

Scrub Bird Road Gravel Pit

Flora and Vegetation Survey



Prepared for Shire of Donnybrook-Balingup
July 2020



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Executive Summary

- Ecoedge was engaged by the Shire of Donnybrook-Balingup in June 2019 to assist with meeting the conditions of clearing permit CPS 6560/2 issued by the Department of Water, Environment and Regulation (DWER).
- The assessment was undertaken on the 1 July 2020.
- The Survey Area comprised of 0.8 ha of rehabilitated gravel pit.
- 34 flora taxa were found within the Survey Area, including 6 introduced species.
- One of the introduced species (**Gomphocarpus fruticosus*: Narrow-Leaf Cotton Bush) is a Declared Pest Plant under the *Biosecurity and Agriculture Management Act 2007*. It is in the C3 (Management) category. This individual plant was removed to reduce the risk of spread.
- Species composition/diversity and density were low.
- Vegetation structure does not represent pre-mining survey results (as would be expected considering the 24-month time-frame) and will not do so for many years.
- Without additional seeding and/or planting the predicted structure is simpler, less diverse and less dense than presurvey vegetation.
- It is recommended that the current presurvey species diversity and density revegetation targets may be unrealistic for the Shire to achieve.
- It is further recommended that the Shire seek to negotiate with DWER a reduced and more achievable diversity and density targets based on, for example the targets in the Department of Biodiversity, Conservation and Attraction's (DBCA) Guidelines for the Management and Rehabilitation of Basic Raw Material Pits Department of Environment and Conservation (now DBCA) 2008).
- Recommendations to achieve a realistic revegetation outcome.

Item	Recommendation	Timing
1	Negotiate a revised realistic revegetation target with reduced species diversity and densities.	
2	Source local provenance seed for direct seeding and propagation of local provenance seedlings, based on species in the pre-clearing area (Appendix 3)	Dec - May
3	Seed revegetated area with local provenance seed using best practice methods.	Autumn
4	Plant tube stock seedlings to achieve a trees species density of 625 stems/ha.	Early Winter
5	Plant tube stock seedlings to achieve an understorey species density of 5000/ha.	Early winter
6	Re-survey revegetation area in 12 months	Spring
7	Re-evaluate the rehabilitation management plan	

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Statement of Limitations

Reliance on Data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and for no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

1 Introduction and Background

The Shire of Donnybrook-Balingup obtained a clearing permit (CPS 6560/2) for the clearing of approximately 4 ha of native vegetation on portion of Lot 13610 on Deposited Plan 28106 (State Forest 29) for the purpose of gravel extraction **Figure 1** and **Figure 2**.

The permit was issued subject to management conditions which, *inter alia*, include the meeting minimum revegetation standards post gravel extraction.

As per the clearing permit Condition 10. Part C.

Within 24 months of laying the vegetative material and topsoil on the cleared area in accordance with condition 10(b) of this Permit:

- i) Engage an environmental specialist to determine the species composition, structure and density of the area revegetated and rehabilitated; and
- i) where in the opinion of an environmental specialist, the composition, structure and density determined under condition 10 (c)(i) of this permit will not result in a similar species composition, structure and density to that of pre-clearing vegetation types in that area, revegetate the area by deliberately planting and/or direct seeding native vegetation that will result in a similar species composition, structure and density of native vegetation to pre-clearing vegetation types in that area and ensuring only local provenance seeds and propagating material are used.

The Shire cleared approximately 0.8 hectare of the four-hectare site in 2017 and reinstated vegetative material and topsoil on top of the cleared area within 12 months of the clearing, in accordance with conditions of the permit. **Figure 2** shows the cleared area within the clearing permit boundary.

Ecoedge was engaged by the Shire in June 2019 to assess the revegetation outcomes required as part of the permit.

Ecoedge also undertook a (then) Level 1 Flora and Vegetation Survey of the proposed gravel pit area in 2014 (Ecoedge 2014) which is used as a basis for comparison of revegetation outcomes.

The assessment was undertaken on the 1 July 2020 and this report complies with the findings of the field survey, assisting the Shire with meeting the conditions of the clearing permit.

2 Scope

To conduct a flora and vegetation survey of approximately 0.8 ha of revegetated gravel pit on Scrubbird Road, Shire of Donnybrook-Balingup. Produce a report that details species composition, structure, density within the revegetated area, as well as any recommendations regarding further planting.

