MINERAL RESOURCES

J5 and Bungalbin East Iron Ore Proposal
Response to Submissions – Appendix J
2015 Rehabilitation Monitoring Report

Carina Mine Rehabilitation Monitoring
Baseline 2015

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EXECUTIVE SUMMARY

Polaris Metals Limited (Polaris) operates the Carina Iron Ore Mine (Carina), located 100 km north-east of Southern Cross and 110 km west of Kalgoorlie in the Goldfields region of Western Australia.

Polaris is required to undertake rehabilitation monitoring for the Carina Iron Ore Mine that meets the conditions of Ministerial Statement 852 (MS852).

The objective of this study was to establish a baseline rehabilitation monitoring program, incorporating vegetation monitoring and landform stability monitoring. This will be used to evaluate the development and stability of the rehabilitated areas, provide feedback for the improvement of rehabilitation techniques, and to assess progress towards long term objectives and the development of adequate, achievable and measurable completion criteria.

The 2015 baseline vegetation rehabilitation monitoring field survey was conducted by Senior Botanist Melissa Hay from 18 to 20 November 2015. Four rehabilitation, five control and six photographic monitoring sites were established and monitored at Carina during the 2015 baseline survey. In addition, six proposed sites at the rehabilitation trial areas have been marked (at the 0 m and 5 m marks) for future monitoring.

Sixty-seven vascular flora taxa were recorded during the survey, of which 27 were at rehabilitation sites and 47 at control sites. Of these, two were Priority flora taxa: *Acacia cylindrica* (Priority 3) and *Grevillea georgeana* (Priority 3) and two were introduced species: **Sonchus oleraceus* and **Solanum hoplopetalum*. **Sonchus oleraceus* was recorded at three rehabilitation sites (SR01, SR02 and SR03); and **Solanum hoplopetalum* was recorded at one (at SR02).

The results of this baseline survey reflect the very young age of the rehabilitation. Low flora diversity (including lower perennial species richness and evenness), low perennial vegetation cover, high variation in dominant strata and a low tree species cover are all characteristic of a recently rehabilitated area. The total mean species richness for each 2 x 2 m quadrat was the same for control and rehabilitation sites (2.7±1.7). However, rehabilitation sites had lower mean perennial species richness (2.1±1.6) and higher mean annual species richness (0.6±0.6) than the controls. The SWDI and species evenness was lower at rehabilitation (1.8 and 0.3, respectively) than control sites (3.1 and 0.5, respectively). The mean perennial cover for each 2 x 2 m quadrat was higher at control (35.0±33.8) than rehabilitation sites (11.0±17.7) and the mean annual cover was higher at rehabilitation (0.5±1.4) than control sites (0).

Rehabilitation sites were dominated by low shrubs (8.4%) and tussock grasses (2.6%), whereas the control sites had a mix strata, including tall shrubs (12.3%), trees (10.3%) and mid shrubs (5.9%). Where the control sites are fairly consistent with the different structural layers, the rehabilitated areas vary substantially between sites. Mean percentage tree cover was less at rehabilitation (0.4) than control sites (17.6). Rehabilitation sites contained no mature trees, with only juveniles and seedlings recorded, whereas the control sites were dominated by mature trees.

1 INTRODUCTION

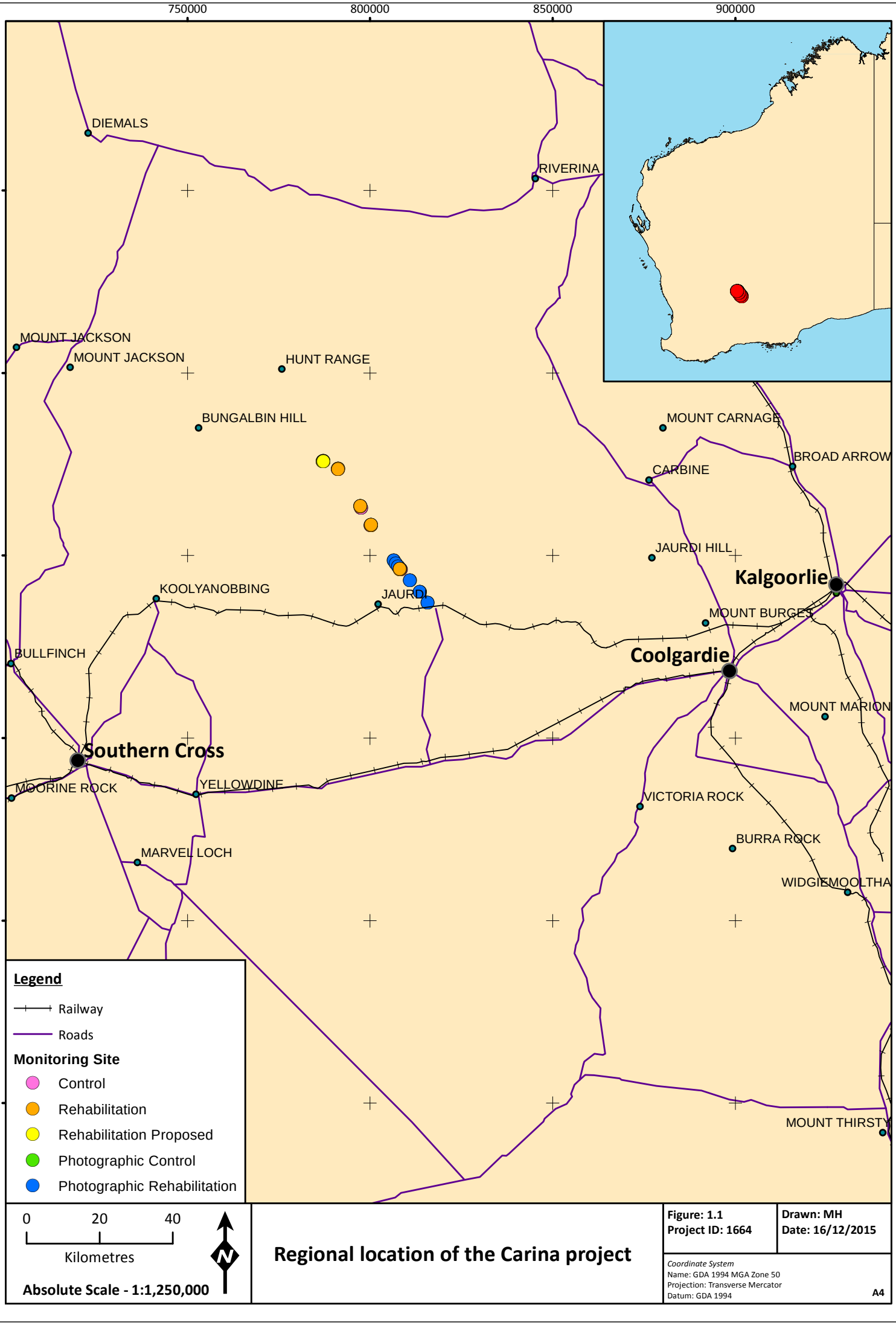
Polaris Metals Limited (Polaris) operates the Carina Iron Ore Mine (Carina), located 100 km north-east of Southern Cross and 110 km west of Kalgoorlie in the Goldfields region of Western Australia. Carina is split into two operational areas including a mine infrastructure area in the north and a crushing and rail siding area in the south, connected by a 48 km haul road (Figure 1.1).

Polaris is required to undertake rehabilitation monitoring for the Carina Iron Ore Mine that meets the conditions of Ministerial Statement 852 (MS852). Current rehabilitation areas include:

- 11 ha of borrow pits along the haul road;
- 25 ha of the 95 ha waste landform, which include a 4 ha completed rehabilitation trial (seeded in August 2015); and
- 3 ha of rehabilitation associated with road infrastructure.

1.1 OBJECTIVES AND SCOPE

The objective of this study was to establish a baseline rehabilitation monitoring program, incorporating vegetation monitoring and landform erosion monitoring. This will be used to evaluate the development and stability of the rehabilitated areas, provide feedback for the improvement of rehabilitation techniques, and to assess progress towards long term objectives and the development of adequate, achievable and measurable completion criteria.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MOUNT CARNAGE
BROAD ARROW
CARBINE
JAURDI HILL
Kalgoorlie
KOOLYANOBBING
JAURD
MOUNT BURGES
BULLFINCH
Coolgardie
MOUNT MARION
Southern Cross
MOORINE ROCK
YELLOWDINE
VICTORIA ROCK
BURRA ROCK
MARVEL LOCH
WIDGIEMOOLTHA
MOUNT THIRSTY
Legend
Railway
Roads
Monitoring Site
Control
Rehabilitation
Rehabilitation Proposed
Photographic Control
Photographic Rehabilitation
0
20
40
Kilometres
N
Absolute Scale - 1:1,250,000
Regional location of the Carina project
Figure: 1.1
Project ID: 1664
Drawn: MH
Date: 16/12/2015
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
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1.2 LEGISLATIVE CONTEXT

Conditions listed in Ministerial Statement 852 (MS852) include:

11 Rehabilitation

11-1 The proponent shall undertake progressive rehabilitation over the life of the proposal to achieve the following outcomes:

1. The waste material landforms shall be non-polluting and shall be constructed so that their stability, surface drainage, resistance to erosion and ability to support local native vegetation are similar to undisturbed natural analogue landforms as demonstrated by Ecosystem Function Analysis or other methodology acceptable to the CEO.

2. The waste material landforms and other areas disturbed through implementation of the proposal (excluding mine pits), shall be progressively rehabilitated with vegetation composed of native plant species of local provenance.

3. Within 12 months of the date of publication of this statement the proponent shall conduct surveys of each of the vegetation communities that will be impacted by the proposal to collect adequate information in preparation for setting completion criteria for rehabilitation to the requirements of the CEO on advice of the DEC.

4. The methodology of the survey required in condition 11-1(3) shall be prepared in consultation and to the satisfaction of the DEC.

5. Within 18 months of mining commencing the proponent will develop completion criteria for rehabilitation to the requirements of the CEO on advice from the DEC.

6. The percentage cover of living self-sustaining native vegetation in all rehabilitation areas shall be comparable to that of undisturbed natural analogue sites as demonstrated by Ecosystem Function Analysis and species diversity as demonstrated by other methodology acceptable to the CEO.

7. No new species of weeds (including both declared weeds and environmental weeds) are introduced into the rehabilitated areas as a result of the implementation of the proposal.

8. The cover of weeds (including both declared weeds and environmental weeds) in rehabilitated areas shall not exceed that identified in the baseline survey condition 10-1(2) or exceed that existing on comparable, nearby land, determined by condition 10-1(3) which has not been disturbed during implementation of the proposal, whichever is less.

11-2 The proponent shall monitor progressively the rehabilitation for a range of sites against the criteria developed pursuant to condition 11-1(5) with appropriately timed surveys as agreed with the DEC, until the completion criteria are met. The surveys shall be conducted annually unless otherwise agreed by the CEO, on advice from the DEC.

11-3 The proponent shall include the results of the rehabilitation monitoring required pursuant to condition 11-2 in the compliance assessment report referred to in condition 4-6 commencing from the date rehabilitation was commenced. The report shall address the following:

1. The progress made towards meeting the completion criteria developed pursuant to condition 11-1(5); and

2. Contingency management measures in the event that the completion criteria required by condition 11-1(5) are unlikely to be met.

11-4 The proponent shall make the monitoring reports required by condition 11-2 publicly available in a manner approved by the CEO.

1.3 VEGETATION MAPPING

Mattiske undertook a detailed flora and vegetation survey of the Carina Exploration Lease Area (Mattiske 2008) and the Carina Transport Route (Mattiske 2009). These surveys mapped 41 vegetation communities across the project area and exploration tenements. The 14 vegetation communities relating to current rehabilitation areas are listed in Table 1.1.

Table 1.1 – Vegetation community mapping

Code	Vegetation community	Landform
S11	Scrub of *Acacia resinimarginea, Callitris preissii, Eucalyptus pileata* and mixed *Allocasuarina* species over *Melaleuca hamata* and *Leptospermum fastigiatum* over *Baeckea* sp. Mt. Clara and mixed shrubs	Lateritic yellow sandy soils on mid to upper slopes
S12(b)	Scrub (fire disturbed) of *Allocasuarina corniculata* and occasional mixed Eucalypt species over *Melaleuca cordata, Euryomyrtus maidenii* and mixed shrubs over *Triodia desertorum*	Yellow sandy soils on gently undulating plains
S13	Scrub of *Allocasuarina corniculata* and *Acacia yorkrakinensis* subsp. *acrita* with emergent mixed Eucalypt species over *Thryptomene kochii, Baeckea* sp. Mt. Clara, *Euryomyrtus maidenii, Leptospermum fastigiatum* and *Melaleuca cordata* over *Triodia ?desertorum*	Lateritic yellow to orange-yellow sandy soils
S14	Scrub of *Acacia burkittii, Allocasuarina corniculata* and *Allocasuarina campestris* with emergent *Eucalyptus loxophleba* subsp. *supralaevis* over *Dodonaea microzyga* and mixed shrubs	Red brown clay soils on flats
S15	Scrub of *Allocasuarina campestris* with emergent *Eucalyptus loxophleba* subsp. *lissophloia* and *Eucalyptus eremophila* subsp. *eremophila* over mixed shrubs over *Triodia irritans*	Lateritic orange brown sandy clay soils
W1	Woodland of *Eucalyptus salmonophloia, Eucalyptus salubris, Eucalyptus sheathiana, Eucalyptus corrugata, Eucalyptus yilgarnensis, Eucalyptus transcontinentalis, Eucalyptus longicornis* and *Eucalyptus ravida* over *Acacia jennerae, Acacia prainii, Acacia colletioides, Santalum acuminatum*, *Exocarpos aphyllus, Eremophila scoparia, Eremophila granitica, Eremophila ionantha, Senna artemisioides subsp. filifolia* and *Atriplex nummularia* over *Atriplex vesicaria, Grevillea acuaria, Olearia muelleri, Olearia pimelioides* and *Austrostipa elegantissima*	Red-brown clay on flats
W2	Woodland of *Eucalyptus salmonophloia* with *Eucalyptus ravida* and mixed Eucalypts over *Eremophila ionantha, Exocarpos aphyllus, Atriplex nummularia* and *Acacia colletioides* over *Atriplex vesicaria*	Flat red clay soils
W4	Woodland of *Eucalyptus longicornis, Eucalyptus salubris, Eucalyptus corrugata* and *Eucalyptus moderata* over *Eremophila ionantha, Eremophila scoparia*, *Senna artemisioides* subsp. *filifolia, Exocarpos aphyllus, Atriplex nummularia* and *Santalum acuminatum* over *Acacia colletioides* and *Atriplex vesicaria*	Red-brown sandy clay flats with scattered ironstone and quartz pebbles
W12	Open Woodland of *Eucalyptus sheathiana, Eucalyptus salubris, Eucalyptus loxophleba* subsp. *lissophloia, Eucalyptus ravida* and *Eucalyptus salmonophloia* over *Acacia burkittii, Eremophila ionantha, Senna artemisioides* subsp. *filifolia* and *Acacia colletioides* over *Grevillea acuaria*	Red-brown clay to sandy clay on flats with scattered ironstone pebbles
W15	Low Woodland of *Eucalyptus corrugata, Eucalyptus loxophleba* subsp. *lissophloia* and *Eucalyptus longicornis* over *Acacia burkittii, Allocasuarina campestris* and *Exocarpos aphyllus* over *Senna artemisioides* subsp. *filifolia*, *Philotheca tomentella, Prostanthera grylloana, Templetonia sulcata* and *Philotheca brucei* subsp. *brucei* over *Grevillea acuaria* and *Scaevola spinescens*	Red-brown clay soils on flats
W22	Open Low Woodland of *Eucalyptus corrugata* with mixed Eucalypts over *Allocasuarina campestris* and *Acacia burkittii* over *Alyxia buxifolia, Philotheca brucei* subsp. *brucei* and *Isopogon gardneri* over *Scaevola spinescens* and *Olearia muelleri*	Red-brown clays soils on mid and lower slopes
W30	Low woodland of *Eucalyptus corrugata* over *Acacia resinimarginea* over *Beyeria brevifolia, Acacia hemiteles*, and mixed shrubs over *Triodia scariosa* and *Triodia ?desertorum*	Yellow to orange sandy clay soils on flats
W31	Woodland of *Eucalyptus longicornis, Eucalyptus sheathiana* and *Eucalyptus loxophleba* subsp. *lissophloia* over *Eremophila scoparia, Atriplex nummularia*, *Exocarpos aphyllus* over *Atriplex vesicaria, Olearia muelleri* and mixed shrubs	Orange brown clay soils on flats
W33	Low woodland of *Eucalyptus corrugata* and mixed Eucalypt species over mixed *Allocasuarina* species and *Acacia burkittii* over *Alyxia buxifolia, Grevillea obliquistigma* subsp. *obliquistigma* over *Prostanthera grylloana* and *Leucopogon* sp. Clyde Hill	Orange to red brown clay soils on flats and lower slopes

1.4 PREVIOUS RECORDS OF INTRODUCED FLORA

Two introduced flora species; **Erodium cicutarium* and **Erodium botrys* were recorded by Mattiske at the Carina Exploration Lease (Mattiske 2008), distributed widely across the survey area, but none were recorded near the current rehabilitation areas. No weeds were recorded along the proposed haul road route (Mattiske 2009).

