Revegetation Management Plan

Cundinup Pit (Lot 300) Cundinup West Road, Cundinup

JULY 2025

Version control

Project number:	SW551			
Project file path:	SW551_Cundinup Pit RMP_R3			
Client:	Shire of Nannup			
Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Rev 0	10/12/24	GJ SW Environmental	GO SW Environmental	SP SW Environmental
Rev 1	17/12/24	GJ SW Environmental	SP SW Environmental	SP SW Environmental
Rev 2	30/04/25	GJ SW Environmental	KP SW Environmental	SP SW Environmental
Rev 3	12/06/25	GJ SW Environmental	SP SW Environmental	SP SW Environmental
Rev 4	2/07/25	GJ SW Environmental	SP SW Environmental	SP SW Environmental

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Abbreviations and acronyms

Common terms	
Proposed clearing area	Proposed clearing footprint (2.67 ha)
Study Area	Total rehabilitation area (3.91 ha)
DBCA	WA Department of Biodiversity, Conservation and Attractions
DCCEEW	Federal Department of Climate Change, Energy, the Environment and Water
DWER	WA Department of Water and Environmental Regulation
FRTBC	Forest Red-tailed Black Cockatoo
RMP	Revegetation Management Plan
WA	Western Australia
WoNS	Weed of National Significance
WRP	Western Ringtail Possum
Legislation	
BC Act	WA *Biodiversity Conservation Act 2016*
EP Act	WA *Environmental Protection Act 1986*
EPBC Act	Federal *Environment Protection and Biodiversity Conservation Act 1999*
Measurements	
cm	Centimetre
ha	Hectare
km	Kilometre
m	Metre

1 Introduction

1.1 Project Background

The Shire of Nannup (herein referred to as 'the Shire') proposes to develop an open pit at Lot 300 on deposited Plan 41104, Cundinup for the purpose of extracting laterite gravel for use in constructing road pavements. The total proposed pit clearing area will cover 2.07 hectares (ha) (Appendix A – Figure 1), inclusive of bunding for overburden and stormwater drainage. A number of additional areas to the east will not be mined, but will be part of the proposed rehabilitation area, including an area abutting the site, and eight small pockets of adjacent land. This brings the total 'Study Area' of land to be rehabilitated to 3.91 ha (Appendix A – Figure 1).

An Extraction and Rehabilitation Plan was provisioned by the Shire to DWER on the 27th of August 2024 to support the clearing application (CPS 10652/1) for the Study Area. The Plan was deemed insufficient by DWER for the requirements of the assessment. SW Environmental was subsequently engaged to prepare a revised Revegetation Management Plan (RMP) for the site.

The site currently consists of juvenile regrowth Jarrah-Marri forest and a cleared gravel pit area, with vegetation condition ranging from Completely Degraded to Very Good (EPA, 2016). Remnants of stacked sawn timber and topsoil exist within the cleared area. Clearing at the site will occur in two stages (Appendix A – Figure 2). The section to be cleared first will be the Old Mill site area, comprising approximately 1.5 ha of land. This will commence in the first year and will yield approximately 40,000 tonnes of gravel. The second stage will be cleared the following year and should yield approximately. 30,000 tonnes of gravel.

This Revegetation Management Plan (RMP) has been prepared with the objective of establishing native vegetation to sufficiently recreate fauna habitat values, in particular black cockatoo[1] foraging (and eventually breeding) habitat, along with the introduction of species that may be utilised by other fauna (such as the Critically Endangered Western Ringtail Possum (WRP, *Pseudocheirus occidentalis*).

1.2 The Study Area

The Study Area is located within the Shire of Nannup, approximately 3 kilometres (km) northwest of Cundinup.

The adjacent land use to the north, sound and east is of remnant native vegetation. A neighbouring property to the west comprises an existing, working gravel pit, however no dwellings exist on this parcel of land. The nearest occupied dwelling is ~ 500 m to the northeast of the Study Area, surrounded by remnant native vegetation.

[1] Collectively referring to the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) (Vulnerable), Baudin's Cockatoo (*Zanda baudinii*) (Endangered) and Carnaby's Black Cockatoo (*Zanda latirostris*) (Endangered), herein referred to as black cockatoos.

For the purpose of this RMP, the proposed clearing includes the 2.07 ha proposed open pit area at Lot 300 on deposited Plan 41104, Cundinup, consisting of remnant vegetation and cleared areas ranging from Very Good to Completely Degraded vegetation condition (condition defined as per EPA (2016) guidance).

1.3 Purpose of the Plan

This RMP has been prepared to provide a framework and management document to formally capture the revegetation management commitments proposed by the Shire of Nannup. The objectives of the Plan are to:

- Revegetate the Study Area, establishing native vegetation capable of generating long-term environmental values that recreate those of the Study Area prior to clearing
- Implement successful revegetation by controlling present and ongoing risks to the site

The Plan has been prepared with general reference to the Department of Water and Environment Regulation's (DWER) publication: *A guide to preparing revegetation plans for clearing permits* (DWER, 2018). In particular, this Plan addresses the aim to *recreate or improve the environmental values of a site to achieve a species composition, structure and diversity similar to that which existed prior to disturbance* (DWER, 2018).

The RMP aims to recreate vegetation to a condition that supports the objectives of the plan. The reintroduction of native vegetation through revegetation would improve site stabilisation, general ecosystem functioning and black cockatoo habitat value, along with other fauna (such as WRP).

1.4 Personnel Preparing the Plan

The Plan has been prepared by Georgia Johnsen (Project Officer – Ecology, SW Environmental), with input from Greg Overton (Revegetation Specialist, SW Environmental), Kelly Paterson (Senior Botanist, SW Environmental) and Shane Priddle (Principal Consultant, SW Environmental). All individuals involved in the plan compilation are experienced in the preparation of revegetation management plans and/or implementing revegetation programs.

1.5 Responsibilities

The Shire of Nannup is responsible for the implementation of the RMP.

1.6 Management Commitments

1.6.1 Vision Statement and Objectives

The management vision for the site is:

> *To recreate the ecological values of the study area by revegetating the landscape post-disturbance, whilst implementing ongoing weed control and management measures.*

The vision, objectives and completion targets are consistent with the **SMART** principles (DWER, 2018):

- **S**pecific
- **M**easurable
- **A**chievable
- **R**elevant
- **T**ime-bound

In view of the above, the key objectives and aims associated with the revegetation works are to:

- Recreate the ecological values present at the site by revegetating the area with existing, endemic flora taxa where possible,
- Implement successful revegetation by controlling present and ongoing risks to the site
- Return the site to a vegetation condition that supports the objectives of the plan (meeting or exceeding the pre-existing condition in the long-term)
- Recreate fauna habitat values
- Meet the proposed project completion targets (provided in Section 3.2 below) and requirements of DWER to create a revised plan (in line with recommendations outlined in DWER's guide to revegetation plans (DWER, 2018)).

1.7 Completion Target

The target is to meet the objectives outlined in Section 3.1. Table 1-1 summarises rehabilitation and revegetation targets for the site.

Table 1-1 Rehabilitation and revegetation targets

Aspect	Attribute	Measure	Target
Flora and vegetation	Vegetation cover	Number of stems per hectare (overstorey/canopy)	600 stems/ha after 10 years
		Percentage of cover (mid stratum and ground stratum)	30 % cover after 2 years 45 % cover after 5 years 60 % cover after 10 years
	Species richness	Number of species present (within each stratum layer)	70 % of total taxa recorded in the adjacent Very Good condition remnant vegetation (42 species) after 10 years (Section 3.2.2).
	Weed species presence and abundance	List of weed species and approximate percentage cover	For number of weeds present to be no more prevalent than their extent prior to clearing activities and not exceeding 15 % cover
Flora/fauna	Presence of species valued by local fauna for foraging and/or breeding habitat	Presence and growth of *Corymbia calophylla* and *Eucalyptus marginata*, along with mid and/or lower stratum black cockatoo foraging species	For trees with locally occurring fauna value to be present and growth rates of such to be increasing.
	Presence of target fauna species utilising revegetated area for foraging and/or breeding habitat	Number of target fauna species observed at site and/or presence of secondary evidence such as chewed nuts and/or presence of hollows.	For evidence that target fauna species are utilising revegetated area to be present at site.

2 Methods

2.1 Desktop Assessment

A brief desktop assessment was undertaken, including a review of available information, datasets and reports relevant to the project. This was undertaken to provide background information to support the RMP. Sources/references interrogated as part of the desktop assessment included:

- 2018 South West Vegetation Complex Statistics Report, utilising the DBCA-047 spatial dataset (DBCA, 2019, 2018)
- Soil Landscape Mapping (Best Available DPIRD-027) spatial dataset (DPIRD, 2022)
- Bureau of Meteorology Climate Data Online (BoM, 2025)
- SW Environmental (2024). *Targeted Fauna Survey: Black Cockatoo and Western Ringtail Possum – Cundinup Pit (Lot 300) Cundinup West Road, Cundinup.* [Prepared for the Shire of Nannup, December 2024].

2.2 Field Survey

2.2.1 Survey Timing and Overview

An initial site visit was conducted on the 9th of October 2024 to assess the existing values of the Study Area. During this visit, a preliminary list of key structural flora and observed weeds was created.

