Appendix A
Karnup Road Widening
Clearing Permit Offset Proposal and Revegetation Plan

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1. Proposed Offset Site

The Shire of Serpentine Jarrahdale (the Shire), has prepared this offset proposal to counterbalance the significant residual impact of clearing native vegetation for the Karnup Road widening project in Hopeland. On-ground management including the replanting of cockatoo habitat within a 0.6 ha section of Yangedi Airfield Reserve (R25911) in Hopeland is proposed by the Shire as the environmental offset for this project. This offset proposal was developed in consideration of the 'WA Environmental Offsets Policy 2011', 'WA Environmental Offsets Guidelines 2014' and 'Environmental offsets metric: Quantifying environmental offsets in Western Australia 2021' for clearing native vegetation under Part V of the *Environmental Protection Act 1986*.

Yangedi Airfield Reserve (the Reserve) is vested with the Shire for the purpose of Recreation, but current uses also include Conservation. It is leased by the Sports Aircraft Builders Club as an airfield requiring safety protocols to be in place for accessing the site. Natural areas in the Conservation Zone are protected through the Shire's Council endorsed 'Marri Woodland Management Plan' (Shire of Serpentine Jarrahdale 2024a). The Marri Woodland Management Plan is a strategic plan which defines management objectives for maintaining and improving the conservation values of marri woodland and to ensure consistent management into the future.

The proposed offset area within the Reserve exists within a designated Conservation Zone (Figure 1). Conservation Zones are characterised by areas of remnant vegetation with high biodiversity and scientific value which contain both dieback free and dieback infected areas. The majority of the reserve belongs to Bush Forever site 378 and the overall vegetation condition is in good to very good condition.

No Threatened or Priority Species have been recorded at the Reserve, however fauna including Black Cockatoos and quenda have been observed. Some of the key threats and pressures include weed invasion, Phytophthora Dieback and feral animals damaging native vegetation (Shire of Serpentine Jarrahdale 2024a).

Of the three vegetation communities in the Reserve, a 0.6 ha area of marri woodland located in the southeast has been selected as a direct offset to undergo rehabilitation and revegetation activities, including the planting of 250 trees suitable for Black Cockatoos. This site was selected on the basis of being the closest local natural area to the Karnup Road clearing area (approximately 4 km), the presence of marri trees to install artificial cockatoo nesting boxes, and its classification with the same under-represented Southern River vegetation complex.

The Shire has set strategic targets to protect and manage the Southern River vegetation complex through its Local Biodiversity Strategy (Shire of Serpentine Jarrahdale 2019). The Southern River vegetation complex is described as Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds.

The remnant vegetation extent of the Southern River Complex is under-represented in the Shire as only 9% of its original extent remains. Investing in supplementary funds through an offset for rehabilitation and revegetation will aid the Shire in achieving its strategic objective of fulfilling representational targets for the long-term preservation of the vegetation complex. Specifically, the offset proposal will address several priority actions of the Marri Woodland Management Plan as outlined in Table 1.

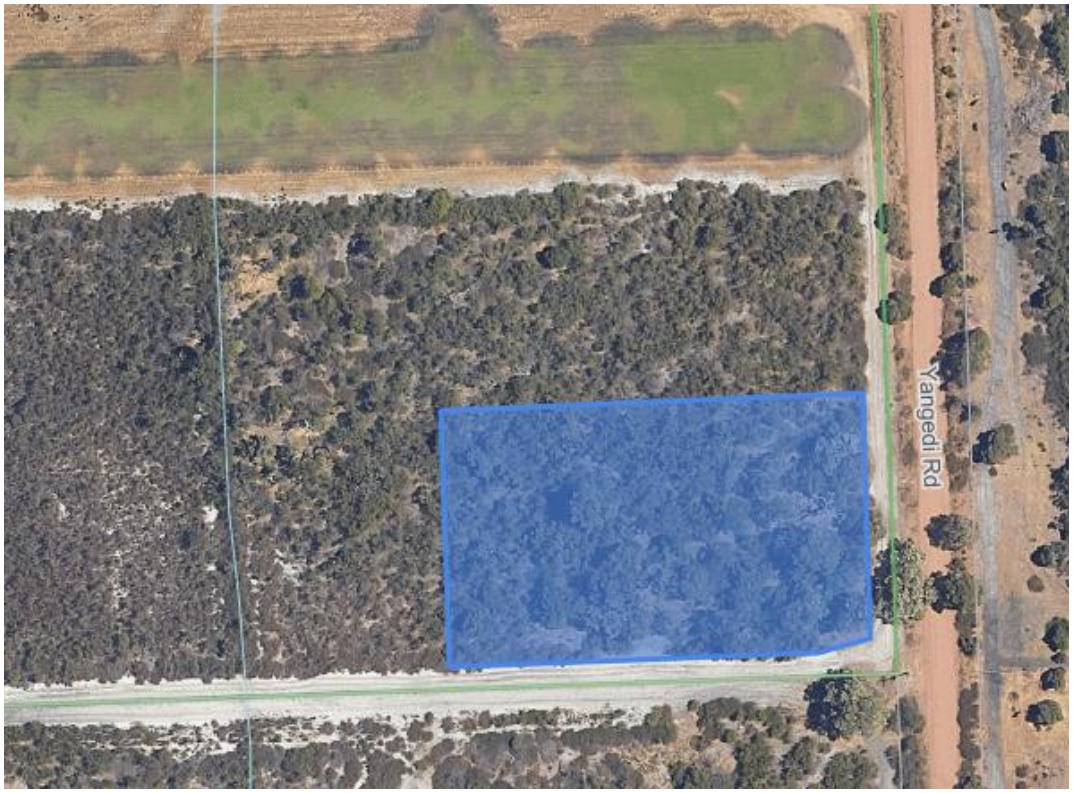

Figure 1. Yangedi Airfield Reserve showing 0.6 ha offset area in blue.