2 VEGETATION MONITORING METHODOLOGY

Vegetation monitoring is used to quantitatively measure the botanical diversity and abundance of the rehabilitated sites and enable comparisons with control sites, in particular; species richness and species evenness (using the Shannon-Wiener diversity index), perennial vegetation cover and vegetation composition. For each vascular plant taxon, data is presented as the mean number of individuals or mean percentage cover per quadrat.

2.1 MONITORING SITES

2.1.1 Site Selection Prior to Survey

Rehabilitation monitoring sites were established in areas that have been rehabilitated, and control sites (reference or analogue sites) were established in adjacent, undisturbed areas with corresponding vegetation, soil, topography and terrain.

The mapped vegetation communities (Table 1.1), as well as aerial imagery taken prior to the commencement of clearing, were used to select appropriate matched rehabilitation and control sites. The following was taken into consideration when establishing sites:

- Sites were located on a homogenous slope, with no obvious changes in slope angle or rehabilitation treatment used;
- Sites did not cross different vegetation communities, topographies or soil types;
- Sites were established in areas of unburnt vegetation; and
- At each site a 50 m transect was surveyed where possible, however in areas where the size of the rehabilitation area is limited, two 25 m transects were surveyed.

Where rehabilitation areas are too small for a monitoring site, a photographic monitoring site (and corresponding site control) were installed.

2.1.2 Naming Convention

The site naming convention is as follows:

- SR = rehabilitation site, consecutively numbered (e.g. SR01, SR02 etc.);
- SC = control site, consecutively numbered (e.g. SC01, SC02 etc.);
- Where a site consists of multiple transects, each transect is also numbered consecutively (e.g. SR01/T1, SR01/T2 etc.);
- Quadrats are consecutively numbered based on metre along the transect (e.g. SC01/Q00, SC01/Q05, SC01/Q10 etc.;
- Start and end points of the transects are named A and B respectively (where SR01/A = SR01/Q00);
- PR = Photographic rehabilitation site, consecutively numbered (e.g. PR01, PR02 etc.); and
- PC = Photographic control site, consecutively numbered (e.g. PC01, PC02 etc.).

2.1.3 Monitoring site setup

A schematic diagram of a typical monitoring site is provided in Figure 2.1. Each site consists of ten 2 x 2 m quadrats which are surveyed at 5 m intervals along a 50 m transect for all flora species. The first quadrat is located at the 0 m mark with each subsequent quadrat located 5 m from the previous quadrat for the remaining length of the transect. Each quadrat is located to the right on the transect line when looking from A to B (for example Q10 is located along the 10 m to 12 m mark, and to the right of the transect). Additionally a 50 x 50 m (2,500 m^2) overstorey vegetation quadrat is surveyed spanning 25 m either side of the transect. Markers are installed at each corner of the 50 x 50 m quadrat and corners of the 2 x 2 m quadrats along the transect line to allow quadrats to be accurately relocated.

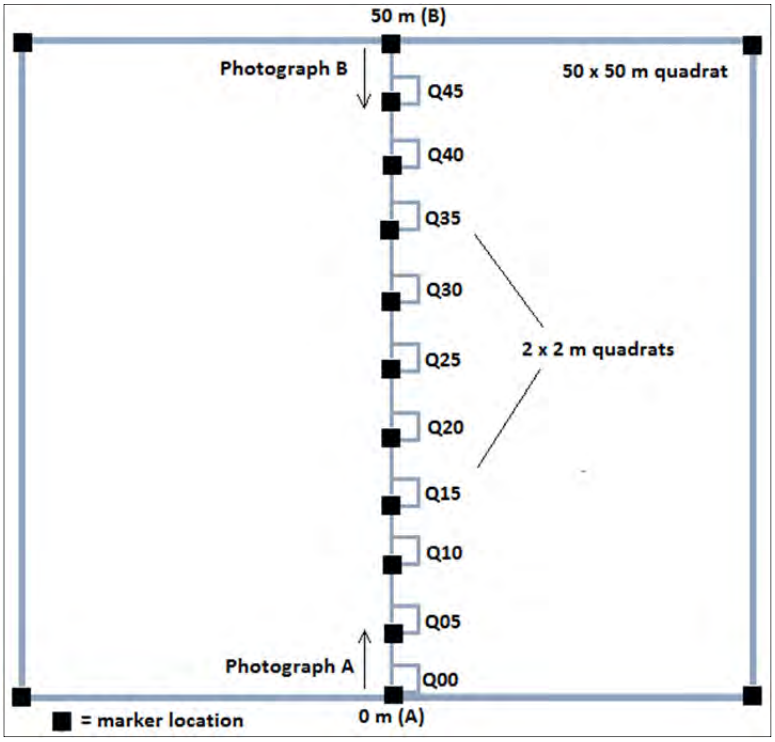


Figure 2.1 – Schematic diagram of a monitoring site (one transect)

Where a 50 metre transect cannot be established due to the size of the rehabilitation area, two 25 metre transects were sampled. The two transects are set up 50 metres apart and parallel to each other and the overstorey quadrat spans a further 25 metres from each transect line, covering 100 x 25 metres (2,500 m^2) in total. The quadrats are consecutively labelled (Figure 2.2).

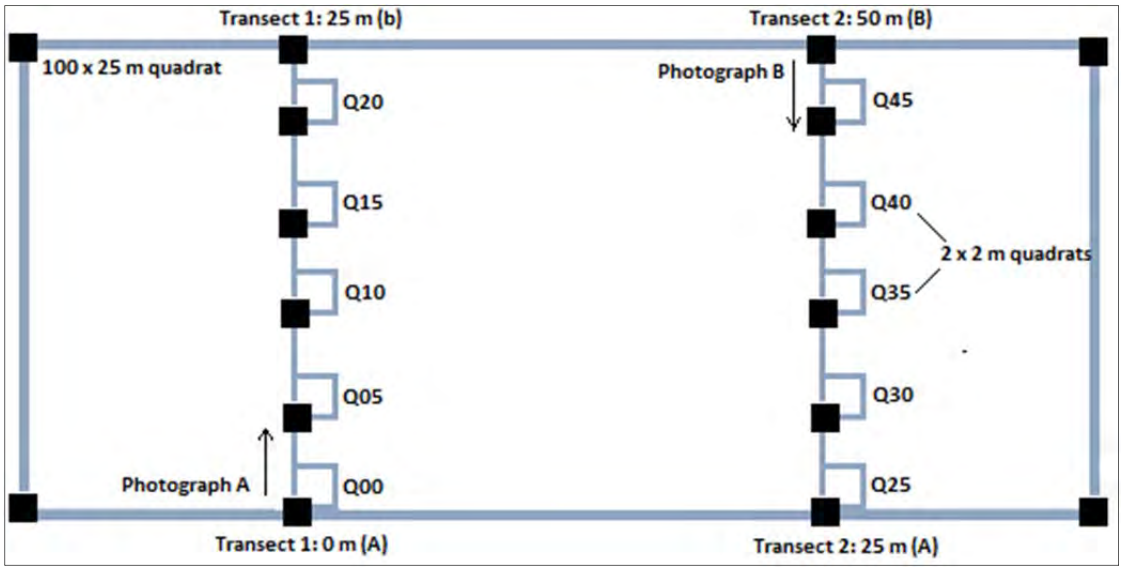


Figure 2.2 – Schematic diagram of a monitoring site (two transects)

2.2 FIELD PARAMETERS

2.2.1 Monitoring Site Parameters

At each monitoring site the following parameters were recorded:

- GPS coordinates for each marker;
- Two photographs taken:
  - Photograph A: taken from standing on the start of the transect (A) pointing towards the end (B), with the fence dropper for Q05 aligned in the middle of the photograph and with the measuring tape laid out (Figure 2.1). For multiple transects, photograph A is taken at transect 1 (Figure 2.2);
  - Photograph B: taken from standing on the end of the transect (B) pointing towards the start (A), with the fence dropper for Q45 aligned in the middle of the photograph and with the measuring tape laid out (Figure 2.1). For multiple transects, photograph B is taken at transect 2 (Figure 2.2);
- Habitat description;
- Vegetation community structure based on the National Vegetation Information System (NVIS) guidelines (ESCAVI 2003);

Vegetation condition, based on Trudgen (1991) (Table 2.1) for control sites;

- Rehabilitation condition (including any erosion or disturbances, Table 2.2), for rehabilitation sites;
- Rehabilitation year and treatment;
- Any animal sightings; and
- Time since last fire.

2.2.2 2 x 2 m Quadrat Parameters

At each 2 x 2 m quadrat the following parameters were recorded:

- For each flora taxon (including weeds and annuals, with stems inside and outside):
  - Foliage cover (defined as the estimated percentage cover of vegetation material including the foliage and branches which are treated as opaque and only alive material is to be included);
  - Stratum: (herb, tussock grass, hummock grass, sedge, low shrub (<1 m), mid shrub (1-2 m), tall shrub (>2 m), tree (trees are defined as woody plants, more than 2 m tall with a single stem or branches well above the base when mature);
  - Count of individuals (perennials only, with the stems growing inside the quadrat); and
  - Presence of reproductive material (flower or fruit).
- Presence of vertebrate and/or invertebrate fauna species; and
- Estimated count of faecal matter within the quadrat (native or introduced).

2.2.3 Overstorey Quadrat Parameters

For each 2,500 m^2 (50 x 50 m or 100 x 25 m) overstorey quadrat the following parameters were recorded:

- For each tree species (trees are defined as woody plants, more than 2 m tall with a single stem or branches well above the base when mature i.e. *Eucalyptus, Acacia aneura* etc.).
  - The number of individuals with stems growing inside the quadrat. Counts are to be classified as: seedling (< 1 m), juvenile (1 - 2 m) and mature (>2 m).
  - Foliage cover for each species (including overhanging plants). Cover is to be classified as: seedling (< 1 m), juvenile (1 - 2 m) and mature (>2 m); and
- Weed species canopy cover and count estimated.

Table 2.1 – Vegetation condition (Trudgen 1991)

Vegetation Condition	Criteria
Excellent	Pristine or nearly so, no obvious sign of damage caused by European man.
Very Good	Some relatively slight signs of damage caused by the activities of European man e.g. damage to tree trunks by repeated fires, the presence of some relatively non-aggressive weeds or occasional vehicle tracks.
Good	More obvious signs of damage caused by the activities of European man, including some obvious impact to vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive species.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of European man such as grazing or partial clearing or very frequent fires. Presence of some more aggressive weeds.
Very Poor	Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weeds species including aggressive species.
Completely Degraded	Areas that are completely or almost completely without native vegetation e.g. areas that are cleared or parkland cleared with their flora comprising weed or crop species with isolated native trees or shrubs.

Table 2.2 – Rehabilitation condition ratings

Attribute	Rating			
Erosion	Extensive rills or gullies	Moderate rills or gullies	Scattered rills or gullies	No erosion
	4	**3**	**2**	**1**
Disturbance (tracks, grazing etc.)	Extensive disturbance (>40% of site affected)	Moderate disturbance (10-40% of site affected)	Low disturbance (<10% of site affected)	No disturbance
	4	**3**	**2**	**1**

2.2.4 Photographic Site Parameters

At each photographic monitoring site the following parameters were recorded:

- GPS coordinates of the photo point (A) (where the photograph was taken from) and the reference/monitoring point (B) (the subject photographed). A marker was placed at both the photo point (A) and reference point (B) to easily align photographs taken for future monitoring events;
- Date;
- A photograph will be taken from the photo point (A) to the reference point (B), with the fence dropper aligned in the middle of the photograph;
- Vegetation condition (Table 2.1) based on Trudgen (1991) for control sites;
- Rehabilitation condition (including any erosion or disturbances, Table 2.2) for rehabilitation sites;
- Rehabilitation year and treatment;
- Any animal sightings;
- Time since last fire;
- Any weed species in the vicinity and estimated foliage cover for a 50 x 50 m area; and
- Estimation of perennial foliage cover for a 50 x 50 m area.

2.3 FIELD SURVEY

2.3.1 Timing

The 2015 baseline rehabilitation monitoring field survey was conducted by Senior Botanist Melissa Hay from 18 to 20 November 2015.

2.3.2 Rainfall Prior to the Field Survey

The nearest Bureau of Meteorology (BoM) stations for which comprehensive rainfall data is available is Southern Cross (Site No. 12320), 100 km south-west of the study area and Kalgoorlie (Site No. 12038), 110 km east of the study area. Rainfall prior to the November survey is shown in Figure 2.3). Above average rainfall was recorded at both Southern Cross and Kalgoorlie with 59.4 mm and 5.3 mm more rain falling, respectively, than the historical average for the three months prior to the survey (BoM 2015).

