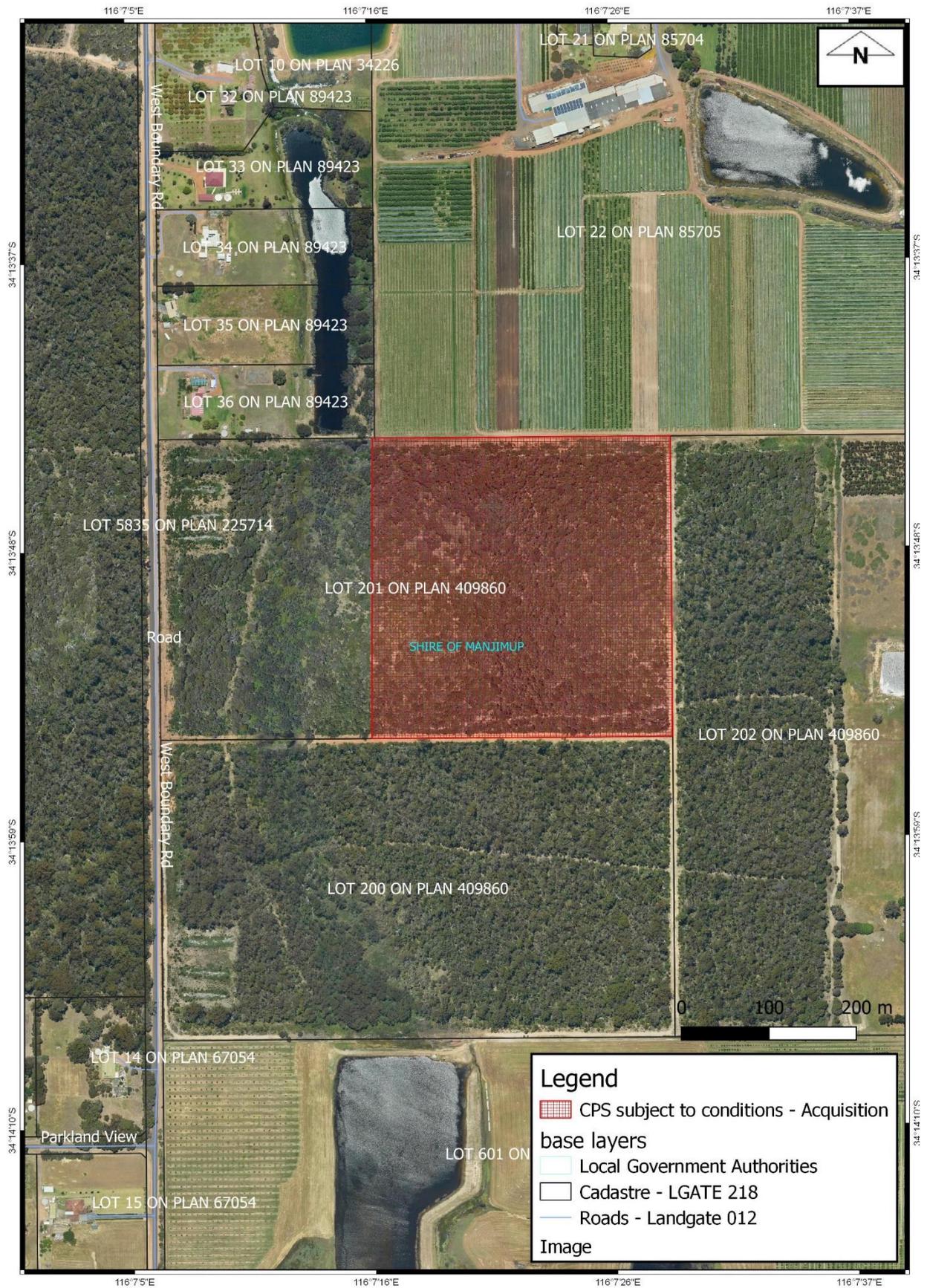


Figure 2: Land acquisition area

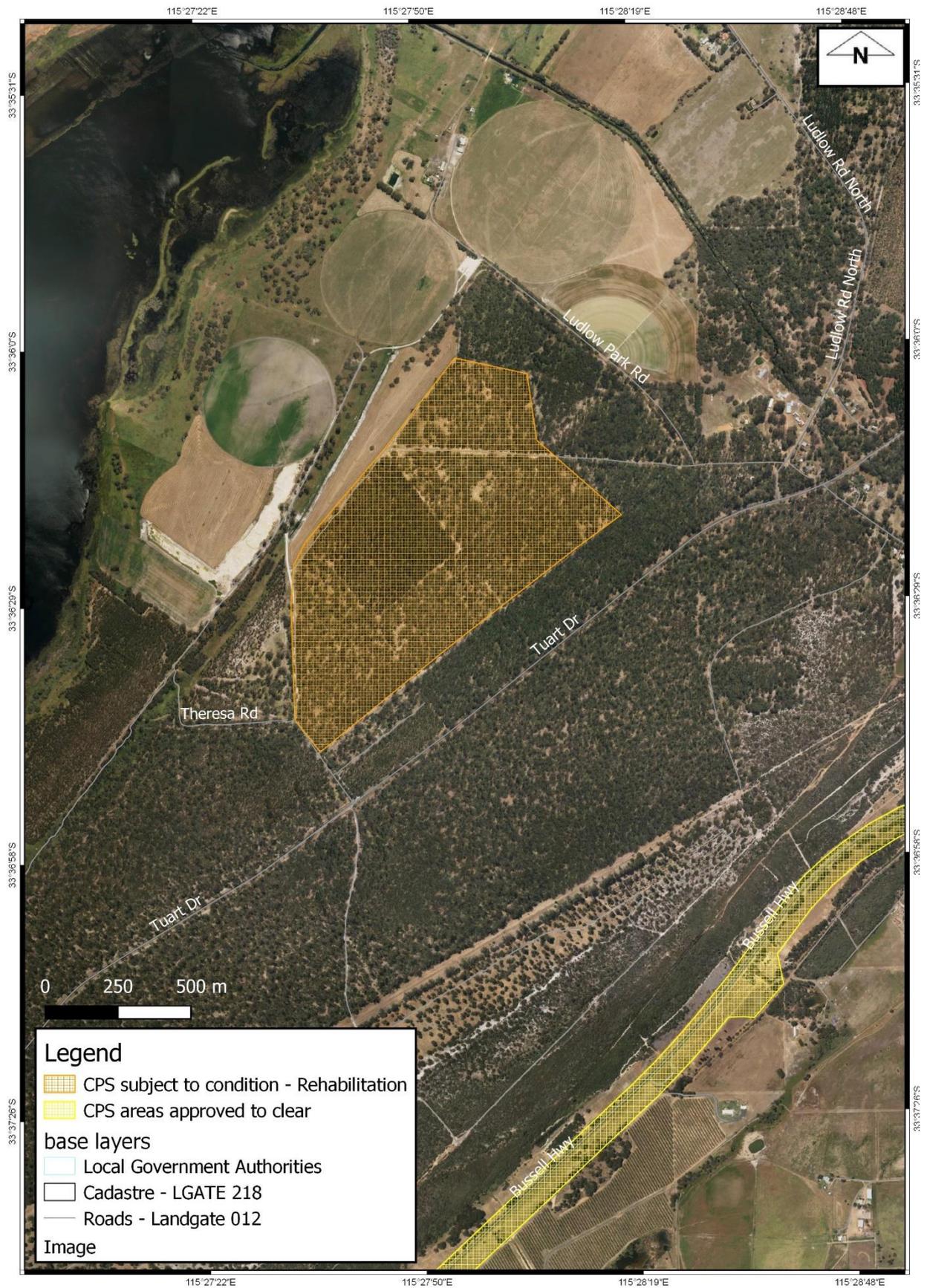


Figure 3: Map of the boundary of the areas cross-hatched orange within which the rehabilitation in accordance with condition 20 of this Permit must occur. Within this area the Permit Holder must install one artificial black cockatoo nesting hollow.

Schedule 3 – How to design and place artificial hollows for Carnaby's cockatoo

Artificial hollows for Carnaby's cockatoo



How to design and place artificial hollows for Carnaby's cockatoo

Artificial hollows can be used to help conserve the threatened Carnaby's cockatoo by enabling the cockatoos to breed in areas where natural hollows are limited.

A wide variety of artificial hollow designs have been used with mixed success. Evidence suggests that, while the hollow must meet some basic requirements, other factors such as proximity to existing breeding areas may be more important in determining the success of artificial hollows. Before using this information sheet to construct or install an artificial hollow, you should refer to the criteria listed in the separate information sheet; *When to use artificial hollows for Carnaby's cockatoo*.

This information sheet contains broad guidelines for the design and placement of artificial hollows for Carnaby's cockatoo.

Below are three examples of successful artificial hollows used by Carnaby's cockatoo for nesting. Artificial hollows made from a natural log with cut side entrance (left), white industrial pipe with top entrance (centre) and natural log with natural side entrance (right).



Photos by Christine Groom (left and right) and Rick Dawson (centre)

Walls

The walls of the artificial hollow need to be constructed from a material that is;

- Durable enough to withstand exposure to elements for an extended period of time (i.e. 20+ years).
- Able to simulate the thermal properties of a natural tree hollow.
- Not less than 380 mm in internal diameter.
- Preferably 1.2 m deep overall and 1m deep to top of substrate/nesting material.

Successful artificial hollows have been constructed from sections of salvaged natural hollow, black and white industrial pipe. When using non-natural materials care must be taken to ensure there are no toxic residues and that the materials are safe to ingest.