A follow-up visit was undertaken on the 16th of April 2025, aiming to establish an external reference quadrat to identify floristic values, and map the vegetation condition across the Study Area. The second site visit did not occur during recommended optimal timing for flora and vegetation surveys within the South-West botanical province, as per EPA Technical Guidance (EPA, 2016). This was not a requirement for the survey.

The Study Area was traversed on foot, with point locations marked (utilising a handheld Global Positioning System (GPS) unit) for corresponding notes on existing site values. Representative photographs were taken. Disturbances to the Study Area were noted. Personnel involved in the surveys are listed in Table 2-1. Further survey methodology is detailed below.

Table 2-1 Survey Personnel and Licensing Information

Personnel	Experience	Flora Collecting Permit (WC Act (WA))	Role	Survey
Kelly Paterson *Senior Botanist* *BSc (Natural Resource Management - Botany)*	>10 years	FB62000182-2b TFL-2425-0086	Field Survey/Lead Plant Identifications	16/04/25
Georgia Johnsen *Ecologist/Botanist* *BSc (Marine Science & Conservation Biology)*	~3 years	FB62000470-2 TFL 2324-0179	Field Survey/Lead Reporting	9/10/24 16/04/25
Greg Overton *Revegetation Expert*	> 40 years	N/A	Field Survey Technical Advice Reporting Support	9/10/24
Shane Priddle *Principal Consultant* *BSc (Marine Science)* *Certified Environmental Practitioner EIANZ (No. 910)*	~25 years	N/A	Project Manager	N/A

2.2.2 Reference Quadrat

One 10 m by 10 m representative reference quadrat was established in a GPS-marked location outside of the Study Area. The quadrat size utilised was indicative for flora and vegetation surveys within the relevant Jarrah Forest bioregion, as per EPA (2016) Technical Guidance. The reference quadrat was placed in adjacent vegetation of the best available vegetation condition. The quadrat placement aimed to replicate a species composition representative of what was observed within the Study Area. All visually identifiable vascular flora taxa observed within the quadrat were recorded, along with their corresponding cover and height, inclusive of both native and introduced taxa.

2.2.3 Plant Collection and Identification

Plants were collected using methodology consistent with guidance from the Western Australian Herbarium (2020). All plant material was collected under relevant *Flora Taking (Biological Assessment) Licence* (under Regulation 62 of the WA *Biodiversity Conservation Regulations 2018*) and *Authorisation to Take or Disturb Threatened Species* (pursuant to Section 40 of the BC Act).

Plant identifications were undertaken using taxonomic keys where available, utilising available resources such as existing herbarium specimens and/or consultation with taxonomic experts. Plant identifications were overseen by a Senior Botanist with extensive previous experience working in the region (>10 years) (outlined in Table 2-1).

2.2.4 Vegetation Condition Mapping

The vegetation condition scale presented in Section 5.6 of the EPA Technical Guidance (EPA, 2016; Keighery, 1994) for the South West and Interzone Botanical Provinces was used to describe the vegetation condition observed during the field survey. Vegetation condition scale descriptions are presented in Table 3-3. Vegetation condition notes were recorded at GPS-marked locations across the Study Area, mapping boundaries where vegetation experienced a change in condition.

Table 2-2 Vegetation condition scale (EPA 2016).

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

2.2.5 Opportunistic Records

Whilst traversing both the Study Area and adjacent, representative vegetation, additional flora taxa were opportunistically recorded. A species list consisting of vascular flora taxa recorded during the survey is presented in Appendix C. The species list was utilised to inform the Revegetation Species List and Seed Rates, presented in Appendix E.

2.2.6 Weed Mapping

Mapping of weedy Watsonia presence on the property (extending outside of the Study Area) was completed by Shire of Nannup personnel. The data was provided to SW Environmental in June 2025 to be added to the RMP as part of the weed control program.

2.2.7 Additional Rehabilitation Areas

To the east of the clearing area, eight small rehabilitation areas were added to the Study Area by the Shire of Nannup following initial SW Environmental surveys. These areas were not assessed directly by

SW Environmental personnel but were instead interpreted through photo evidence and communications with the Shire of Nannup.

3 Results

3.1 Desktop Assessment

3.1.1 Property Details

The site is located within Lot 300 on deposited Plan 41104, Cundinup, within the Shire of Nannup. The Shire currently has a Management Order on the site for gravel extraction. Lot 300 is zoned as Public Open Space under the Shire's Local Planning Scheme No., 4. Adjacent properties are zoned as Priority Agriculture, Environmental Conservation and Rural. Remnant native vegetation exists on properties to the north, east and south of the site. An existing working gravel pit is located on the property to the west of the rehabilitation area.

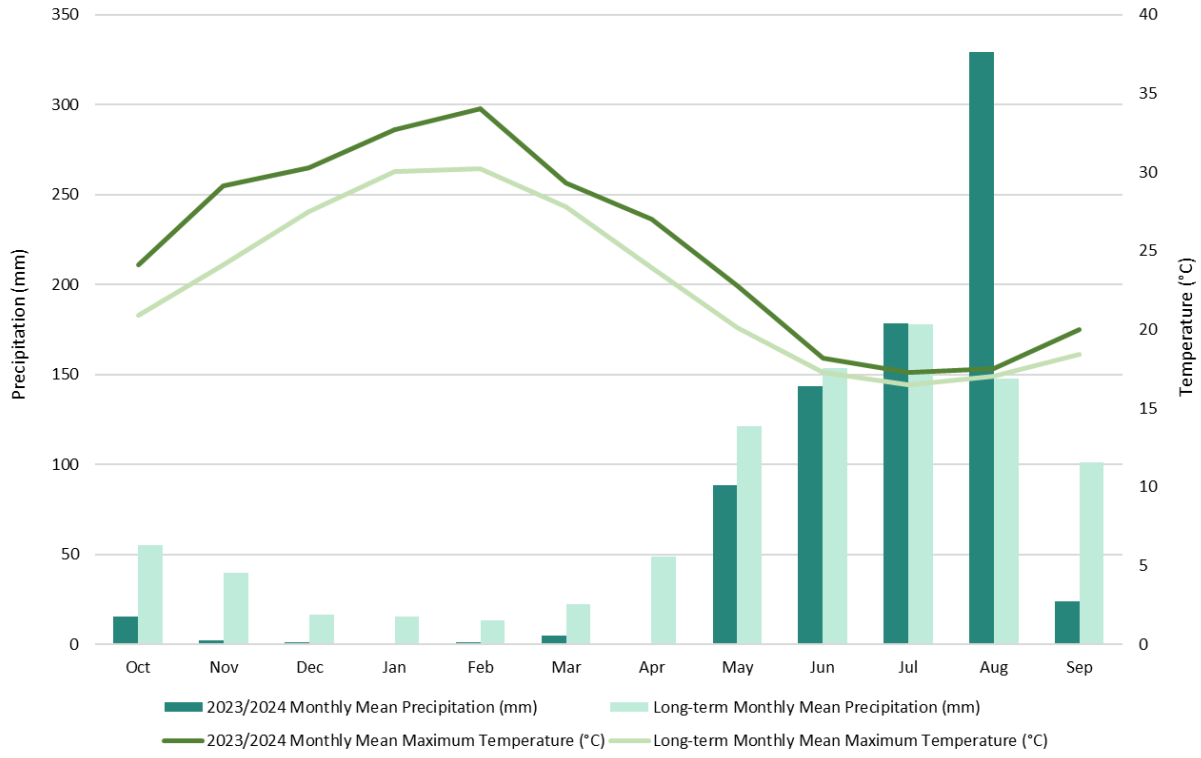
3.1.2 Climate, Landform and Soils

The site exists within the Southern Jarrah Forest (JAH02) Subregion of the Jarrah Forest Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion (DCCEEW, 2022)(DCCEEW, 2023). Soils within the Study Area, as mapped by Department of Agriculture (now the Department of Primary Industries and Regional Development) (DPIRD, 2022), include:

- **255LvGA Gale subsystem –** Footslope fans over gneiss. Soils are sandy gravels.

The JAF02 IBRA subregion located within the Menzies Botanical District, an area that experiences a warm, mediterranean climate, with average winter precipitation of 600 – 1200 mm and 5-6 dry months per year (Beard, 2015). Graph 1 presents climatic information from the Jarrahwood station (station number 9842), the most relevant meteorological station to the study area, situated 11.3 km from the locality of Cundinup (BoM, 2024). Long-term mean maximum temperatures range from 30.2°C in the hottest month of February, to 16.5°C in the coolest month of July. The long-term average annual rainfall is 913.1 mm, with 479.5 mm recorded in winter months of 2024.

Weather records from 2023/2024 indicate that temperatures have been consistently above average over the past 12 months. Precipitation has been substantially below between the months October 2023 to April 2024. The long term mean monthly precipitation exceeds rainfall records from the last 12 months by over 120 mm (Graph 1).



Graph 1 Temperature and rainfall data from the Jarrahwood station (station number 9842) (BoM, 2024)

3.1.3 Regional Vegetation

Vegetation complexes (Webb et al., 2016) at the site are mapped as:

- **Gale Complex – Darling Plateau Uplands:** Tall open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia grandis* on slopes off escarpment in perhumid and humid zones.