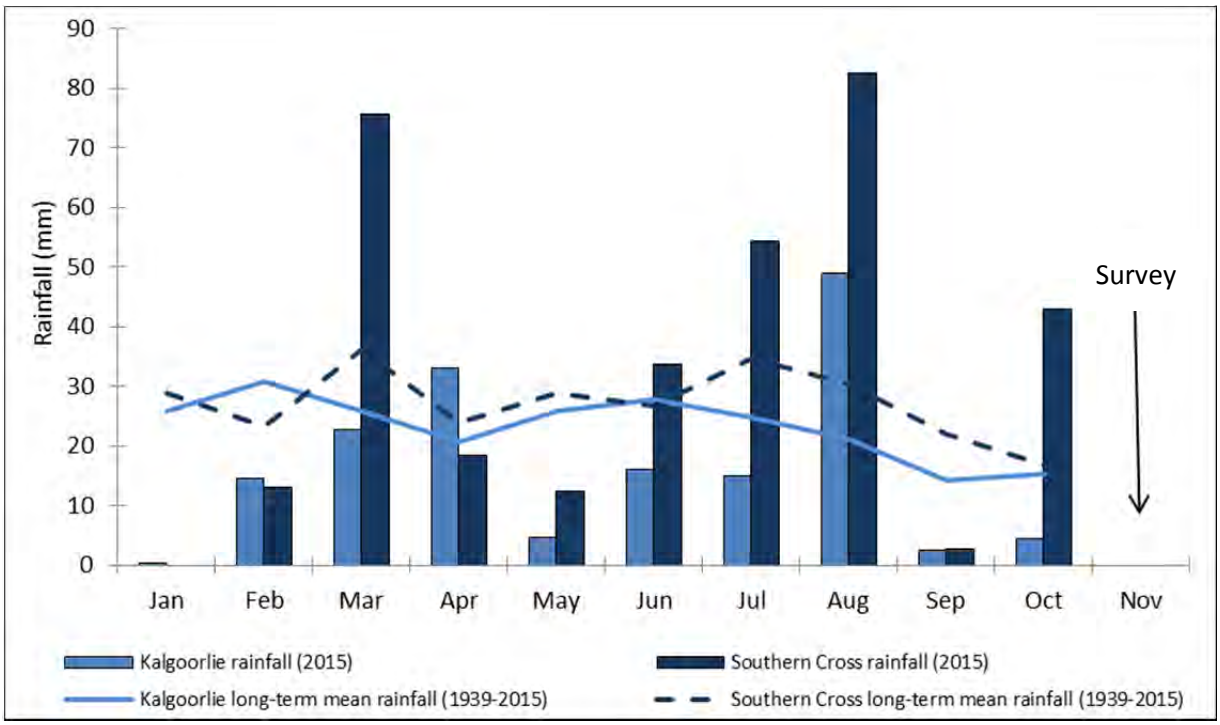
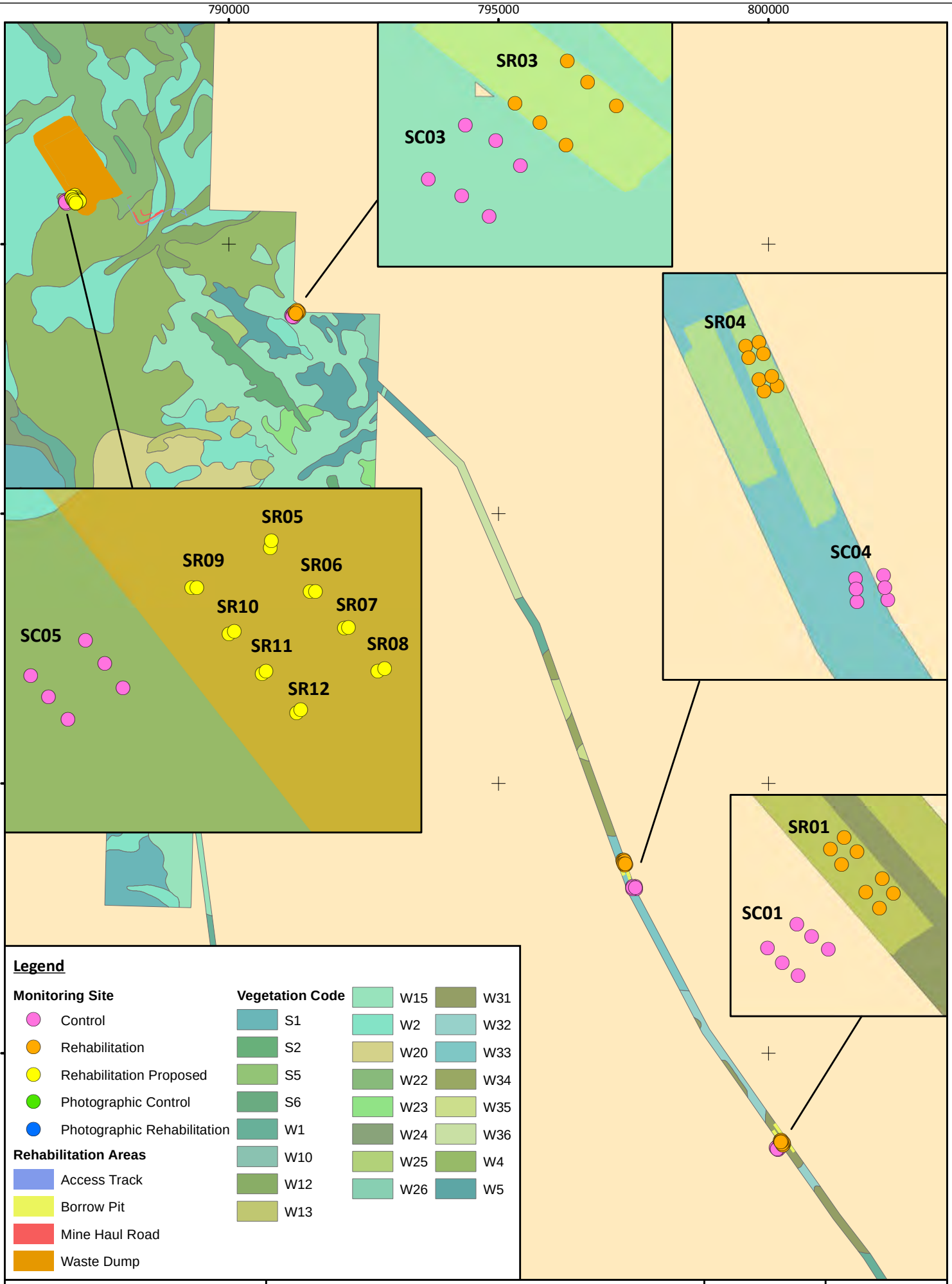


Figure 2.3 – Rainfall data recorded at Southern Cross and Kalgoorlie

2.3.3 Baseline 2015 Monitoring Sites

Four rehabilitation, five control and six photographic monitoring sites were established and monitored at Carina during the 2015 baseline survey. In addition, six proposed sites at the rehabilitation trial areas have been marked (at the 0 m and 5 m marks) for future monitoring. These were not monitored during the current study as there was no vegetation growth and are only included as photo monitoring sites for this year. Sites are mapped on Figure 2.4 and coordinates are provided in Appendix A.



Monitoring sites (north)

Figure: 2.4
Project ID: 1664

Drawn: MH
Date: 16/12/2015

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

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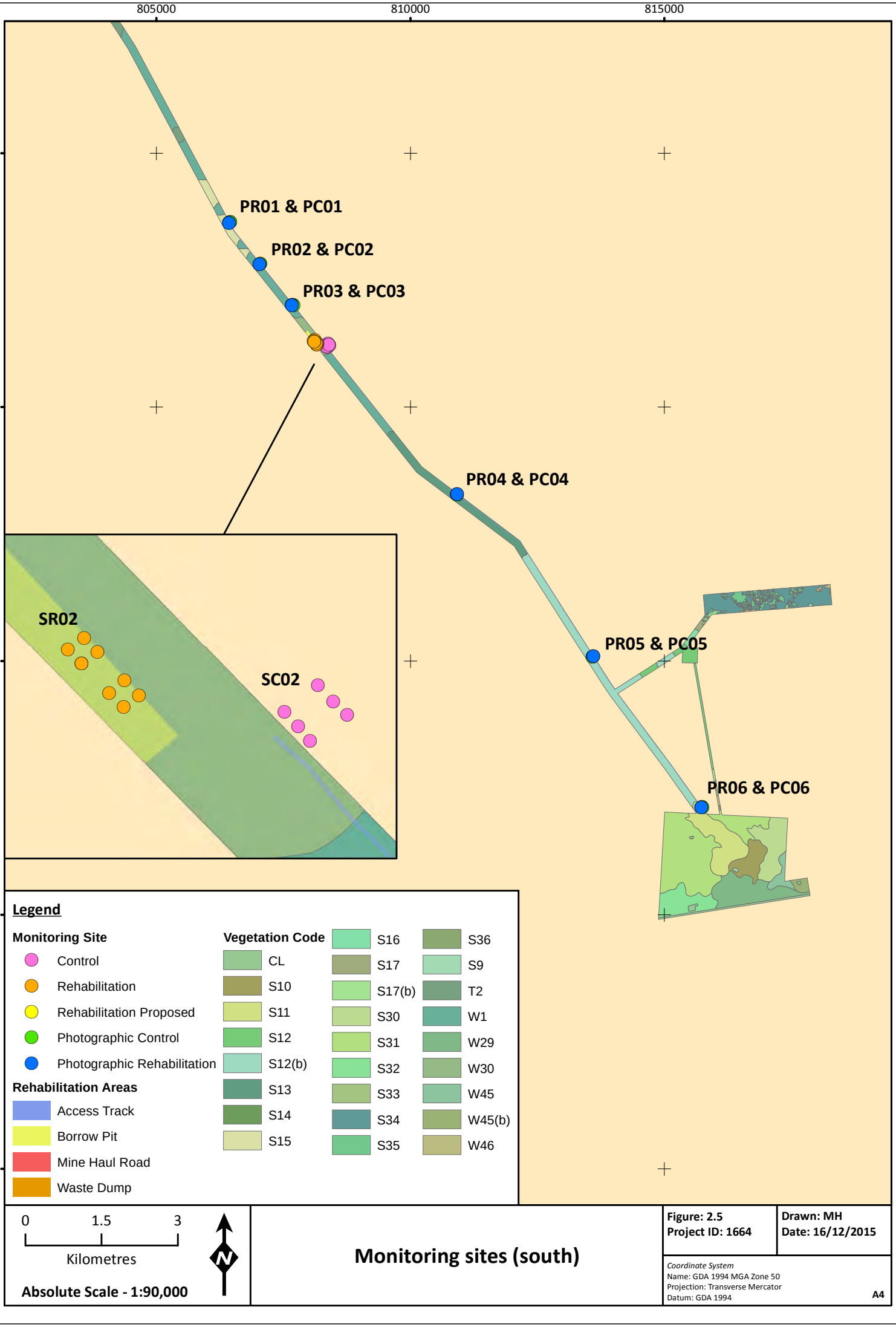
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Legend
Monitoring Site
Control
Rehabilitation
Rehabilitation Proposed
Photographic Control
Photographic Rehabilitation
Rehabilitation Areas
Access Track
Borrow Pit
Mine Haul Road
Waste Dump
Vegetation Code
CL
S10
S11
S12
S12(b)
S13
S14
S15
S16
S17
S17(b)
S30
S31
S32
S33
S34
S35
S36
S9
T2
W1
W29
W30
W45
W45(b)
W46
0
1.5
3
Kilometres
N
Absolute Scale - 1:90,000
Monitoring sites (south)
Figure: 2.5
Project ID: 1664
Drawn: MH
Date: 16/12/2015
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
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The Mattiske 2008 and 2009 vegetation community mapped at each monitoring site is provided in Table 2.3 below.

Table 2.3 – Monitoring sites and vegetation community mapping

Sites	Code	Vegetation community	Landform
SR01 & SC01	W31	Woodland of *Eucalyptus longicornis, Eucalyptus sheathiana* and *Eucalyptus loxophleba* subsp. *lissophloia* over *Eremophila scoparia, Atriplex nummularia*, *Exocarpos aphyllus* over *Atriplex vesicaria, Olearia muelleri* and mixed shrubs	Orange brown clay soils on flats
SR02 & SC02	W30	Low woodland of *Eucalyptus corrugata* over *Acacia resinimarginea* over *Beyeria brevifolia, Acacia hemiteles*, and mixed shrubs over *Triodia scariosa* and *Triodia ?desertorum*	Yellow to orange sandy clay soils on flats
SR03 & SC03	W15	Low Woodland of *Eucalyptus corrugata, Eucalyptus loxophleba* subsp. *lissophloia* and *Eucalyptus longicornis* over *Acacia burkittii, Allocasuarina campestris* and *Exocarpos aphyllus* over *Senna artemisioides* subsp. *filifolia*, *Philotheca tomentella, Prostanthera grylloana, Templetonia sulcata* and *Philotheca brucei* subsp. *brucei* over *Grevillea acuaria* and *Scaevola spinescens*	Red-brown clay soils on flats
SR04 & SC04	W33	Low woodland of *Eucalyptus corrugata* and mixed Eucalypt species over mixed *Allocasuarina* species and *Acacia burkittii* over *Alyxia buxifolia, Grevillea obliquistigma* subsp. *obliquistigma* over *Prostanthera grylloana* and *Leucopogon* sp. Clyde Hill	Orange to red brown clay soils on flats and lower slopes
SR05, SR06, SR07, SR08, SR09, SR10, SR11, SR12 & SC05	W4	Woodland of *Eucalyptus longicornis, Eucalyptus salubris, Eucalyptus corrugata* and *Eucalyptus moderata* over *Eremophila ionantha, Eremophila scoparia*, *Senna artemisioides* subsp. *filifolia, Exocarpos aphyllus, Atriplex nummularia* and *Santalum acuminatum* over *Acacia colletioides* and *Atriplex vesicaria*	Red-brown sandy clay flats with scattered ironstone and quartz pebbles
PR01 & PC01	S15	Scrub of *Allocasuarina campestris* with emergent *Eucalyptus loxophleba* subsp. *lissophloia* and *Eucalyptus eremophila* subsp. *eremophila* over mixed shrubs over *Triodia irritans*	Lateritic orange brown sandy clay soils
PR02 & PC02	S14	Scrub of *Acacia burkittii, Allocasuarina corniculata* and *Allocasuarina campestris* with emergent *Eucalyptus loxophleba* subsp. *supralaevis* over *Dodonaea microzyga* and mixed shrubs	Red brown clay soils on flats
PR03 & PC03	W1	Woodland of *Eucalyptus salmonophloia, Eucalyptus salubris, Eucalyptus sheathiana, Eucalyptus corrugata, Eucalyptus yilgarnensis, Eucalyptus transcontinentalis, Eucalyptus longicornis* and *Eucalyptus ravida* over *Acacia jennerae, Acacia prainii, Acacia colletioides, Santalum acuminatum*, *Exocarpos aphyllus, Eremophila scoparia, Eremophila granitica, Eremophila ionantha, Senna artemisioides subsp. filifolia* and *Atriplex nummularia* over *Atriplex vesicaria, Grevillea acuaria, Olearia muelleri, Olearia pimelioides* and *Austrostipa elegantissima*	Red-brown clay on flats
PR04 & PC04	S13	Scrub of *Allocasuarina corniculata* and *Acacia yorkrakinensis* subsp. *acrita* with emergent mixed Eucalypt species over *Thryptomene kochii, Baeckea* sp. Mt. Clara, *Euryomyrtus maidenii, Leptospermum fastigiatum* and *Melaleuca cordata* over *Triodia ?desertorum*	Lateritic yellow to orange-yellow sandy soils
PR05 & PC05	S12(b)	Scrub (fire disturbed) of *Allocasuarina corniculata* and occasional mixed Eucalypt species over *Melaleuca cordata, Euryomyrtus maidenii* and mixed shrubs over *Triodia desertorum*	Yellow sandy soils on gently undulating plains
PR06 & PC06	S11	Scrub of *Acacia resinimarginea, Callitris preissii, Eucalyptus pileata* and mixed *Allocasuarina* species over *Melaleuca hamata* and *Leptospermum fastigiatum* over *Baeckea* sp. Mt. Clara and mixed shrubs	Lateritic yellow sandy soils on mid to upper slopes

3 LANDFORM STABILITY MONITORING METHODOLOGY

In recent years landform stability monitoring has seen a number of different applied methods, with subjective qualitative methods typified by LFA/EFA monitoring being phased out in favour of objective quantitative methods involving direct empirical measurement. The use of LiDAR (light detection and ranging) techniques has been developed by Soilwater Consultants for use in rehabilitation monitoring to produce high resolution digital elevation models of landscape surfaces.

