



BUSHLAND REHABILITATION AND REVEGETATION GUIDELINES

CONSERVATION MANAGEMENT PLAN APPENDIX D

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Amendment History

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1	19/08/2013	First version	Joanne Wann (JAH EM)	J. Fraser
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1 Introduction

No areas within the Jandakot Airport Conservation Precincts are currently identified as requiring rehabilitation or revegetation. However, in the event that revegetation is required to be undertaken at some future point, these Rehabilitation and Revegetation Guidelines have been developed to assist in planning.

2 Triggers for Revegetation.

The need to undertake rehabilitation or revegetation within the Conservation Precincts of Jandakot Airport may be triggered by:

- Bushfires (where natural regeneration has not been successful).
- Impacts of weeds on vegetation condition are not successfully managed by weed control (i.e. areas defined as degraded in 2016 bushland condition survey show further decline in subsequent 5-yearly survey despite weed treatment).
- Impacts of dieback on vegetation condition are not successfully managed by phosphite and other dieback management measures (i.e. areas defined as degraded in 2016 survey show further decline in subsequent 5-yearly survey despite dieback treatment).
- The closure of surplus or non-essential firebreaks and access tracks.
- Verge impacts from the construction of new roads as detailed in Master Plan 2014.
- The creation of wildlife corridors.

3 Understanding the Area to be Revegetated

It is essential to know as much as possible about the area to be revegetated, including:

- Original vegetation type, including dominant species.
- Dieback status.
- Threats (e.g. feral and native grazing pressures, susceptibility to erosion, etc.).

4 Species for Use in Revegetation

Only species endemic to the local area that are consistent with the area's original vegetation type may be used for revegetation works. The only exceptions to this are:

- For revegetation of heavily impacted dieback areas where the original dominant vegetation type is known to be dieback-susceptible, and using these species in revegetation is likely to have a low probability of success.
- The Conservation Management Plan action requiring inclusion of "open flowered members of Myrtaceae in the perimeter plantings (Precinct 1A and 1B) and in bushland rehabilitation" in order to provide a preferred food source for the wasp that pollinates *Caladenia huegelii*.

Plant species endemic to Jandakot Airport are listed in Attachment 1. Nearly half of the species naturally occurring on the site are susceptible to dieback, including many of the tree species.

4.1 Dieback Infested Areas

In dieback areas, only dieback resistant species (see Attachment 1) should be planted. In areas adjacent to dieback infestations or high risk areas for dieback spread (e.g. areas subject to significant earthmoving), primarily dieback resistant species should be planted.

Eucalyptus marginata (Jarrah) is particularly susceptible to dieback; however, some dieback resistant populations have been identified in South West WA. JAH will obtain seed produced by dieback resistant Jarrah trees for revegetation in dieback infested areas where there has been significant Jarrah overstorey decline.

In addition, *Eucalyptus tottiana* (Prickly bark) and *Nuytsia floribunda* (WA Christmas tree) will be considered for planting in infested areas, as these species have demonstrated high levels of natural resistance to dieback. Shearer and Hill (1989) observed that in *Banksia* woodlands of the Bassendean Dune system of the Swan Coastal Plain, most of the dominants and many understorey species are susceptible to *P. cinnamomi*. *Banksia attenuata*, *B. ilicifolia* and *B. menziesii* are commonly lost from communities, leaving scattered trees of *Eucalyptus tottiana* and *Nuytsia floribunda*, both of which are largely resistant to infection.

4.2 Local Provenance

In addition to using plants or seeds of the right species for revegetation, it is also important to use plants that have the right genes for the local area. It is JAH policy to wherever practicable use or propagate seed of local provenance, as this maintains the genetic diversity and integrity of a given species. Plants of local provenance are better adapted to local conditions and prove to be more successful in revegetation works. The primary exception to this is for revegetation of heavily impacted dieback areas where dieback-resistant strains sourced from other localities may be used.

The hierarchy of provenance seed is summarised below:

- 1st Preference – seed collected from airport land
- 2nd Preference – seed collected from the Swan Coastal Plain within 20 km of Jandakot Airport
- 3rd Preference – seed collected from the Swan Coastal Plain.

5 Revegetation Techniques

Revegetation can be undertaken using three main techniques: regeneration, direct seeding and replanting, or a combination thereof.

The Jandakot Airport Banksia Woodland Revegetation Project, undertaken by the WA Department of Biodiversity, Conservation and Attractions (DBCA) utilising offset funds from EPBC 2009/4796, has investigated the effectiveness of different methods of banksia woodland restoration. Once released/published, the outcome of this research will provide further guidance for future revegetation works in the Conservation Precincts of Jandakot Airport.