Remnant vegetation within the Study Area consisted of juvenile regrowth *Eucalyptus marginata* subsp. *Marginata* and *Corymbia calophylla* (Photo 1) with varying levels of understorey coverage.

3.1.4 Regional Fauna

Local fauna assemblages within the Study Area may include native animals such as Threatened or Priority fauna such as the Critically Endangered WRP, Quenda (*Isoodon fusciventer*) (Priority 4), and Southern Brush-tailed Phascogale (*Phascogale tapoatafa*) (Specially Protected), and foraging habitat for black cockatoos - Forest Red-tailed Black Cockatoo (FRTBC) (*Calyptorhynchus banksii subsp. naso*) (Vulnerable), Baudin's cockatoo (*Zanda baudinii*) (Endangered) and Carnaby's cockatoo (*Zanda latirostris*) (Endangered).

The Study Area falls within the DAWE (2022) referral guideline Region 3; Jarrah Forest, characterised by the presence of Jarrah and Marri Forest. All three black cockatoo species breed in the region and it is the main area used by Baudin's cockatoo and the FRTBC for breeding. SW Environmental (2024) conducted a Targeted Fauna Survey at the site, and recorded the presence of fresh FRTBC feed residue, dispersed broadly across the Study Area (Photo 3-1). No recent Baudins or Carnaby's black cockatoo

feed residue was observed. SW Environmental (2024) determined that Jarrah and Marri forested areas within the proposed clearing area were consistent with high quality foraging habitat (1.32 ha) for all three cockatoo species, that paddock trees of Jarrah and Marri provided moderate quality foraging habitat (0.04 ha), and that recently cleared regenerating areas provided low quality foraging habitat (0.13 ha).

No evidence of black cockatoos roosting within or immediately adjacent to the Study Area were observed (SW Environmental, 2024). Seventy-two suitable Diameter at Breast Height (DBH) trees were recorded, of which six were hollow bearing. Hollows may also provide habitat to other fauna species.

Only FRTBC were observed during the RMP site visits. White-tailed black cockatoos were seen utilising neighbouring properties, with the species undetermined. Numerous snakes, lizards, birds and other common animals may occur at the site, with a probable reptile burrow observed (Photo 3-2). Western grey kangaroo (*Macropus fuliginosus*) scat was also found (Photo 3-3). The revegetation area is considered as suitable habitat for introduced European rabbit (*Oryctolagus cuniculus*). Evidence of rabbit activity was present at the site, with a warren and multiple diggings observed (Photo 3-4).

Photo 3-1 FRBC chewings on *Corymbia calophylla* fruit

Photo 3-2 Reptile burrow

Photo 3-3 Western Grey Kangaroo (*Macropus fuliginosus*) scat

Photo 3-4 Rabbit warren entrance

3.2 Field Survey

3.2.1 Existing Vegetation

One broad structural vegetation unit was observed with varying levels of degradation across the Study Area. This consisted of juvenile regrowth *Eucalyptus marginata* and *Corymbia calophylla* forest over low open shrubland to shrubland over various sedges and forbs (Photo 3-5). The presence of weeds within remnant vegetation was generally low, with increases in cover towards the edges, where the vegetation transitioned to recently cleared areas or on stockpiles in the gravel pit area. Weed presence is further discussed in Section 4.1.2. Additional revegetation pockets located east of the proposed gravel pit are predominantly completely cleared, with the exception of one pocket with tree canopy remaining (Photo 3-6).

Photo 3-5 Remnant vegetation within the Study Area

Photo 3-6 Additional revegetation area existing tree canopy with predominantly completely cleared understorey

3.2.2 Reference Quadrat

A summary of floristic data from the reference quadrat is presented in Table 3-1, with raw data detailed in Appendix B. The quadrat corner point locations are presented in Figure 4 (Appendix A). The quadrat was placed in vegetation in Very Good condition, as vegetation in Excellent condition was not available within the area surrounding the site.

Table 3-1 Reference quadrat summary

Quadrat ID	Description	Soil Type	Representative Photos
C01	*Corymbia calophylla* and *Eucalyptus marginata* mid closed forest over *Xanthorrhoea preissii* low isolated shrubs over *Hibbertia hypericoides*, *Leucopogon capitellatus* and *Banksia dallanneyi* low open shrubland over *Conostylis aculeata* isolated clumps of forbs over *Desmocladus fasciculatus* and *Netrostylis* sp. Jarrah Forest (R. Davis 7391) closed sedgeland.	Brown/Grey Sandy Loam	 (NW Corner)  (SE Corner)

3.2.3 Vegetation Condition

Historical logging, dumping of rubbish and weed invasion were evident across the Study Area. Vegetation condition throughout the Study Area ranged from Completely Degraded (Photo 3-6) to Very Good (Photo 3-7). The majority of the Study Area was in Completely Degraded condition (1.77 ha), having been subject to widespread clearing, with little to no vegetation structure remaining. Vegetation conditions can be broken down as follows:

- Very good: 0.48 ha total (including proposed clearing area to be revegetated: 0.39 ha)
- Good: 1.25 ha total (including proposed clearing area to be revegetated: 0.89 ha)
- Degraded: 0.41 ha total (including proposed clearing area to be revegetated: 0.24 ha)
- Completely Degraded: 1.77 ha total (including proposed clearing area to be revegetated: 0.56 ha)

Disturbances impacting the site are discussed further in Section 4.1.

Photo 3-7 Completely Degraded area

Photo 3-8 Area of Very Good vegetation condition

3.3 Hydrology and Drainage

The site consists of a gently sloping gradient to the northeast in vegetated areas. Along the perimeter of previously cleared areas, banks with steep drop-offs are evident (Photo 3-8). Within currently cleared areas, evidence of scouring is present, indicating that water run-off occurs in a N/NE direction around topsoil mounds, occasionally pooling in depressions (Photo 3-9, Photo 3-10). Within the adjacent rehabilitation site, some cleared areas exist where gravel extraction will not occur. Ripping across the contour in these areas will assist with drainage issues following revegetation. No water courses or evidence of erosion were present at the site in areas to be retained. Erosion and stormwater drainage should be addressed within a Pit Management Plan (PMP).

Photo 3-9 Banks along the perimeter of existing clearings

Photo 3-10 Drainage across previously cleared areas

Photo 3-11 Evidence of water pooling in cleared area depression

4 Revegetation Management

4.1 Disturbances, Risks and Management

The proposed revegetation site, having been previously subject to disturbance activities, faces a number of risks requiring management. The proliferation of weeds on existing topsoil mounds presents the risk of weed spread that must be managed prior to the movement of stockpiles. Further topsoil stockpiling must follow methodology that does not compromise the quality and viability of the soil. Management of topsoil mounds must be undertaken to prevent the risk of weeds spreading throughout the site.

4.1.1 Topsoil Management

To achieve the greatest chances of revegetation success, topsoil must be stockpiled and managed in a way that preserves the soil biology. This would enhance the success of plant growth and seed germination following revegetation. Topsoil storage methodology is discussed in Section 4.

4.1.2 Weeds

Invasive flora taxa were observed proliferating in concentrated patches on topsoil stockpiles within the Study Area (Photo 4-1). Weeds were also present in lower, scattered numbers throughout remnant vegetation, with greater densities on the edges of vegetated areas.

Broadleaf weeds observed within the Study Area included *Arctotheca calendula* (Capeweed), *Raphanus raphanistrum* (Wild Radish), *Hypochaeris glabra* (Smooth Cats-ear) and various Thistles. Bulbous weeds included *Watsonia meriana* (Watsonia) and *Freesia leichtlinii* subsp. *alba* × *leichtlinii* subsp. *leichtlinii* (Freesia). Grassy weeds included *Briza maxima* (Blowfly Grass), *Avena fatua* (Wild Oat), *Ehrharta longiflora* (Annual Veldt Grass) and *Cenchrus clandestinus* (Kikuyu). Invasive herbs included *Asparagus asparagoides* (Bridal Creeper), *Lysimachia arvensis* (Pimpernel) and *Gomphocarpus fruticosus* (Cottonbush). Woody weeds included a single location of *Acacia dealbata* (Silver Wattle).

One of the observed taxa, Bridal Creeper, is a listed Weed of National Significance (WoNS) (Weeds Australia, 2021) and a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (DPIRD, 2024). Ten of the observed species are rated as Rapidly invasive: Bridal Creeper, Wild Radish, Smooth Cats-ear, Freesia, Blowfly Grass, Wild Oat, Kikuyu, Annual Veldt Grass and Cottonbush (DBCA, 2023). Four introduced taxa are rated as being of high ecological impact: Bridal Creeper, Watsonia, Freesia, Wild Oat and Kikuyu.

A 3.97 ha area has been mapped outlining the extent of a Watsonia infestation occurring in the eastern half of the property (Photo 4-2) (Figure 3, Appendix A). The density of invasive Watsonia varies across the mapped area, with a concentrated patch in the north-eastern corner of the site (~95 % cover, 0.37 ha). Scattered dense clumps and isolated occurrences extend southward along the eastern boundary of the property (~20 % cover, 1.54 ha), and sparse records continue along the northern boundary towards the west (~1 % cover, 2.06 ha). This area intersects five of the proposed rehabilitation area. Although this infestation extends outside of the Study Area, this RMP will include control mechanisms to target its occurrence.