LiDAR systems work by emitting light and detecting the reflection of the light in order to accurately determine the distance to the reflected object. Rather than making a single measurement as in a laser rangefinder or reflector less total stations, a LiDAR scanner has rotating mirrors as well as the entire scanner rotates, which allows millions of measurements to be made over a scene in just a few minutes.

For the purpose of this study a Maptek ISite ground based LiDAR scanner was used. The I-Site's primary sensing system is a time-of-flight long range scanner, which records 3D point data as well the intensity of the return from each point. It operates by emitting a pulse of laser light that is reflected off the scanned object. A sensor measures the time of flight for the optical pulse to travel to and from the reflected surface.

The effective speed of acquisition of the I-Site system is 8800 points per second (Maptek, 2012). From the distance and the orientation of the laser pulse, the xyz coordinates associated with each reflected pulse can be determined. In addition the intensity of the returned pulse is determined. In general light coloured objects and closer objects give a higher reflection compared with darker objects and objects father away. Together, the xyz coordinates and associated intensity values for millions of data points outputted by the laser make up the "point cloud"

The secondary sensing system is the panoramic digital camera that provides colour texture overlays for the laser scan data at a higher spatial resolution than the 3D point cloud. The camera operates through a wide dynamic range and includes filters to remove laser effects from the image and algorithm to correct for lens distortion.

LiDAR devices are capable of generating dense point clouds that can be processed to yield three dimensional (x, y, z) definitions of the features / area being scanned.

3.1 POINT CLOUDS

Point clouds by themselves are not useful without software to process the data and make measurements and other calculations. In order for the point clouds to be useful the point cloud data needs to interface easily with computer aided design/drafting (CADD) and slope stability programs.

The first step in point cloud processing is to orient the point cloud into the real world coordinate system based on data taken in the field. Maptek I-Site Studio has the ability to register these point clouds by registering the orientation of the scanner (orient by scanner and back-sight method) together with an accurate GPS of the survey position. The back-sighting method uses a built in optical telescope to site to know points so that the orientation of the scan be determined. This orientation can be registered by I-Site Studio which measures the scanner bearing.

The next step is to create a surface mesh from the point cloud data. In the process of creating a surface mesh, erroneous data points in the point cloud can be filtered. This includes the removal of points outside the area of interest, the removal of points directly in front of the area of interest (due to vehicles, vegetation or other objects) and the removal of vegetation along the area of interest.

These are accomplished by hand-editing and through various filtering tools. It is important to properly filter scans to create a model that is both optimized for size and is still an accurate representation of the data. Filtering point clouds is done on a case by case basis, not all scan data requires all filtering options. After some data filtering a triangulated surface can be rendered from

the point cloud data, after which many subsequent calculations and visitations can be made using the 3D DTM surface. In addition a photo-overlay can be overlayed onto the 3D surface. Figure 3.1 shows a triangulated mesh with photo overlay for part of a point cloud, illustrating the deep gullying which can develop on post-mine landforms which have not been properly rehabilitated.

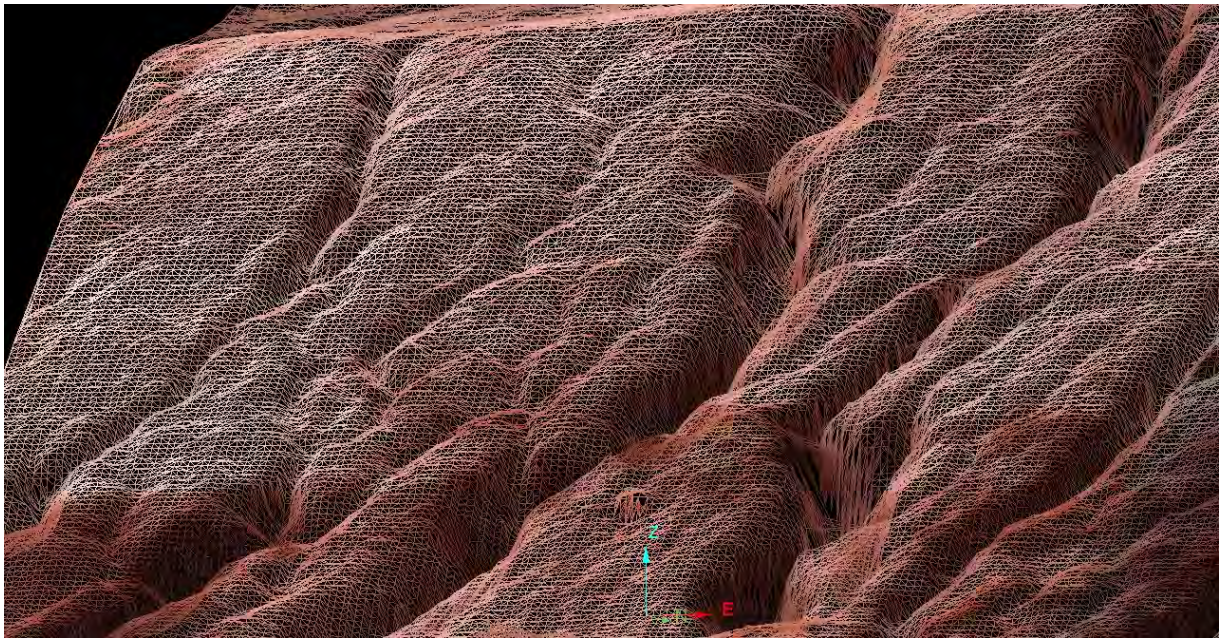

Figure 3.1 – Triangulated mesh surface with photo overlay of part of a point cloud

The average point spacing in a point cloud is a very important parameter that should be optimized for a particular application. In general, point spacings of 2 cm or less are optimum for most geotechnical applications. Point cloud spacings up to 5cm are acceptable for the scanning high slopes but point cloud spacings greater than 5 cm are not recommended for any geotechnical applications. For non-geotechnical applications involving the generation of a 3d digital terrain model, point cloud spacings up to 10 cm are acceptable

3.2 SURVEY METHODOLOGY

A ground-based LiDAR survey was conducted by SWC personnel in November 2015. A total of 8 scans were taken ranging over two different point cloud resolutions. Ground based LiDAR data was collected using a Maptek ISite ground-based scanner. Data from the 8 scan positions collected were merged together using Maptek Istudio and a Trimble R8 differential GPS system with a base station within a 5-km range.

The ISite scanner was used to collect surface data in the form of a non-spatially referenced 3-dimensional point clouds. The short wavelength was useful for ensuring accurate distance to any surface object in the laser beam's path. This creates a shadow effect behind vegetation where no surface data can be recorded. To account for this shadow effect and develop a digital surface model of the entire rehabilitated area, LiDAR scans were taken from multiple directions. Common backsights were established around the site, which were used to align and merge the point clouds in post processing.

The coordinates of the eight scanning locations is provided in Table 3.1.

Table 3.1 – Flora taxa and frequency (number of 2 x 2 m quadrats)

Scan Site ID	Coordinates GDA 94 (Zone 50)		Elevation (m RL)
	Easting	Northing	
Site 01	787,765	6,626,107	462.7
Site 02	787,702	6,626,208	463.2
Site 03	787,767	6,626,358	438.8
Site 04	787,882	6,626,196	436.7
Site 05	787,043	6,625,885	432.0
Site 06	787,107	6,625,789	432.6
Site 07	787,289	6,625,774	461.6
Site 08	787,225	6,625,871	461.4

3.3 POINT CLOUD POST PROCESSING

An explicit useful dataset is achieved by joining all point clouds of multiple scans of a targeting object, the vectors can be projected onto a plan surface or transformed into a map or make a 3D perspective view and DTM.

After joining all datasets into a single point cloud model with a common coordinate system a further step is to transform the local coordinate systems into a geodetic system by using ground control points measured by ground surveying in this study using GPS. The registered point cloud data was processed using Maptek I-Site Studio 3.5.1. This software package allows for point cloud datasets to be efficiently integrated modelled and manipulated. Data in areas of overlap were thinned to produce a single point cloud. The resulting point cloud was then subjected to data filtering and the vegetation removal process to produce a bare earth digital terrain model. This terrain model can then be compared with subsequent monitoring datasets to empirically assess erosion rates and overall landform stability of rehabilitated landform areas.

4 RESULTS

The vegetation monitoring data collected during the survey is provided in Appendix B to E and has been provided electronically in Appendix F.

4.1 FLORA TAXA

Sixty-seven vascular flora taxa were recorded during the survey, of which 27 were at rehabilitation sites and 47 at control sites (Table 4.1). Six of these taxa could only be identified to genus level, but are considered to represent taxa not otherwise recorded, so are included in the species richness counts. Five additional taxa are considered likely to be repeats of others and have not been included (as indicated by ^ below). Two Priority flora taxa: *Acacia cylindrica* (Priority 3) and *Grevillea georgeana* (Priority 3) and two introduced species: **Sonchus oleraceus* and **Solanum hoplopetalum* were recorded.

Table 4.1 – Flora taxa and frequency (number of 2 x 2 m quadrats)

Family	Taxa	Frequency	
		Control quadrats	Rehabilitation quadrats
Amaranthaceae	*Ptilotus nobilis* subsp. *nobilis*	-	8
Apocynaceae	*Alyxia buxifolia*	5	-
Araliaceae	*Trachymene ceratocarpa*	-	1
Asteraceae	*Asteraceae* sp. 1	1	-
Asteraceae	*Olearia muelleri*	5	-
Asteraceae	**Sonchus oleraceus*	-	10
Casuarinaceae	*Allocasuarina acutivalvis* subsp. *acutivalvis*	4	-
Casuarinaceae	*Allocasuarina campestris*	8	-
Chenopodiaceae	*Atriplex nummularia*	3	2
Chenopodiaceae	*Chenopodiaceae* sp.^	-	1
Chenopodiaceae	*Maireana* sp. 1	-	5
Chenopodiaceae	*Sclerolaena cuneata*	-	3
Chenopodiaceae	*Sclerolaena diacantha*	-	12
Cupressaceae	*Callitris preissii*	0	-
Cyperaceae	*Lepidosperma lyonsii*	1	-
Dilleniaceae	?*Hibbertia* sp.^	-	1
Dilleniaceae	*Hibbertia exasperata*	10	-
Euphorbiaceae	*Monotaxis luteiflora*	-	2
Fabaceae	*Acacia burkittii*	6	7
Fabaceae	*Acacia cylindrica* (Priority 3)	-	1
Fabaceae	*Acacia erinacea*	3	-
Fabaceae	*Acacia longispinea*	3	-
Fabaceae	*Acacia merrallii*	1	2
Fabaceae	*Acacia sibina*	-	4
Fabaceae	*Acacia tetragonophylla*	2	
Fabaceae	*Templetonia smithiana*	-	1
Goodeniaceae	*Scaevola spinescens*	6	-
Gyrostemonaceae	*Codonocarpus cotinifolius*	0	-
Haloragaceae	*Gonocarpus confertifolius* var. *helmsii*	-	1
Lamiaceae	*Hemigenia westringioides*	1	-
Malvaceae	*Hannafordia bissillii* subsp. *latifolia*	-	6
Malvaceae	*Keraudrenia integrifolia*	-	7
Malvaceae	*Lawrencia diffusa*	-	2
Myrtaceae	*Baeckea elderiana*	4	1
Myrtaceae	*Eucalyptus corrugata*	3	-
Myrtaceae	*Eucalyptus griffithsii*	0	-
Myrtaceae	*Eucalyptus longicornis*	1	-
Myrtaceae	*Eucalyptus loxophleba* subsp. *lissophloia*	3	-
Myrtaceae	*Eucalyptus* sp.^	-	0
Myrtaceae	*Eucalyptus* sp. 1 (glaucous foliage)	-	1
Myrtaceae	*Eucalyptus* sp. 2 (green shiny foliage)	-	0

Family	Taxa	Frequency	
		Control quadrats	Rehabilitation quadrats
Myrtaceae	*Eucalyptus yilgarnensis*	3	-
Myrtaceae	*Melaleuca hamata*	1	-
Myrtaceae	*Melaleuca pauperiflora* subsp. *fastigiata*	1	-
Myrtaceae	*Melaleuca* sp. 1	-	5
Myrtaceae	*Melaleuca vinnula*	2	-
Myrtaceae	*Micromyrtus ?sulphurea*	1	-
Myrtaceae	*Rinzia carnosa*	3	-
Myrtaceae	*Thryptomene urceolaris*	3	-
Poaceae	*Amphipogon caricinus* var. *caricinus*	4	-
Poaceae	*Austrostipa elegantissima*	2	1
Poaceae	*Austrostipa trichophylla*	-	6
Poaceae	*Poaceae* sp.^	-	6
Poaceae	*Triodia tomentosa*	10	-
Proteaceae	*?Hakea* sp.^	1	-
Proteaceae	*Grevillea ?beardiana*	3	-
Proteaceae	*Grevillea didymobotrya* subsp. *didymobotrya*	-	8
Proteaceae	*Grevillea georgeana* (Priority 3)	2	-
Proteaceae	*Grevillea haplantha* subsp. *haplantha*	2	-
Proteaceae	*Grevillea zygoloba*	3	-
Proteaceae	*Hakea* sp. 1	1	-
Proteaceae	*Petrophile seminuda*	1	-
Rhamnaceae	*Cryptandra ?myriantha*	1	-
Rutaceae	*Phebalium canaliculatum*	2	1
Rutaceae	*Phebalium filifolium*	2	-
Santalaceae	*Santalum acuminatum*	1	-
Scrophulariaceae	*Eremophila clarkei*	1	-
Scrophulariaceae	*Eremophila drummondii*	3	1
Scrophulariaceae	*Eremophila ionantha*	1	-
Scrophulariaceae	*Eremophila scoparia*	6	-
Scrophulariaceae	*Eremophila* sp. Mt Jackson (G.J. Keighery 4372)	4	-
Solanaceae	**Solanum hoplopetalum*	-	0

Note: taxa with a zero were recorded in the larger 50 x 50 m quadrat only. ^ = not included in counts.

The most common taxa recorded at the rehabilitation sites were *Sclerolaena diacantha* at 12 quadrats (13.3%) and **Sonchus oleraceus* at 10 quadrats (11.1%). The most common taxa recorded at the control sites were *Triodia tomentosa* and *Hibbertia exasperata*, both recorded at 10 quadrats (11.1%). Six rehabilitation and four control quadrats had no flora taxa recorded within them.

The flora data collected in the 2 x 2 m quadrats is presented in Appendix C.

4.2 DIVERSITY

Diversity is a function of species richness, or the number of species per quadrat and evenness, the relative abundance of those species in an area. Species that were overhanging a quadrat only, was included as one record. Evenness is presented using the Shannon-Weiner Diversity Index (SWDI) for perennial species only. Data for each site is shown in Table 4.2.