Base

The base of the artificial hollow must be;

- Able to support the adult and nestling(s).
- Durable enough to last the life of the nest.
- Free draining.
- At least 380 mm in diameter.
- Covered with 200 mm of sterile, dry, free draining material such as charcoal, hardwood woodchips or wood debris.

Do not use:

- Saw dust or fibre products that will retain moisture.

Example materials that could be used for artificial hollow bases include heavy duty stainless steel, galvanised or treated metal (e.g. Zinalume ®), thick hardwood timber slab or marine ply (not chipboard or MDF). The base material must be cut to size to fit internally with sharp or rough edges ground away or curled inwards and fixed securely to the walls.



Carnaby's cockatoo eggs in an artificial hollow.
Photo by Rick Dawson

Entrance

The entrance of the artificial hollow must;

- Have a diameter of at least 270 mm).
- Preferably be top entry which will minimise use by non-target species.

Top entry hollows are unattractive to nest competitors such as feral bees, galahs and corellas. Side entry hollows have been successful in areas where feral bees are not a problem and where galahs and corellas are deterred.

Ladder

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide a ladder to enable the birds to climb in and out of the hollow easily.

The ladder must be;

- Securely mounted to the inside of the hollow.
- Made from an open heavy wire mesh such as WeldMesh™ with mesh size of 30 - 50 mm, or heavy chain.

Do not use:

- A material that the birds can chew.
- Galvanized because the birds may grip or chew the ladder and ingest harmful compounds.

If using mesh for the ladder, the width will depend on the curvature of the nest walls. A minimum width of about 60 - 100 mm is recommended.

Sacrificial chewing posts

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide sacrificial chewing posts. The birds chew material to prepare a dry base on which to lay their egg(s).

The sacrificial chewing posts must:

- Be made of untreated hardwood such as jarrah, marri or wandoo
- Be thick enough to satisfy the birds' needs between maintenance visits.
- Extend beyond the top of the hollow as an aid to see whether the nest is being used.
- Be placed on the inside of the hollow.
- Be attached in such a way that they are easy to replace e.g. hook over the top of hollow or can slide in/out of a pair of U bolts fitted to the side of the hollow.

It is recommended that at least two posts are provided. Posts 70 x 50 mm have been used, but require replacing at least every second breeding season when the nest is active. Birds do vary in their chewing habits and therefore the frequency at which the chewing posts require replacement will also vary.



Bottom of an artificial hollow showing ladder that is fixed to the wall and a chewed sacrificial post which is 200 mm from the floor.

Photo by Rick Dawson

Mountings

The artificial hollows must be mounted such that:

- The fixings used will last the duration of the nest e.g. galvanized bracket or chain fixed with galvanized coach screws.
- It is secured by more than one anchor for security and stability.
- It is positioned vertically or near vertically.

Placement

Sites should be chosen within current breeding areas and where they can be monitored, but preferably not conspicuous to the general public. It is important that artificial hollows are placed where they will be accessible for future monitoring and maintenance. For more detail refer to the separate information sheet; *When to use artificial hollows for Carnaby's cockatoo*.

The height at which artificial hollows should be placed is variable. The average height of natural hollows in dominant tree species in the area is a good guide. Natural hollows used by Carnaby's cockatoos have been recorded as low as 2 m above the ground. If located on private property the hollows can be placed lower to the ground so they are accessible by ladder or a rope and pulley system can be used. Where public access is possible artificial hollows should be placed at least 7 m high (i.e. higher than most ladders) and on the side of the tree away from public view to reduce the chance of interference or poaching.

Carnaby's cockatoo show no preference for aspect of natural hollows, however, it may still be beneficial to place artificial hollows facing away from prevailing weather and where they receive the most shade and protection.

Artificial hollows to be placed in trees require:

- Accessibility of the tree for a vehicle, elevated work platform or cherry picker.
- A section of trunk 2-3 m long suitable for attaching the hollow

If necessary, artificial hollows may be placed on poles, but this may result in excessive exposure to sun during very hot weather. When erected on poles there should be:

- A hinge at the bottom of the pole that can be secured when the pole is in the upright position.
- Access for a vehicle to assist raising the pole.

Safety

Care needs to be taken when placing artificial hollows to ensure safety is considered at all times. Artificial hollows are heavy and require lifting and manoeuvring into position up to 7 m above the ground.

Maintenance and monitoring

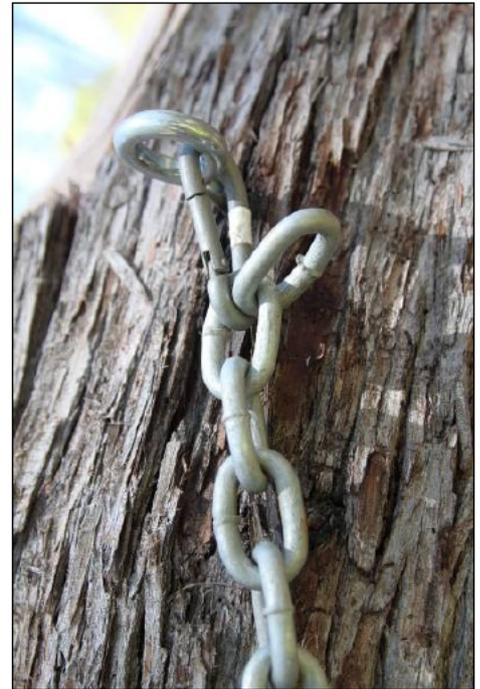
Once artificial hollows have been placed they require monitoring and maintenance to ensure they continue to be useful for nesting by Carnaby's cockatoo. It is important to monitor artificial hollows to determine use by Carnaby's cockatoo, other native species as well as pest species. By undertaking monitoring the success of the design and placement of artificial hollows can be determined and areas for improvement identified for future placement of artificial hollows.

Monitoring can also assess whether any maintenance is required. Without regular maintenance artificial hollows are unlikely to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (to many) decades until a natural replacement hollow is available.

For further advice on monitoring and maintenance of artificial hollows please refer to the separate information sheet; *How to monitor and maintain artificial hollows for Carnaby's cockatoo*.



Carnaby's cockatoo female prospecting an artificial hollow.
Photo by Rick Dawson



Example fixing for artificial hollow
Photo by Christine Groom

Acknowledgements

This information sheet is a joint initiative of Birdlife Australia, the Western Australian Museum and the Department of Parks and Wildlife. Many individuals have contributed to its preparation. Special acknowledgement is made for the contributions of Ron Johnstone from the WA Museum, Alan Elliott from the Serpentine-Jarrahdale Land care Centre and Denis Saunders. This updated version was compiled by Rick Dawson Department of Parks and Wildlife).

Other information sheets in the series: Artificial hollows for Carnaby's cockatoo

- *How to design and place artificial hollows for Carnaby's cockatoo*
- *How to monitor and maintain artificial hollows for Carnaby's cockatoo*

Information sheets available on the *Saving Carnaby's cockatoo* webpage:

<http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals/208-saving-carnaby-s-cockatoo>

Schedule 4 - How to monitor and maintain artificial hollows for Carnaby's cockatoo

Artificial hollows for Carnaby's cockatoo



How to monitor and maintain artificial hollows for Carnaby's cockatoo

It is important to monitor and maintain artificial hollows after they have been erected. Monitoring ensures that the effectiveness of the artificial hollow can be determined. It also means that problems with pest species or any maintenance requirements can be identified and resolved.

Without regular maintenance, artificial hollows are likely to fail to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (to many) decades until a natural replacement hollow is available.

Monitoring should be undertaken in order to detect:

- Use by Carnaby's cockatoo
- Maintenance requirements
- Use by other native species
- Use by pest species (e.g. feral bees, galahs, corellas etc.)



Carnaby's cockatoo female prospecting an artificial hollow.
Photo by Rick Dawson

How do I monitor artificial hollows?

Before undertaking monitoring of artificial hollows for Carnaby's cockatoo it is recommended that you seek advice from BirdLife Australia, the WA Museum or the Department of Parks and Wildlife. It is also important to contact Parks and Wildlife, Wildlife Licensing Section, to determine if a scientific licence is required (wildlifelicencing@dpaw.wa.gov.au).

Monitoring artificial hollows requires keen observation and naturalist skills. It is often not possible to observe evidence of breeding directly (i.e. nestlings or eggs) and inferences must be made based on observation. There are many techniques available to monitor artificial hollows. A combination of several is likely to achieve the best results.

Looking for signs of use

Cobwebs covering the entrance to the hollow will indicate that the hollow has not been used recently. This would also apply to other light debris that may have fallen to cover the opening partially. Signs of recent use or interest in the hollow include evidence of chewing.

Observing parent behaviour around the hollow

The behaviour of parent birds around a hollow will indicate an approximate age of young in the nest.

Parent behaviour	Approximate age/stage of young
Prospecting for hollow	Unborn
Male only seen out of hollow	Egg or very young nestling (< 3 - 4 weeks)
Both parents seen entering/exiting the hollow	Nestling(s) have hatched (> 3 - 4 weeks)

Observing feeding flocks

Flocks of all male birds indicate that the females are incubating eggs. When flocks are mixed it suggests the birds have either not laid yet or that the nestlings have hatched and no longer require brooding (approximately 3 - 4 weeks old).

Tapping

When females are sitting on eggs they will usually respond to tapping at the base of their tree (or pole) by appearing at the entrance or flying from the hollow opening. This is not a guarantee of breeding activity, but an indication that it is possibly occurring in the hollow.