The site is likely to require significant ongoing monitoring and maintenance if initial weed control efforts are not comprehensive. There is an additional potential for ongoing weed invasion to occur, dispersing from adjacent, open properties, however this may be managed with periodic monitoring and follow-up weed control (as detailed in Section 4), along with the successful establishment of native species, which may outcompete invasive flora taxa. Overall, planting of native species sourced from local provenance will improve vegetation condition, habitat quality and connectivity within the site over the long term.

Photo 4-1 Weeds proliferating on existing topsoil stockpiles

Photo 4-2 Invasive Watsonia presence (Photo provided by C. Connor – Shire of Nannup)

4.1.3 Grazing Pressures

With evidence of kangaroo and rabbit activity observed within the study area, it is likely that grazing pressure has contributed to the lack of understory species throughout the site. Management strategies to exclude grazing pressures include the installation/upgrade of fencing, in combination with rabbit baiting. Rabbit netting and vermin mesh could be installed to achieve this. By ensuring that grazing species are excluded from the rehabilitation area prior to the commencement of revegetation works, ongoing control efforts can be alleviated, along with the requirement for plant guards.

Fencing is currently in place at the northern site boundary; however, no fencing demarcates the perimeter of the clearing area. It is recommended that fencing is established and upgraded where it is currently existing to exclude grazing species following revegetation.

4.1.4 Other

Phytophthora cinnamomi may exist on site. This – along with other pathogens – could be introduced through tubestock, or equipment used in rehabilitation (including on the clothes or person of site workers). This risk can be reduced by only using material from a NGIWA accredited nursery. Standard plant hygiene practices would also be utilised during revegetation, to minimise the risk of further spread (provided in Appendix D).

4.2 Implementation Schedule

Recommended timing for implementation of primary weed control and initial planting activities are shown in Table 4-1. Implementation has been broken down into three phases, detailing the tasks to be undertaken:

- prior to **(Phase I)**
- during **(Phase II)**
- and following the completion of **(Phase III)** planting and seeding.

Actual implementation timing may be impacted by the stages of clearing. availability of seedlings, contractors and rainfall. The timing and extent of ongoing maintenance activities depend on findings from site monitoring following revegetation (Section 8).

Table 4-1 Implementation schedule for primary weed control and planting at the site

Task	Timing	Process Notes
Phase I		
Sourcing of plant stock/seed	Immediately	Recommended use of native species stock (indicative list in Appendix E), sourced from local provenance (Appendix F)
Weed control – initial	At least one year prior to planting, seeding and/or movement of weed-infested topsoil stockpiles To be undertaken at two-month intervals during the growing season of weeds (following rainfall, generally between April/May through to November)	As detailed in Section 4.4
Fencing installation and upgrade	Following gravel extraction, prior to revegetation	As detailed in Section 4.3.3
Rabbit control	Following upgrade of fencing, prior to seeding/planting	As detailed in Section 4.3.4
Soil preparation	Following extraction processes. After rain, just prior to seeding	As detailed in Section 4.3.5
Seeding	Immediately following soil preparation, after rain	As detailed in Section 4.3.6
Bacteria/Mycorrhizal introduction	At seeding	As detailed in Section 4.3.7
Phase II		
Weed control – follow-up	During year of revegetation, through until time of planting and seeding after sufficient soil moisture is present.	As detailed in Section 4.4
Planting	May/June when soil moisture levels are suitable (period when reasonable rainfall has occurred or	As detailed in Section 4.5

	is predicted to occur during planting)	
Watering	Not required if planting / seeding occurs during period of suitable soil moisture content	–
Plant protection	Not required if fencing is upgraded/installed sufficiently	Installation/upgrading of fencing and elimination - as opposed to control - of grazing pests should eliminate the requirement of plant guards Plant guards not required for germination of dispersed seed
Phase III		
Monitoring	To occur: - In spring the year following implementation of works - Annually for two years following implementation - 5- and 10-years post completion To reduce ongoing costs, it is recommended that additional brief monitoring checks-ups are undertaken each month following implementation for the following growing season Topsoil mounds should be regularly monitored during clearing/revegetation of surrounding areas.	As detailed in Section 5
Weed control – follow-up	Following planting for at least one year following implementation at regular intervals. Further requirements as identified through regular monitoring.	Selective herbicides suitable for weeds present (Section 4.4)

4.3 Site Preparation

Site preparation activities are essential for the site to obtain the greatest chance of successful rehabilitation to meet completion requirements. Recommendations for site and soil preparation to be carried out prior to revegetation within the study area are outlined in Table 4-1.

Table 4-2 Summary of recommended tasks for site preparation within the study area, to be performed prior to revegetation.

Task	Purpose	Process
Weed control – initial	Remove invasive weeds Improve chances of growing success for native species (both regenerated and revegetated) by reducing competition Improve condition of site	General non-selective herbicide application for patches of mixed weeds Selective herbicide application for concentrated patches of same-type weeds.
Topsoil Storage	Maintain soil biology Enhance plant growth and seed germination, increasing chances of revegetation success	Minimise time of storage to maximise seed viability. Stockpile storage in bunds no more than 2 m height Isolate weed-infested topsoil and spread separately. Manage weeds before moving or spreading stockpiles
Fencing upgrade	Grazing exclusion	Installation of vermin mesh to be considered on existing fence on eastern and northern boundaries Recommended installation of rabbit netting to all fence boundaries
Pest control	Rabbit-specific exclusion Removes the requirement for future rabbit control Removes the requirement for plant guards	Rabbit baiting Potential for warren fumigation
Soil preparation – ripping, spreading of topsoil, management	Soil aeration and turning Moisture retention Preparation of suitable seed bed Reintroduction of carbon into soil profile	Return of topsoil to surface of revegetation area at earliest convenience. Ripping across the site contour, recommended at 1 m intervals to 800 mm depth with a bulldozer
Seeding	Adequate seed mix preparation to maximise chances of successful germination Spread of seed for implementation of revegetation	Treat seed mix Prepare seed mix by adding a microbial inoculant such as MycoApply® Maxx to reintroduce Mycorrhizal Fungi into the soil profile Prepare seed mix by adding medium grade vermiculite granules to bulk up the seed for ease of even broadcasting.

Bacteria reintroduction	Reintroduction of bacteria and carbon into soil profile that may have been lost in existing topsoil stockpiles Enhance growing conditions revegetation	Spraying of microbial inoculant such as Bactivate® (liquid form) across whole revegetation area, as per manufacturer guidance Recommended use products Bactivate5 (containing bacteria), applied with Bactivate® BioBoost Enhance (containing carbon)

4.3.1 Weed Control – Initial

As detailed in Section 4.4, widespread, non-selective herbicide application is recommended for heavily weed infested topsoil mounds and surrounding areas. Two weed management zones exist within the revegetation area: the gravel extraction area (to be cleared), and the additional rehabilitation area (to be retained and enhanced), which is further discussed in Section 4.6 below.

Within area to be cleared:

- Widespread non-selective herbicide to be applied on pre-existing topsoil mounds and surrounding cleared area to the extent of weed coverage
- Ensure that weeds are completely eradicated on topsoil mounds prior to moving them for the commencement of gravel extraction
- These mounds can then be moved for storage once weed control has also been implemented in that area on those mounds

Within area to be rehabilitated but where extraction is not occurring:

- Ongoing weed control to be implemented whilst stages 1, 2 and 3 of gravel extraction occur

Within external area of Watsonia infestation:

- Immediate and ongoing selective weed control to be implemented whilst stages 1, 2 and 3 of gravel extraction occur

Widescale natural regeneration of naturally occurring species has been noted across the site. Care should be taken during weed control, to ensure that emergent seedlings of native species are not impacted. Using selective herbicides and careful spot spraying techniques should be considered in areas where natural regeneration is occurring, as this is likely to significantly increase the future diversity and cover across the Study Area and reduce ongoing costs that may be required for infill planting.

Timing: To be undertaken at least one year prior to planting, seeding and/or movement of weed-infested topsoil stockpiles, at two-month intervals during the growing season of weeds (following rainfall, generally between April/May through to November)

4.3.2 Topsoil Storage

Topsoil mounds from previous disturbance are currently located within cleared areas, and weeds have proliferated across mound surfaces. Immediate weed control must occur on existing topsoil mounds

before they are moved for storage. Weed-infested topsoil must be kept in isolation from any further stockpiles established once clearing commences, and they should be spread separately.

Topsoil storage time should be minimized, with removal best to be done immediately before mining, and return at the earliest convenience. This will increase the viability of soil stored seed and maximise the density and diversity of regeneration. Topsoil should also be managed in a bund of no more than 2 m height. This may increase the viability of seed and plant recruitment from the topsoil. During the period of storage, recruitment of native and introduced flora taxa may occur. Weed recruitment must be actively managed on stored bunds whilst the gravel extraction process is underway.

Timing: To be undertaken immediately and throughout the clearing process.