Table 4.2 – Diversity data

Site	Shannon-Weiner Diversity Index	Evenness	Total species richness	Total perennial species richness	Total annual species richness	Mean total species richness	Mean perennial species richness	Mean annual species richness
SR01	1.0	0.3	11	9	2	3.6	2.6	1.0
SR02	1.7	1.0	10	7	3	1.3	0.8	0.5
SR03	1.3	0.7	9	8	1	2.3	1.5	0.8
SR04	1.9	0.9	9	9	0	3.4	3.4	0
Rehab total	**1.8**	**0.3**	**27**	**22**	**5**	**-**	**-**	**-**
Rehab mean	**1.5**	**0.7**	**9.8**	**8.3**	**1.5**	**2.7**	**2.1**	**0.6**
SC01	1.6	0.8	7	7	0	1.5	1.5	0
SC02	1.3	0.6	10	10	0	2.7	2.7	0
SC03	2.5	1.0	15	15	0	2.9	2.9	0
SC04	2.0	0.8	14	14	0	3.5	3.5	0
SC05	2.5	1.0	14	14	0	2.8	2.8	0
Control total	**3.1**	**0.5**	**47**	**47**	**0**	**-**	**-**	**-**
Control mean	**2.0**	**0.8**	**12.0**	**12.0**	**0**	**2.7**	**2.7**	**0**

The total mean species richness for each 2 x 2 m quadrat was the same for control and rehabilitation sites (2.7±1.7). However, rehabilitation sites had lower mean perennial species richness (2.1±1.6) and higher mean annual species richness (0.6±0.6) than the controls (Figure 4.1, Table 4.2).

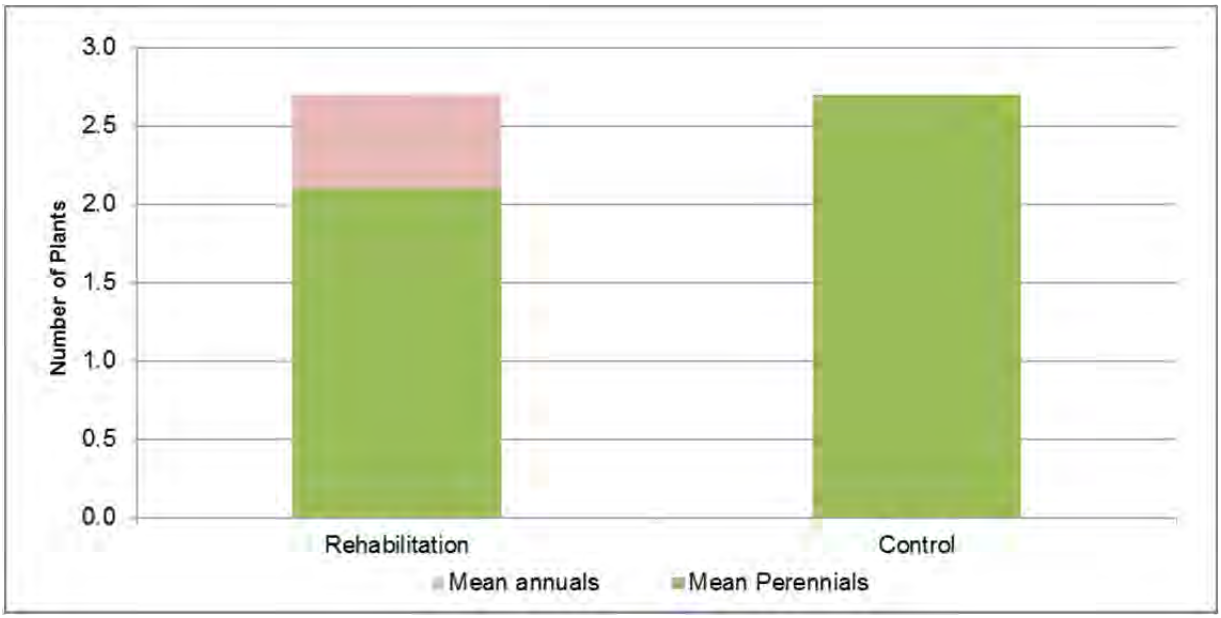

Figure 4.1 – Mean annual and perennial species richness for rehabilitation and control sites

Rehabilitation sites SR01 and SR02 had the highest and lowest total mean species richness of rehabilitation sites, with 3.6±0.5 and 1.3±1.6 respectively, and control sites SC04 and SC01 had the highest and lowest total mean species richness of control sites, with 3.5±1.2 and 1.5±1.3 respectively (Figure 4.2, Table 4.2).

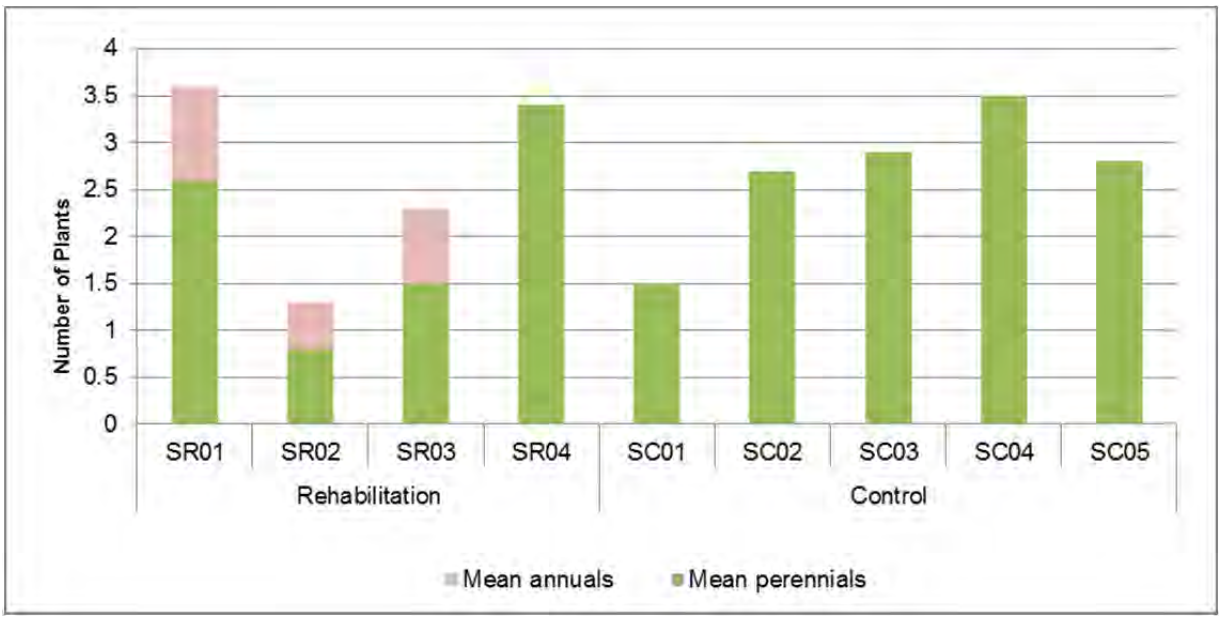

Figure 4.2 - Mean annual and perennial species richness for sites

The SWDI and species evenness was lower at rehabilitation (1.8 and 0.3, respectively) than control sites (3.1 and 0.5, respectively) (Figure 4.3, Table 4.2).

Figure 4.3 – SWDI and species evenness scores for rehabilitation and control sites

4.3 VEGETATION STRUCTURE, COVER AND DENSITY

Vegetation structure and cover is shown for sites using the mean perennial and annual percentage cover for each stratum. Density is shown as the number of perennial individuals per metre square metre. Data for each site is shown in Table 4.3.

Table 4.3 – Vegetation structure, foliage cover and density data

Site	Density	Mean perennial cover	Mean annual cover	Mean herb cover	Mean sedge cover	Mean tussock grass cover	Mean hummock grass cover	Mean low shrub cover	Mean mid shrub cover	Mean tall shrub cover	Mean tree Cover
SR01	7.7	18.6	0.1	0.1	0	10.2	0	8.4	0	0	0
SR02	0.2	0.1	0.1	0.1	0	0	0	0.1	0	0	0
SR03	1.4	1.9	2.0	2.0	0	0.1	0	1.8	0	0	0
SR04	1.4	23.5	0	0	0	0	0	23.5	0	0	0
Rehab mean	**2.7**	**11.0**	**0.5**	**0.5**	**0**	**2.6**	**0**	**8.4**	**0**	**0**	**0**
SC01	0.5	10.5	0	0	0	0	0	4.6	2.7	2.2	1.0
SC02	1.9	35.7	0	0	0	0	12.3	2.4	5.3	9.1	6.5
SC03	0.8	33.0	0	0	0	0.2	0	3.4	6.7	15.6	7.0
SC04	1.6	67.5	0	0	0.1	0	0	5.8	11.8	28.7	21.0
SC05	0.7	28.6	0	0	0	0	0	4.0	2.8	5.8	16.0
Control mean	**1.1**	**35**	**0**	**0**	**0**	**0.1**	**2.5**	**4.1**	**5.9**	**12.3**	**10.3**

The mean perennial cover for each 2 x 2 m quadrat was higher at control (35.0±33.8) than rehabilitation sites (11.0±17.7) and the mean annual cover was higher at rehabilitation (0.5±1.4) than control sites (0) (Figure 4.4, Table 4.3).

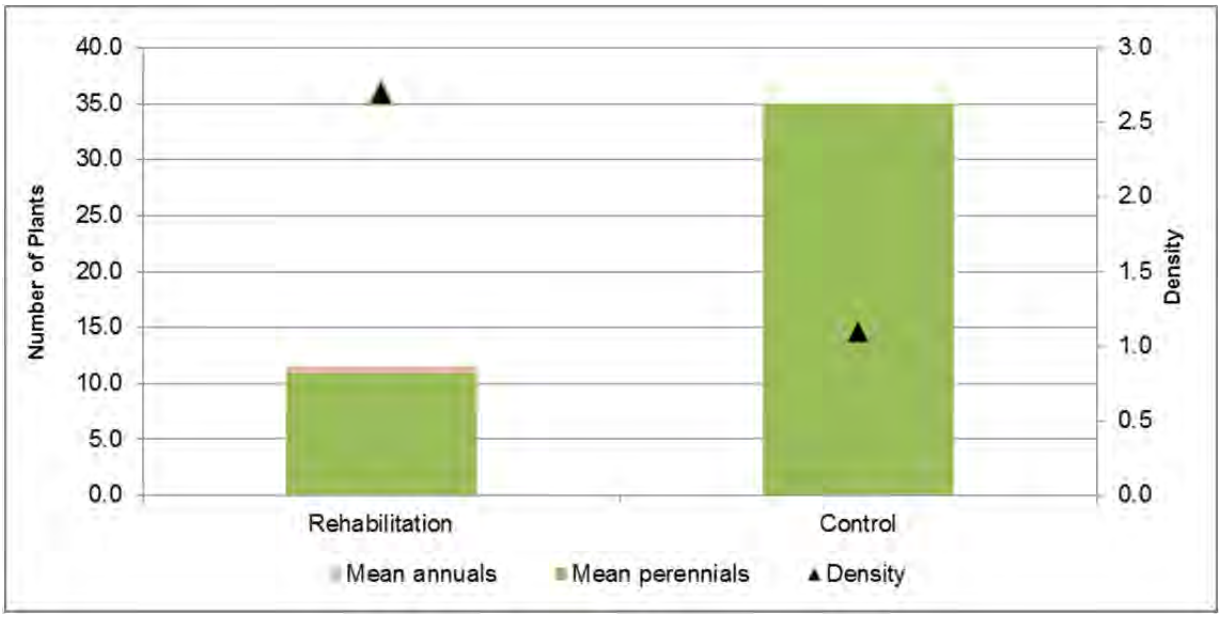

Figure 4.4 – Mean cover and density of vegetation at rehabilitation and control sites

Rehabilitation sites were dominated by low shrubs (8.4%) and tussock grasses (2.6%), whereas the control sites had a mix strata, including tall shrubs (12.3%), trees (10.3%) and mid shrubs (5.9%) (Figure 4.5, Table 4.3).

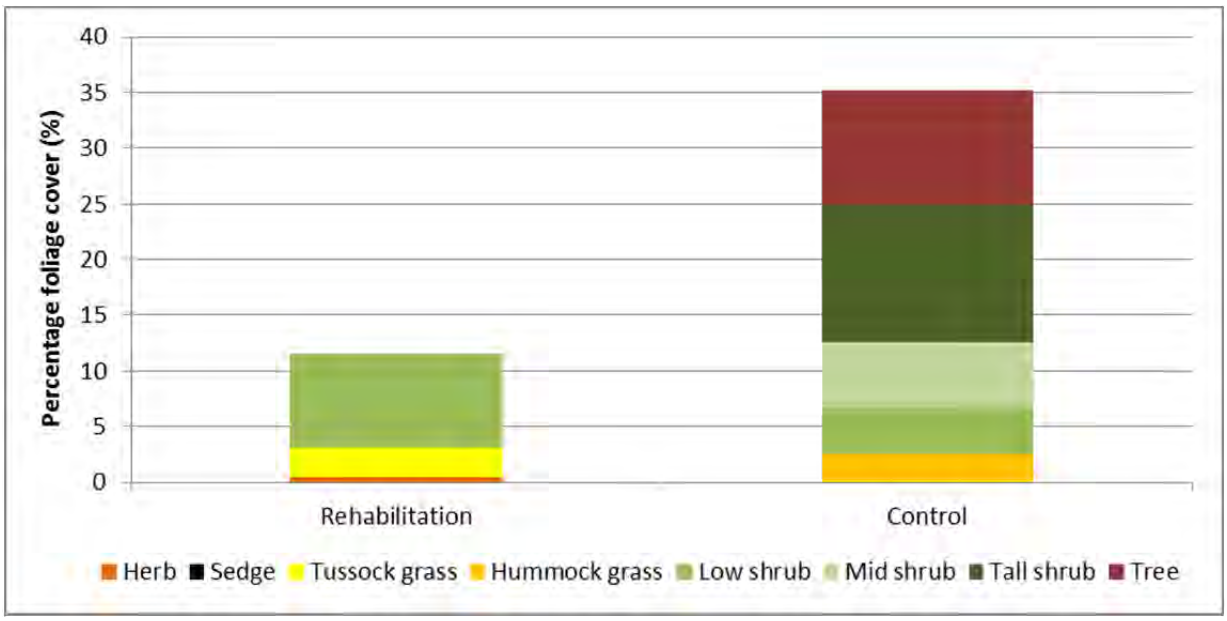

Figure 4.5 – Mean cover of vegetation for each stratum at rehabilitation and control sites

The mean cover of vegetation for each stratum at sites is presented in Figure 4.6. Where the control sites are fairly consistent with the different structural layers, the rehabilitated areas vary substantially between sites.