5.1 Regeneration

Regeneration involves the natural regrowth of endemic vegetation, using existing seed bank in the soil or from nearby vegetation sources. It guarantees that vegetation is endemic and possesses the local genes to be successful. Where practical, natural regeneration of native species, in preference to replanting, is encouraged in the first instance as the revegetation method.

Regeneration, however, is most appropriate for areas that have only recently been cleared, where topsoil is intact and seed stock is available. Areas of long-term disturbance or landuse may not be appropriate. The transfer of topsoil from recently cleared areas of the same vegetation type may be beneficial in promoting regeneration. Topsoil may be collected from cleared areas for reuse in revegetation as long as materials from dieback infested areas are kept within the infestation boundaries.

However, this technique is unlikely to be successful for species that do not readily propagate via a soil-based seed bank and may need to be augmented by direct seeding or replanting.

5.2 Direct Seeding

Direct seeding involves the sowing of seeds, either by hand or machine, directly to a revegetation area. Direct seeding is considered more cost and labour efficient than planting, excluding time required for seed collection, and allows for a higher plant density, which provides shelter to seedlings and reduces the potential for smothering by weeds. Direct seeding also results in a more natural mix of trees, shrubs and groundcovers than can be achieved through planting.

Seeds for use in direct seeding projects should be collected from Jandakot Airport bushland (preferably from areas scheduled to be cleared) well in advance of being required and stored in managed 'seed banks'. Prior to use, it is beneficial to undertake germination trials to determine the viability of the seed and thereby calculate the amount required to achieve the desired density of key species.

In dieback infested areas, it may be appropriate to revegetate using direct seeding instead of planting seedlings as seedlings are known to be particularly susceptible to death from dieback, even if they are not of a dieback susceptible species.

5.3 Replanting

Replanting involves the direct planting of endemic seedlings or tubestock. Plants are propagated in a Nursery Industry Accreditation Scheme Australia (NIASA)-accredited nursery using either provenance seed or cuttings.

The number of plants required is dependent factors such as the required vegetation type and survival rates.

Transplants, generally sourced from areas scheduled for clearing, can also be used, with the greatest success expected from seedlings and juvenile plants as opposed to mature individuals. Some species are also known to transplant more readily, with others not tolerating root disturbance. Transplants should not be collected from dieback infested areas. Seed can be collected from dieback infested areas as long as appropriate dieback clean-down procedures are implemented for all shoes, vehicles and tools.

6 Management Techniques to Ensure Success

Planning, site preparation and ongoing management techniques will increase the probability of successful revegetation. The type of techniques used will be dependent on the revegetation technique used.

6.1 Planning

The table below provides indicative timing for which key activities should be undertaken.

Activity	Timing
Begin propagating plants in nursery from seed or cuttings.	October – November
Collect local seed	Seasonally dependent. Usually November – February.
Site Preparation	March/April. Note areas with heavy weed infestations may require 12-18 months of weed control prior to revegetation occurring.
Planting	May – July.

6.2 Site preparation

Prior to revegetating an area, a range of site preparation works will be required. The following activities are recommended during site preparation.

Activity	Purpose
Weed Control	To prevent weeds smothering revegetation.
Fencing	To prevent damage by: <ul style="list-style-type: none">• grazing (e.g. rabbits, bandicoots and macropods)• vehicles• pedestrians.
Ripping	To encourage root penetration to aid seedling establishment. Care required in areas prone to erosion.
Mounding	To aid seedling survival in damp areas prone to waterlogging.
Mulch	<p>Mulching after planting may be of benefit in areas used for direct planting. Mulching may help plants establish by protecting the roots and preventing excessive moisture loss from the surrounding soil, but it may also help to stabilise areas prone to erosion (e.g. bunds and slopes).</p> <p>Mulching (with the exception of hydromulching) is not recommended in areas where direct seeding is undertaken or regeneration from transferred topsoil is being promoted.</p> <p>Mulch may be collected from cleared areas for reuse in revegetation as long as materials from dieback infested areas are kept within the infestation boundaries.</p>

6.3 Ongoing Management

Once an area is regenerating or has been replanted, some ongoing monitoring and management will be required to ensure high survival rates. This may include watering seedlings during dry periods for the first year, ongoing weed control, rabbit control and infilling bare areas.