Table 1. Action Plan for Yangedi Airfield Reserve (extracted from Council endorsed Marri Woodland Management Plan, Shire of Serpentine Jarrahdale 2024a)

No.	Action	Priority	Timing	Status	Responsibility	Cost
2	Keep up to date with the latest research trends with regard to marri woodland and integrate into reserve management.	High	Long Term	Ongoing	Natural Reserves, Emergency Services	Staff Time
7	Monitor and manage new and emerging pests and diseases such as	High	Medium Term	Ongoing	Natural Reserves	Budget Dependent - $2,000

No.	Action	Priority	Timing	Status	Responsibility	Cost
	polyphagous shot hole borer.					
9	Work with user groups to protect and minimize impacts to remnant vegetation.	High	Business as Usual	Ongoing	Natural Reserves, User Groups	Staff Time
13	Establish dieback hygiene policies, including vehicle washdown points and foot baths for pedestrians with appropriate signage.	High	Long Term	Implemented in Part	Natural Reserves	Budget Dependent - $2,000
17	Establish and implement a weed control program that utilises best practice methods.	Key	Business as Usual	Ongoing	Natural Reserves, Landcare SJ	Budget Dependent - $8,000
18	Conduct feral animal control when required, following all relevant health and safety regulations.	Medium	Business as Usual	Ongoing	Natural Reserves, Landcare SJ	Budget and/or Funding Dependent - $1,500
20	Avoid disturbance to the Conservation Zone and to dieback-free areas.	High	Short Term	Not Yet Implemented	Natural Reserves	Staff Time
29	Revegetate with local provenance seedlings as necessary and appropriate.	Medium	Medium Term	Implemented in Part	Friends Groups, Landcare SJ, Natural Reserves	Funding Dependent - $2,500
31	Update actions according to best practice management and monitoring outcomes.	High	Medium Term	Not Yet Implemented	Strategic Environment	Staff Time

2. Principals for the use of Environmental Offsets

This section presents an evaluation of the environmental offset proposal in relation to the six principles governing the application of environmental offsets.

1. *Environmental Offsets will only be considered after avoidance and mitigation options have been pursued*

Several avoidance and mitigation measures will be implemented in the proposed clearing area for the Karnup Road widening project. These include a reduced clear zone distance, pre-clearing tree survey and Black-cockatoo assessment (Ecology Matters 2024), dieback and weed management, timing work for optimal conditions, tree marking, inspection of cockatoo hollows (if present) prior to clearing, and engagement of a qualified arborist to undertake pruning and removal works.

Reduced clear zone distance: As outlined in the Shire's 'Application for a new permit to clear native vegetation', Main Road's recommended clear zone distance for a 100kmph road is 5 m either side of the road. To avoid and reduce the necessity for tree removal, the Shire reduced the clear zone distance from 5 m to 1.5 m either side of the road. This reduced clear zone distance design has avoided the potential clearing of 312 trees, significantly reducing the total number of trees impacted to just 21 trees.

Dieback and weed management: the Shire will implement weed and dieback management during earth works. This will involve working in drier weather where possible, cleaning mud and plant material from machinery and vehicles prior to accessing and leaving the project area, and seeking to utilise dieback-free and weed-free gravel and road material. The Shire will ensure all soil and green waste generated through the proposed clearing is disposed of in an authorized waste facility or left in-situ as mulch.

Working in optimal conditions: where possible, the works will be scheduled for drier months of late spring and summer to reduce the potential for interference with surface water flows, complications with topsoil disturbance (erosion, dust and sedimentation), fauna breeding, and the introduction and spread of water borne pathogens.

Tree marking: the Shire has clearly marked the trees proposed to be cleared with flagging tape or paint marker. The Shire will clearly communicate to its contractors that only the taped or marked trees are to be removed or pruned, and the remaining trees are to be retained and protected.

Cockatoo habitat assessment: The Shire will engage a fauna specialist to undertake an inspection of the potential nesting trees for evidence of current or past breeding within 72 hours of the proposed clearing (9 potential nesting trees). Although breeding is unlikely due to the disturbed nature of the site, if any is observed, clearing will not proceed until the fauna specialist observes the breeding activity to have finished.

Qualified arborist: the Shire will engage the services of a qualified arborist to perform the pruning works to ensure the trees remain undamaged and retain their structural integrity.

2. *Environmental offsets are not appropriate for all projects*

The Shire considers that an offset is necessary in this circumstance as residual impacts were identified in the Shire's Environmental Offset calculations (DWER 2021, Appendix A-C). The impact to Black Cockatoo habitat values is the primary impact of this project.

3. *Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted*

Section 4 of this proposal provides a revegetation and rehabilitation plan including a cost estimate (Table 4). These costs have been informed via the budget estimates from the Council Endorsed Marri Woodland Management Plan (Shire of Serpentine Jarrahdale 2024b). The proposed site is considered to be relevant due to the three key reasons outlined in section 1: the closest local natural area to the clearing site; existing in the same vegetation complex; and presence of marri trees where artificial nesting boxes can be installed.

The Shire also regards the environmental offset to be proportionate to the significance of the environmental value being impacted. The project involves the clearing of 19 trees, including 15 black cockatoo habitat trees, from along a 2km stretch of degraded roadside vegetation. Comparatively, the proposed offset area will enhance a larger 0.6 ha area of marri woodland from good to very good condition and involve the replanting of 250 tubestock suitable for black cockatoo habitat.

The offset area is also contiguous with an existing conservation area and includes actions to address threatening processes which are further described in section 4 of this proposal. The Shire will install at least 9 artificial hollows in the offset area to counterbalance the loss of the potential nesting trees which may have developed hollows in the future.