Observing insect activity around nest

The faecal matter produced by nestlings in a nest attracts insects, especially flies and ants. The type and number of these insects will help indicate how old any nestlings present may be. Factors such as temperature and humidity will also affect insect activity and so observations of insect activity should only be used as supporting evidence for other indications of age/use. Blowflies around a nest usually indicate that a death has occurred.

Listening for nestlings

With experience it is possible to determine if one or two nestlings are present and a broad estimate of age based on the type and loudness of noises they make.

Looking inside the nest

This can be achieved either with the aid of a telescopic pole and camera or mirror, or with the use of a ladder or other climbing equipment. This method can obtain the most detailed monitoring information for artificial hollows. However it is also the most time consuming and difficult to organise. Special equipment is likely to be needed depending on the height and positioning of artificial hollows. There are also safety issues associated with ladder or rope climbing options to reach nests to undertake observations.

How often should I monitor artificial hollows?

The minimum frequency of monitoring and the techniques used will be determined by the aims of the monitoring and the resources available. It is important to limit disturbance to breeding birds and this should be considered when determining the techniques used and frequency.

How do I maintain artificial hollows?

Artificial hollows require maintenance to ensure they continue to have the greatest chance of them being used by Carnaby's cockatoos. Periodic maintenance checks should be undertaken at least every two years, preferably annually. These checks should be undertaken prior to the breeding season which is between July and January with breeding occurring later in this period in southern areas. It is important to maintain a regime of regular maintenance as long as the artificial hollow is required. It may take several (to many) decades until a natural replacement hollow is available.

Maintenance checks should assess the following as a minimum:

- Condition of chewing posts (if present)
- Condition of attachment points
- Condition of hollow bases
- Stability of tree or pole used to mount the artificial hollow



Artificial hollow base needing repair.
Photo by Christine Groom

Repairing hollows

Any problems identified during maintenance checks should be addressed, and any repairs required done, as soon as possible. If breeding is currently occurring, maintenance may need to be delayed if it is likely to disturb the parents or nestling. Likely maintenance needs include replacement of chewing posts (frequently) or nest bases (occasionally) and repairing of any cracks (infrequently). Maintenance concerns regarding the security of attachment points or the stability of the tree or pole should be addressed as a priority for safety reasons.

For artificial hollows known to be used, spare chewing posts should be taken into the field when undertaking maintenance checks.

Monitoring of artificial hollows:

Monitoring aim	Frequency of visits	Monitoring techniques
To determine possible use by Carnaby's cockatoo	At least once during peak breeding season (i.e. between September and December)	<ul style="list-style-type: none"> • Observing behaviour of adults around hollow • Tapping to see if female will flush from hollow (best undertaken between 10am and 3pm when females most likely to be sitting) • Listening for nestlings • Looking for evidence of chewing • Looking inside nest
To confirm use by Carnaby's cockatoo	At least two visits during peak breeding season (i.e. between September and December)	<p>To observe at least two of the following:</p> <ul style="list-style-type: none"> • Breeding behaviour of adults around hollow or evidence of chewing • Female flushed from hollow • Noises from nestlings in hollow <p>Or to observe:</p> <ul style="list-style-type: none"> • Nestlings or eggs in nest
To determine nesting success by Carnaby's cockatoo	The more visits, the better. Preferably fortnightly visits between July and December. As a minimum, at least 3 visits spread throughout breeding season.	<ul style="list-style-type: none"> • Looking inside nest to observe eggs or nestlings.
To determine use by any species	As often as possible.	<ul style="list-style-type: none"> • Inspection from ground as a minimum. • Looking inside nest for detailed observations.
To determine maintenance requirements	At least every two years and preferably annually if hollow fitted with sacrificial chewing posts, can be longer if without.	<ul style="list-style-type: none"> • A basic maintenance check can be undertaken from the ground. A ladder or elevated work platform will be required for a comprehensive check and to replace sacrificial chewing posts

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Other information sheets in the series: Artificial hollows for Carnaby's cockatoo

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Appendix 2: A Guide to Preparing Revegetation Plans for Clearing Permits - Checklist

- Title which clearly outlines the name of the revegetation project and its location.
- Table of contents. Suggested headings include:
 - Introduction
 - Reporting requirements
 - Background of revegetation site
 - Current disturbances and threats
 - Reference site floristic data collection
 - Revegetation commitments and completion criteria
 - Site preparation
 - Vegetation establishment
 - Proposed monitoring plan
 - Maintenance and contingency measures
 - Schedule and budget
 - References and appendices

Introduction

This section should contain the following information on the background of the site and include, but is not limited to:

- Purpose of the plan.
- Section explaining how the proposed revegetation addresses the impacts of the clearing.
- Clearing permit number (CPS xxx/x) that the revegetation plan relates to.
- Key contacts and details of person who developed the plan.
- Level of qualification and experience of person who developed the plan.
- Location of clearing, property details, clearing size and purpose.
- Location of revegetation site, property details and size of revegetation site.
- Map outlining the boundary of the clearing area, the revegetation site, aerial photography, cadastral boundaries, roads and other relevant factors. Include area in hectares.
- Associated spatial data for the clearing area is provided in approved format (for example, shapefile).
- Name and qualifications of company providing expertise on completion criteria development and onsite revegetation techniques.

Background of revegetation site

This section should contain information on the existing environment and land details of the revegetation site and include:

- Details of ownership, vesting and zoning of the land (current and/or proposed).
- Details of agreement with landowner to access and carry out revegetation (if not the owner of the revegetation site).
- Details on how the long-term security of the revegetation site will be ensured, including any existing or proposed management arrangements (for example, a conservation covenant).

- Map outlining the existing vegetation unit/s, summary structure and condition. When mapping each vegetation unit and vegetation condition across the site, include area in hectares.
- Map outlining the existing soil types, landforms and topography. Include area in hectares.
- Associated spatial data for the revegetation site (vegetation units, soil types, landforms and topography) is provided in Geographic Information Systems (GIS) format (for example shapefile).
- Existing hydrology and drainage.
- Existing evidence of fauna.
- Photos of the existing environment should be provided.

Current disturbance and threats

This section should contain the current disturbances and threats to the revegetation site:

- Site history (for example, grazing or logging).
- Existing land use disturbances that need to be addressed such as grazing, rubbish dumping, four wheel drive access and fire.
- Existing physical site factors that need to be addressed or repaired such as soil compaction, erosion and surface water diversion.
- Existing biological site conditions that need to be repaired such as weed invasion, disease, lack of fauna habitat, feral animals and low floristic diversity.

Revegetation commitments

This section should contain the overall vision of the plan as well as objectives for the revegetation project.

- Vision: an overarching statement of the intent of the plan and its ultimate goal.
- Objectives: set the main goals of the revegetation (for example, safe and stable landforms and soils, establishment of natural hydrology, resilient and self-sustaining vegetation, reaching agreed numeric targets for revegetation recovery and to provide fauna habitat).

Reference site floristic data collection

If more than one vegetation unit is being revegetated, reference site data for each vegetation unit is required. Species lists from different vegetation units are not to be combined.

- Identify each unique vegetation unit to be revegetated (if there are many vegetation units, contact DWER to discuss).
- Describe and justify chosen reference site/s in the context of developing completion criteria.
- Provide map showing reference site location, tenure and size; boundaries of vegetation units; aerial photograph; and quadrat locations, size and number. Also include site vegetation condition mapping, site weed mapping and site disease mapping (include area in hectares).
- Associated spatial data for the reference site/s is provided in GIS format (for example shapefile).
- Provide all reference site data sets as outlined in Section 5.3 in this guide. This includes entire floristics for each quadrat as outlined (electronically). If more than one vegetation unit is being revegetated, separate reference site data is required.

Targets and completion criteria

If more than one vegetation unit is being revegetated, each will require a set of unique completion criteria. Do not combine different vegetation units into one, unless through prior discussion with DWER.

- Outline targets and completion criteria.
- Describe clearly how each target and completion criterion was developed and how they meet the SMART principles. If existing data sets were used, describe and justify their inclusion.

Species list compilation and revegetation techniques

This section should include details on how and when vegetation establishment is to occur.

- Species list and amounts from completion criteria. Describe and confirm where these species can be acquired, in the required amounts and at the correct time of year.
- Seed collection (for either direct seeding or seedling propagation). Details on the timing of seed collection and the source and methods used to collect seeds are required. Include provenance.
- Direct seeding. A species list, timing and details on the methods used to direct seed are required as well as the target species composition and sowing rate (kilogram per hectare). Justify species composition and sowing rate (if undertaken).
- Topsoil. A list of expected species and species composition from the topsoil is required, along with the methods and timing of collecting, stockpiling and spreading the topsoil on the revegetation site (if undertaken).
- Mulching. Details on timing and methods are required.
- Confirm that seedlings are obtained from dieback-free sources to prevent introduction or spread of disease.

Site preparation

This section should contain details on the site preparation required prior to vegetation establishment.

- Describe techniques, timing and methods to be used to undertake site preparation actions. For example, actions may include ripping; grading and contouring; stockpiling of topsoil; mulching or matting; and pre-planting weed control.
- Describe revegetation site protection actions to be undertaken including methods and timing. For example:
 - Protecting the site through fencing and providing protection from grazing. Provide map of current and proposed fencing boundaries.
 - Signage and schedule for installation.
 - Provide dieback mapping and site hygiene plan showing hygiene boundaries to prevent spread of dieback and other plant diseases. Please provide map in report and associated spatial data in GIS format (for example shapefile).
 - Provide weed mapping and hygiene boundaries to prevent spread of dieback and other plant diseases. Please provide map in report and associated spatial data in GIS format (for example shapefile).