3 Location

The Survey Area is situated approximately 14 km east north east of the town of Balingup within State Forest on the west side of Scrub Bird Road (**Figure 1**). It is located within the Southern Jarrah Forest (JF2) sub-region of the Jarrah Forest Bioregion as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Australian Government, 2009).

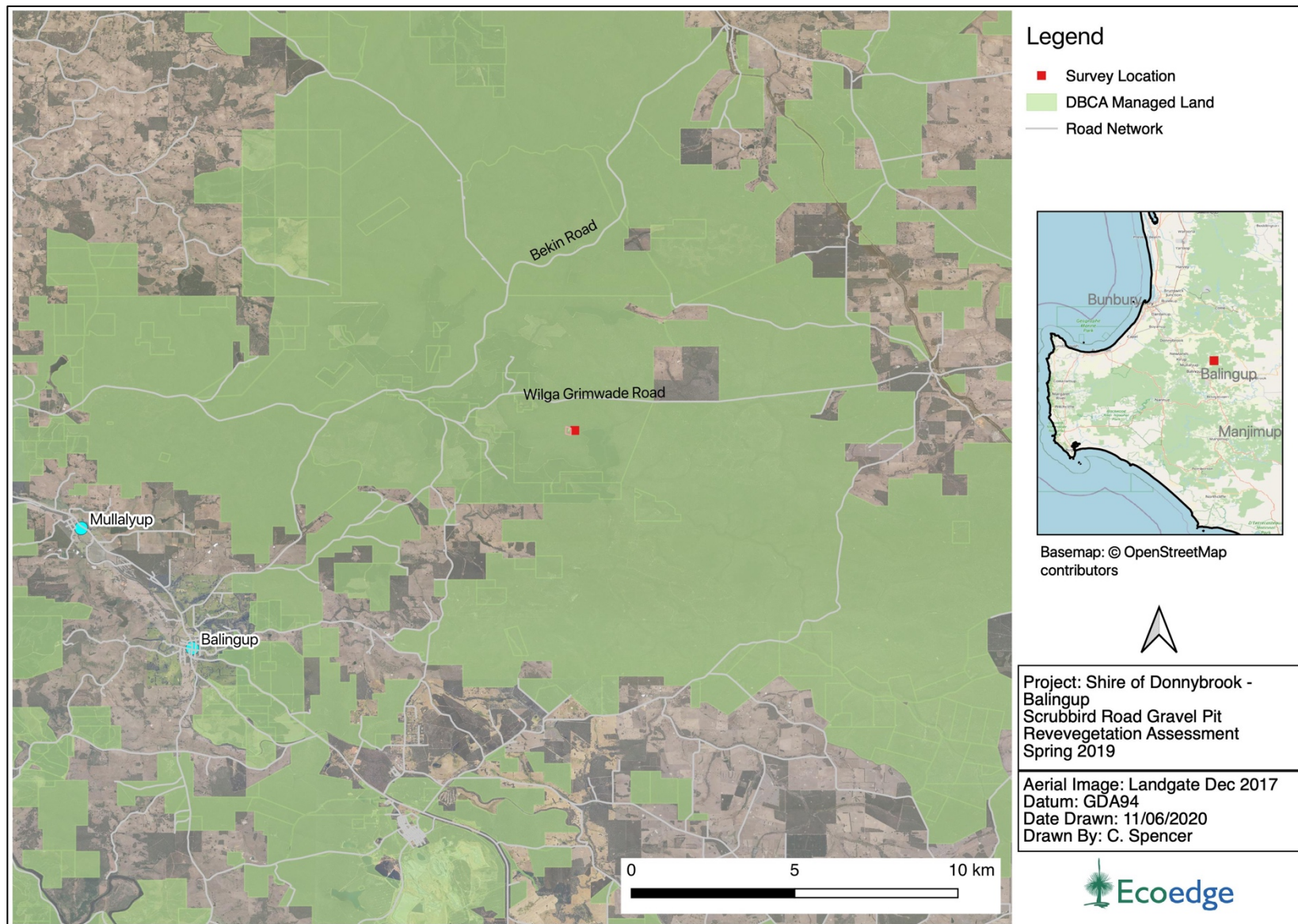


Figure 1. Aerial photograph showing the location of the Survey Area.