4. *Environmental offsets will be based on sound environmental information and knowledge*

The proposed environmental offset has been informed by the Shire's Marri Woodland Management Plan, prepared by Dr Penny Hollick, a Strategic Environmental Specialist and the Local Biodiversity Strategy and Update Report prepared by Ironbark Environmental and overseen by Dr Penny Hollick.

5. *Environmental offsets will be applied with a framework of adaptive management*

The Shire acknowledges that an adaptive approach to management will be necessary in the implementation of the proposed offset. Contingency measures will form part of the Revegetation Plan to mitigate and address potential risks.

6. *Environmental offsets will be focussed on longer term strategic outcomes*

The Shire is committed to protecting, retaining and enhancing approximately 1690 ha of its local natural areas and protecting ecological features and processes through its Local Biodiversity Strategy and Local Biodiversity Update Report (Shire of Serpentine

Jarrahdale 2009, Shire of Serpentine Jarrahdale 2019). Furthermore, the Shire's Local Planning Policy 2.7: Biodiversity Planning Policy sets out to ensure that any development in proximity to biodiversity will not have detrimental impacts on biodiversity.

The Shire is in the process of developing an Environmental Offsets Strategy aimed at establishing strategic objectives for offset areas, ensuring alignment with scientific literature and State and Federal Environmental Offset frameworks. The Department of Water and Environmental Regulation (DWER) and other relevant stakeholders will be consulted in this process to ensure the Strategy complements the State's longer term strategic outcomes.

3. Quantification of Offset

The Shire has prepared a draft quantification of its proposed offset as demonstrated in Appendices A-C. To adequately offset the removal of 15 habitat trees along Karnup Road, the Shire considered that replanting trees and revegetation works would be necessary. Subsequently, the Shire conducted two WA Environmental Offsets calculations, one based on trees as a feature and the second utilising area. The Shire will work with DWER to adjust the calculations as needed to ensure the offset calculations are accurate and appropriate for the clearing. According to both calculations, the proposed offset is adequate (Appendix B, Appendix C).

4. Revegetation and Rehabilitation Proposal

Section 4 provides a five year Revegetation Plan for the proposed offset area. This plan was developed using DWER's 'Guide to Preparing Revegetation Plans for Clearing Permits under Part V of the *Environmental Protection Act 1986'*.

4.1 Introduction

This Revegetation Plan will help to address the impacts of clearing roadside vegetation representative of the Southern River Complex and habitat suitable for Black Cockatoos. As outlined in the 'Application for a clearing permit', the purpose of the clearing permit is to undertake a road widening project to provide safer driving conditions in a recognised Black Spot area. Karnup Road is a Regional Distributer Road and a Shire of Serpentine Jarrahdale managed road asset. Figure 2 shows the 2 km extent of the road widening project along Karnup Road in Hopeland.

Figure 2. Karnup Road Project Area, Hopeland.

The revegetation site is a 0.6 ha area located in the south east corner of Yangedi Airfield Reserve (R25911), Hopeland (Figure 1). As described in Section 1 of this proposal, the Reserve is vested with the Shire for Recreation with the proposed revegetation area managed for Conservation.

4.2 Background of Revegetation Site

The revegetation area resides in Yangedi Airfield Reserve, a 64.7 ha area containing 32.9 ha of remnant vegetation including banksia woodland, marri woodland and clay-based wetlands. The vegetated areas of the reserve belong to Threatened Ecological Communities, and all but the northeastern corner is an Environmentally Sensitive Area. The majority of the reserve (except for the northeastern corner) belongs to Bush Forever site 378, which extends into several neighbouring properties to provide a larger area of habitat. The vegetation is in good to very good condition overall (Shire of Serpentine Jarrahdale 2024a).

Approximately 4.6 ha of Yangedi Airfield Reserve consists of marri woodland, with the dedicated revegetation area comprising 0.6 ha of this woodland. Although this portion of marri woodland is only a section of the broader vegetation type of the reserve, the Shire intends to develop an Environmental Offsets Strategy in 2025/2026 which will systematically identify remaining areas of marri woodland suitable for offset areas in consideration of existing offsets, stakeholder feedback, appropriate timelines and budgetary constraints.

4.3 Disturbances and threats

Threats and pressures to the conservation values of Yangedi Airfield Reserve include:

- Recreational and development pressure from users, including pressure for expansion into bushland for more aircraft hangars,
- Community anxiety about fire hazard and pressure for control burning, particularly considering the high value of the aircraft and the BoM tower,
- Fire threat of highly flammable aircraft fuel,
- Weed invasion, from surrounding land and carried in by users,
- Feral and domestic animals (foxes, rabbits, cats) predating fauna and damaging vegetation,

- Dieback disease (*Phytophthora cinnamomi*) and marri canker, and
- Contaminated runoff from runways, aircraft hangars, helipad etc. entering wetland and other bushland areas.

The 0.6 ha revegetation area is particularly threatened by weed encroachment due to the long linear nature of the reserve and proximity to Yangedi Road.

4.4 Revegetation commitments

The Shire is committed to revegetating this section of marri woodland to enhance its habitat value for cockatoos and improve the condition of vegetation within the Southern River Complex which is under-represented in the Shire of Serpentine Jarrahdale. This area has been selected to provide a larger benefit to loss ratio for counteracting the damage to roadside vegetation caused by the clearing for Karnup Road.

4.5 Reference site floristic data and species list

The flora of Yangedi Airfield Reserve has been frequently surveyed and is diverse. No Threatened and Priority flora species have been recorded in the area. Appendix D contains a list of flora species which have been recorded in Yangedi Airfield Reserve and form the basis for the revegetation species list (Shire of Serpentine Jarrahdale 2024b).