Maintenance and contingency measures

This section should outline the maintenance and contingency measures that will be put in place to ensure revegetation is successful.

- Post-planting weed control (for example, spot-spraying, hand weeding and mulching). Timing and methods used should be documented.
- Remedial planting or seeding requirements (dependent on establishment and ongoing success). Timing and methods used should be documented.
- Dieback treatment if required. Contractor name, timing and methods used should be documented.
- Inspection of fencing. Timing and methods used should be documented.
- Erosion. Cause and remedial action to be used should be documented.
- Other maintenance actions. Timing and methods used should be documented.

Schedule and budget

This section should include a detailed work plan that outlines the timing for each action per year including

monitoring and maintenance. It should also outline the costings and source of funding for each revegetation action.

- Schedule of actions (timeline) in table format (see Table 4) showing actions to be undertaken per month/season and per year of the project. This includes specialist environmental consultancy services, materials, site preparation, on ground works, maintenance, monitoring and overheads/administration. A date for the commencement of revegetation should be identified.
- The entity or person responsible to implement each action outlined in the schedule of actions.
- Budget and costings (see examples in Appendix E).
- Source of funding.

Monitoring and analysis

This section should include details on the proposed methods for monitoring and data analysis. Describe monitoring methods to be used:

- Describe monitoring frequency and timing (month / year).
- Outline the statistical analysis to use and the features of the revegetation to analyse.

References and appendices

This section should include references used to create the plan and any appendices.

- References used to create the revegetation plan.
- Aerial photographs.
- Onsite photographs (photopoints) of both reference site/s and revegetation site.
- Required datasets in entirety. Both reference site/s and revegetation site (site floristics, quadrat vegetation structure, quadrat vegetation condition, quadrat per cent bare ground and vegetation. Datasets are to be clearly named with a basic description of each required.
- Maps of fence boundary, dieback mapping, vegetation condition mapping, photopoint locations and monitoring quadrat locations.
- Associated spatial data of the revegetation site features is provided in GIS format (for example shapefile). Shapefiles are to be clearly named to reflect content.
- Copy of written agreement with landowner (if not the owner of the revegetation site).

Appendix 3: DBCA Letter for Offsets at State Forest No.2 (Ludlow Tuart Forest)

Appendix 4: Main Roads Reference Site Quadrat Data

BC01

Project		Hutton to Sabina Reference Sites - Ludlow State Forest No. 2	
Date:	5/9/2023	Time	10:05am
Name:	Main Roads botanists		
Quadrat No.	BC01-2023	GPS Co-ordinates	Easting 358 955 GDA94 Northing 628 6911
Photopoint number(s)	NW - SW - SE - NW		
Species richness (No.)	27 (14 native)		
Weed cover (%):			
Weed species present:	<i>Zantedeschia aethiopica</i> , <i>Trachyandra divaricata</i> Many weeds still young, minor cover, <i>Arctotheca calendula</i>		
Bare ground cover (%):	25% - 30% - may be previously disturbed		
Vegetation structure: (ESCAVI 2003)	Woodland		
Vegetation condition (Keighery):	Good		
Stems (No.) (excluding trees):	<i>Hibbertia cuneiformis</i> only meaningful stems besides tree		
Plant health (evidence of disease, insect damage and nutrient deficiencies):	Mostly healthy		
Notes:	Previous limestone quarry ~ 20m SE. Some disturbance from scattered rubbish, weeds and previous logging.		

Stratum (m)	Canopy Cover (%)	Stems	Dominant Species
20m x 20m expanded tree quadrat			
20-25	40	7	<i>Eucalyptus gomphocephala</i>
10-15	30-40	~53	<i>Agonis flexuosa</i> – 53 stems includes juveniles ~ 30 mature
10m x 10m floristic quadrat			
15-20	40		<i>Eucalyptus gomphocephala</i>
10-15	60		<i>Agonis flexuosa</i>

Species	Introduced	Height (m)	%Cover	Comments
10m x 10m floristic quadrat				
<i>Eucalyptus gomphocephala</i>		15-20	40	
<i>Agonis flexuosa</i>		10-15	60	Some younger saplings
<i>Hibbertia cuneiformis</i>		1.5	5	
<i>Lepidosperma squamatum</i>		0.6	60	
<i>Geranium molle</i>	*	0.3	1	
<i>Hardenbergia comptoniana</i>		C	+	
<i>Conostylis aculeata</i>		+2	+	
<i>Diuris</i> sp.		0.4	+	5 in flower
<i>Thysanotus manglesianus</i>		C	+	
<i>Caladenia flava</i>		0.1	+	2 in bud
<i>Ehrharta longiflora</i>	*	0.4	1-2	
<i>Avena barbata</i>	*	0.4	+	
<i>Patersonia occidentalis</i>		0.4	0.5	
<i>Poaceae</i> sp.		0.3	~2	
<i>Thysanotus ?multiflorus</i>		0.15	+	
<i>Lomandra micrantha</i>		0.1	+	
<i>Vicia sativa</i>	*	0.4	3	
<i>Zantedeschia aethiopica</i>	*	0.6	5	
<i>Briza maxima</i>	*	0.2	+	
<i>Galium murale</i>	*	0.05	2	
<i>Asparagus asparagoides</i>	*	C	+	
<i>Euphorbia peplus</i>	*	0.01	+	
<i>Romulea rosea</i>	*	0.1	+	
<i>Trachyandra divaricata</i>	*	0.3	+	
<i>Lagurus ovatus</i>	*	0.2	+	
<i>Oxalis corniculata</i>	*	0.2	+	
<i>Pyrorchis nigricans</i>		+	+	
<i>Lysiandra calycina</i>				OPPORTUNISTIC
<i>Kunzea</i> sp. (planted)				OPPORTUNISTIC
<i>Sowerbaea laxiflora</i>				OPPORTUNISTIC
<i>Spyridium globulosum</i>				OPPORTUNISTIC



BC03

Project			
Date:	12/9/2023	Time	10:15am
Name:	Main Roads botanists		
Quadrat No.	BC03-2023	GPS Co-ordinates	Easting 357 431 GDA94 Centre Northing 627 9914
Photopoint number(s)	NW - SW - SE - NE		
Species richness (No.)	28 (13 native)		
Weed cover (%):			
Weed species present:	See species list		
Bare ground cover (%):	Moss, leaf litter		
Vegetation structure: (ESCAVI 2003)	Open Woodland		
Vegetation condition (Keighery):	Good		
Stems (No.) (excluding trees):			
Plant health (evidence of disease, insect damage and nutrient deficiencies):	<i>Lepidosperma squamatum</i> has some insect/scale issue. <i>Hibbertia cuneiformis</i> has some rust disease.		
Notes:	Previous logging		

Stratum (m)	Canopy Cover (%)	Stems	Dominant Species
20m x 20m expanded tree quadrat			
25-30	20	2	<i>Eucalyptus gomphocephala</i>
5-10	15-20	17	<i>Agonis flexuosa</i>
5	2	3	* <i>Olea europaea</i>
10m x 10m floristic quadrat			
2	10	8	<i>Hibbertia cuneiformis</i>
1.5	60	Lots	<i>Lepidosperma squamatum</i>
25-30	40	1	<i>Eucalyptus gomphocephala</i>
5-10	8	2	<i>Agonis flexuosa</i>
5	10	3	* <i>Olea europaea</i>

Species	Introduced	Height (m)	%Cover	Comments
10m x 10m floristic quadrat				
<i>Eucalyptus gomphocephala</i>		30	40	
<i>Agonis flexuosa</i>		8	25-30	
<i>Olea europaea</i>	*	5	10	
<i>Hibbertia cuneiformis</i>		2	10	
<i>Lepidosperma squamatum</i>		1.5	60	
<i>Lysiandra calycina</i>		0.5	+	
<i>Geranium molle</i>	*	0.1	+	
<i>Hardenbergia comptoniana</i>		C	+	
<i>Lomandra micrantha</i>		0.1	+	
<i>Caladenia flava</i>		0.1	+	
<i>Thysanotus manglesianus</i>		C	+	
<i>Lasiopetalum ?membranaceum (P3)</i>		0.2	+	
<i>Styphelia propinqua</i>		0.6	0.01	
<i>Caesia micrantha</i>		C	+	
<i>Galium murale</i>	*	0.05	+	
<i>Drosera</i> sp. climbing		C	+	
<i>Ehrharta longiflora</i>	*	0.15	+	
<i>Zantedeschia aethiopica</i>	*	1	25	
<i>Euphorbia pepus</i>	*	0.01	+	
<i>Trifolium dubium</i>	*	0.1	+	
<i>Briza maxima</i>	*	0.2	2	
<i>Vicia sativa</i>	*	0.2	+	
<i>Arctotheca calendula</i>	*	0.1	+	
<i>Hypochaeris glabra</i>	*	0.01	2	
<i>Briza minor</i>	*	0.1	+	
<i>Cotula turbinata</i>	*	0.05	+	
<i>Trachyandra divaricata</i>	*	0.4	+	



BC02

Project		Hutton to Sabina Reference Sites - Minnipup Block	
Date:	5/9/2023	Time	4:10pm
Name:	Main Roads botanists		
Quadrat No.	BC02-2023	GPS Co-ordinates	Easting 366 529 Centre GDA94 Northing 629 5211
Photopoint number(s)	NW - SW - SE - NE		
Species richness (No.)	28 (17 native)		
Weed cover (%):			
Weed species present:	<i>Zantedeschia aethiopica</i> (See list for others)		
Bare ground cover (%):	20% - 30%		
Vegetation structure: (ESCAVI 2003)	Open Woodland		
Vegetation condition (Keighery):	Good		
Stems (No.) (excluding trees):			
Plant health (evidence of disease, insect damage and nutrient deficiencies):	Mostly healthy, some insect damage on jarrah.		
Notes:	Upland within Minnipup forest block, close to coast, can hear waves, previous grazing, rubbish.		