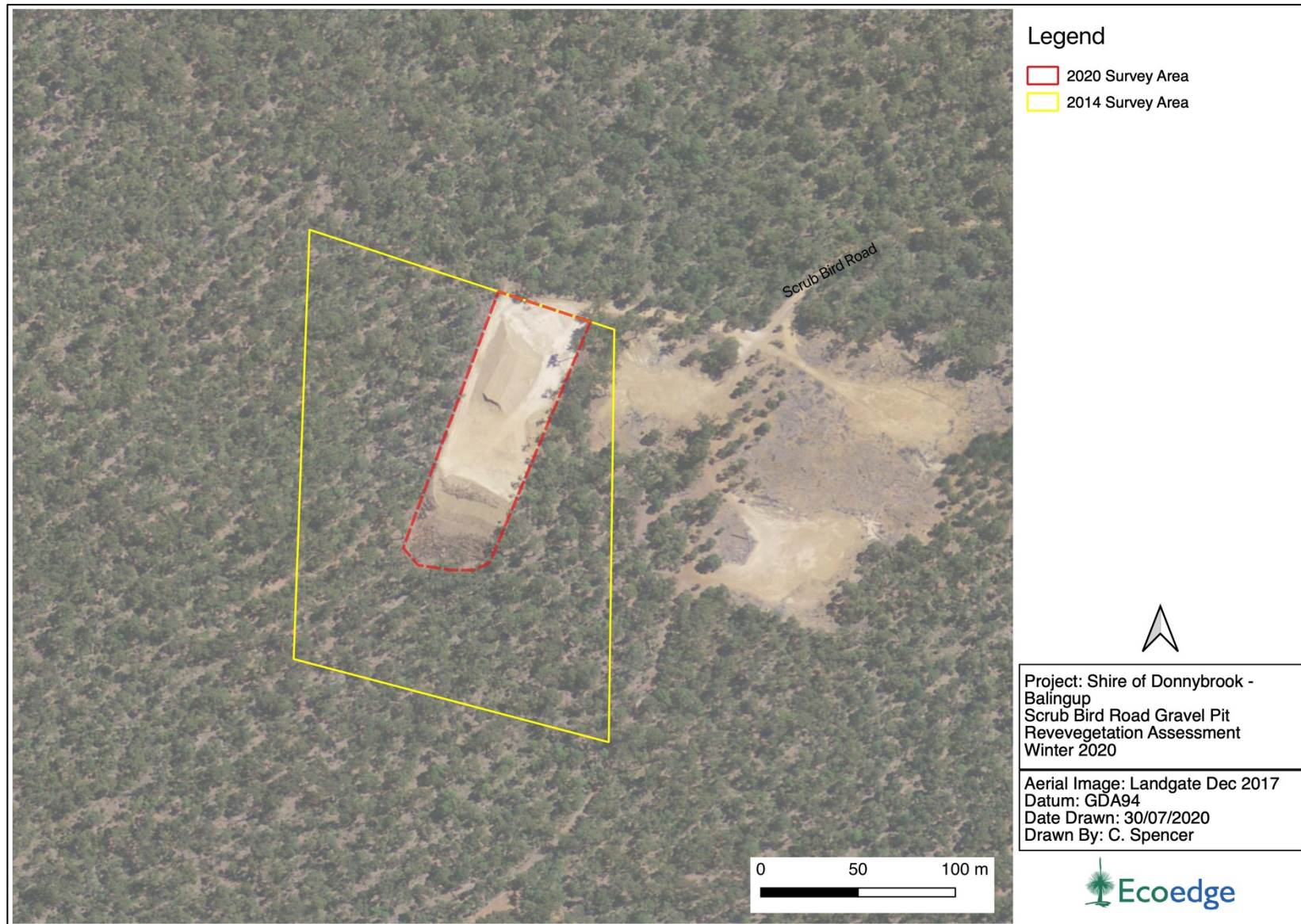


Figure 2. Survey Area, Scrubbird Road pit.

4 Methods

4.1 Field Survey

The revegetated gravel pit was surveyed by Colin Spencer (SL flora permit FB62000169) and Debbie Brace according to the requirements of EPA (2016) on 1st July 2020. Data on species composition and density number of tree seedlings and vegetation structure was collected at 8 relevés (data points) within the gravel pit area. For point of comparison two relevés were recorded in undisturbed bushland outside of the clearing area.

At each relevé the data was collected within an approximate 10 m radius of the central point. Observation of soil type and a photo was recorded at each relevé. Assuming an area of 314 m² for each relevé a total of 31% of the approximately 0.8-hectare revegetated gravel pit site was sampled.

The species and number of individuals per relevé was used to calculate species composition and diversity.