4.6 Targets and completion criteria

The revegetation works will aim to achieve the completion criteria outlined in Table 2. These completion criteria were informed by the Shire's Marri Woodland Management Plan 2024 which highlighted that marri woodlands have diverse and variable floristics ranging from 21 native species and 7 weeds to 195 native species and 55 weeds. The Shire has set reasonable targets to increase species richness in both degraded and good condition areas of the revegetation site to a total 21 native species to enhance vegetation condition from degraded or good to very good condition. The Shire has also set the objective to reduce weed cover and areas of bare ground to less than 10% and 20% respectively. To support Black Cockatoos, 9 nesting boxes will be installed, as well as plants used by Black Cockatoos and representative of the Southern River Complex included in the planting list (Appendix B).

Table 2. Revegetation Completion Criteria

Criterion	Measure	Measure sub-category	Completion criteria (Revegetation Plan)
A	Species richness	Species richness across site	21 native species across the revegetation site in comparison to reference list (aim of 20% upper storey, 30% mid-storey, 50% lower storey) Density of one stem per two square metres in planting area Vegetation representative of Southern River Complex and suitable habitat for Black Cockatoos
B	Weed cover	General weed cover	10% or lower across the site
		Declared weeds	No Declared weeds in the revegetation area
		Woody weeds	No woody weeds in the revegetation area
C	Vegetation condition		Vegetation improved to very good condition
D	Vegetation cover		<20% bare ground
E	Cockatoo habitat	Habitat box	9 habitat boxes installed

4.7 Revegetation techniques

4.7.1 Weed control and site preparation

The revegetation activities are scheduled to commence in 2026 and span for a 5 year period (Table 3). The first year of the Revegetation Plan will commence with site preparation including pre-planting weed control. These activities will promote regeneration of existing native vegetation, provide space for planting and protect the site from ongoing damage.

On an annual basis, two weed control events will be undertaken, the first during winter targeting grasses (*Avena barbata*, *Briza* spp., *Eragrostis curvula*, *Ehrharta calycina*) and the second during spring target bulbs (*Gladiolus caryophyllaceus*, *Watsonia meriana*, *Zantedeschia aethiopica*) and woody weeds (*Acacia iteaphylla*, *Pinus radiata*). The target environmental weeds will be treated according to the recommended methodology outlined on the Department of Biodiversity, Conservation and Attraction's Florabase and undertaken by a qualified landcare contractor. Weed control will continue for at least the first three years, and continue if necessary for an additional two years until the completion criteria in Table 2 are met.

4.7.2 Local provenance seed and seedling propagation

The Shire maintains a local provenance seed bank that includes species from marri woodlands which are suitable for propagation. The Shire intends to utilise this seed for

planting in degraded and good condition areas of the revegetation area. It is estimated that approximately one quarter of the reserve has space available for planting, equating to 1625 square metres and the equivalent number of tubestock available for planting at one plant per two metres squared.

4.7.3 Planting

Planting will commence in 2027 following one year of pre-planting weed control. Planting will be undertaken by a qualified landcare operator during winter in suitable weather conditions (Winter). Planting will be undertaken at a density of one plant per two square metres with care taken not to disturb surrounding vegetation.

4.7.4 Dieback and site hygiene

The reserve is known to have dieback free and dieback infested areas. Access within this area must utilise dieback hygiene procedures such as clean-down and take extreme care to prevent spread of dieback from infected to uninfected areas.

4.8 Schedule and budget

Table 3 below provides an approximate cost estimate for the revegetation works and Table 4 outlines a proposed schedule for the revegetation activities planned to occur between 2026 and 2030. Maintenance and contingency methods including weed control and infill planting have been incorporated in the cost estimate and vegetation schedule. Additional weed control, pest control, Phytophthora Dieback treatment, fencing repair or watering may be identified as further contingency methods subject to the results of the quadrat monitoring.

Table 3. Cost estimate of revegetation works within Yangedi Airfield Reserve (ex GST)

Component	Quantity	Unit cost ex GST	Total
2026			
Tubestock order/seed collection	800 tubestock	$3.00/ea	$2400
Weed control (winter, spring)	2 events	$3000/ha	$3900
Fence repair (fence currently in good condition due to land use as an airfield)	TBA	$55/m	TBA
Supply and installation of Cockatubes	9	$750	$6750
2027			
Revegetation - planting	800 tubestock	$2.00/ea	$1600
Weed control (winter, spring)	2 events	$3000/ha	$3900
Quadrat monitoring & reporting	2 quadrats	$1500/yr	$1500
Cockatube monitoring	1	$400/event	$400
2028			
Tubestock Tubestock order/seed collection (infill)	400 tubestock	$3.00/ea	$1200
Weed control (winter, spring)	2 events	$3000/ha	$3900
Quadrat monitoring & reporting	2 quadrats	$1500/yr	$1500
Cockatube monitoring	1	$400/event	$400
2029			
Revegetation - planting (infill)	400 tubestock	$2.00/ea	$800
Weed control (winter, spring)	2 events	$3000/ha	$3900
Quadrat monitoring & reporting	2 quadrats	$1500/yr	$1500
Cockatube monitoring	1	$400/event	$400
2030			
Weed control (winter, spring)	2 events	$3000/ha	$3900
Quadrat monitoring & reporting	2 quadrats	$1500/yr	$1500
Cockatube monitoring	1	$400/event	$400
TOTAL			**$39,850**

Table 4. Revegetation schedule for implementation of environmental offset works in Yangedi Airfield Reserve

2026												
Component	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Tubestock order/seed collection												
Dieback hygiene												
Weed control												
Cockatube installation												
2027												
Component	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Revegetation (planting)												
Dieback hygiene												
Weed control												
Cockatube monitoring												
2028												
Component	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Tubestock order/seed collection (infill)												
Dieback hygiene												
Weed control												
Quadrat monitoring & reporting												
Cockatube monitoring												
2029												
Component	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Revegetation (planting)												
Dieback hygiene												
Weed control												
Quadrat monitoring & reporting												
Cockatube monitoring												