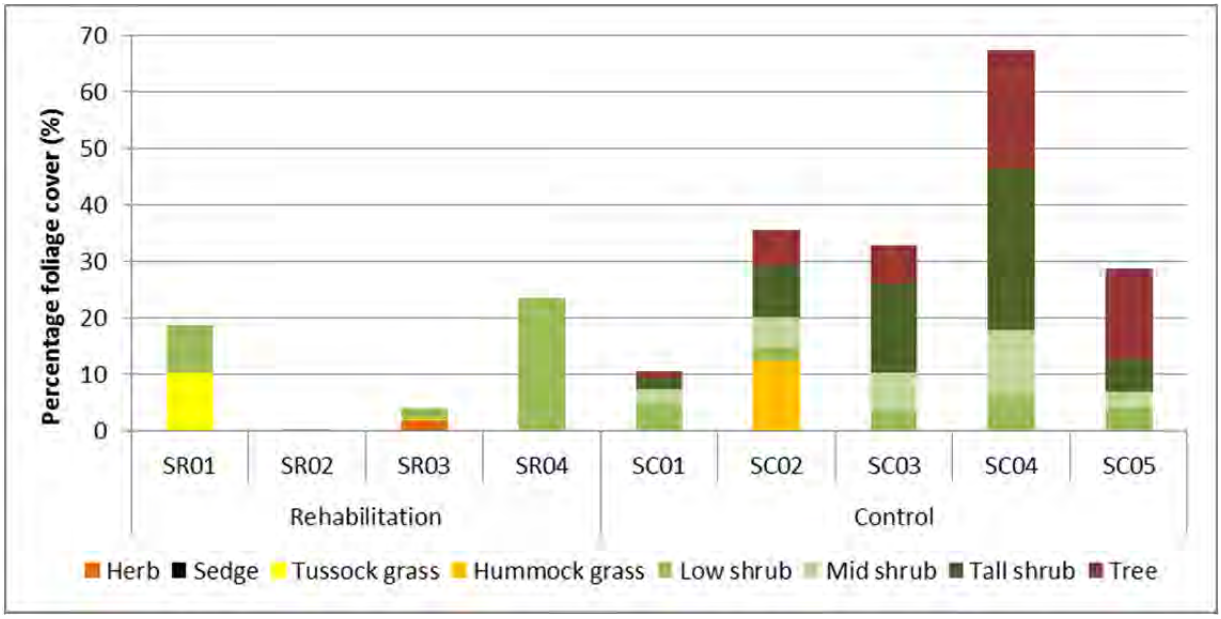

Figure 4.6 – Mean cover of vegetation for each stratum at sites

4.4 OVERSTOREY TREE SPECIES

Data for the tree species that were recorded within the overstorey quadrat is provided in Table 4.4 and in Appendix D.

Table 4.4 – Diversity data for overstorey trees

Site	Total species richness	Total foliage cover	Foliage cover mature	Foliage cover juvenile	Foliage cover seedling
SR01	2	1.3	0	1.1	0.2
SR02	0	0	0	0	0
SR03	1	0.1	0	0.1	0
SR04	1	0.1	0	0.1	0
Rehab total	**4**	-	-	-	-
Rehab mean	-	**0.4**	**0**	**0.3**	**0.1**
SC01	3	46	15.3	0	0
SC02	5	37.3	10.7	1.7	0.1
SC03	1	20	20.0	0	0
SC04	2	25	12.5	0	0
SC05	1	10	10.0	0	0
Control total	**12**	-	-	-	-
Control mean	-	**17.6**	**13.7**	**3.8**	**0.1**

Mean percentage tree cover was less at rehabilitation (0.4) than control sites (17.6) (Figure 4.7, Table 4.4).

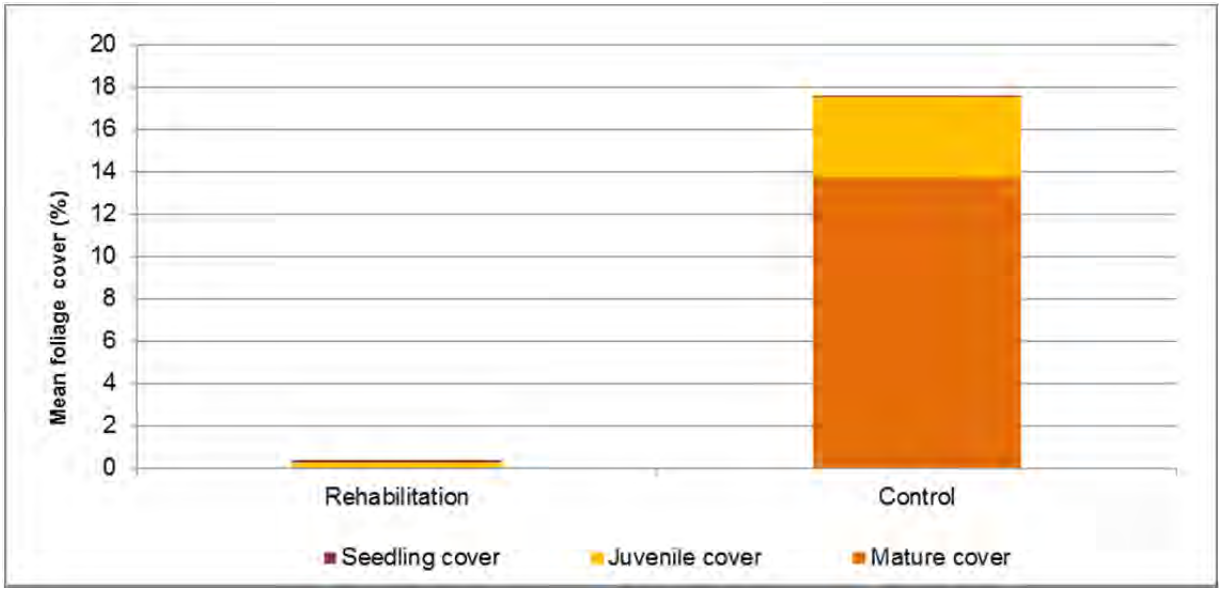

Figure 4.7 – Mean cover of trees for each stratum at rehabilitation and control sites

Rehabilitation sites contained no mature trees, with only juveniles and seedlings recorded, whereas the control sites were dominated by mature trees (Figure 4.8, Table 4.4).

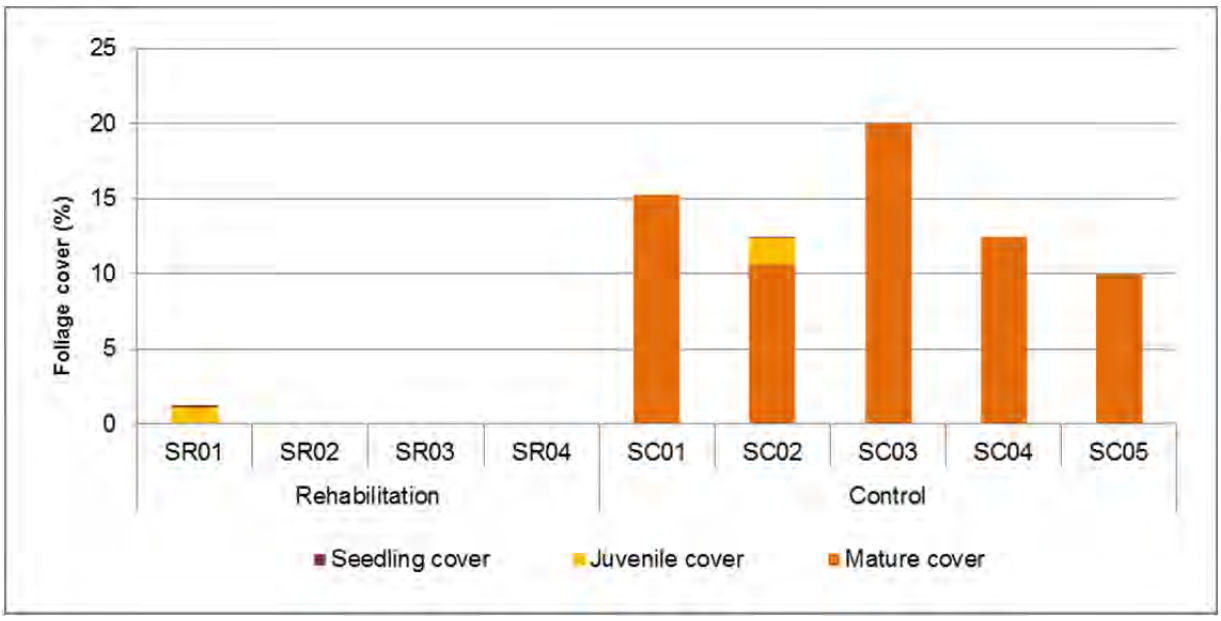

Figure 4.8 – Total cover of trees for each stratum at sites

4.5 FLOWERING AND FRUITING SPECIMENS

Of the 240 flora records from the 2 x 2 m quadrats, 43 percent were flowering and/or fruiting at the time of the survey and 57 percent were sterile. At rehabilitation sites 54 percent were flowering and/or fruiting at the time of survey and at control sites, 35 percent were flowering and/or fruiting at the time of survey (Figure 4.9).

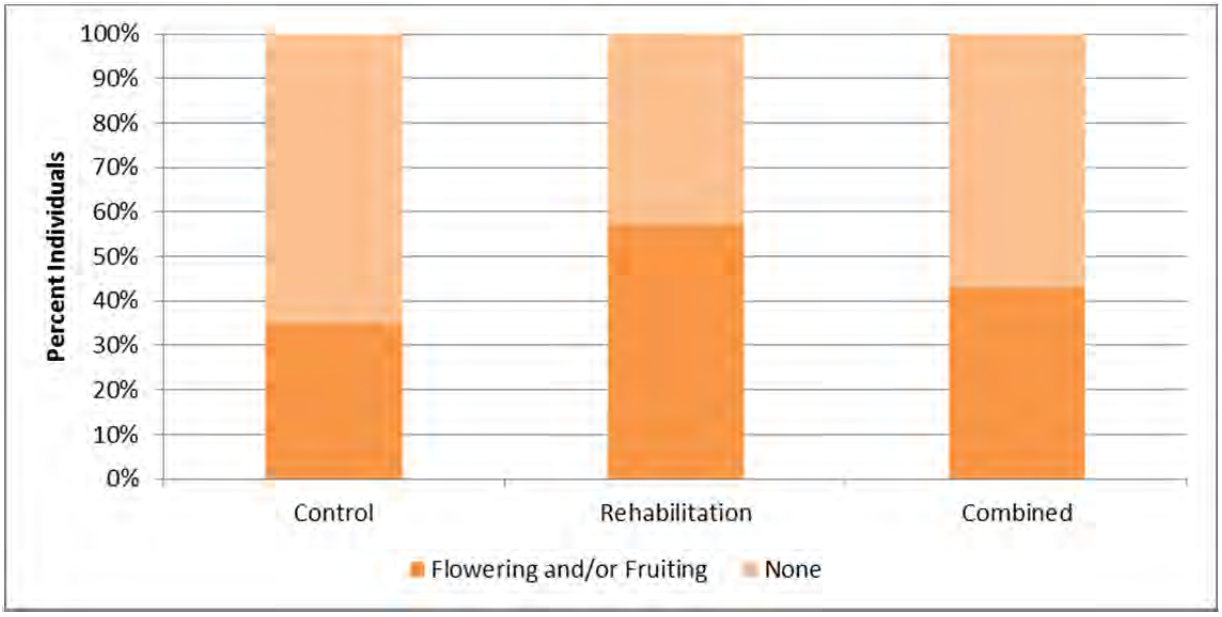

Figure 4.9 – Percent of individuals flowering and fruiting in the 2 x 2 m quadrats

4.6 INTRODUCED FLORA

Two introduced flora species were recorded during the current survey: **Sonchus oleraceus* at three rehabilitation sites (SR01, SR02 and SR03); and **Solanum hoplopetalum* (at SR02) (Table 4.5).

Table 4.5 – Introduced flora data

Taxon	Site	50x50 m cover	50x50 m count estimate	Number of 2x2 m quadrats recorded in	Sum of cover within 2x2 m quadrats
**Sonchus oleraceus*	SR01	<1	10	0	0
	SR02	<1	10	2	0.2
	SR03	4	200	8	20.3
**Solanum hoplopetalum*	SR02	<1	50	0	0

4.7 PHOTOGRAPHIC MONITORING SITES

Data and photographs for the photographic monitoring sites are presented in Appendix E. The mean perennial percentage cover was 1.8 percent at the rehabilitation sites and 64.2 percent at the control sites with the total perennial cover per site shown in Figure 4.10. No weeds were recorded at any of the sites.

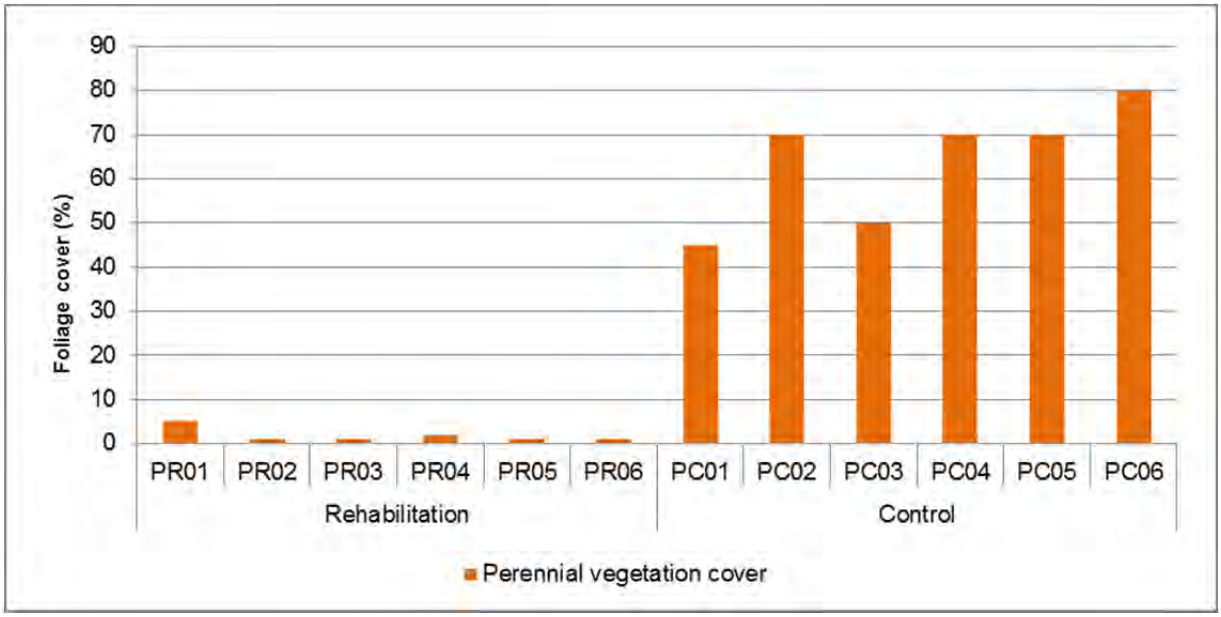

Figure 4.10 – Mean perennial vegetation cover at the photographic monitoring sites

4.8 REHABILITATION CONDITION

Generally the condition of the rehabilitated areas was good. Rehabilitation condition scores for sites are listed in Appendix B.

4.9 LIDAR MONITORING

The digital terrain models created from the 8 different point clouds of the two rehabilitated areas of the WRL are shown in Figures 4.11 and 4.12. The top figure shows each landform section from a perpendicular viewpoint, looking at the WRL, whilst the bottom figures show an oblique view.

The scans clearly show the different surface treatments which have been applied, with each slope containing two areas which have been ripped across contour, separated by an area which has been ripped across the contour (down slope).