Attachment 1 - Jandakot Airport Flora Species Dieback Susceptibility

S = Dieback Susceptible; R = Dieback Resistant

<i>Acacia applanata</i>		<i>Caladenia discoidea</i>		<i>Desmocladius asciculatus</i>	
<i>Acacia huegelii</i>	R	<i>Caladenia flava</i>		<i>Desmocladius fasciculatus</i>	R
<i>Acacia pulchella</i>	R	<i>Caladenia huegelii</i>		<i>Desmocladius flexuosus</i>	R
<i>Acacia saligna</i>	R	<i>Caladenia longicauda</i>		<i>Dianella revoluta</i>	S
<i>Acacia stenoptera</i>	S	<i>Caladenia paludosa</i>		<i>Dielsia stenostachya</i>	
<i>Acacia willdenowiana</i>		<i>Calectasia narragara</i>		<i>Diuris corymbosa</i>	
<i>Actinotus glomeratus</i>		<i>Calytrix angulata</i>		<i>Diuris emarginata</i>	
<i>Adenanthos cygnorum</i>	S	<i>Calytrix flavescens</i>	R	<i>Diuris laxiflora</i>	
<i>Adenanthos obovatus</i>	S	<i>Calytrix fraseri</i>	S	<i>Diuris longifolia</i>	
<i>Allocasuarina fraseriana</i>	S	<i>Calytrix strigosa</i>		<i>Drosera erythrorhiza</i>	R
<i>Allocasuarina humilis</i>	S	<i>Cassytha flava</i>	R	<i>Drosera glanduligera</i>	
<i>Amphipogon laguroides</i>		<i>Cassytha glabella</i>	R	<i>Drosera macrantha</i>	R
<i>Amphipogon turbinates</i>		<i>Cassytha racemosa</i>		<i>Drosera menziesii</i>	
<i>Anigozanthos humilis</i>		<i>Centrolepis aristata</i>		<i>Drosera paleacea</i>	
<i>Anigozanthos manglesii</i>	R	<i>Centrolepis drummondiana</i>		<i>Drosera pulchella</i>	
<i>Aotus sp. procumbent</i>		<i>Centrolepis humillima</i>		<i>Eremaea asterocarpa</i>	
<i>Arnocrinum preissii</i>		<i>Chamaescilla corymbosa</i>	R	<i>Eremaea pauciflora</i>	
<i>Astartea fascicularis</i>	R	<i>Chordifex microcodon</i>		<i>Eriachne sp.</i>	
<i>Astartea scoparia</i>		<i>Comesperma calymega</i>	R	<i>Eucalyptus gomphocephala</i>	R
<i>Asteraceae sp.</i>		<i>Conospermum stoechadis</i>	S	<i>Eucalyptus marginata</i>	S
<i>Astroloma pallidum</i>		<i>Conospermum triplinervium</i>	S	<i>Eucalyptus rudis</i>	R
<i>Astroloma xerophyllum</i>	S	<i>Conostephium minus</i>		<i>Eucalyptus todtiana</i>	S
<i>Austrodanthonia occidentalis</i>		<i>Conostephium pendulum</i>	S	<i>Euchilopsis linearis</i>	
<i>Austrodanthonia pilosa</i>		<i>Conostephium preisii</i>		<i>Euchiton sphaericus</i>	
<i>Austrostipa compressa</i>		<i>Conostylis aculeata</i>	R	<i>Eutaxia virgata</i>	
<i>Austrostipa elegantissima</i>	?	<i>Conostylis aurea</i>		<i>Gastrolobium capitatum</i>	
<i>Baeckea camphorosmae</i>	R	<i>Conostylis caricina</i>		<i>Gompholobium capitatum</i>	R
<i>Banksia attenuata</i>	S	<i>Conostylis juncea</i>		<i>Gompholobium confertum</i>	
<i>Banksia dallanneyi</i>	S	<i>Conostylis serrulata</i>	?	<i>Gompholobium scabrum</i>	
<i>Banksia grandis</i>	S	<i>Conostylis setigera</i>	R	<i>Gompholobium tomentosum</i>	R
<i>Banksia ilicifolia</i>	S	<i>Crassula colorata</i>		<i>Gonocarpus pithyoides</i>	
<i>Banksia littoralis</i>	S	<i>Croninia kingiana</i>		<i>Goodenia pulchella</i>	
<i>Banksia menziesii</i>	S	<i>Cryptostylis ovata</i>	R	<i>Haemodorum paniculatum</i>	R
<i>Banksia nivea</i>	S	<i>Cyanicula gemmata</i>		<i>Haemodorum spicatum</i>	
<i>Baumea articulata</i>		<i>Cyanicula sericea</i>		<i>Hardenbergia comptoniana</i>	R
<i>Beaufortia elegans</i>		<i>Cyathochaeta avenacea</i>	R	<i>Helichrysum leucopsidium</i>	
<i>Beaufortia squarrosa</i>		<i>Dampiera linearis</i>	R	<i>Hemiandra pungens</i>	R
<i>Boronia busselliana</i>		<i>Danthonia pilosa</i>		<i>Hensmania turbinata</i>	
<i>Boronia crenulata</i>	R	<i>Dasypogon bromeliifolius</i>	S	<i>Hibbertia aurea</i>	
<i>Boronia fastigiata</i>		<i>Daviesia gracilis</i>		<i>Hibbertia huegelii</i>	S
<i>Boronia ramosa</i>		<i>Daviesia incrassata</i>	S	<i>Hibbertia hypericoides</i>	S
<i>Bossiaea eriocarpa</i>	S	<i>Daviesia juncea</i>		<i>Hibbertia racemosa</i>	R
<i>Brachyloma preissii</i>		<i>Daviesia nudiflora</i>		<i>Hibbertia sericosepala</i>	
<i>Burchardia congesta</i>	R	<i>Daviesia physodes</i>	S	<i>Hibbertia subvaginata</i>	
<i>Burchardia umbellata</i>		<i>Daviesia triflora</i>		<i>Homalosciadium homalocarpum</i>	