2030												
Component	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Dieback hygiene												
Weed control												
Quadrat monitoring & reporting												
Cockatube monitoring												
Ongoing maintenance eg fence repair, infill planting, pest control												

4.9 Monitoring and analysis

Two permanent monitoring quadrats will be installed and surveyed annually to determine if revegetation is progressing towards meeting the completion criteria as well as inform adaptive management (Table 4). The survey will occur during autumn to determine post summer survival and inform infill planting for the subsequent year. The monitoring will include a photo point from the NW corner and capture data including revegetation survival, floristics (native and weeds), vegetation structure, vegetation condition and other pertinent information such as pests and erosion issues. The Shire will also engage the services of a qualified ecologist to monitor the cockatubes for breeding activity on an annual basis during black cockatoo breeding season in spring.

5. Spatial data

An ESRI shapefile of the environmental offset area has been provided with Application for Clearing permit for Karnup Road Widening.

6. References

Department of Water and Environmental Regulation 2021, 'Environmental offsets metric: Quantifying environmental offsets in Western Australia.

Department of Water and Environmental Regulation 2018, 'A Guide to Preparing Revegetation Plans for Clearing Permits under Part V of the Environmental Protection Act 1986.

Department of Water and Environmental Regulation 2011, 'WA Environmental Offsets Policy'.

Department of Water and Environmental Regulation 2014, 'WA Environmental Offsets Guidelines'.

Ecology Matters 2024, 'Tree Survey and Black Cockatoo Assessment Karnup Road Hopeland'. Prepared for the Shire of Serpentine Jarrahdale (IBSA-2024-0382).

ENV Australia 2008, 'Flora and Vegetation of Yangedi Reserve', Prepared for Shire of Serpentine Jarrahdale (IBSA-2025-0015).

Shire of Serpentine Jarrahdale 2024a, 'Marri Woodland Management Plan'. Available from: Marri Woodland Management Plan

Shire of Serpentine Jarrahdale 2024b, 'Banksia Woodland Management Plan'. Available from: Banksia Woodland Management Plan

Shire of Serpentine Jarrahdale 2019, 'Local Biodiversity Strategy Update Report'. Available from: Local Biodiversity Strategy - Update Report

Shire of Serpentine Jarrahdale 2009, 'Local Biodiversity Strategy'. Available from: Shire of Serpentine-Jarrahdale Biodiversity Strategy

7. Appendix A – Offset Quantification - Summary

Road widening in Intensive Land use Zone									
Existing environmental impact	**Mitigation**			**Significant residual impact**	**Offset calculation methodology**				
	Avoid and minimise	**Rehabilitation type**	**Likely success**		**Type**	**Risk**	**Likely offset success**	**Time lag**	**Offset quantification**
Clearing of 19 trees and pruning of 2 trees									
15 trees of Black Cockatoo Habitat cleared	1 tree will be pruned rather than cleared	On-site rehabilitation is not possible, as road and shoulder is being installed	NA	Extent: Permanent loss of 15 cockatoo habitat trees. Quality: Trees in excellent condition (overall vegetation condition is degraded) Conservation significant: As the application is at variance to principle b, and impacts on Threatened species habitat, there is a high conservation significance. Land tenure: NA – not conservation Time scale: permanent.	On-site management – revegetation and rehabilitation	Low risk – works will be in accordance with Council endorsed Management Plan and Local Biodiversity Strategy.	<u>Can measures be defined and measured?</u> Yes- value to Black Cockatoos can be measured <u>Operator experience:</u> Shire of SJ has experience in effectively managing local natural areas and will engage qualified landcare operator to undertake works.	Artificial nesting boxes will provide immediate nesting opportunities; revegetation will take 7-10 years to become productive for foraging; 3-5 years for other rehabilitation actions	Total offset of 0.6 ha to be rehabilitated and revegetated.
Clearing of under-represented Southern River Complex	Clear zone distance reduced to avoid clearing additional trees								
Wetlands (Multiple Use) – potential impact	As above								

					Overall: residual impact is significant as it impacts species listed as threatened under the EPBC Act 1999.			<u>Type of vegetation being revegetated:</u> Habitat suitable for Black Cockatoos and representative of Southern River Vegetation Complex		

8. Appendix B – WA Environmental Offsets Calculator and Rationale - Feature

Step 1: Determining conservation significance

Clear Data

Key:
- Data to be entered
- Drop-down selection
- Automatically-generated scores (Or, if appropriate, manual data entry permitted)

Area / feature (Impact site)

Conservation significance determination for the environmental value impacted		
Conservation significance	Description	Black cockatoo nesting, foraging and roosting habitat
	Type of environmental value	Species (flora/fauna)
	Conservation significance of environmental value	Rare/threatened species - endangered
	Conservation significance score	1.2%

Please select *area* or *feature* for the calculations	Feature

Feature (impact site)

Part A: Significant impact calculation *Feature*

Significant impact	Description	Quantum of impact	
	Clearing of 15 Black Cockatoo habitat trees, including 9 potential nesting trees	Type of feature	Number
		Habitat tree	15.00
		Total quantum of impact	15.00

Part B: Rehabilitation credit calculation *Feature* (onsite)

Rehabilitation credit	Description				
	No on-site rehabilitation is possible on-site	Start number (of type of feature)	15.00	Time until ecological benefit (years)	0.00
		Future number WITHOUT rehabilitation	0.00	Confidence in rehabilitation result (%)	0.0%
		Future number WITH rehabilitation	0.00	Rehabilitation credit	0.00