Stratum (m)	Canopy Cover (%)	Stems	Dominant Species
20m x 20m expanded tree quadrat			
20-25	30%	1	<i>Eucalyptus gomphocephala</i>
5-10	25%	4	<i>Agonis flexuosa</i>
5-10	12%	2	<i>Banksia attenuata</i>
5-10	15-20%	22	<i>Eucalyptus marginata</i>
10m x 10m floristic quadrat			
20-25	15%		<i>Eucalyptus gomphocephala</i> (cover only)

Species	Introduced	Height (m)	%Cover	Comments
10m x 10m floristic quadrat				
<i>Eucalyptus gomphocephala</i>		20-25	15%	
<i>Agonis flexuosa</i>		5-10	15%	
<i>Banksia attenuata</i>		5-10	10%	
<i>Eucalyptus marginata</i>		5-10	5%	
<i>Hibbertia cuneiformis</i>		1.0	+	
<i>Hibbertia hypericoides</i>		0.6	30%	
<i>Lysiandra calycina</i>		0.3	0.5%	
<i>Caladenia flava</i>		0.1	+	
<i>Macrozamia riedlei</i>		0.5	+	
<i>Lagenophora huegelii</i>		0.1	+	
<i>Craspedia variabilis</i>		0.2	+	
<i>Orthrosantus laxus</i>		0.15	+	
<i>Thysanotus ?multiflorus</i>		0.2	+	
<i>Hardenbergia comptoniana</i>		-	+	
<i>Geranium molle</i>	*	0.3	+	
<i>Trifolium dubium</i>	*	0.05	+	
<i>Trachyandra divaricata</i>	*	0.2	+	
<i>Hypochaeris glabra</i>	*	0.05	+	
<i>Zantedeschia aethiopica</i>	*	0.2	+	
<i>?Nothoscordum gracile</i>		0.5	0.5%	
<i>Ranunculus colonorum</i>		0.2	+	
<i>Poaceae</i> sp.			20-30%	



Appendix 5: Total Species - Main Roads and Gibson et al (1994) Quadrats

Family	Species	Introduced	Site						
			BC01-2023	BC02-2023	BC03-2023	MINN-1	MINN-2	MINN-3	PEPB-1
Alliaceae	? <i>Nothoscordum gracile</i>	*		1	1				
Apiaceae	<i>Daucus glochidiatus</i>					1	1	1	
Apiaceae	<i>Eryngium pinnatifidum</i> subsp. <i>pinnatifidum</i>							1	
Araceae	<i>Zantedeschia aethiopica</i>	*	1	1	1	1			1
Araliaceae	<i>Hydrocotyle diantha</i>						1	1	
Araliaceae	<i>Trachymene pilosa</i>					1	1	1	
Asparagaceae	<i>Asparagus asparagoides</i>	*	1						1
Asparagaceae	<i>Dichopogon capillipes</i>					1	1	1	1
Asparagaceae	<i>Lomandra caespitosa</i>						1	1	
Asparagaceae	<i>Lomandra micrantha</i>		1		1	1		1	1
Asparagaceae	<i>Lomandra suaveolens</i>						1	1	
Asparagaceae	<i>Sowerbaea laxiflora</i>					1	1	1	1
Asparagaceae	<i>Thysanotus ?multiflorus</i>		1	1					
Asparagaceae	<i>Thysanotus patersonii</i>								1
Asparagaceae	<i>Thysanotus</i> sp. <i>manglesianus/patersonii</i> group		1		1		1		
Asphodelaceae	<i>Trachyandra divaricata</i>	*	1	1	1	1			
Asteraceae	<i>Arctotheca calendula</i>	*			1				
Asteraceae	<i>Asteridea pulverulenta</i>						1	1	
Asteraceae	<i>Carduus pycnocephalus</i>	*							1
Asteraceae	<i>Cotula turbinata</i>	*			1		1		
Asteraceae	<i>Craspedia variabilis</i>			1					
Asteraceae	<i>Craspedia</i> sp. (GJK 13121)								1
Asteraceae	<i>Hypochaeris glabra</i>	*		1	1	1	1	1	
Asteraceae	<i>Lagenophora huegelii</i>			1			1	1	1
Asteraceae	<i>Picris squarrosa</i>								1
Asteraceae	<i>Senecio spanomerus</i>						1		
Asteraceae	<i>Sonchus oleraceus</i>	*				1	1		1
Asteraceae	<i>Waitzia suaveolens</i>						1	1	
Caryophyllaceae	<i>Cerastium glomeratum</i>	*				1	1		
Caryophyllaceae	<i>Petrorhagia dubia</i>	*				1	1	1	
Caryophyllaceae	<i>Silene gallica</i>	*				1	1		

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Bussell Highway Duplication (Hutton to Sabina) - State Forest No. 2 (Sites 1 and 3) - CPS 9168/1 Project Rehabilitation Plan

Family	Species	Introduced	Site						
			BC01-2023	BC02-2023	BC03-2023	MINN-1	MINN-2	MINN-3	PEPB-1
Chenopodiaceae	<i>Rhagodia baccata</i> subsp. <i>baccata</i>					1			1
Colchicaceae	<i>Burchardia congesta</i>							1	
Convolvulaceae	<i>Dichondra repens</i>				1				1
Cyperaceae	<i>Carex thecata</i>					1			1
Cyperaceae	<i>Ficinia marginata</i>	*					1		
Cyperaceae	<i>Ficinia nodosa</i>	*			1				
Cyperaceae	<i>Lepidosperma angustatum</i>							1	
Cyperaceae	<i>Lepidosperma gladiatum</i>		1						
Cyperaceae	<i>Lepidosperma squamatum</i>				1				
Dennstaedtiaceae	<i>Pteridium esculentum</i>								1
Dilleniaceae	<i>Hibbertia cuneiformis</i>		1	1	1	1	1		1
Dilleniaceae	<i>Hibbertia hypericoides</i>			1		1	1	1	
Droseraceae	<i>Drosera erythrorhiza</i>							1	
Droseraceae	<i>Drosera drummondii</i>							1	
Droseraceae	<i>Drosera sp. climbing</i>				1				
Ericaceae	<i>Leucopogon parviflorus</i>					1			
Ericaceae	<i>Styphelia discolor</i>							1	
Ericaceae	<i>Styphelia propinqua</i>				1		1	1	
Euphorbiaceae	<i>Euphorbia peplus</i>	*	1		1				
Fabaceae	<i>Acacia willdenowiana</i>					1	1		
Fabaceae	<i>Bossiaea eriocarpa</i>						1		
Fabaceae	<i>Hardenbergia comptoniana</i>		1	1	1	1	1	1	1
Fabaceae	<i>Hovea chorizemifolia</i>						1		
Fabaceae	<i>Hovea trisperma</i> var. <i>trisperma</i>							1	
Fabaceae	<i>Kennedia prostrata</i>								1
Fabaceae	<i>Ornithopus compressus</i>	*				1			
Fabaceae	<i>Trifolium campestre</i>	*				1	1	1	
Fabaceae	<i>Trifolium cernuum</i>	*				1	1		1
Fabaceae	<i>Trifolium dubium</i>	*		1	1				
Fabaceae	<i>Trifolium glomeratum</i>	*					1		
Fabaceae	<i>Vicia sativa</i>	*	1		1	1			1
Geraniaceae	<i>Geranium molle</i>	*	1	1	1	1	1		

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Busse Highway Duplication (Hutton to Sabina) - State Forest No. 2 (Sites 1 and 3) - CPS 9168/1 Project Rehabilitation Plan

Family	Species	Introduced	Site						
			BC01-2023	BC02-2023	BC03-2023	MINN-1	MINN-2	MINN-3	PEPB-1
Geraniaceae	<i>Geranium retrorsum</i>						1		1
Haemodoraceae	<i>Conostylis aculeata</i>		1				1	1	
Hemerocallidaceae	<i>Caesia</i> aff. <i>micrantha</i> (GJK 10857)								1
Hemerocallidaceae	<i>Chamaescilla corymbosa</i>								1
Hemerocallidaceae	<i>Dianella brevicaulis</i>								1
Hemerocallidaceae	<i>Stypandra glauca</i>								1
Hemerocallidaceae	<i>Tricoryne elatior</i>				1				1
Iridaceae	<i>Orthrosanthus laxus</i>			1			1	1	1
Iridaceae	<i>Patersonia occidentalis</i>		1						
Iridaceae	<i>Romulea rosea</i>	*	1					1	
Juncaceae	<i>Luzula meridionalis</i>						1		1
Malvaceae	<i>Lasiopetalum ?membranaceum</i> (P3)					1			
Myrtaceae	<i>Agonis flexuosa</i>		1	1	1	1	1	1	1
Myrtaceae	<i>Eucalyptus gomphocephala</i>		1	1	1	1	1	1	1
Myrtaceae	<i>Eucalyptus marginata</i>			1			1	1	
Oleaceae	<i>Olea europaea</i>	*				1			
Orchidaceae	<i>Caladenia flava</i>		1	1	1				
Orchidaceae	<i>Caladenia flava</i> subsp. <i>flava</i>						1	1	1
Orchidaceae	<i>Caladenia latifolia</i>						1	1	1
Orchidaceae	<i>Caladenia longicauda</i>								1
Orchidaceae	<i>Diuris</i> aff. <i>amplissima</i>								1
Orchidaceae	<i>Diuris</i> sp.		1						
Orchidaceae	<i>Elythranthera brunonis</i>								1
Orchidaceae	<i>Eriochilus dilatatus</i>								1
Orchidaceae	<i>Pterostylis</i> aff. <i>pyramidalis</i>							1	1
Orchidaceae	<i>Pterostylis vittata</i>							1	1
Orchidaceae	<i>Pyrorchis nigricans</i>		1						1
Orchidaceae	<i>Thelymitra fuscolutea</i>								1
Orchidaceae	<i>Thelymitra</i> sp. indet.								1
Orobanchaceae	<i>Orobanche minor</i>	*					1	1	
Orobanchaceae	<i>Parentucellia latifolia</i>	*						1	1
Oxalidaceae	<i>Oxalis corniculata</i>	*	1						