4.3.3 Fencing Upgrade

For the purpose of grazing exclusion – as opposed to ongoing control – it is recommended that boundary fencing around the rehabilitation area is installed and upgraded prior to revegetation. Currently, fencing exists on the northern and western perimeter of the site. Existing fencing is sufficient to prevent kangaroo access, however, fencing should be installed around the extent of the rehabilitation area after extraction has occurred. Vermin mesh should be utilised for fencing. It is recommended that rabbit netting is installed to all fence boundaries at a height of ~ 600 mm, attached to the fence with 300 mm folded to the ground to act as an impenetrable mat. It is to be noted that the installation of rabbit netting is also likely to inhibit the movement of small, ground-dwelling animals into site (such as the Quenda (*Isoodon fusciventer*) (P4)). Therefore, based on the results of ongoing monitoring, a decision could be made to remove the rabbit netting at a stage when revegetated plants are well established.

To ensure that complete grazing exclusion is achieved, vermin mesh and rabbit netting must also be installed to site access gateways that may be installed.

Timing: To be undertaken after gravel extraction, before revegetation.

Photo 4-3 **Fencing present at the northern boundary of Lot 300.**

4.3.4 Pest Control

The revegetation area is considered suitable habitat introduced European Rabbits (*Oryctolagus cuniculus*), with evidence of rabbit activity observed on site. To ensure that rabbits are completely excluded from the site prior to the commencement of revegetation works, a combination of baiting and upgraded fencing is required. Baiting implementation can be carried out by a local contractor (with potential contractors outlined in Appendix F). Fumigation is also an option that can be carried out by contractors if warrens are observed within the study area. This would further ensure that rabbits are completely excluded.

Timing: To be undertaken following fencing upgrades

4.3.5 Soil Preparation

Adequate soil preparation is essential for ensuring the maximum chances of revegetation success. After each stage of the gravel extraction process, topsoil specific to the area of rehabilitation should be spread in order to enhance water catchment and provide suitable furrows for revegetation. This should occur prior to ripping for rehabilitation. When ripping occurs, topsoil will fall into the rip line, providing a better medium for plants to grow into. Ripped areas should be blended gradually with surrounding vegetated areas, ensuring no drop-off bank remains around the revegetation area.

The batters and floor of the pit should be ripped in a direction working across the contour of the rehabilitation area (i.e. east to west) to ensure that water movement is slowed, increasing the chances of water retention for greater chances of revegetation success.

One of the immediate consequences of topsoil stockpiling has been noted as a decline in organic carbon levels (Visser et al., 1984). If sawn timber (remaining from the gravel extraction process) is not deemed merchantable by the Forest Products Commission, it could be beneficial to mulch the timber and spread it across the revegetation area prior to ripping. This may allow for the carbon-containing mulch to be mixed into the soil for greatest chances of revegetation success. Unutilised timber could also be left at the site and used as a refuge for fauna.

Timing: To be undertaken directly prior to Ripping.

4.3.6 Seeding

Seed preparation is required prior to spreading. This includes appropriate seed treatment for the purpose of breaking seed dormancy and promoting successful germination. Treatment types will vary based on the species of seed. Seed species and rates recommended for this site are detailed in Appendix E. Seed species are selected for their suitability to enhance black cockatoo foraging and breeding habitat, along with providing value to other fauna species. Species are additionally selected based on their suitability for the site soil type and surrounding/remnant native vegetation present on site.

It is recommended for this site that approximately 2 kg of seed is spread per hectare.

Seeds should be spread using direct seeding methodology, occurring immediately following ripping of the target area. This would allow for greater chances of successful seed bedding after rain. By spreading

seed directly following ripping, the seed is subject to better soil contact, as opposed to being spread on a flat, compact surface.

It is recommended that seed is mixed with a microbial inoculant such as MycoApply® Maxx to enhance the soil profile. Mycorrhizal fungi are often reduced or destroyed during the topsoil stockpiling process. The addition of a microbial inoculant would enhance the extent of Mycorrhizal Fungi in the soil, potentially aiding successful revegetation and supplementing any loss in Mycorrhizal Fungi that may have occurred during the stockpiling process. Vermiculite granules of medium size should also be added to the seed mix to increase moisture and nutrient retention for germination success.

Timing: To be undertaken immediately following soil preparation, prior to rain.

4.3.7 Bacteria Reintroduction

Prolonged topsoil stockpile storage intensifies the loss of the bacterial element of the soil (Harris & Birch, 1989). Some older, pre-existing stockpiles at the site may have suffered a loss in soil ecosystem function. To ensure that the bacterial community within the soil is sufficient to promote plant growth, bacteria can be reintroduced to the soil profile prior to planting across all topsoil stockpiles. The product Bactivate®5, applied with Bactivate® BioBoost Enhance can be sprayed in liquid form across the site to introduce bacteria, along with some carbon to the soil. This will increase chances of successful germination and plant growth.

Timing: To be undertaken following seeding, prior to Phase II processes and planting.

4.4 Weed Control

The implementation of a weed control program is essential as part of a revegetation plan, to support the success of native plant establishment from seed and tube stock, as well as encouraging natural regeneration within areas not requiring significant revegetation.

Weed control for the Study Area is inclusive of:

- Initial widespread/general control, during the growth stage allowing sufficient time for follow up treatment prior to planting. This should include grass and broadleaf weeds on existing topsoil stockpiles, as well as the surrounding extent of weeds, including any weeds in the adjacent rehabilitation area where no gravel will be extracted.
- Initial targeted control of Watsonia infestation, during the growth stage (April to November) occurring concurrently to other initial widespread/general control.
- Ongoing targeted control of remnant weeds on topsoil stockpiles and/or surrounding areas. In areas where natural regeneration is occurring additional care should be taken, with consideration of selective herbicides and careful spot spraying to specifically target weed species. Personnel should be trained and able to identify native species, including emergent seedlings.
- Targeted control of remnant weeds following planting/seeding. Additional care should be taken to protect establishing native plants, with consideration of selective herbicides

and careful spot spraying to specifically target weed species. Personnel should be trained and able to identify native species, including emergent seedlings.

- Targeted control of remnant weeds identified during ongoing monitoring. Once again, care must be taken to avoid impact to native plants. Selective herbicides can be used, and careful spot spraying to avoid impact to non-target species. Personnel should be trained and able to identify native species, including emergent seedlings.

Chemical weed control should be undertaken in accordance with the general guidelines for herbicide application included in Table 4-3.

Table 4-3 Standard guidelines for herbicide application

Standard	Detail
Trained personnel and legal use	Herbicide application should be undertaken by qualified personnel who are able to identify relevant weed species, identify and avoid native species including emergent seedlings, and follow legal requirements for application (including application in accordance with manufacturers' instructions and safety requirements).
Monitor for weeds appearing later/not identified in survey	Late spring and summer spraying may be necessary for weeds that were not present during initial treatment.
Work planning/staging	Weed control activities should generally commence in areas of best condition, moving into areas in worse condition. This helps to minimise the risk of transporting weeds from the low condition areas into better areas.
Weather conditions	Spray during still, dry conditions, when no rain is predicted within 12 hours. Conduct spraying to minimise spray drift that could affect non-target species.
Timing of post-treatment planting	Planting should not occur until at least two weeks after spraying, or once sprayed weeds are effectively dead.

4.4.1 Species-Specific Control Methods

Note: Weed management methods should be checked and carried out by a suitably qualified weed contractor with specialist knowledge of weed control in natural areas.

Grasses

Weedy grasses observed at the site included annuals *Avena barbata* (Wild Oat), *Briza maxima* (Blowfly Grass) and *Ehrharta longiflora* (Annual Veldt Grass), and the perennial *Cenchrus clandestinus* (Kikuyu). Grasses are generally concentrated in patches on topsoil stockpiles but are also present in limited numbers within remnant vegetation, becoming more frequent on edges of vegetated areas.

For initial control (May/June and August/September one year prior to planting), blanket weed control using non-selective herbicide such as Glyphosate is recommended for areas invaded with both grass and broadleaf weeds. Note that if areas present grassy-only weeds, grass-selective herbicide such as Haloxyfop can also be used for efficiency.

For follow-up control (May/June just prior to planting and August/September following planting, plus ongoing control as required after monitoring for at least 15 months after revegetation), grass-selective herbicide can be utilised to eliminate remaining invasive grasses.

Control method: For non-selective application, spray with Glyphosate (mixed as per label instructions) throughout areas requiring revegetation. For grass-selective application, spot-spray with a Haloxyfop herbicide (mixed as per label instructions).

Broadleaf Weeds

Broadleaf weeds were observed in concentrated patches on and surrounding topsoil stockpiles, and in scattered numbers throughout remnant vegetation (particularly on edges). These may easily be controlled through initial widespread application of non-selective herbicide, such as Glyphosate. If broadleaf weeds persist, selective herbicide can be applied, such as Lontrel®.

Control method: For non-selective application, spray with Glyphosate (mixed as per label instructions) throughout areas requiring revegetation. For broadleaf-selective application, spot-spray with a Lontrel® herbicide (mixed as per label instructions).

Invasive Herbs

One observation of *Asparagus asparagoides* (Bridal Creeper), along with multiple observations of other invasive herbs such as *Lysimachia arvensis* (Pimpernel) and the shrubby perennial herb *Gomphocarpus fruticosus* (Cottonbush) were recorded during the site visit. Although only one record of Bridal Creeper was recorded within the rehabilitation area, it is within the remnant vegetation that is to be retained, adjacent to the clearing envelope. It is also a WoNS and Declared Pest (DPIRD, 2024; Weeds Australia, 2021), and exclusion of the species prior to revegetation would be favourable in preventing future management issues. The use of herbicides have been identified by Weeds Australia (2021) as the most effective control method for controlling the species. This methodology is also recommended for other invasive herbs.