Part C: Significant residual impact calculation *Feature*

Significant residual impact		
	Total quantum of impact	15.00
	Rehabilitation credit	0.00
	Significant residual impact	15.00

***Feature* (offset site)**

Offset calculation *Feature*							
Offsets calculation	Description	Start number (of type of feature)	50.00	Time until ecological benefit (years)	10.00	Offset value	177.51
	Rehabilitation and revegetation of 0.6 ha of native vegetation at Yangedi Airfield Reserve, including planting of at least 250 tubestock comprising 6 different cockatoo habitat species	Future number WITHOUT offset	50.00	Confidence in offset result (%)	80.0%	What-if Analysis	1183.4%
		Future number WITH offset	300.00				
						OFFSET ADEQUATE?	YES

Add header

WA Environmental Offsets Calculator

Rationale for scores used in the offsets calculator

Clear Data

Environmental value to be offset			
Calculation		***Score (Feature)***	***Rationale***
Conservation significance			
Description		Black cockatoo nesting, foraging and roosting habitat	15 Black cockatoo habitat trees are proposed to be cleared as part of the road widening for Karnup Road
Type of environmental value		Species (flora/fauna)	Black Cockatoo Species (Zanda baudinii, Zanda latirostris, Calypttorhynchus banksii naso)
Conservation significance of environmental value		Rare/threatened species - endangered	Baudin's Black-Cockatoo (Zanda baudinii), listed as Endangered under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 (EPBC Act) and Schedule 2 Division 2 (Endangered) under the Western Australian Biodiversity Conservation Act 2016 (BC Act). Carnaby's Black-Cockatoo (Zanda latirostris), listed as Endangered under the EPBC Act and Schedule 2 Division 2 (Endangered) under the BC Act. Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso), listed as Vulnerable under the EPBC Act and Schedule 2 Division 3 (Vulnerable) of the BC Act
Landscape-level value impacted		yes/no	No
Significant impact			***Carnaby's Black-Cockatoo (Zanda latirostris), listed as***
Description		Clearing of 15 Black Cockatoo habitat trees, including 9 potential nesting trees	Clearing of 15 Black Cockatoo habitat trees, including 9 potential nesting, 10 foraging and 10 roosting trees (Ecology Matters, 2024)
Significant impact (hectares) / Type of feature		Habitat tree	15 habitat substantial trunks, limbs, roots or branches that would necessitate tree removal or major pruning to facilitate construction of the road
Quality (scale) / Number		15.00	Total number of trees is 15.
Rehabilitation credit			
Description		No on-site rehabilitation is possible on-site	As the area is a narrow road verge, to maintain public safety, no on-site rehabilitation is proposed to occur on-site.
Proposed rehabilitation (area in hectares)		N/A	As above.
Current quality of rehabilitation site / Start number (of type of feature)		15.00	As above.
Future quality WITHOUT rehabilitation (scale) / Future number WITHOUT rehabilitation		0.00	As above.

Future quality WITH rehabilitation (scale) / Future number WITH rehabilitation		0.00	As above.
Time until ecological benefit (years)		0.00	As above.
Confidence in rehabilitation result (%)		0	As above.
Offset			
Description		Rehabilitation and revegetation of 0.6 ha of native vegetation at Yangedi Airfield Reserve, including planting of at least 250 tubestock comprising 6 different cockatoo habitat species	The Environmental Offsets Proposal includes the provision to revegetate 0.6 ha of Marri Woodland within Yangedi Airfield Reserve. At least 250 tubestock comprising black cockatoo habitat species will be planted in this area. Refer to Appendix D of the Environmental Offsets Proposal for a species list containing cockatoo species suitable for the rehabilitation site.
Proposed offset (area in hectares)		N/A	
Current quality of offset site / Start number (of type of feature)		50.00	The majority of the reserve belongs to Bush Forever site 378 and there are estimated to be approximately 50 cockatoo habitat trees presently in the offset area.
Future quality WITHOUT offset (scale) / Future number WITHOUT offset		50.00	The number of cockatoo habitat trees is expected to remain stable into the future without the offset works.
Future quality WITH offset (scale) / Future number WITH offset		300.00	With the offset works, at least 250 cockatoo habitat trees will be planted, increasing the number from 50 to 300 trees.
Time until ecological benefit (years)		10.00	Artificial nesting boxes will provide immediate nesting opportunities; revegetation will take 7-10 years to become productive for foraging.
Confidence in offset result (%)		0.8	The Shire is confident that the offset rehabilitation works will be successful. A revegetation plan has been developed by an experienced ecologist and the works will be undertaken by a reputable landcare operator.
Duration of offset implementation (maximum 20 years)		N/A	
Time until offset site secured (years)		N/A	
Risk of future loss WITHOUT offset (%)		N/A	
Risk of future loss WITH offset (%)		N/A	
Offset ratio (Conservation area only)		N/A	
Landscape level values of offset?	N/A	N/A	

9. Appendix C – WA Environmental Offsets Calculator and Rationale – Area

WA Environmental Offsets Calculator

Step 1: Determining conservation significance

Clear Data

Key:
- Data to be entered
- Drop-down selection
- Automatically-generated scores (Or, if appropriate, manual data entry permitted)

Area / feature (Impact site)

Conservation significance determination for the environmental value impacted	
Description	Black cockatoo nesting, foraging and roosting habitat
Type of environmental value	Species (flora/fauna)
Conservation significance of environmental value	Rare/threatened species - endangered
Conservation significance score	1.2%

Please select *area* or *feature* for the calculations	Area

Step 2: Calculating significant residual impact

Clear Data

Key:

	Data to be entered
	Drop-down selection
	Automatically-generated scores

Environmental value (step 1)	Black cockatoo nesting, foraging and roosting habitat