The species density was determined by the number of individuals (stems) per hectare and calculated using the area covered by eight relevés as a proportion of one hectare. The flora species list prepared for the 4.1 ha survey area in 2014 was used as the basis for determining likely presurvey species diversity.

The number of tree and understorey species was recorded to calculate the vegetation structure of the Survey Area.

4.2 Survey Limitations

Potential limitations with regard to the assessment are addressed in **Table 1**.

Table 1. Limitations of the field survey with regard to assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	No	The survey scope was prepared in consultation with the client and was designed to comply with DWER requirements.
Proportion of flora identified	Minor	The survey was conducted outside the main flowering period for southwest Western Australian native plants, however, most taxa were identifiable. Some annuals had not germinated or were not readily identifiable.
Survey timing, climatic and seasonal effects	Minor	Rainfall for the wet season in the south-west up till the time of survey was about average.
Availability of contextual information	Negligible	A comprehensive regional surveys of remnant vegetation, as well as more localised surveys, have been carried out in the southern Jarrah Forest.
Survey effort and extent	Negligible	All areas of native vegetation were able to be accessed by foot.
Access within the Survey Area	Negligible	All parts of the Survey Area were accessible.
Competency, experience and knowledge of the botanists	No	The botanist undertaking the Survey has 3 years' experience in Jarrah forest IBRA region and was assisted by former Shire of Donny Brook Balingup Environmental officer of 10 years. The Senior supervising botanist has 25 years' experience working in south west vegetation.
Disturbance (fire, grazing, clearing)	Minor	Not applicable as the gravel pit is a revegetation site.

5 Results

The 2020 results were compiled from relevés within the Survey Area and illustrated in **Figure 3**.

5.1 Species composition and diversity

Thirty-four taxa were identified within the Survey Area, six of which were introduced species. **Figure 4** is a photo taken across the Survey Area. **Figure 5** (relevé 6) shows limited species diversity and density.

The percentage of introduced species (17%) is quite high and reflects the disturbed nature of the site. One of the introduced species (*Gomphocarpus fruticosus*: Narrow-Leaf Cotton Bush¹) is a Declared Pest Plant under the Biosecurity and Agriculture Management Act 2007. It is in the C3 (Management) category.

Native species diversity across the approximately 0.8 ha survey area was 28 taxa, half of the number (56) surveyed in the 2014 survey area. The maximum native species within the much smaller reference sites was 21 species **Table 2**.

Within the revegetated gravel pit area, the maximum diversity of native taxa in any of the relevés was 12, with the average being 9 species per relevé. This average is less than half of the average diversity (21 taxa) for the reference sites.

Table 2. Species diversity within the Survey Area.

	Revegetation Area	2014 Survey	Reference Sites
Area (ha)	0.8	4.1	0.0628
Total number of taxa	34	56	21
Number of native taxa	28	53	21
Number of introduced species	6	3	0

¹ Note – this one individual was pulled up on site to reduce the spread of Cotton bush.