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Busse Highway Duplication (Hutton to Sabina) - State Forest No. 2 (Sites 1 and 3) - CPS 9168/1 Project Rehabilitation Plan

Family	Species	Introduced	Site						
			BC01-2023	BC02-2023	BC03-2023	MINN-1	MINN-2	MINN-3	PEPB-1
Oxalidaceae	<i>Oxalis perennans</i>					1	1		1
Phyllanthaceae	<i>Lysiandra calycina</i>			1	1		1	1	
Plantaginaceae	<i>Veronica arvensis</i>	*				1	1		
Poaceae	<i>Austrostipa semibarbata</i> group						1	1	
Poaceae	<i>Austrostipa flavescens</i>					1		1	1
Poaceae	<i>Aira caryophyllea</i>	*					1	1	
Poaceae	<i>Avena barbata</i>	*	1			1	1		
Poaceae	<i>Avena fatua</i>	*							1
Poaceae	<i>Briza maxima</i>	*	1		1	1	1	1	1
Poaceae	<i>Briza minor</i>	*			1		1	1	
Poaceae	<i>Bromus diandrus</i>	*				1	1	1	1
Poaceae	<i>Dichelachne crinita</i>							1	
Poaceae	<i>Ehrharta calycina</i>	*							
Poaceae	<i>Ehrharta longiflora</i>	*	1		1	1			1
Poaceae	<i>Lagurus ovatus</i>	*	1			1	1		
Poaceae	<i>Microlaena stipoides</i>						1	1	1
Poaceae	<i>Rytidosperma occidentale</i>							1	
Poaceae	<i>Poaceae</i> sp.	*	1	1					
Primulaceae	<i>Lysimachia arvensis</i>	*				1			
Proteaceae	<i>Banksia attenuata</i>			1			1	1	
Ranunculaceae	<i>Ranunculus colonorum</i>			1		1			
Rhamnaceae	<i>Cryptandra</i> sp. indet.						1		
Rhamnaceae	<i>Spyridium globulosum</i>					1			1
Rubiaceae	<i>Galium murale</i>	*	1		1	1	1		1
Rubiaceae	<i>Opercularia hispidula</i>						1		
Rubiaceae	<i>Opercularia vaginata</i>								
Rubiaceae	<i>Sherardia arvensis</i>	*				1			
Urticaceae	<i>Parietaria debilis</i>						1	1	
Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>							1	
Zamiaceae	<i>Macrozamia riedlei</i>			1		1	1	1	
TOTAL			27	22	28	49	60	54	37

Appendix 6: Total Species - Reference Site Baseline Surveys

Offset Site 7 (Stream 2022)

Family	Species	Introduced
Apiaceae	<i>Daucus glochidiatus</i>	
	<i>Eryngium pinnatifidum</i> ?subsp. <i>pinnatifidum</i>	
Araceae	<i>Zantedeschia aethiopica</i>	*
Araliaceae	<i>Trachymene pilosa</i>	
Asparagaceae	? <i>Dichopogon</i> sp.	
	<i>Sowerbaea laxiflora</i>	
Asphodelaceae	<i>Trachyandra divaricata</i>	*
Asteraceae	<i>Arctotheca calendula</i>	*
	Asteraceae sp.	
	<i>Cotula turbinata</i>	*
	<i>Hypochaeris glabra</i>	*
	<i>Lagenophora huegelii</i>	
	<i>Sonchus oleraceus</i>	*
Caryophyllaceae	<i>Petrorhagia dubia</i>	*
Cyperaceae	<i>Lepidosperma gladiatum</i>	
Dilleniaceae	<i>Hibbertia cuneiformis</i>	
Droseraceae	<i>Drosera</i> ? <i>erythrorhiza</i>	
	<i>Drosera stolonifera</i>	
Euphorbiaceae	<i>Euphorbia pepus</i>	*
Fabaceae	<i>Hardenbergia comptoniana</i>	
	<i>Kennedia prostrata</i>	
	<i>Trifolium campestre</i> var. <i>campestre</i>	*
	<i>Vicia sativa</i>	*
Geraniaceae	<i>Erodium cicutarium</i>	*
	<i>Geranium molle</i>	*
Hemerocallidaceae	<i>Chamaescilla corymbosa</i>	
Hypoxidaceae	<i>Hypoxis</i> sp.	
Iridaceae	<i>Orthrosanthus laxis</i>	
	<i>Romulea rosea</i>	*
Myrtaceae	<i>Agonis flexuosa</i>	
	<i>Corymbia calophylla</i>	
	<i>Eucalyptus gomphocephala</i>	
Orchidaceae	<i>Caladenia attingens</i>	
	<i>Caladenia flava</i>	
	<i>Caladenia latifolia</i>	
	<i>Disa bracteata</i>	*

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Family	Species	Introduced
Oxalidaceae	<i>Oxalis pes-caprae</i>	*
Pinaceae	<i>Pinus radiata</i>	*
Poaceae	<i>Briza maxima</i>	*
	<i>Briza minor</i>	*
	<i>Bromus diandrus</i>	*
	<i>Ehrharta longiflora</i>	*
	<i>Tetrarrhena laevis</i>	
Polygonaceae	<i>Rumex acetosella</i>	*
Primulaceae	<i>Lysimachia arvensis</i>	*
Proteaceae	<i>Banksia attenuata</i>	
Rubiaceae	<i>Galium</i> sp.	
	<i>Opercularia hispidula</i>	
	<i>Opercularia vaginata</i>	
Solanaceae	<i>Solanum nigrum</i>	*
Violaceae	<i>Hybanthus calycinus</i>	
Zamiaceae	<i>Macrozamia riedlei</i>	

Offset Site 10 (Stream 2023)

Family	Species	Introduced
Apiaceae	<i>Daucus glochidiatus</i>	
Araceae	<i>Zantedeschia aethiopica</i>	*
Asparagaceae	<i>Asparagus asparagoides</i>	*
	<i>Dichopogon capillipes</i>	
	<i>Lomandra micrantha</i>	
	<i>Sowerbaea laxiflora</i>	
	<i>Thysanotus manglesianus</i>	
Asphodelaceae	<i>Trachyandra divaricata</i>	*
Asteraceae	<i>Arctotheca calendula</i>	*
	<i>Cotula turbinata</i>	*
	<i>Hypochaeris glabra</i>	*
Campanulaceae	<i>Wahlenbergia capensis</i>	
Caryophyllaceae	<i>Petrorhagia dubia</i>	*
Cyperaceae	<i>Lepidosperma ? longitudinale</i>	
Dilleniaceae	<i>Hibbertia cuneiformis</i>	
Euphorbiaceae	<i>Euphorbia pepus</i>	*
Fabaceae	<i>Hardenbergia comptoniana</i>	
	<i>Jacksonia furcellata</i>	
	<i>Trifolium campestre</i> var. <i>campestre</i>	*
	<i>Trifolium dubium</i>	*
	<i>Vicia sativa</i>	*
Geraniaceae	<i>Geranium molle</i>	*
Haemodoraceae	<i>Anigozanthos</i> sp.	
	<i>Conostylis aculeata</i>	
Hemerocallidaceae	<i>Tricoryne elatior</i>	*
Iridaceae	<i>Patersonia occidentalis</i>	
	<i>Freesia alba</i> × <i>leichtlinii</i>	*
	<i>Romulea rosea</i>	*
Myrtaceae	<i>Agonis flexuosa</i>	
	<i>Corymbia calophylla</i>	
	<i>Eucalyptus gomphocephala</i>	
	<i>Kunzea?</i> <i>glabrescens</i>	
Orchidaceae	<i>Diuris</i> sp.	
	<i>Caladenia attingens</i>	
Oxalidaceae	<i>Oxalis corniculata</i>	*
Phyllanthaceae	<i>Lysiandra calycina</i>	
Poaceae	<i>Aira cupaniana</i>	*
	<i>Austrostipa flavescens</i>	
	<i>Briza maxima</i>	*

Family	Species	Introduced
	<i>Briza minor</i>	*
	<i>Bromus diandrus</i>	*
	<i>Ehrharta calycina</i>	
	<i>Lagurus ovatus</i>	*
	<i>Vulpia muralis</i>	*
	<i>Avena barbata</i>	*
Proteaceae	<i>Banksia attenuata?</i>	
	<i>Bossiaea linophylla</i>	
	<i>Hakea prostrata</i>	
Rhamnaceae	<i>Spyridium globulosum</i>	