***Area* (impact site)**

Part A: Significant impact calculation *Area*

Significant impact	Description	Quantum of impact	
	Clearing of black cockatoo foraging, roosting and nesting habitat	Significant impact (hectares)	0.02
		Quality (scale)	3.00
		Total quantum of impact	0.01

Part B: Rehabilitation credit calculation *Area* (onsite)

Rehabilitation Credit	Description				
		Proposed rehabilitation (area in hectares)		Time until ecological benefit (years)	
		Current quality of rehabilitation site (scale)		Confidence in rehabilitation result (%)	
		Future quality WITHOUT rehabilitation (scale)		Rehabilitation credit	0.00
		Future quality WITH rehabilitation (scale)			

Part C: Significant residual impact calculation *Area*

Significant residual impact		
	Total quantum of impact	0.01
	Rehabilitation credit	0.00
	Significant residual impact	0.01

Step 3: Calculating offsets

Clear Data

Key:

	Data to be entered
	Drop-down selection
	Automatically-generated scores

Environmental value (step 1)	Black cockatoo nesting, foraging and roosting habitat	Significant impact (step 2, part A)	15.02
		Rehabilitation credit (step 2, part B)	0.00
		Significant residual impact (step 2, part C)	15.01

***Area* (offset site)**

Offset calculation
Area

Offsets calculation							
	Description	**Proposed offset (area in hectares)**	0.60	**Duration of offset implementation (maximum 20 years)**	5.00	**Offset value**	**0.08**
	Revegetation of 0.6 ha at Yangedi Airfield Reserve, Hopeland	**Current quality of offset site (scale)**	5.00	**Time until offset site secured (years)**	0.00	What-if Analysis	**1136.1%**
		Future quality WITHOUT offset (scale)	5.00	**Risk of future loss WITHOUT offset (%)**	10.0%		
		Future quality WITH offset (scale)	7.00	**Risk of future loss WITH offset (%)**	10.0%	What-if Analysis Reinstate Formula	
		Time until ecological benefit (years)	10.00				
		Confidence in offset result (%)	80.0%			**OFFSET ADEQUATE?**	**YES**

Rationale for scores used in the offsets calculator

Clear Data

Environmental value to be offset			
Calculation	***Score (Area)***		***Rationale***
Conservation significance			
Description	Black cockatoo nesting, foraging and roosting		Black cockatoo habitat trees are proposed to be cleared as part of the road widening for Karnup Road.
Type of environmental value	Species (flora/fauna)		Black Cockatoo Species (Zanda baudinii, Zanda latirostris, Calyptorhynchus banksii naso)
Conservation significance of environmental value	Rare/threatened species - endangered		Baudin's Black-Cockatoo (Zanda baudinii), listed as Endangered under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 (EPBC Act) and Schedule 2 Division 2 (Endangered) under the Western Australian Biodiversity Conservation Act 2016 (BC Act). Carnaby's Black-Cockatoo (Zanda latirostris), listed as Endangered under the EPBC Act and Schedule 2 Division 2 (Endangered) under the BC Act. Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso), listed as Vulnerable under the EPBC Act and Schedule 2 Division 3 (Vulnerable) of the BC Act
Landscape-level value impacted	yes/no		No
Significant impact			
Description	Clearing of black cockatoo foraging, roosting and nesting habitat		Clearing of 15 Black Cockatoo habitat trees, including 9 potential nesting, 10 foraging and 10 roosting trees (Ecology Matters, 2024)
Significant impact (hectares) / Type of feature	0.02		Black cockatoo habitat trees along the Karnup Road verge, with a canopy extent of approximately 0.0225 ha are proposed to be cleared.
Quality (scale) / Number	3.00		The trees are in excellent condition, growing over a degraded understory of mixed annual grasses and annual weeds.
Rehabilitation credit			
Description	0		As the area is a narrow road verge, to maintain public safety, no on-site rehabilitation is proposed to occur on-site.
Proposed rehabilitation (area in hectares)	0.00		As above
Current quality of rehabilitation site / Start number (of type of feature)	0.00		As above
Future quality WITHOUT rehabilitation (scale) / Future number WITHOUT rehabilitation	0.00		As above

Future quality WITH rehabilitation (scale) / Future number WITH rehabilitation	0.00		As above
Time until ecological benefit (years)	0.00		As above
Confidence in rehabilitation result (%)	0		As above
Offset			
Description	Revegetation of 0.6 ha at Yangedi Airfield		On-ground management within a 0.6 ha section of Yangedi
Proposed offset (area in hectares)	0.60		Of the three vegetation communities in the Reserve, a 0.6 ha area of marri woodland located in the southeast has been selected as a direct offset to undergo rehabilitation and revegetation activities. This site was selected on the basis of being the closest local natural area to the Karnup Road clearing area (approximately 4 km), the presence of marri trees to install artificial cockatoo nesting boxes, and its classification with the same under-represented Southern River vegetation complex.
Current quality of offset site / Start number (of type of feature)	5.00		The majority of the reserve belongs to Bush Forever site 378 and the overall vegetation condition is in good to very good condition. The proposed offset area contains patches of degraded vegetation.
Future quality WITHOUT offset (scale) / Future number WITHOUT offset	5.00		The future quality of the offset site is expected to remain stable without the offset works.
Future quality WITH offset (scale) / Future number WITH offset	7.00		The Shire has set reasonable targets to increase species richness in both degraded and good condition areas of the revegetation site to a total 21 native species to enhance vegetation condition from degraded or good to very good condition.
Time until ecological benefit (years)	10.00		Artificial nesting boxes will provide immediate nesting opportunities; revegetation will take 7-10 years to become productive for foraging.
Confidence in offset result (%)	0.8		The Shire is confident that the offset rehabilitation works will be successful. A revegetation plan has been developed by an experienced ecologist and the works will be undertaken by a reputable landcare operator.
Duration of offset implementation (maximum 20 years)	5.00		A revegetation plan has been developed to guide the offset rehabilitation works over a 5 year time-frame.
Time until offset site secured (years)	0.00		Yangedi Airfield Reserve (the Reserve) is vested with the Shire for the purpose of Recreation, but current uses also include Conservation. It is leased by the Sports Aircraft Builders Club as an airfield requiring safety protocols to be in place for accessing the site. Natural areas in the Conservation Zone are protected through the Shire's Council endorsed 'Marri Woodland Management Plan' (Shire of Serpentine Jarrahdale 2024a).
Risk of future loss WITHOUT offset (%)	10.0%		The site has a high level of security due to Council's commitment to protecting conservation zones though the 'Local Biodiversity Strategy 2008' and Shire's Council endorsed 'Marri Woodland Management Plan'.
Risk of future loss WITH offset (%)	10.0%		As above.
Offset ratio (Conservation area only)	N/A		
Landscape level values of offset?	N/A	N/A	