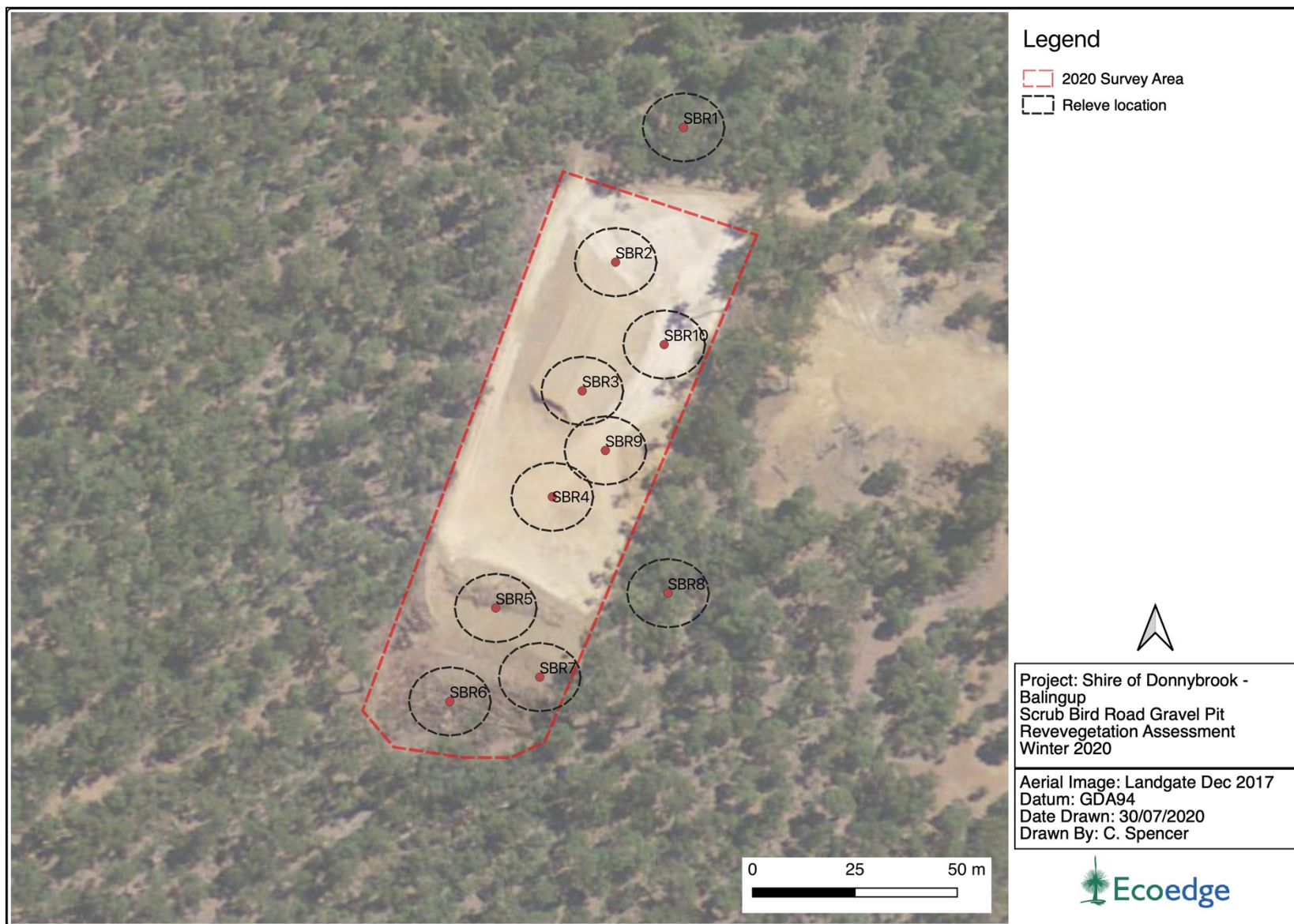


Figure 3. Location of relevés within the Survey Area.

5.2 Species density

The total average species density of the survey area was 3073 stems / ha based on data from 8 relevés in the revegetation area. The total average species density of the two reference sites was about three times this, at 9047 stems/ha.

The average tree density (310 stems/ ha) for the revegetation area was about one sixth of the reference area (1813 stems/ ha) and comprised mostly of *Eucalyptus marginata* seedlings/saplings.

The average understorey density 2763 (stems / ha) for the revegetation area is about 38% of the reference area (7234 stems / ha).

Table 3 provides a breakdown of the species density for the revegetation area, 2014 survey and reference sites. **Table 4** provides a breakdown of the estimated tree density per relevé.

Table 3. Species diversity for three Survey Areas.

	Revegetation Area	2014 Survey	Reference Sites
Area (ha)	0.8	4.1	0.0628
Number of taxa	34	56	21
Number of native trees	3	3	5
Number native Shrubs/grasses/sedges	23	53	16
Avg canopy tree density stems/ha	310	No data	1813
Avg understorey shrub density stems/ha	2763	No data	7234
Total average density	3073		9047

Table 4. Tree density per hectare, per relevé.

	Stems per hectare								
SPECIES	R2	R3	R4	R5	R6	R7	R9	R10	Average
<i>Corymbia calophylla</i>	0	0	0	0	32	64	0	0	12
<i>Eucalyptus marginata</i>	0	32	64	95	350	191	286	700	215
<i>Persoonia longifolia</i>	286	0	0	0	318	0	64	0	83
Totals	286	32	64	95	700	255	350	700	310

5.3 Vegetation Structure

The current vegetation structure is simple, consisting of scattered young seedlings / saplings of primarily *Eucalyptus marginata* (up to 150 cm) over a sparse coverage of young shrubs, mainly *Acacia pulchella*, *Hibbertia amplexicaulis* and *H. pilosa* (60-80 cm high) and the native herb *Senecio diaschides* which is common.

Based on current species list and densities a predicted structure will likely approximate the following vegetation unit.