<i>Hovea trisperma</i>	R
<i>Hyalosperma cotula</i>	
<i>Hypocalymma angustifolium</i>	R
<i>Hypocalymma robustum</i>	S
<i>Hypolaena exsulca</i>	
<i>Hypolaena pubescens</i>	
<i>Isolepis marginata</i>	
<i>Jacksonia furcellata</i>	S
<i>Jacksonia sternbergiana</i>	S
<i>Juncus kraussii</i>	
<i>Kennedia prostrata</i>	R
<i>Kunzea ericifolia</i>	S
<i>Kunzea glabrescens</i>	
<i>Lagenophora huegelii</i>	R
<i>Laxmannia ramosa</i>	
<i>Laxmannia squarrosa</i>	
<i>Lechenaultia biloba</i>	R
<i>Lechenaultia expansa</i>	
<i>Lechenaultia floribunda</i>	
<i>Lepidosperma angustatum</i>	
<i>Lepidosperma effusum</i>	
<i>Lepidosperma longitudinale</i>	
<i>Lepidosperma pubisquameum</i>	
<i>Lepidosperma scabrum</i>	R
<i>Lepidosperma squamatatum</i>	R
<i>Lepidosperma tenue</i>	R
<i>Leporella fimbriata</i>	R
<i>Leptocarpus canus</i>	
<i>Leptocarpus tenax</i>	R
<i>Leptomeria empetriformis</i>	
<i>Leptospermum erubescens</i>	R
<i>Lepyrodia muirii</i>	
<i>Leucopogon australis</i>	S
<i>Leucopogon conostephioides</i>	S
<i>Leucopogon insularis</i>	
<i>Leucopogon nutans</i>	S
<i>Leucopogon oxycedrus</i>	S
<i>Leucopogon pendulus</i>	R
<i>Leucopogon polymorphus</i>	S
<i>Leucopogon propinquus</i>	S
<i>Leucopogon pulchellus</i>	S
<i>Leucopogon racemulosus</i>	
<i>Leucopogon sprengelioides</i>	
<i>Leucopogon strictus</i>	
<i>Levenhookia pusilla</i>	
<i>Levenhookia stipitata</i>	
<i>Lobelia tenuior</i>	
<i>Lomandra caespitosa</i>	
<i>Lomandra endlicheri</i>	
<i>Lomandra hermaphrodita</i>	