Initial, non-selective application or herbicide such as Glyphosate is recommended, with ongoing monitoring to be utilised as a measure of exclusion effectiveness. Glyphosate application can occur during both initial and follow-up control periods for the site.

Control methods: Spot-spray the isolated plant with Glyphosate (mixed as per label instructions).

Bulbous Weeds

An extensive infestation of *Watsonia meriana* (Watsonia) exists at the property, along with multiple patches of *Freesia leichtlinii* subsp. *alba* × *leichtlinii* subsp. *leichtlinii* (Freesia). With a large Watsonia infestation area to be controlled, selective herbicide is recommended for the most efficient methodology. Spot spraying or wiping foliage with non-selective Glyphosate could also be implemented, however this methodology would be much more labour intensive. For Freesias that are not in the Watsonia infestation area, general control within areas of concentrated mixed weed populations should be sufficient.

Control methods: Spot-spray plants with appropriate selective herbicide, for example a herbicide containing Chlorsulfuron or Metsulfuron (mix as per label instructions). For Freesias that in concentrated mixed weed patches, apply non-selective application of Glyphosate (mixed as per label instructions).

Woody Weeds

One mature *Acacia dealbata* (Silver Wattle) occurrence was recorded. The suggested method of management and control for mature plants is the application of 250 ml of Access® in 15 L of diesel to basal 50 cm of trunk (basal bark), or drill and fill with 50% glyphosate (Western Australian Herbarium, 1998-). Old plants can also be ringbarked. During ongoing monitoring, recruitment can be identified, and if it any seedlings are observed, they should be manually hand-pulled.

Control methods: Apply Access® in 15 L of diesel to basal 50 cm of trunk (basal bark), or drill and fill with 50% glyphosate (mix as per label instructions).

4.4.2 Weed Control Schedule

Adequate weed control is essential prior to revegetation, soon after planting and then ongoing maintenance to ensure successful seedling establishment. It is essential that the weeds currently proliferating on existing topsoil stockpiles are eradicated prior to relocation. If this is not achieved, it is likely that ongoing weed management issues will occur following revegetation. If stockpile weeds are managed sufficiently, only minor weed management efforts should be required following revegetation. Table 6-2 provides a guide to weed control implementation at Lot 300. Ongoing maintenance weed control following revegetation will be required based on results from site monitoring.

Table 4-4 Recommended weed control timeline within the study area.

Timing		Control
Phase I (prior to extraction)	At two-month intervals During the growing season (April/May through until November)	Widespread, non-selective herbicide control Targeted, selective control within Watsonia infestation area.
Phase II (following extraction, prior to planting/seeding)	May/June	Non-selective herbicide control
	August/September	
Phase III (following revegetation/during monitoring)	May/June	Non-selective or selective herbicide where/if required, as dictated by site monitoring results following revegetation
	August/September	Selective herbicide for remnant weeds where/if required

4.5 Planting

4.5.1 Revegetation Requirements

The total revegetation area at Lot 300 is 3.91 ha in size (Figure 1 Appendix A). Following clearing, the gravel extraction site will be in Completely Degraded condition, with no native vegetation present. The additional rehabilitation area adjacent to the clearing envelope consists of cleared area (Degraded and Completely Degraded) and pockets of remnant vegetation (Good to Very Good condition) (Figure 4, Appendix A). Requirements for revegetation are to recreate or improve the existing environmental values of the site, achieving a species composition, structure and diversity that is similar to what existed prior to gravel extraction. Values include the provision of black cockatoo habitat species, along with the introduction of other flora taxa that may be utilised by other fauna (also providing value to the WRP (Critically Endangered).

4.5.2 Plant Stock

Seedlings may include tube stock, with a preference for forestry pots over small plant cells to maximise chances of success. Forestry pots are economical and are generally at a stage of growth that is able to establish successfully during revegetation.

Advanced 1 litre pots are recommended for planting of tree species. Benefits to utilising advanced plants include their ability to withstand erosion events better than seedlings, their higher survival rates and their ability to gain better access to ground moisture when planted with an auger. This would allow plants to more effectively withstand dry periods, additionally decreasing the number of plants required

to cover the revegetation area. If plants are subject to grazing pressures, they are additionally more resilient to rabbit and kangaroo damage.

An indicative list of species for revegetation are listed in Appendix E. It is possible that not all species listed will be available, or additional species will be required to reach the diversity criteria. In this case, other species could be considered, based on the species list or additional observations of taxa present within the adjacent Jarrah Marri vegetation (Appendix C). Where possible, seeds and tube stock should be sourced from suppliers that collect local provenance seed and propagation material, as this is more likely to be genetically similar to the plants that would naturally have occurred within the Study Area. Local plants and seed are also more likely to be suited to site conditions. A list of local potential suppliers and revegetation contractors is provided in Appendix F.

Tubestock may help introduce microorganisms that have become depleted in the site soil, which can be beneficial to revegetation success. It is essential that plants are sourced from a reputable supplier and inspected for health prior to purchase and importation to the site Stock must be sourced from accredited dieback free suppliers (refer to Appendix F for recommended suppliers).

4.5.3 Density

Sufficient planting density for the study area is recommended, of at least 2500 per hectare, inclusive of 600 canopy species and the remainder under and midstory. This planting density does not include seeding, which is discussed in Section 4.3.6.

The majority of the Study Area is to be treated as one management zone, with planting methodology consistent across the area. This includes all cleared areas. An exception to this methodology will be within remnant vegetation pockets in Good or Very Good condition that occur in the adjacent rehabilitation area, discussed further in Section 4.6.2 below.

Professional revegetation practitioners should be engaged to oversee appropriate distribution of seedlings throughout the site, which will vary across the site. The recommended densities are aimed at achieving a target of 600 stems/ha after 10 years in overstorey species, along with mid stratum and ground stratum vegetation cover of 30 % after 2 years, 45 % after 5 years, and 60 % after 10 years following revegetation.

Plants should be randomly distributed, rather than evenly spaced, to achieve a natural effect. Grouping of several seedlings of the same species will also reflect a more natural distribution.

4.5.4 Diversity

Species diversity of 70% (42 species) of the total taxa recorded in the adjacent Very Good condition remnant vegetation (60 species) is required after 10 years, to achieve a Good or better vegetation condition rating (Keighery, 1994). This diversity will be achieved through a combination of direct planting and seeding (species list in Appendix E-49), regeneration from stored topsoil and natural recruitment from adjacent remnant vegetation.

4.5.5 Timing

Planting of seedlings across most of the site should occur between the months of or around May to June. This should occur when soil moisture levels are suitable, usually following a rainfall event.

Timing of planting must also give due consideration to weed control activities, with regular weed control carried out, beginning at least one year prior to planting and seeding. Weed control recommended for the site is detailed in Section 6.

4.5.6 Methodology

All plants should be planted with the use of an Auger to ensure that sufficient planting depth is achieved, and a shallow basin is formed. Plant root balls should be loosened in soil during planting to overcome compaction and improve drainage. This will facilitate successful plant establishment. Plants are not required to be staked for support. Free standing plants generally have increased durability and strength in the long-term, as opposed to staked plants.

For seedlings, low phosphorous fertiliser pills are recommended to be added at the time of planting (with the exclusion of Proteaceae spp.). For advanced plants, it is recommended that TerraCottem© soil conditioner granules are added during planting (or a similar product). This will increase the likelihood of successful plant growth in marginal soil conditions.

Plants should be placed in suitable locations based on individual species light requirements or growth habits. Professional revegetation practitioners distribute plants and seed accordingly, relevant to the existing values of the area.

If possible, storage and translocation of mature *Xanthorrhoea* spp. and *Macrozamia riedlei* from within the vegetated areas to be subjected to clearing is recommended prior to clearing. Plants can be removed using a small excavator, placed in a shallow pit in a holding area and covered with soil from the site with fronds exposed. Once buried, fronds just above ground level should be cut. Once extraction is completed and planting is being undertaken, plants can be removed and replanted as required.

4.5.7 Revegetation Maintenance

Revegetation works will require ongoing maintenance after planting, including:

- follow-up weed control as specified in Section 4.4, and
- replacement plantings.

It is expected that following revegetation there will be a maximum loss of about 50% of the original plantings. Subsequently, replacement plantings may be required to maintain the original planting numbers at a minimum of 30 % cover after 2 years, 45 % cover after 5 years and 60 % cover after 10 years following revegetation for mid stratum and ground stratum cover, along with a density of 600 stems/ha after 10 years for overstorey species.

4.6 Management of Adjacent Rehabilitation Area

The area immediately abutting the eastern boundary of the clearing area is to be included in the rehabilitation area but will not be subject to clearing (3.58 ha). This area includes Degraded and Completely Degraded or cleared areas, as well as patches of remnant vegetation in Good or Very Good condition. These will be considered separately, as discussed below.