Eucalyptus marginata Open Woodland over *Persoonia longifolia* Low Open Woodland over *Hibbertia pilosa*, *Hibbertia amplexicaulis* and *Acacia pulchella* Low Open Shrubland with scattered *Macrozamia riedlei* over a Very Open Herbland of *Senecio diaschides* and weed species.

This unit is a much simpler in terms of its diversity and density than both the reference site and presurvey vegetation units described.



Figure 4. View across the Survey.



Figure 5. View across Survey Area showing a sparse cover of shrubs.

Reference Site 2020 description

Corymbia calophylla, *Eucalyptus marginata* Open Forest over *Banksia grandis* and *Persoonia longiflora* Low Open Woodland over *Xanthorrhoea gracilis*, *Macrozamia riedlei* and *Acacia pulchella* Open Shrubland over *Leucopogon capitellatus*, *Hibbertia hypericoides*, *Hibbertia amplexicaulis* Low Shrubland over *Lagenophora huegelii*, *Oxalis exilis* Very Open Herbland.

Ecoedge 2014 Survey description (Figure 6)

Open Forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Persoonia longifolia* scattered low trees over a shrubland of *Hibbertia commutata*, *H. cunninghamii*, *H. hypericoides*, *Leucopogon capitellatus*, *Macrozamia riedlei* and *Xanthorrhoea gracilis* over very open herbs of *Craspedia variabilis*, *Daucus glochidiatus*, *Pentapeltis peltigera*, *Stylidium androsaceum* and *Trachymene pilosa*.



Figure 6. Vegetation in the adjacent bushland surveyed by Ecoedge (2014).

5.4 Survey Area topography and Soil Type

The Survey Area appears to have been returned to the general preclearing topography and all relevés within the gravel pit revegetation area were recorded as having a covering of gravelly loam which was generally similar to the undisturbed bushland areas. However, the presence of the desired gravelly loam did appear patchy and inconsistent in some areas.

Notably an area in the north east of Survey Area was partially inundated with water at time of survey as removal of gravel has brought the soil surface closer to the water table.

6 Conclusions and recommendations

The flora and vegetation survey was conducted on 1st July 2020 at the Scrubbird Road gravel pit revegetation site to comply with DWER's clearing permit conditions (CPS 6560/2).

Species composition and diversity was about half of the number of target species which occur within the adjacent undisturbed bushland, based on a comparison of 2014 presurvey data.

The average species density for the revegetation area was about a third of the of average species density for the adjacent undisturbed bushland based on a comparison of reference site data.

The average species density for the canopy tree species was about 16% for canopy species and about 40% for understorey species of the reference target.

Based on this data, the current level of revegetation will not result in a similar species composition, structure and density to that of pre-clearing vegetation types as required under Condition 10 of the clearing permit.

The predicted structure is simpler, less diverse and less dense than presurvey vegetation.

In order to achieve comparable revegetation outcomes understorey density of 3 plants per 4 m² and canopy species of 1 plant per 4 m² is required. This equates to a combined planting density of approximately 1 plant per m². This may be achieved via a combination of supplementary direct seeding and planting of seedlings.

However, it will be challenging to achieve guaranteed comparable pre-species diversity of 56 species as many of the survey area species, including species of orchid (6 species) and *Stylidium* (4 species) are not generally commercially available, especially from ²local provenance seed stock.

Furthermore, it may also be challenging to achieve target densities in the modified soil environment. Whilst the replaced top soil appeared to comprise of a reasonable cover of gravelly loam similar to the adjacent uncleared areas, it did not appear to be supporting a cover of naturally regenerating seedlings. This could be due to a range of factors including depth of reapplication of soil or uneven spreading.

It may be wise to try negotiating a reduced and achievable target for species diversity based on commercially propagatable species.

The Shire may also negotiate with DWER a reduced and more achievable density target. For example, the DBCA's Guidelines for the Management and Rehabilitation of Basic Raw Material Pits (Department of Environment and Conservation (now DBCA) 2008) requires a canopy target of 625 stems / ha for 85% of sampled sites and 2500 stems per ha for both leguminous and non-leguminous species for understorey species. This equates to just over half the current target density, or about 6 plants per 10 m².

It is also recommended that recent 'wetland' that has been created in the north-east corner of the Survey Area be planted with local occurring wetland. A list of appropriate species included in **Appendix 4**.

² Local provenance seed and cuttings is a requirement of the clearing permit

A basic course of action to achieve a realistic revegetation outcome over the gravel pit is presented in **Table 5** below.