<i>Lomandra micrantha</i>	
<i>Lomandra nigricans</i>	R
<i>Lomandra odora</i>	S
<i>Lomandra preissii</i>	R
<i>Lomandra purpurea</i>	
<i>Lomandra suaveolans</i>	
<i>Lomandra sp.</i>	
<i>Lotus sp.</i>	
<i>Loxocarya cinerea</i>	S
<i>Lyginia barbata</i>	
<i>Lyginia imberbis</i>	
<i>Lysinema ciliatum</i>	S
<i>Lysinema elegans</i>	
<i>Macrozamia fraseri</i>	
<i>Macrozamia riedlei</i>	S
<i>Medicago sp.</i>	
<i>Melaleuca incana</i>	
<i>Melaleuca preissiana</i>	R
<i>Melaleuca scabra</i>	S
<i>Melaleuca seriata</i>	
<i>Melaleuca systema</i>	
<i>Melaleuca thymoides</i>	S
<i>Melaleuca viminea</i>	
<i>Mesomelaena pseudostygia</i>	
<i>Mesomelaena stygia</i>	R
<i>Mesomelaena tetragona</i>	R
<i>Microtis media</i>	
<i>Microtis sp.</i>	
<i>Millotia tenuifolia</i>	R
<i>Monotaxis grandiflora</i>	
<i>Neurachne alopecuroidea</i>	
<i>Nuytsia floribunda</i>	R
<i>Opercularia vaginata</i>	S
<i>Patersonia occidentalis</i>	S
<i>Pericalymma ellipticum</i>	S
<i>Persoonia saccata</i>	R
<i>Petrophile linearis</i>	S
<i>Philothea spicata</i>	
<i>Phlebocarya ciliata</i>	R
<i>Phlebocarya filifolia</i>	
<i>Phyllangium divergens</i>	
<i>Phyllangium paradoxum</i>	
<i>Pimelea angustifolia</i>	
<i>Pimelea imbricata</i>	
<i>Pimelea rosea</i>	
<i>Pimelea sulphurea</i>	
<i>Pithocarpa pulchella</i>	
<i>Platysace compressa</i>	S
<i>Platytheca galioides</i>	
<i>Podotheca angustifolia</i>	

<i>Podotheca chrysantha</i>	
<i>Poranthera microphylla</i>	
<i>Prasophyllum parvifolium</i>	
<i>Prasophyllum sp.</i>	
<i>Pterostylis pyramidalis</i>	
<i>Pterostylis recurva</i>	
<i>Pterostylis vittata</i>	
<i>Pterostylis sp.</i>	
<i>Pultenaea reticulata</i>	
<i>Pyrorchis nigricans</i>	
<i>Quinetia urvillei</i>	
<i>Regelia ciliata</i>	
<i>Regleia inops</i>	
<i>Restio microcodon</i>	
<i>Rhodanthe sp</i>	
<i>Ricinocarpus glaucus</i>	
<i>Scaevola paludosa</i>	
<i>Scaevola repens</i>	
<i>Schoenus brevisetis</i>	
<i>Schoenus caespititius</i>	
<i>Schoenus curvifolius</i>	R
<i>Schoenus efoliatus</i>	
<i>Schoenus globifer</i>	
<i>Schoenus sp.</i>	
<i>Scholtzia involucrata</i>	S
<i>Senecio pinnatifolius</i>	
<i>Siloxerus humifusus</i>	
<i>Sowerbaea laxiflora</i>	
<i>Stackhousia monogyna</i>	
<i>Stirlingia latifolia</i>	S
<i>Stylidium brunonianum</i>	R
<i>Stylidium carnosum</i>	
<i>Stylidium guttatum</i>	
<i>Stylidium junceum</i>	S
<i>Stylidium piliferum</i>	R
<i>Stylidium repens</i>	
<i>Stylidium schoenoides</i>	S
<i>Stylidium sp.</i>	
<i>Synaphea spinulosa</i>	
<i>Synaphea sp.</i>	
<i>Tetratea setigera</i>	S
<i>Thelymitra campanulata</i>	
<i>Thelymitra crinita</i>	
<i>Thelymitra fuscolutea</i>	
<i>Thelymitra sp.</i>	
<i>Thysanotus arbuscula</i>	
<i>Thysanotus manglesianus</i>	
<i>Thysanotus multiflorus</i>	
<i>Thysanotus patersonii</i>	
<i>Thysanotus sparteus</i>	

<i>Thysanotus thyrsoideus</i>	S
<i>Thysanotus triandrus</i>	
<i>Thysanotus sp.</i>	
<i>Trachymene pilosa</i>	
<i>Tricoryne elatior</i>	R

<i>Tricoryne tenalla</i>	
<i>Tripterococcus brunonis</i>	
<i>Verticordia drummondii</i>	
<i>Wahlenbergia preissii</i>	
<i>Waitzia suaveolens</i>	

<i>Xanthorrhoea gracilis</i>	S
<i>Xanthorrhoea preissii</i>	S
<i>Xanthosia huegelii</i>	R

Taken from information compiled by E.Groves, G.Hardy and J.McComb, Murdoch University. Species list reviewed by Mark Brundrett, 2011 and the Jandakot Airport floristic surveys 2001-2017 (Mattiske).

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