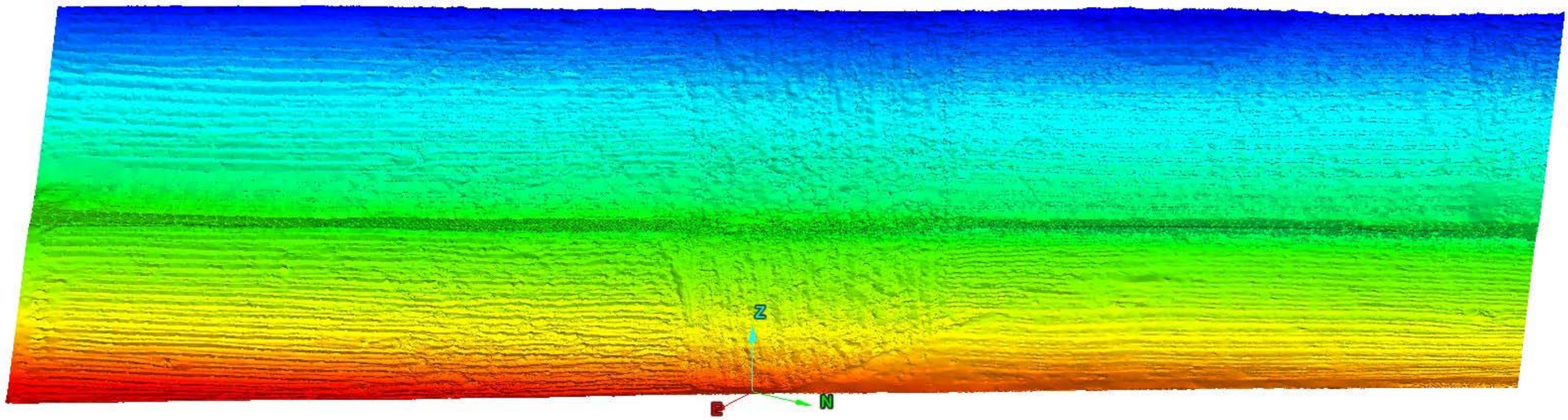

Figure 4.11 – Digital Terrain Models of Eastern Rehabilitation Site

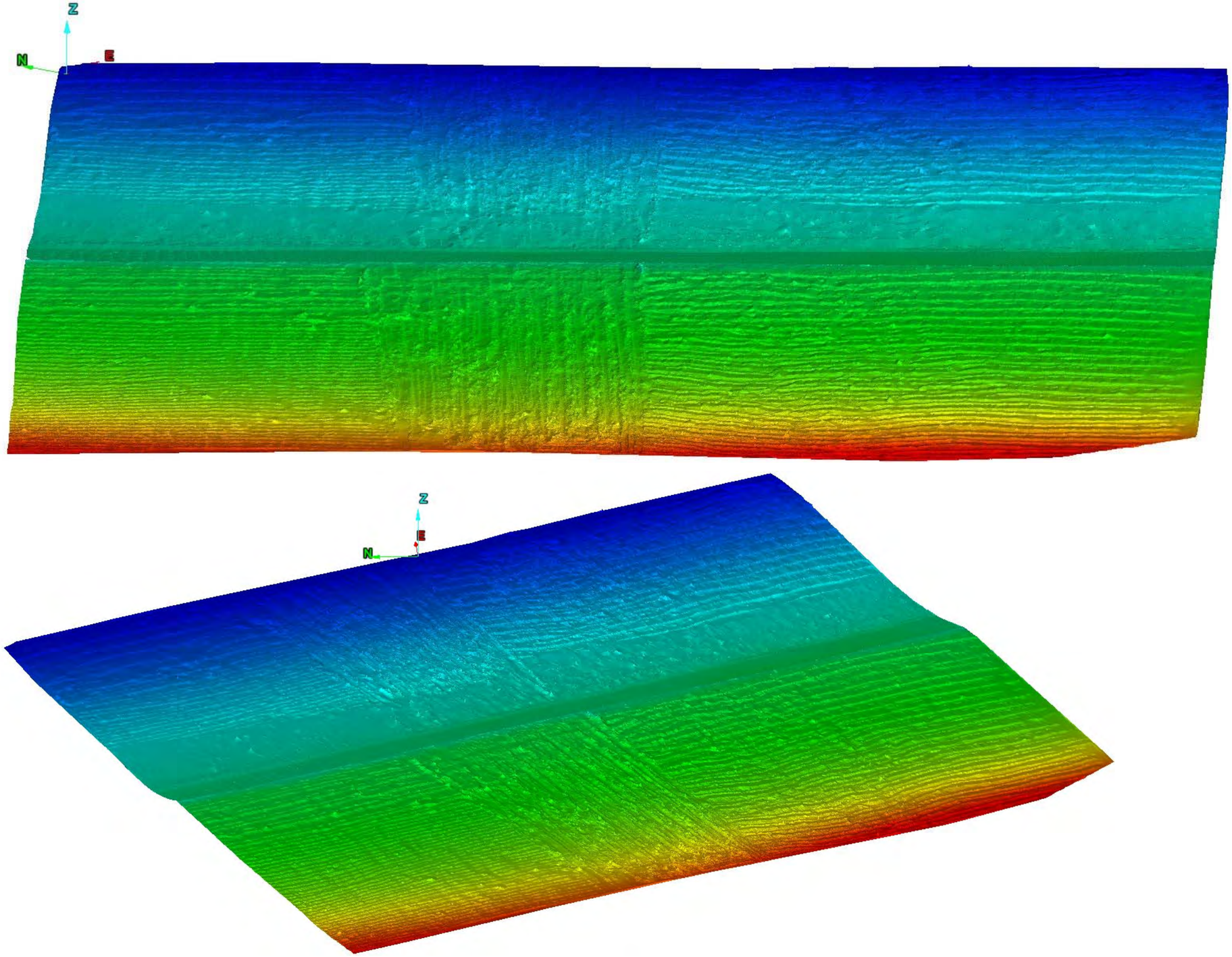

Figure 4.12 – Digital Terrain Models of Western Rehabilitation Sitee

5 DISCUSSION

5.1 VEGETATION MONITORING

Vegetation monitoring parameters change rapidly with rehabilitation age. Vegetation cover is generally low during the first growing season, increasing rapidly after favourable conditions and finally stabilising once the capacity of the site is reached.

The results of this baseline survey reflect the very young age of the rehabilitation. Low flora diversity (including lower perennial species richness and evenness), low perennial vegetation cover, high variation in dominant strata and a low tree species cover are all characteristic of a recently rehabilitated area.

5.1.1 Flora

Lower species richness was recorded from the rehabilitation sites (27 taxa across the four sites) than the control sites (47 taxa across five sites). This can be attributed to the rehabilitation sites being very young with few plant species germinated. As the rehabilitation ages, an increase in richness is expected. Thereafter, a decrease in species richness is expected as perennial species become dominant and inhibit the growth of other species. Rehabilitation sites had lower mean perennial species richness (2.1 taxa) and higher mean annual species richness (0.6 taxa) than the controls. This is expected as many new seedlings, including annual species, have grown at the rehabilitation sites and as the rehabilitation ages, the species diversity is expected to decline as the established perennial species become dominant and there is less opportunity, particularly for annual species, to germinate and grow. Therefore, future monitoring events are therefore expected should show an increase in richness at the rehabilitated sites.

5.1.2 Diversity

Mean species richness (as measured by the Shannon-Weiner diversity index) was the same at rehabilitation and control sites (2.7). Mean species evenness was lower at rehabilitation sites (0.3) than control sites (0.5), which is likely attributed to the young age of the rehabilitation, as many species are present in low abundance in the recently rehabilitated areas.

5.1.3 Vegetation Structure, Cover and Density

The mean percentage cover of perennial vegetation was lower at rehabilitation sites (11.0%) than control sites (35.0%), which is expected in such young rehabilitation. In future years the perennial vegetation cover may increase past that of the control sites due to higher growth rates and synchronised development, but is then expected to fall as the more established shrubs become dominant.

The vegetation at the rehabilitation sites consisted mostly of low shrub (8.4%) and tussock grass (2.6%) cover, whereas the majority of control sites were dominated by tall shrub (12.3%), tree (10.3%) and mid shrub (5.9%) cover. Individual rehabilitation sites also varied substantially in the cover of individual strata, whereas the control sites showed a fairly consistent pattern and proportion of each stratum. The low shrubs in the rehabilitation are expected to develop into mid and tall shrubs as the vegetation ages.

5.1.4 Overstorey Tree Species

Three rehabilitation sites had an overstorey species cover (0.4%), substantially lower than the control sites, which all had a substantial overstorey species cover (17.6%). Over time, successful rehabilitation sites are expected to have a reduced cover of annual speciess and grasses, an increased cover of shrubs and the emergence of overstorey taxa.

5.1.5 Introduced Flora Species

As the two weeds recorded during the current survey (**Sonchus oleraceus* and **Solanum hoplopetalum*) were not recorded during the baseline surveys, they may have been introduced during earthworks or have germinated due to ground disturbance or additional water availability on the side of the road. MS852 section 11-1 (6&7) stipulates that no new weed species (or an increase in cover of previously recorded weeds) is seen at rehabilitated areas. These weed species will therefore need to be carefully managed to prevent their spread into neighbouring rehabilitated areas.

5.1.6 Rehabilitation Condition

SR02 had a 'low' disturbance at the site where small piles of dirt were noted. SR04 had a 'moderate' disturbance noted where large stock piles of soil and rocks were seen across the site. No erosion was seen at any sites.

5.1.7 Photographic Monitoring

The mean percentage cover of perennial species at the photographic monitoring sites was lower at the rehabilitation (1.8%) than the controls (64.2%), which was expected due to the young age of the rehabilitation. The rehabilitated areas are currently in good condition with no disturbances, erosion or weeds noted.

5.2 LANDFORM STABILITY MONITORING

The LiDAR scans taken of each rehabilitation area show that the rip lines developed during the initial rehabilitation earthworks are still well developed, with no 'breaking' of individual rip lines having occurred as a result of local erosion of each rip line face depositing topsoil into the downstream trough, thereby providing a continual water flow pathway and negating the effectiveness of the contour ripping in controlling surface water flow and its associated erosion.

The LiDAR scans and their associated digital terrain models represent baseline terrain data which can be compared against subsequent monitoring scans to ascertain the extent of sediment movement both locally (i.e. within each rip line) and off slope. This comparison will show where different surface treatment options have been effective at erosion control, and which techniques are ineffective. It can also be used to calculate the rate of sediment loss, which when paired with landform characteristics (such as contour depth) and vegetation monitoring (e.g. the rate of vegetation establishment) can provide information on the likely condition of landform stability in the near future and the possible need for remedial action.

6 CONCLUSIONS & RECOMMENDATIONS

The results of the baseline survey reflect the very young age of the rehabilitated areas. Low flora species richness (including lower perennial species richness and evenness), lower perennial vegetation cover, a variation in dominant strata and a low tree species cover are all characteristic of a young rehabilitated area. This is also reflected in the LiDAR scans, which show little indication of erosion having occurred, with no development of rilling and little filling of contour rip lines.

As this is the baseline survey meaningful comparisons, including statistical analysis on rehabilitation progress cannot be made until subsequent monitoring has been completed.

It is recommended that:

- As outlined in MS852 11-2, the development of completion criteria will be required for setting acceptable rehabilitation outcomes for the project; and
- A weed management strategy is implemented for the two weed species which have not previously been recorded at the project.

7 REFERENCES

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Appendix A Site Coordinates

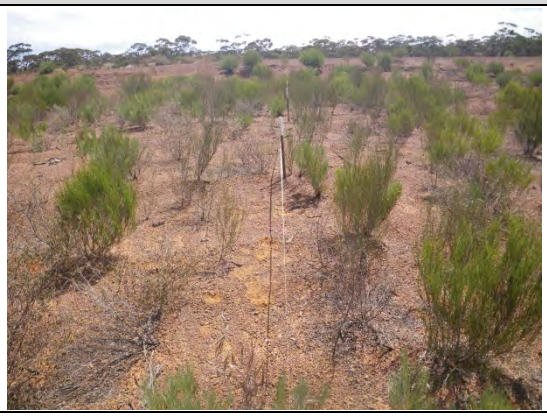
Site type	Site	Datum GDA94		
		Zone	Easting	Northing
Transect start and end waypoints				
Control	SC01/A	51	225012	6608932
Control	SC01/B	51	224980	6608897
Control	SC02/A	51	233802	6597328
Control	SC02/B	51	233841	6597361
Control	SC03/A	51	215222	6623877
Control	SC03/B	51	215199	6623831
Control	SC04/A	51	222054	6613589
Control	SC04/B	51	222105	6613593
Control	SC05/A	50	787021	6625801
Control	SC05/B	50	786978	6625773
Rehabilitation	SR01/T1/A	51	225089	6609009
Rehabilitation	SR01/T1/B	51	225071	6608991
Rehabilitation	SR01/T2/A	51	225060	6609043
Rehabilitation	SR01/T2/B	51	225043	6609026
Rehabilitation	SR02/T1/A	51	233604	6597383
Rehabilitation	SR02/T1/B	51	233587	6597366
Rehabilitation	SR02/T2/A	51	233573	6597419
Rehabilitation	SR02/T2/B	51	233555	6597404
Rehabilitation	SR03/A	51	215286	6623927
Rehabilitation	SR03/B	51	215253	6623893
Rehabilitation	SR04/T1/A	51	221851	6614060
Rehabilitation	SR04/T1/B	51	221877	6614069
Rehabilitation	SR04/T2/A	51	221870	6614015
Rehabilitation	SR04/T2/B	51	221893	6614023
Overstorey corner waypoints				
Control	SC01	51	224995	6608948
Control	SC01	51	224963	6608916
Control	SC01	51	224998	6608881
Control	SC01	51	225031	6608916
Control	SC02	51	233816	6597309
Control	SC02	51	233857	6597344
Control	SC02	51	233823	6597382
Control	SC02	51	233786	6597346
Control	SC03	51	215240	6623857
Control	SC03	51	215219	6623815
Control	SC03	51	215175	6623844
Control	SC03	51	215200	6623889
Control	SC04	51	222102	6613619
Control	SC04	51	222111	6613569
Control	SC04	51	222052	6613610
Control	SC04	51	222056	6613564
Control	SC05	50	787007	6625821
Control	SC05	50	786965	6625792
Control	SC05	50	787034	6625779
Control	SC05	50	786992	6625753
Rehabilitation	SR01	51	225102	6608990
Rehabilitation	SR01	51	225087	6608971
Rehabilitation	SR01	51	225030	6609046
Rehabilitation	SR01	51	225045	6609061
Rehabilitation	SR02	51	233557	6597437
Rehabilitation	SR02	51	233539	6597422
Rehabilitation	SR02	51	233621	6597364
Rehabilitation	SR02	51	233604	6597348
Rehabilitation	SR03	51	215307	6623908
Rehabilitation	SR03	51	215272	6623875
Rehabilitation	SR03	51	215235	6623908
Rehabilitation	SR03	51	215271	6623944
Rehabilitation	SR04	51	221903	6614003
Rehabilitation	SR04	51	221880	6613992
Rehabilitation	SR04	51	221845	6614084
Rehabilitation	SR04	51	221868	6614092
2x2 m quadrat waypoints				
Control	SC01/Q00	51	225012	6608932
Control	SC01/Q05	51	225013	6608930