Table 5. Table of Recommendations

Item	Recommendation	Timing
1	Negotiate a revised realistic revegetation target with reduced species diversity and densities.	
2	Source local provenance seed for direct seeding and propagation of local provenance seedlings, based on species in the pre-clearing area (Appendix 3)	Dec - May
3	Seed revegetated area with local provenance seed using best practice methods.	Autumn
4	Plant tube stock seedlings to achieve a trees species density of 625 stems/ha.	Early Winter
5	Plant tube stock seedlings to achieve an understorey species density of 5000/ha.	Early winter
6	Re-survey revegetation area in 12 months	Spring
7	Re-evaluate the rehabilitation management plan	

References

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Appendix 1. Number of seedlings/ha of all species within the Revegetated Gravel pit.

SPECIES	Stems / ha								
	SB_R2	SB_R3	SB_R4	SB_R5	SB_R6	SB_R7	SB_R9	SB_10	Average
<i>Acacia extensa</i>	0	0	32	0	0	0	32	95	20
<i>Acacia pulchella</i>	0	286	477	477	0	223	509	445	302
<i>Acacia willdenowiana</i>	0	0	0	32	0	0	0	0	4
<i>Babiana angustifolia</i>	0	0	0	0	0	64	0	0	8
<i>Banksia dallaneyi</i>	0	0	0	0	0	0	0	0	0
<i>*Carduus sp.</i>	0	0	0	0	32	0	0	0	4
<i>Clematis pubescens</i>	0	0	0	0	64	127	0	0	24
<i>Conyza bonariensis</i>	0	0	0	32	0	0	0	0	4
<i>Corymbia calophylla</i>	0	0	0	0	32	64	0	0	12
<i>Eucalyptus marginata</i>	0	32	64	95	350	191	286	700	215
<i>*Gomphocarpus fruticosus</i>	0	0	0	0	32	0	0	0	4
<i>Hibbertia amplexicaulis</i>	254	509	477	700	0	382	827	509	457
<i>Hibbertia hypericoides</i>	0	0	0	0	0	0	0	0	0
<i>Hibbertia pilosa</i>	95	413	731	668	954	668	1145	159	604
<i>Hovea chorizemifolia</i>	0	0	0	0	0	0	0	32	4
<i>Hovea elliptica</i>	0	0	0	0	32	0	0	0	4
<i>Kennedia prostrata</i>	0	0	0	0	0	0	0	32	4
<i>Lagenophora huegelii</i>	0	0	32	32	0	0	0	0	8
<i>Leucopogon capitellatus</i>	0	0	0	0	0	0	32	0	4
<i>Leucopogon propinquus</i>	0	0	32	32	0	0	0	0	8
<i>Leucopogon verticillatus</i>	0	0	0	0	0	0	0	0	0
<i>Lomandra sp.</i>	0	0	0	0	0	0	0	32	4
<i>*Lotus sp.</i>	159	0	0	0	0	0	0	0	20
<i>Macrozamia riedlei</i>	32	0	32	0	32	95	0	0	24
<i>Persoonia longifolia</i>	286	0	0	0	318	0	64	0	83

<i>SPECIES</i>	SB_R2	SB_R3	SB_R4	SB_R5	SB_R6	SB_R7	SB_R9	SB_10	Average
<i>Phyllanthus calycinus</i>	0	0	0	0	286	0	0	0	36
<i>*Phytolacca octandra</i>	0	0	0	0	64	0	0	0	8
<i>Senecio diaschides</i>	318	0	95	1272	0	6678	413	32	1101
<i>Senecio quadridentatus</i>	0	0	0	0	32	0	0	0	4
<i>Stylidium sp.</i>	0	0	0	0	0	64	0	0	8
<i>Tetrarrhena laevis</i>	159	0	32	64	32	0	0	0	36
<i>Thysanotus patersonii</i>	0	0	0	0	0	0	0	32	4
<i>Trachymene pilosa</i>	0	0	0	0	0	0	0	32	4
<i>Xanthorrhoea gracilis</i>	0	0	0	0	0	0	0	0	0
<i>Xanthosia candida</i>	0	0	0	0	0	318	64	32	52
Total	1304	1272	2067	3498	2576	8999	3657	2830	3275

Appendix 2. List of Naturalised Vascular Flora (weeds)

GENUS	SPECIES
Iridaceae	<i>Babiana angustifolia</i>
Asteraceae	<i>Carduus</i> sp.
Asteraceae	<i>Conyza bonariensis</i>
Apocynaceae	<i>Gomphocarpus fruticosus</i> *
Fabaceae	<i>Lotus</i> sp.