10. Appendix D – Species List Yangedi Airfield Reserve (ENV Consulting 2008, Shire of Serpentine Jarrahdale 2024b)

Species	Cockatoo habitat	Priority Environmental Weed
Acacia huegelii		
**Acacia iteaphylla*		x
Acacia lasiocarpa		
Acacia stenoptera		
Acacia willdenowiana		
Adenanthos cygnorum		
Allocasuarina fraseriana		
Allocasuarina humilis		
Amphipogon turbinatus		
Anigozonthos manglesii		
Arnocrinum preissii		
Austrodanthonia acerosa		
Austrostipa compressa		
Austrostipa elegantissima		
**Avena barbata*		x
Baeckea camphorosmae		
Banksia attenuata	x	
Banksia ilicifolia	x	
Banksia menziesii	x	
Bossiaea eriocarpa		
**Briza maxima*		x
**Briza minor*		
Burchardia congesta		
Caesia micrantha		
Caladenia flava		
Callitris pyramidalis		
Calytrix angulata		
Calytrix fraseri		
**Carpobrotus edulis*		
Cassytha sp.		
Centrolepis drummondiana		
Chamaescilla corymbosa		
Conostephuim pendulum		
Conostephium preissii		
Conostylis aculeata		
Conostylis juncea		
Corymbia calophylla	x	
Crassula colorata		
Cyathochaeta avenacea		

Species	Cockatoo habitat	Priority Environmental Weed
**Cyperus congestus*		
Dampiera linearis		
Dasypogon bromeliifolius		
Daviesia preissii		
Desmocladus flexuosus		
**Disa bracteata*		
Drakaea glyptodon		
Drosera erythrorhiza		
Drosera menziesii		
Drosera nitidula		
**Ehrharta calycina*		x
**Eragrostis curvula*		x
Eremaea asterocarpa		
Eremaea pauciflora		
Eucalyptus marginata		
Eucalyptus rudis		
Euchilopsis linearis		
Evandra pauciflora		
Gastrolobium capitatum		
**Gladiolus caryophyllaceus*		x
Gompholobium capitatum		
Gompholobium tomentosum		
Haemodorum laxum		
Haemodorum spicatum		
Hemiandra pungens		
Hibbertia ferruginea		
Hibbertia huegelii		
Hibbertia hypericoides		
Hibbertia subvaginata		
Hibbertia vaginata		
Hovea trisperma		
Hypocalymma robustum		
**Hypochaeris glabra*		
**Hypochaeris radicata*		
Hypolaena exsulca		
Isolepis cernua		
Jacksonia furcellata	x	
Johnsonia pubescens		
Juncus pallidus		
Kunzea glabresens		
Kunzea recurva		
Lachnagrostis filiformis		

Species	Cockatoo habitat	Priority Environmental Weed
Laxmannia squarrosa		
Lechenaultia biloba		
Lechenaultia floribunda		
Lepidosperma pubisquameum		
Lepidosperma squamatum		
Leucopogon sp.		
Lomandra nigricans		
Lomandra preissii		
Lomandra sp.		
Lomandra suaveolens		
Loxocarya cinerea		
Lyginia barbata		
Lyginia imberbis		
Lysinema ciliatum		
Macarthuria australis		
Macrozamia riedlei		
Melaleuca preissiana		
Melaleuca thymoides		
Microtis media		
Neurachne alopecuroidea		
Nuytsia floribunda		
**Orobanche minor*		
Patersonia occidentalis		
Persoonia saccata		
Petrophile linearis		
Philotheca spicata		
Phlebocarya ciliata		
**Pinus radiata*		x
Podotheca chrysantha		
Podotheca gnaphalioides		
Prasophyllum parvifolium		
Pterostylis nana		
Pterostylis vittata		
Pyrorchis nigricans		
Quinetia urvillei		
Regelia ciliata		
**Romulea rosea*		
Schoenus curvifolius		
Scholtzia involucrata		
Siloxerus humifusus		
**Sonchus oleraceus*		
Sowerbaea laxiflora		

Species	Cockatoo habitat	Priority Environmental Weed
Stachystemon vermicularis		
Stirlingia latifolia		
Stylidium brunonianum		
Stylidium repens		
Stylidium neurophyllum		
Stylidium schoenoides		
Tetraria octandra		
Thelymitra macrophylla		
Thysanotus manglesianus		
Thysanotus sparteus		
Thysanotus triandrus		
Trachymene pilosa		
Tricoryne elatior		
**Ursinia anthemoides*		
**Watsonia meriana*		x
Xanthorrhoea brunonis		
Xanthorrhoea gracilis		
Xanthorrhoea preissii	x	
Xanthosia huegelii		
**Zantedeschia aethiopica*		x

*denotes weed species