4.6.1 Cleared Areas (Degraded or Completely Degraded Condition)

These areas will be treated as per the recommendations for the remainder of the site, as they do not include any significant numbers of naturally occurring flora species. This makes up 1.05 ha of the additional rehabilitation area. This area is to be included in the total revegetation area as it required intensive management to regenerate to a condition that will achieve the target criteria (Section 1.7).

4.6.2 Remnant Vegetation Areas (Good or Very Good Condition)

These areas including existing vegetation that retains basic vegetation structure, or has the ability to regenerate, with numerous species noted to be regenerating from seed within these areas. Weed management should be prioritised, with care taken to protect natural regeneration by using selective herbicides and careful spot spraying. Broad herbicide application within these areas should be avoided. Planting densities across these areas will be significantly lower, it is likely that with careful weed control these areas will naturally regeneration to achieve sufficient plant cover and density. Infill planting could be considered in sparser areas of the remnant vegetation, including if monitoring indicates the targets are not being achieved. This makes up 0.39 ha of the additional rehabilitation area. This area is to be included in the total revegetation area as it will require intensive weed management and monitoring to determine any infill planting requirements, to regenerate to a condition that will achieve the target criteria (Section 1.7).

4.7 Management of Additional Rehabilitation Pockets

Eight additional rehabilitation areas occur to the east of the Study Area (0.34 ha) (Figure 1, Appendix A). Five of the additional areas were completely cleared. One area contained a single tree in poor health, and two areas consisted of open tree canopy with varying levels of understorey shrubs and native regrowth. The areas were in predominantly Degraded to Completely Degraded vegetation condition, with one area of Good condition evident.

Management of predominantly cleared areas in Degraded to Completely Degraded condition should be treated as per recommendations stated above in Section 4.6.1. The area of Good vegetation condition should be treated as per what is outlined in Section 4.6.2. It is to be noted that these areas were not assessed by SW Environmental and were instead interpreted through communications and photographic evidence provided by the Shire of Nannup. If native germination and therefore

regeneration is observed within areas currently mapped as Degraded with tree canopy cover within the additional rehabilitation pockets, vegetation condition can be upgraded to Good vegetation condition.

5 Monitoring and Maintenance

A program of revegetation monitoring is required to ensure that the revegetation objectives are achieved. Monitoring is recommended to be undertaken at the following intervals:

- During gravel extraction works – constant monitoring of topsoil mounds for weeds
- In spring the year following implementation of revegetation works
- Annually in spring for the following two years
- After five years
- After 10 years

An additional recommendation includes regular (monthly) quick check-ups during the initial monitoring interval to ensure that weed and pest control measures are acting effectively on the site. This may reduce long-term costs by decreasing the requirement for significant maintenance works down the track.

Recommended monitoring methodology is inclusive of two procedures:

- Overstorey/canopy monitoring utilising permanent 10 m x 10 m plots to sample tree density (number of stems), height, and stem diameter at breast height (DBH) by species (for measuring growth rates and vegetation cover). Species present in the understorey will also be listed, to allow comparison with the baseline floristic data and contribute to the calculation of species richness.
- Understorey monitoring utilising permanent transects consisting of a line of ten 1 m x 1 m quadrats (along the edge of the 10 m x 10 m plot) to sample native plant density and species present (for measuring vegetation cover, species richness, along with the presence of invasive species).
- It is recommended that two monitoring plots per hectare are established, totalling nine monitoring plots across the Study Area.
- The location of the plots will be confirmed in the spring following the implementation of the rehabilitation. The adjacent area should include at least two monitoring plots, one within the remnant vegetation and one within the areas that were previously cleared.

Graphs can then be produced to illustrate vegetation cover, species richness and growth rates. Signs of fauna habitat utilisation and signs of pest activity may be opportunistically recorded during monitoring visits. Monitoring of the presence of weed species and pest activity should determine the control measures required at the site. Where weed and pest control issues are identified, reference should be made to control methodologies detailed in Section 6 and 5.2. If additional weed or pest species become established over time, advice must be sought from a suitably experienced contractor to determine suitable control methods.

Fence boundaries should also be inspected upon each monitoring visit to ensure that their integrity has not been compromised. If fencing becomes inadequate, maintenance activities should be undertaken. Once native plant species are suitably established, rabbit netting can be removed to allow the access of

smaller native fauna species to utilise the revegetated habitat. Where planting is unsuccessful and does not meet completion targets, additional planting may be required. If the scale of additional planting required is significant, consideration should be given as to potential reasoning why seedling establishment was unsuccessful, and any issues should be addressed for subsequent plantings. Examples of problems may be:

- Grazing by fauna due to insufficiencies in fencing upgrade
- Competition with weeds
- Poor planting technique
- Poor herbicide application
- Excessive shading
- Localised conditions not suited to species
- Physical disturbance by humans

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Appendix A Figures

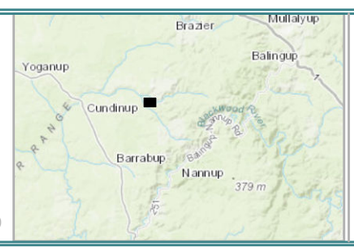
Figure 1 Location Map of Clearing and Revegetation Area
Figure 2 Clearing Location and Stages
Figure 3 Watsonia Infestation Mapping
Figure 4 Flora Reference Quadrat and Vegetation Condition

FIGURE 1 LOCATION MAP OF CLEARING AND REVEGETATION AREA

CUNDINUP PIT (LOT 300)
CUNDINUP WEST ROAD, CUNDINUP

Ref: SW551 rehab_GJ_May25
Date: 2/07/2025 Author: SP

— Road
Proposed Clearing (2.07 ha)
Proposed Rehabilitation (3.91 ha)



A3 @ 1:2500
0 20 40 80 m
GRID: GDA zone 50
N

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

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www.swenvironmental.com.au

FIGURE 2 CLEARING LOCATION AND STAGES

CUNDINUP PIT (LOT 300)
CUNDINUP WEST ROAD, CUNDINUP

Ref: SW551 rehab_GJ_May25
Date: 2/07/2025 Author: SP

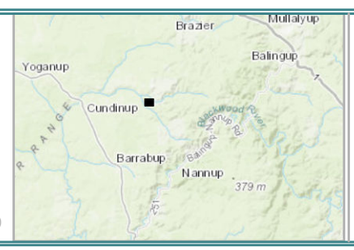
— Road

Vegetation Condition

Stage 1 clearing (approximate)

Stage 2 clearing (approximate)

Proposed Rehabilitation (3.91 ha)



A3 @ 1:1500

0 10 20 40 m

GRID: GDA zone 50

N

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FIGURE 3 WATSONIA INFESTATION MAPPING

CUNDINUP PIT (LOT 300)
CUNDINUP WEST ROAD, CUNDINUP

Ref: SW551 rehab_GJ_May25
Date: 2/07/2025 Author: SP

— Road
Proposed Clearing (2.07 ha)
Proposed Rehabilitation (3.91 ha)

Watsonia Density Mapping
Very Dense (~95 %)
Scattered (~20 %)
Sparse (~1 %)

A3 @ 1:5000
0 30 60 120 m
N
GRID: GDA zone 50

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FIGURE 4 FLORA REFERENCE QUADRAT AND VEGETATION CONDITION

CUNDINUP PIT (LOT 300)
CUNDINUP WEST ROAD, CUNDINUP

Ref: SW551 rehab_GJ_May25
Date: 2/07/2025 Author: SP

— Road

Proposed Rehabilitation (3.91 ha)

Clearing

Stage 1 clearing (approximate)

Stage 2 clearing (approximate)

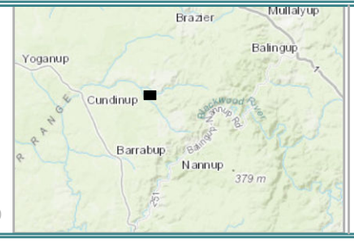
Vegetation Condition

Completely Degraded

Degraded

Good

Very Good



A3 @ 1:2500

0 15 30 60 m

GRID: GDA zone 50

N

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Appendix B Raw Reference Quadrat Data

Quadrat ID	C01
Personnel	Kelly Paterson, Georgia Johnsen
Date	16/04/2025
Datum	GDA 94
UTM Zone	50
Easting	387737.8946 (NW Corner)
Northing	6256015.0797 (NW Corner)
Structural Description	*Corymbia calophylla* and *Eucalyptus marginata* mid closed forest over *Xanthorrhoea preisii* low isolated shrubs over *Hibbertia hypericoides, Leucopogon capitellatus* and *Banksia dallaneyi* low open shrubland over *Conostylis aculeata* isolated clumps of forbs over *Desmocladus fasciculatus* and *Netrostylis* sp. Jarrah Forest (R. Davis 7391) closed sedgeland.
Vegetation Condition (Southwest Botanical Province)	Very Good
Fire History	>10 years
Disturbance	Logging, grazing, minor weeds
Landform Type	Upper Slope
Slope Class	Very Gently Inclined (~1°)
Soil Type	Sandy Loam
Soil Colour	Brown/Grey
Rock Outcropping	None
Surface Stoniness	2 – 10 % (laterite)