Appendix 7: Indicative Revegetation Species List

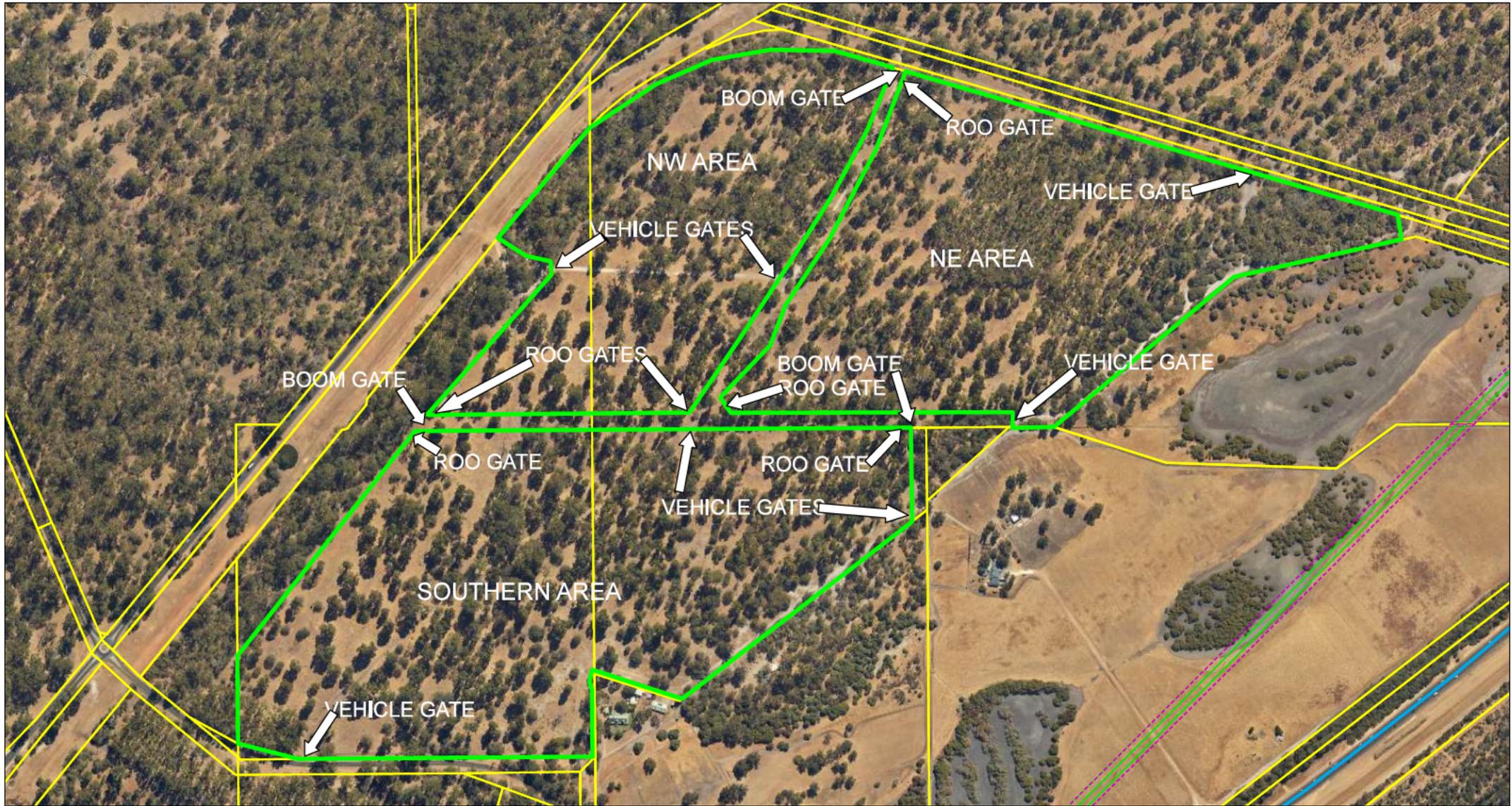
Species	Seedling quantity/ha	Dryland	Wetland - transition	Form	WRP forage	Black Cockatoo forage
<i>Acacia cyclops</i>	≥100	X		Shrub	X	
<i>Acacia extensa</i>	0-100	X		Shrub		
<i>Acacia pulchella</i>	0-100	X	X	Shrub		
<i>Acacia saligna</i>	≥100	X		Shrub / Tree	X	X
<i>Acanthocarpus preissii</i>	0-100	X		Shrub		
<i>Adenanthos meisneri</i>	0-100			Shrub		
<i>Agonis flexuosa</i>	300	X	X	Tree	X	
<i>Allocasuarina humilis</i>	0-100	X	X	Shrub		
<i>Alyxia buxifolia</i>	0-100	X		Shrub		
<i>Anigozanthos manglesii</i>	0-100	X	X	Grass / herb		
<i>Anthocercis littorea</i>	0-100	X		Shrub		
<i>Banksia attenuata</i>	100	X		Tree		X
<i>Banksia grandis</i>	150	X		Tree		X
<i>Banksia littoralis</i>	50		X	Tree		X
<i>Baumea juncea</i>	0-100		X	Rush		
<i>Billardiera fusiformis</i>	0-100	X		Shrub		
<i>Bossiaea eriocarpa</i>	0-100	X		Shrub		
<i>Clematis linearifolia</i>	0-100	X		Climber		
<i>Conostylis aculeata</i>	0-100	X		Grass		
<i>Corymbia calophylla</i>	150	X		Tree	X	X
<i>Cyathochaeta avenacea</i>	0-100			Grass		
<i>Daviesia physodes</i>	0-100	X	X	Shrub		
<i>Dianella brevicaulis</i>	0-100	X	X	Herb		
<i>Diplolaena dampieri</i>	0-100	X		Shrub		
<i>Eucalyptus gomphocephala</i>	300	X		Tree		X
<i>Eucalyptus marginata</i>	100	X		Tree	X	X
<i>Eucalyptus rudis</i>	100			Tree	X	X
<i>Ficinia nodosa</i>	0-100	X		Rush		
<i>Gahnia trifida</i>	0-100			Rush		
<i>Gastrolobium praemorsum</i>	0-100			Shrub		
<i>Gompholobium tomentosum</i>	0-100	X		Shrub		
<i>Haemodorum spicatum</i>	0-100			Herb		
<i>Hakea amplexicaulis</i>	≥100	X		Shrub		X
<i>Hakea lissocarpa</i>	≥100	X	X	Shrub		X
<i>Hakea prostrata</i>	≥100	X		Shrub		X
<i>Hakea ruscifolia</i>	≥100	X		Shrub		X
<i>Hakea varia</i>	≥100		X	Shrub		X
<i>Hardenbergia comptoniana</i>	≥100	X		Climber	X	
<i>Hemiandra pungens</i>	0-100	X		Shrub		
<i>Hibbertia cuneiformis</i>	50-100	X	X	Shrub		
<i>Hypocalymma angustifolium</i>	0-100			Shrub		
<i>Jacksonia furcellata</i>	0-100	X	X	Shrub		

Species	Seedling quantity/ha	Dryland	Wetland - transition	Form	WRP forage	Black Cockatoo forage
<i>Juncus pallidus</i>	0-100			Rush		
<i>Kennedia prostrata</i>	0-100	X		Groundcover		
<i>Kunzea glabrescens</i>	≥100	X		Shrub	X	
<i>Kunzea micrantha</i>	0-100		X	Shrub		
<i>Lepidosperma gladiatum</i>	0-100	X		Sedge		
<i>Lepidosperma longitudinale</i>	0-100			Sedge		
<i>Lepidosperma pubisquameum</i>	0-100			Sedge		
<i>Logania vaginalis</i>	0-100			Herb		
<i>Lysiandra calycina</i>	0-100	X	X	Shrub		
<i>Melaleuca incana</i>	0-100		X	Shrub		
<i>Melaleuca preissiana</i>	≥100		X	Tree	X	
<i>Melaleuca raphiophylla</i>	0-100		X	Tree		
<i>Melaleuca thymoides</i>	0-100	X	X	Shrub		
<i>Melaleuca viminea</i>	≥100		X	Shrub	X	
<i>Orthrosanthus laxus</i>	0-100	X	X	Grass / Herb		
<i>Patersonia occidentalis</i>	0-100	X		Grass / Herb		
<i>Regelia ciliata</i>	0-100		X	Shrub		
<i>Rhagodia baccata</i>	0-100	X		Shrub		
<i>Solanum symonii</i>	0-100	X		Shrub		
<i>Spyridium globulosum</i>	0-100	X		Shrub		
<i>Trymalium ledifolium</i>	0-100		X	Shrub		
<i>Xanthorrhoea brunonis</i>	0-100	X		Grass		
<i>Xanthorrhoea preissii</i>	≥100			Grass		X
<i>Xylomelum occidentale</i>	0-100	X	X	Tree		
Total	≥3000					

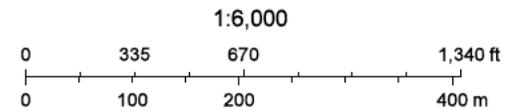
Appendix 8: Offset Site Fencing

Offset Site 1 – Fencing Design

Main Roads WA: Site 1 BORR and Bussell Hwy (Hutton to Sabina) Offset - Fences and Gates