* Cotton bush

Appendix 3. List of Vascular flora found before clearing

Family	Species	Legume	Structure
Apiaceae	<i>Daucus glochidiatus</i>		Understorey
	<i>Pentapeltis peltigera</i>		Understorey
	<i>Xanthosia candida</i>		Understorey
Araliaceae	<i>Trachymene pilosa</i>		Understorey
Asparagaceae	<i>Lomandra purpurea</i>		Understorey
	<i>Thysanotus patersonii</i>		Understorey
	<i>Craspedia variabilis</i>		Understorey
	<i>Lagenophora huegelii</i>		Understorey
	<i>Millotia tenuifolia</i>		Understorey
	<i>Rhodanthe citrina</i>		Understorey
	<i>Senecio hispidulus</i>		Understorey
Campanulaceae	<i>Isotoma hypocrateriformis</i>		Understorey
	<i>Lepidosperma squamatum</i>		Understorey
Dennstaedtiaceae	<i>Pteridium esculentum</i>		Understorey
Dilleniaceae	<i>Hibbertia amplexicaulis</i>		Understorey
	<i>Hibbertia commutata</i>		Understorey
	<i>Hibbertia cunninghamii</i>		Understorey
	<i>Hibbertia hypericoides</i>		Understorey
Elaeocarpaceae	<i>Tetratheca hirsuta</i>		Understorey
Ericaceae	<i>Leucopogon capitellatus</i>		Understorey
	<i>Leucopogon propinquus</i>		Understorey
	<i>Leucopogon verticillatus</i>		Understorey
Fabaceae	<i>Acacia browniana</i>	Legume	Understorey
	<i>Acacia extensa</i>	Legume	Understorey
	<i>Acacia pulchella</i>	Legume	Understorey
	<i>Acacia willdenowiana</i>	Legume	Understorey
	<i>Hovea chorizemifolia</i>	Legume	Understorey
	<i>Isotropis cuneifolia</i>	Legume	Understorey
	<i>Kennedia prostrata</i>	Legume	Understorey
Geraniaceae	<i>Geranium solanderi</i>		Understorey
	<i>Haemodorum laxum</i>		Understorey
	<i>Corymbia calophylla</i>		Understorey
	<i>Eucalyptus marginata</i>		Canopy
Loranthaceae	<i>Nuytsia floribunda</i>		Canopy
Orchidaceae	<i>Caladenia flava</i>		Understorey
	<i>Caladenia macrostylis</i>		Understorey
	<i>Caladenia reptans</i>		Understorey
	<i>Elythranthera brunonis</i>		Understorey
	<i>Thelymitra crinita</i>		Understorey

Family	Species	Legume	Structure
	<i>Thelymitra vulgaris</i>		Understorey
Phyllanthaceae	<i>Phyllanthus calycinus</i>		Understorey
Pittosporaceae	<i>Billardiera heterophylla</i>		Understorey
	<i>Billardiera variifolia</i>		Understorey
Poaceae	<i>Neurachne alopecuroidea</i>		Understorey
	<i>Tetrarrhena laevis</i>		Understorey
Polygalaceae	<i>Comesperma virgatum</i>		Understorey
Proteaceae	<i>Banksia dallanneyi</i>		Understorey
	<i>Banksia grandis</i>		Canopy
	<i>Hakea lissocarpha</i>		Understorey
	<i>Persoonia longifolia</i>		Canopy
Ranunculaceae	<i>Clematis pubescens</i>		Understorey
Rubiaceae	<i>Opercularia apiciflora</i>		Understorey
Rutaceae	<i>Boronia spathulata</i>		Understorey
Stylidiaceae	<i>Levenhookia pusilla</i>		Understorey
	<i>Stylidium adnatum</i>		Understorey
	<i>Stylidium amoenum</i>		Understorey
	<i>Stylidium androsaceum</i>		Understorey
Violaceae	<i>Hybanthus calycinus</i>		Understorey
Xanthorrhoeaceae	<i>Xanthorrhoea gracilis</i>		Understorey
Zamiaceae	<i>Macrozamia riedlei</i>		Understorey

Appendix 4. Possible species for low-lying areas

	Species
1	<i>Acacia mooreana</i>
2	<i>Juncus pallidus</i>
3	<i>Lepidosperma effusum</i>
4	<i>Lepidosperma tetraquetrum</i>
5	<i>Taxandria linearifolia</i>