Taxon	**Height (m)**	**Cover (%)**
Corymbia calophylla	18	70
Eucalyptus marginata	17	20
Xanthorrhoea preissii	0.6	15
Xanthorrhoea gracilis	0.4	<2
Hakea lissocarpha	0.4	<2
Hibbertia hypericoides	0.3	20
Styphelia propinqua	0.3	<2
Hibbertia cunninghamii	0.3	<2
Hakea amplexicaulis	0.2	<2
Leucopogon capitellatus	0.2	10
Conostylis aculeata	0.2	5
Billardiera variifolia	0.2	<2

**Briza maxima*	0.2	<2
Poaceae sp. [sterile annual grasses]	0.2	<2
Tetratheca (*hispidissima*)	0.15	<2
Banksia dallanneyi	0.1	10
Banksia bipinnatifida	0.1	<2
Styphelia erectifolia	0.1	<2
Bossiaea ornata	0.1	<2
Desmocladus fasciculatus	0.1	60
Netrostylis sp. Jarrah Forest (R. Davis 7391)	0.1	40
Chamaescilla corymbosa	0.1	<2
Xanthosia huegelii	0.1	<2
Lomandra sericea	0.1	<2
Lomandra sp. (nigricans group)	0.1	<2
Xanthosia candida	0.1	<2
Stylidium caespitosum	0.1	<2
Scaevola calliptera	0.1	<2
Dampiera [*linearis* group]	0.1	<2
Sphaerolobium sp.	0.1	<2
Pyrorchis nigricans	0.1	<2
Microlaena stipoides	0.1	<2
Corymbia calophylla	18	70
Clematis pubescens	-	<2
Opportunistic Taxa		
Hovea elliptica		
Macrozamia riedlei		
Luzula meridionalis		
Opercularia hispidula		
Banksia grandis		
Stylidium [*amoenum*]		
Acacia [*insolita*]		
Orianthera serpyllifolia subsp. *angustifolia*		
Persoonia longifolia		

Note: Taxa prefaced with * indicates that they are alien to Western Australia. Species epithet in () indicates tentative ID.

Photos

(NW Corner)

(SE Corner)

Appendix C Vascular Plants Observed

Family	Taxon
Apiaceae	*Pentapeltis silvatica*
	Platysace filiformis
	Xanthosia candida
	Xanthosia huegelii
Apocynaceae	*Gomphocarpus fruticosus
Araliaceae	Trachymene pilosa
Asparagaceae	**Asparagus asparagoides*
	Lomandra sp. [*nigricans* group]
	Lomandra sericea
	Thysanotus sp.
Asteraceae	**Arctotheca calendula*
	**Hypochaeris glabra*
Brassicaceae	**Raphanus raphanistrum*
Campanulaceae	*Lobelia* sp.
Cyperaceae	*Morelotia octandra*
	Netrostylis sp. Jarrah Forest (R. Davis 7391)
Dilleniaceae	*Hibbertia cunninghamii*
	Hibbertia hypericoides
Elaeocarpaceae	*Tetratheca* [*hispidissima*]
	Tremandra diffusa
Ericaceae	*Leucopogon verticillatus*
	Leucopogon capitellatus
	Styphelia erectifolia
	Styphelia propinqua
Fabaceae	*Acacia* [*insolita*]
	Acacia applanata
	Acacia extensa
	Acacia pulchella
	Bossiaea aquifolium
	Bossiaea ornata
	Gompholobium polymorphum
	Hovea elliptica
	Kennedia prostrata
	Mirbelia dilatata
	Sphaerolobium sp.
Goodeniaceae	*Lechenaultia biloba*
	Scaevola calliptera
Haemodoraceae	*Conostylis aculeata*
	Haemodorum discolor
Hemerocallidaceae	*Chamaescilla corymbosa*

Iridaceae	**Freesia leichtlinii* subsp. *alba* x *leichtlinii* subsp. *leichtlinii*
	**Watsonia meriana*
	Patersonia occidentalis
Juncaceae	*Luzula meridionalis*
Loganiaceae	*Orianthera serpyllifolia* subsp. *angustifolia*
Myrtaceae	*Corymbia calophylla*
	Eucalyptus marginata
	Hypocalymma angustifolium
	Taxandria parviceps
Orchidaceae	*Caladenia flava*
	Pyrorchis nigricans
Phyllanthaceae	*Lysiandra calycina*
Pittosporaceae	*Billardiera* [*variifolia*]
Poaceae	**Avena fatua*
	**Briza maxima*
	**Cenchrus clandestinus*
	**Ehrharta longiflora*
	Microlaena stipoides
Primulaceae	**Lysimachia arvensis*
Proteaceae	*Banksia grandis*
	Banksia bipinnatifida
	Banksia dallanneyi
	Hakea lissocarpha
	Hakea amplexicaulis
	Persoonia longifolia
	Synaphea [*gracillima*]
Ranunculaceae	*Clematis pubescens*
Restionaceae	*Desmocladus fasciculatus*
Rubiaceae	*Opercularia hispidula*
Rutaceae	*Philotheca spicata*
Stylidiaceae	*Stylidium caespitosum*
Xanthorrhoeaceae	*Xanthorrhoea gracilis*
	Xanthorrhoea preissii
Zamiaceae	*Macrozamia riedlei*

Note: Taxa prefaced with * indicates that they are alien to Western Australia

Appendix D Plant Hygiene

Activity	Requirement
All site access – personnel	Ensure shoes and gloves are clean. Sterilize if known to have recently visited a site where pathogens are present (e.g. *Phytophthora spp*), or working in wet areas. This can be achieved by first scraping boots clear of mud, then standing the soles in a disinfecting solution that contains benzalkonium chloride. The remainder of the boot should be rinsed or sprayed with disinfecting solution. Note: disinfecting solutions should be prevented from entering any water bodies. Use of rubber boots (gumboots) is recommended because of the ease of cleaning these.
Use of tools and machinery	All tools and machinery should be adequately cleaned, and if necessary, disinfected, prior to use on the site, especially if previously used in a damp area or where disease is known to be present.
Tubestock acquisition	Ensure stock has no signs of disease, e.g. no withered or discoloured leaves, deformed growth, discolouration, shrivelled or insufficient looking quantity of roots; no visible pests on foliage, stems or roots; and no weeds growing in pots.

Appendix E Indicative Revegetation Species List and Seed Rates

	Planting			Seeding	
	Per Ha (Stems)	Total (Stems)	Plant Size	Per Ha	Total (g)
Canopy					
Eucalyptus marginata	315	**1232**	Forest Tube	240	**938**
Corymbia calophylla	315	**1232**	Forest Tube	280	**1095**
Mid Story					
Acacia pulchella	-	**-**	-	185	**723**
Anigozanthos manglesii	125	**489**	Forest Tube	100	**391**
Banksia grandis	210	**821**	Forest Tube	-	**-**
Bossiaea aquifolium	-	**-**	-	185	**723**
Bossiaea linophylla	-	**-**	-	185	**723**
Chorizema sp.	-	**-**	-	10	**39**
Conostylis aculeata	315	**1232**	Forest Tube	-	**-**
Hakea amplexicaulis	195	**762**	Forest Tube	-	**-**
Hakea cyclocarpa	195	**762**	Forest Tube		
Hakea lissocarpha	195	**762**	Forest Tube	-	**-**
Hibbertia cunninghamii	315	**1232**	Forest Tube	-	**-**
Hibbertia hypericoides	315	**1232**	Forest Tube	-	**-**
Hovea chorizemifolia	-	**-**	-	240	**938**
Hypocalymma angustifolium	-	**-**	-	240	**938**
Patersonia occidentalis	-	**-**	-	100	**391**
Ground Cover					
Kennedia prostrata	-	**-**	-	240	**938**
Banksia dallanneyi	125	**489**	Forest Tube	-	**-**
Dampiera linearis	125	**489**	-	-	**-**
Total	2745	**10733**	**(Grams)**	2005	**7840**

This is an indicative list only. It is possible that not all species listed will be available, or additional species may be required to reach the diversity criteria. In this case, other species could be considered, based on the species list for the adjacent Jarrah Marri vegetation.

Appendix F Relevant Local Suppliers and Contractors

Potential local plant/seed stockists

Note: early ordering of plant/seed is of high importance. Ordering from multiple suppliers as opposed to just one may decrease the risk of not obtaining stock.

Carramar Coastal Nursery: 1834 Mandurah Road, Port Kennedy, Ph: 0407 472 894

Hamel Nursery: 178 Attein Road, West Coolup, Ph: 0439 769 379

Leschenault Landcare Community Nursery: 114 Johnston Road, Bunbury, Ph: 0477 799 900

Geographe Community Landcare Nursery: Queen Elizabeth Ave, Busselton, Ph: 0429 644 885

The Tube Nursery: Blond St, Cowaramup, Ph: 9755 5509

Everyday Potted Plants: Sebbes Rd, Forest Grove, Ph: 9757 7424

Boyanup Botanical: South West Highway, Boyanup, Ph: 9731 5470

APACE: 1 Johanna St, Fremantle, Ph: 93361262

Potential local revegetation contractors

CapeLife Environmental Services: 57 Kevill Road, Margaret River, Ph: 0422 428 884

Tranen Revegetation Southwest: 20 Possum Place, City of Busselton, Ph: 9754 2643

Potential local pest control contractors

Animal Pest Management Services: 4/2 Lot 103 Estuary Drive, Bunbury, Ph: 9726 2537