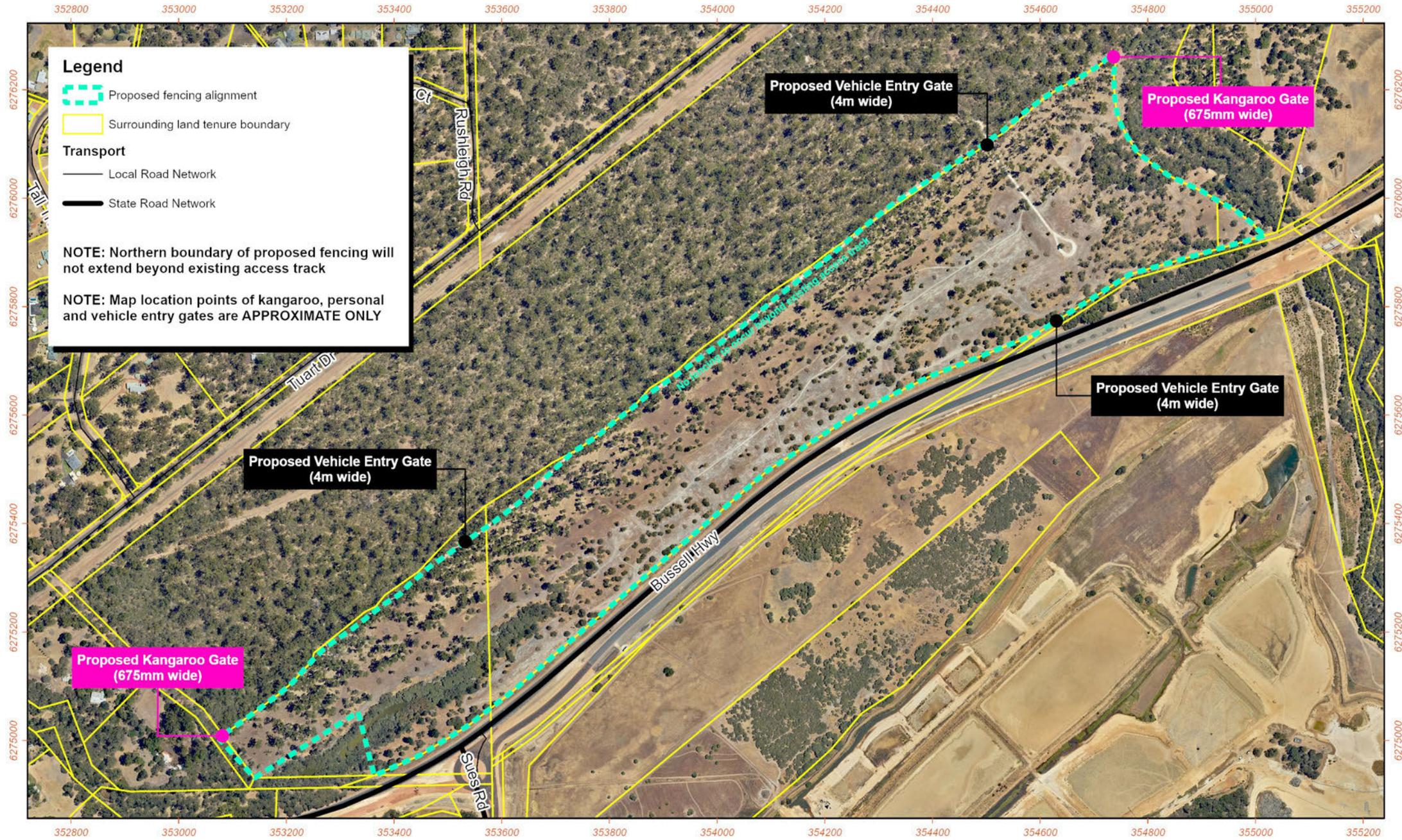


19/11/2024, 13:52:18



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Offset Site 3 – Fencing Design



Legend

- Proposed fencing alignment
- Surrounding land tenure boundary

Transport

- Local Road Network
- State Road Network

NOTE: Northern boundary of proposed fencing will not extend beyond existing access track

NOTE: Map location points of kangaroo, personal and vehicle entry gates are APPROXIMATE ONLY

N
 Coordinate System: GDA2020 MGA Zone 50
 Scale: 1:9,000 @ A4
 Created Date: 5/03/2024
 Author: c9511

0 250 500
 Meters

Site 3, Ludlow - BORR Offsets

FENCING DESIGN with KANGAROO & ENTRY GATE LOCATIONS (EXISTING and PROPOSED)



Appendix 9: Revegetation Planting and Seeding Procedures

Revegetation Methodology

Planting methods will follow the Revegetation Planning and Techniques Doc. No. 6707/031 (MRWA 2004). Techniques for site preparation for seed and seedling planting are described below.

Seed & Seedling sources

Licensed seed collectors will be engaged to collect native seed over several years until sufficient seed is collected. Collected seed will be used for both propagation of seedlings and for direct seeding in select areas. Vegetative material such as cuttings and material obtained by division may also be collected. All seed and vegetative material will be local provenance as defined by CPS 9168/1, being within 100 km of the offset sites and within the Swan Coastal Plain IBRA Region. Seedlings may also be sourced directly from commercial nurseries as long as it meets the definition of local provenance.

Seedlings required for the project will be sourced from nurseries accredited under the Nursery Industry Accreditation Scheme of Australia. The nurseries are required to comply with the potting mix requirements of AS 7343 and to use industry approved containers for the seedlings. All containers are sterilised prior to any material being placed in them to avoid the introduction or spread of soil borne pathogens.

Only suitably mature tube stock with well-developed roots, 10-15 cm high foliage that has been hardened off and is in generally good health will be accepted. In-fill planting seedlings will be ordered on an annual basis (typically November) to allow sufficient time for seed collection and plant propagation.

Direct Seeding

The site will be prepared by ripping to up to 500 mm deep and rotary hoeing the soil where possible (i.e. if not too rocky). Seed will be sown in late May / early June (depending on the season) and shallow raked to bed the seed in.

Seedling Planting

Planting will be undertaken during the winter season when the soil moisture is suitable for seedling establishment, usually between May and July. Depending upon the site conditions, planting will be undertaken using either the rip-mound-plant; rip furrow plant or infill planting using individual augur hole planting methods.

All seedlings are to be planted with an industry standard, 20 g slow release native fertiliser tablet approximately 200 mm deep and 200 mm from the roots.

Rip Mound Planting

This method involves an initial herbicide application followed by ripping and rotary hoeing of the areas to be mounded to remove large soil aggregates and improve soil friability. This is followed by the ripping of soil to a minimum depth of 500 mm and the mounding of the soil into rows approximately 500 mm high (soil will settle to approximately 300 mm high). All mounds are then to be treated with a pre-emergent herbicide. Mulch is then spread over the mounds to an optimal depth of 70 mm and seedlings are planted on the top of these mounds.

In waterlogged soil conditions this method provides the advantage of creating a zone of aerated soil for root development. Additional advantages of creating this rip mound plant area are the definition of a maintenance zone for weed control. Mounded rows should traverse any slopes to discourage water movement and soil erosion.

Rip Furrow Planting

This method involves an initial herbicide application followed by scalping of the weedy topsoil to

create a furrow approximately 100 mm deep. This is then followed by the ripping of the soil in the centre of the furrow line to a minimum depth of 500 mm forming rows. All furrowed areas are then treated with a pre-emergent herbicide. Mulch is then spread along the furrows to an optimal depth of 70 mm and seedlings are planted along the rip lines.

In drier conditions or in non-wetting soils such as grey sands, the inverted furrows also need to follow existing contours to promote localised areas for water infiltration and avoid scour problems.

Auger Planting

This method is used in situations where creating a mound is undesirable for soil erosion reasons, where site access is too restrictive, where the area is relatively small or for in-fill planting. After weed control measures are undertaken, holes are augured to a minimum depth of 500 mm with a CSIRO tree auger or equivalent. Seedlings are planted into these holes and mulch is placed around the seedling for approximately 1 m² and 70 mm deep.

Weed Control

Weed control is undertaken the year prior to planting (e.g. herbicide application), when it is most suitable to eradicate the species present and any time after seedling planting, when required to control annual grasses.

Weed control shall be conducted prior to any new planting works as failure to control weeds will result in unsuccessful revegetation. Control of weeds will be undertaken using Roundup Bioactive® and other herbicides as appropriate. Weed control will continue for up to three years after planting, or as necessary.

Pest control

New planting sites that are likely to be damaged by local fauna will have fencing, temporary fencing or tree guards placed around seedlings as required to minimise damage from rabbits and kangaroos. Control methods for rabbits may need to be implemented prior to any revegetation works and during the establishment period. Monitoring of this threat is to be undertaken on a regular basis to ensure the extent of infestations is known and the appropriate management is implemented.

Appendix 10: Monitoring Record Form

Project			
Date:		Time	
Name:			
Quadrat No.		GPS Co-ordinates	
Photopoint number(s)			
Species richness (No.)			
Weed cover (%):			
Weed species present:			
Bare ground cover (%):			
Vegetation structure: (ESCAVI 2003)			
Vegetation condition (Keighery):			
Stems (No.) (excluding trees):			
Plant health (evidence of disease, insect damage and nutrient deficiencies):			
Notes:			

Stratum (m)	Canopy Cover (%)	Stems	Dominant Species
20m x 20m expanded tree quadrat			
10m x 10m floristic quadrat			

Species	Introduced	Height (m)	%Cover	Comments
10m x 10m floristic quadrat				

OFFICIAL

Species	Introduced	Height (m)	%Cover	Comments