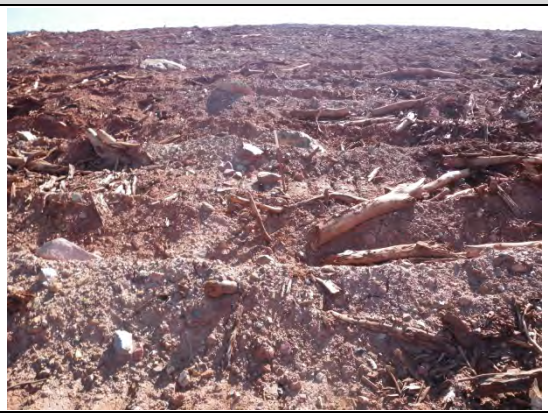
Site type	Site	Datum GDA94		
		Zone	Easting	Northing
Control	SC01/Q10	51	225010	6608924
Control	SC01/Q15	51	225005	6608922
Control	SC01/Q20	51	225001	6608918
Control	SC01/Q25	51	224997	6608915
Control	SC01/Q30	51	224997	6608911
Control	SC01/Q35	51	224993	6608905
Control	SC01/Q40	51	224989	6608903
Control	SC01/Q45	51	225017	6608934
Control	SC02/Q00	51	233802	6597328
Control	SC02/Q05	51	233804	6597333
Control	SC02/Q10	51	233810	6597336
Control	SC02/Q15	51	233813	6597339
Control	SC02/Q20	51	233815	6597341
Control	SC02/Q25	51	233821	6597344
Control	SC02/Q30	51	233826	6597348
Control	SC02/Q35	51	233830	6597351
Control	SC02/Q40	51	233834	6597354
Control	SC02/Q45	51	233835	6597355
Control	SC03/Q00	51	215222	6623877
Control	SC03/Q05	51	215220	6623870
Control	SC03/Q10	51	215218	6623865
Control	SC03/Q15	51	215214	6623862
Control	SC03/Q20	51	215213	6623859
Control	SC03/Q25	51	215208	6623855
Control	SC03/Q30	51	215208	6623849
Control	SC03/Q35	51	215205	6623846
Control	SC03/Q40	51	215204	6623841
Control	SC03/Q45	51	215201	6623837
Control	SC04/Q00	51	222054	6613589
Control	SC04/Q05	51	222061	6613588
Control	SC04/Q10	51	222067	6613587
Control	SC04/Q15	51	222072	6613590
Control	SC04/Q20	51	222076	6613589
Control	SC04/Q25	51	222082	6613590
Control	SC04/Q30	51	222086	6613592
Control	SC04/Q35	51	222091	6613590
Control	SC04/Q40	51	222095	6613593
Control	SC04/Q45	51	222101	6613594
Control	SC05/Q00	50	787021	6625801
Control	SC05/Q05	50	787016	6625797
Control	SC05/Q10	50	787013	6625792
Control	SC05/Q15	50	787008	6625788
Control	SC05/Q20	50	787004	6625789
Control	SC05/Q25	50	787000	6625786
Control	SC05/Q30	50	786995	6625782
Control	SC05/Q35	50	786990	6625779
Control	SC05/Q40	50	786987	6625778
Control	SC05/Q45	50	786985	6625774
Rehabilitation	SR01/Q00	51	225089	6609009
Rehabilitation	SR01/Q05	51	225086	6609003
Rehabilitation	SR01/Q10	51	225082	6608999
Rehabilitation	SR01/Q15	51	225078	6608997
Rehabilitation	SR01/Q20	51	225075	6608993
Rehabilitation	SR01/Q25	51	225060	6609043
Rehabilitation	SR01/Q30	51	225056	6609040
Rehabilitation	SR01/Q35	51	225054	6609037
Rehabilitation	SR01/Q40	51	225050	6609033
Rehabilitation	SR01/Q45	51	225045	6609030
Rehabilitation	SR02/Q00	51	233604	6597383
Rehabilitation	SR02/Q05	51	233600	6597380
Rehabilitation	SR02/Q10	51	233599	6597376
Rehabilitation	SR02/Q15	51	233594	6597373
Rehabilitation	SR02/Q20	51	233591	6597370
Rehabilitation	SR02/Q25	51	233573	6597419
Rehabilitation	SR02/Q30	51	233568	6597416

Site type	Site	Datum GDA94		
		Zone	Easting	Northing
Rehabilitation	SR02/Q35	51	233565	6597413
Rehabilitation	SR02/Q40	51	233562	6597411
Rehabilitation	SR02/Q45	51	233557	6597407
Rehabilitation	SR03/Q00	51	215286	6623927
Rehabilitation	SR03/Q05	51	215284	6623924
Rehabilitation	SR03/Q10	51	215280	6623921
Rehabilitation	SR03/Q15	51	215277	6623916
Rehabilitation	SR03/Q20	51	215273	6623913
Rehabilitation	SR03/Q25	51	215270	6623909
Rehabilitation	SR03/Q30	51	215267	6623906
Rehabilitation	SR03/Q35	51	215263	6623902
Rehabilitation	SR03/Q40	51	215259	6623898
Rehabilitation	SR03/Q45	51	215256	6623895
Rehabilitation	SR04/Q00	51	221851	6614060
Rehabilitation	SR04/Q05	51	221856	6614062
Rehabilitation	SR04/Q10	51	221863	6614063
Rehabilitation	SR04/Q15	51	221868	6614066
Rehabilitation	SR04/Q20	51	221873	6614069
Rehabilitation	SR04/Q25	51	221870	6614015
Rehabilitation	SR04/Q30	51	221874	6614016
Rehabilitation	SR04/Q35	51	221880	6614019
Rehabilitation	SR04/Q40	51	221885	6614019
Rehabilitation	SR04/Q45	51	221889	6614022
Proposed sites 2x2 m quadrat waypoints				
Rehabilitation (proposed site)	SR05/Q00	50	787148	6625898
Rehabilitation (proposed site)	SR05/Q05	50	787149	6625904
Rehabilitation (proposed site)	SR06/Q00	50	787177	6625859
Rehabilitation (proposed site)	SR06/Q05	50	787181	6625859
Rehabilitation (proposed site)	SR07/Q00	50	787202	6625827
Rehabilitation (proposed site)	SR07/Q05	50	787205	6625827
Rehabilitation (proposed site)	SR08/Q00	50	787226	6625789
Rehabilitation (proposed site)	SR08/Q05	50	787231	6625791
Rehabilitation (proposed site)	SR09/Q00	50	787088	6625865
Rehabilitation (proposed site)	SR09/Q05	50	787092	6625865
Rehabilitation (proposed site)	SR10/Q00	50	787115	6625824
Rehabilitation (proposed site)	SR10/Q05	50	787119	6625826
Rehabilitation (proposed site)	SR11/Q00	50	787139	6625789
Rehabilitation (proposed site)	SR11/Q05	50	787142	6625791
Rehabilitation (proposed site)	SR12/Q00	50	787164	6625754
Rehabilitation (proposed site)	SR12/Q05	50	787167	6625757
Photographic monitoring waypoints				
Control	PC01/A	51	231771	6599664
Control	PC01/B	51	231771	6599670
Control	PC02/A	51	232409	6598877
Control	PC02/B	51	232411	6598879
Control	PC03/A	51	233100	6598105
Control	PC03/B	51	233103	6598103
Control	PC04/A	51	236517	6594545
Control	PC04/B	51	236520	6594542
Control	PC05/A	51	239352	6591505
Control	PC05/B	51	239352	6591502
Control	PC06/A	51	241666	6588662
Control	PC06/B	51	241671	6588660
Rehabilitation	PR01/A	51	231748	6599653
Rehabilitation	PR01/B	51	231751	6599650
Rehabilitation	PR02/A	51	232393	6598864
Rehabilitation	PR02/B	51	232396	6598863
Rehabilitation	PR03/A	51	233070	6598099
Rehabilitation	PR03/B	51	233074	6598094
Rehabilitation	PR04/A	51	236519	6594555
Rehabilitation	PR04/B	51	236522	6594553
Rehabilitation	PR05/A	51	239364	6591513
Rehabilitation	PR05/B	51	239368	6591512
Rehabilitation	PR06/A	51	241647	6588655
Rehabilitation	PR06/B	51	241651	6588651

Appendix B Monitoring Site Data

Site	Date	Vegetation unit	Site description	Animal sightings	Fire	Veg condition	Erosion	Disturbance	Rehab year	Rehab treatment
SR01	19/11/2015	Mixed low sparse shrubland	Rehabilitated area	None	No sign	n/a	1	1	2014	Ripping
SR02	19/11/2015	Mostly bare	Rehabilitated area	None	No sign	n/a	1	2	2015	Ripping
SR03	18/11/2015	Mostly bare	Rehabilitated area	None	No sign	n/a	1	1	2014	Ripping
SR04	18/11/2015	Mixed low sparse shrubland	Rehabilitated area	None	No sign	n/a	1	3	2012	Ripping
SR05	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Contour rip, no litter, fertiliser
SR06	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Deep vertical rip, litter, fertiliser
SR07	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Contour rip, litter, fertiliser
SR08	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Deep contour rip, fertiliser
SR09	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Contour rip, no litter, no fertiliser
SR10	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Deep vertical rip, litter, no fertiliser
SR11	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Contour rip, litter, no fertiliser
SR12	20/11/2015	No vegetation regrowth	Waste dump	None	No sign	n/a	1	1	2015	Deep contour rip, no fertiliser
SC01	19/11/2015	*Eucalyptus loxophleba* subsp. *lissophloia* (+/-*Eucalyptus corrugata* and *Eucalyptus longicornis*) low woodland, over *Acacia merrallii* and *Eremophila scoparia* tall to mid sparse shrubland, over *Atriplex nummularia* low sparse shrubland	Red-orange sandy-clay plain	Ants	No sign	Excellent	n/a	n/a	n/a	n/a
SC02	19/11/2015	*Eucalyptus yilgarnensis* (+/-*Eucalyptus griffithsii* and *Eucalyptus corrugata*) low woodland, over *Melaleuca hamata, Grevillea haplantha* subsp. *haplantha* and *Acacia longispinea* (+/-*Thryptomene urceolaris*) open tall to mid shrubland, over *Triodia tomentosa* sparse hummock grassland	Yellow sandy plain	None	No sign	Excellent	n/a	n/a	n/a	n/a
SC03	18/11/2015	*Eucalyptus loxophleba* subsp. *lissophloia* open low woodland, over *Acacia burkittii, Grevillea georgeana* and *Acacia tetragonophylla* tall shrubland, over *Rinzia carnosa, Alyxia buxifolia* and *Baeckea elderiana* sparse mid to low shrubland	Gravelly ironstone plain	None	No sign	Excellent	n/a	n/a	n/a	n/a
SC04	18/11/2015	*Eucalyptus corrugata* and *Eucalyptus loxophleba* subsp. *lissophloia* low woodland, over *Allocasuarina campestris* and *Melaleuca vinnula* tall shrubland, over *Grevillea zygoloba, Phebalium filifolium* and *Baeckea elderiana* open mid shrubland, over *Eremophila ionantha, Hibbertia exasperata* and *Olearia muelleri* sparse low shrubland	Low rocky ironstone hillslope	None	No sign	Excellent	n/a	n/a	n/a	n/a
SC05	20/11/2015	*Eucalyptus corrugata* open low woodland, over *Eremophila scoparia, Eremophila* sp. Mt Jackson (G.J. Keighery 4372) and *Alyxia buxifolia* open tall to mid shrubland, over *Scaevola spinescens* and *Cryptandra ?myriantha* sparse low shrubland	Gravelly ironstone plain	Ants	No sign	Excellent	n/a	n/a	n/a	n/a

Rehabilitation Sites	
SR01 (A)	**SR01 (B)**
	
SR02 (A)	**SR02 (B)**
	
SR03 (A)	**SR03 (B)**
	
SR04 (A)	**SR04 (B)**
	

Rehabilitation Trial Sites	
SR05 (A)	**SR06 (A)**
	
SR07 (A)	**SR08 (A)**
	
SR09 (A)	**SR10 (A)**
	
SR11 (A)	**SR12 (A)**
	

Control Sites	
SC01 (A)	**SC01 (B)**
	
SC02 (A)	**SC02 (B)**
	
SC03 (A)	**SC03 (B)**
	
SC04 (A)	**SC04 (B)**
	

SC05 (A)	SC05 (B)
	

Appendix C 2 x 2 m Quadrat Data

Quadrat Data

Site	Quadrat	Litter cover	Animal sightings	Faecal material	Count annual taxa	Count perennial taxa	Count total taxa	Total perennial cover	Total annual cover	Total herb cover	Total sedge cover	Total tussock grass cover	Total hummock grass cover	Total low shrub cover	Total mid shrub cover	Total tall shrub cover	Total tree cover
SR01	Q00	15	None	None	1	3	4	7	0.1	0.1	0	2	0	5	0	0	0
SR01	Q05	<5	None	None	2	1	3	10	0.2	0.2	0	0	0	10	0	0	0
SR01	Q10	<5	None	None	1	3	4	21.1	0.1	0.1	0	0	0	21.1	0	0	0
SR01	Q15	<5	None	None	1	2	3	3.1	0.1	0.1	0	0	0	3.1	0	0	0
SR01	Q20	<5	None	None	1	2	3	20.1	0.1	0.1	0	0	0	20.1	0	0	0
SR01	Q25	<5	None	None	1	3	4	0.3	0.1	0.1	0	0.1	0	0.2	0	0	0
SR01	Q30	<5	None	None	1	2	3	16	0.1	0.1	0	15	0	1	0	0	0
SR01	Q35	10	None	None	1	3	4	88	0.1	0.1	0	80	0	8	0	0	0
SR01	Q40	<5	None	None	1	3	4	13.1	0.1	0.1	0	5.1	0	8	0	0	0
SR01	Q45	10	None	None	0	4	4	7.2	0	0	0	0.2	0	7	0	0	0
SR02	Q00	20	None	None	1	3	4	0.3	0.1	0.1	0	0.1	0	0.2	0	0	0
SR02	Q05	15	None	None	2	2	4	0.2	0.2	0.2	0	0	0	0.2	0	0	0
SR02	Q10	<5	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SR02	Q15	20	Ants	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SR02	Q20	20	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SR02	Q25	<5	Ants	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SR02	Q30	20	None	None	1	0	1	0	0.1	0.1	0	0	0	0	0	0	0
SR02	Q35	40	None	None	0	2	2	0.2	0	0	0	0.1	0	0.1	0	0	0
SR02	Q40	<5	None	None	0	1	1	0.1	0	0	0	0	0	0.1	0	0	0
SR02	Q45	<5	None	None	1	0	1	0	0.1	0.1	0	0	0	0	0	0	0
SR03	Q00	15	None	None	1	2	3	5.1	3	3	0	0	0	5.1	0	0	0
SR03	Q45	10	None	None	1	5	6	12.1	5	5	0	0	0	12.1	0	0	0
SR03	Q40	20	None	None	1	2	3	0.2	2	2	0	0	0	0.2	0	0	0
SR03	Q35	<5	None	None	1	2	3	0.2	5	5	0	0	0	0.2	0	0	0
SR03	Q30	10	None	None	1	2	3	1.1	5	5	0	1	0	0.1	0	0	0
SR03	Q25	25	None	None	1	2	3	0.2	0.1	0.1	0	0.1	0	0.1	0	0	0
SR03	Q20	10	None	None	1	0	1	0	0.1	0.1	0	0	0	0	0	0	0
SR03	Q15	<5	None	None	1	0	1	0	0.1	0.1	0	0	0	0	0	0	0
SR03	Q10	5	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SR03	Q05	10	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SR04	Q00	<5	None	None	0	1	1	3	0	0	0	0	0	3	0	0	0
SR04	Q05	10	None	None	0	4	4	26.1	0	0	0	0	0	26.1	0	0	0
SR04	Q10	50	None	None	0	4	4	42	0	0	0	0	0	42	0	0	0

Site	Quadrat	Litter cover	Animal sightings	Faecal material	Count annual taxa	Count perennial taxa	Count total taxa	Total perennial cover	Total annual cover	Total herb cover	Total sedge cover	Total tussock grass cover	Total hummock grass cover	Total low shrub cover	Total mid shrub cover	Total tall shrub cover	Total tree cover
SR04	Q15	20	None	None	0	1	1	0.1	0	0	0	0	0	0.1	0	0	0
SR04	Q20	<5	None	None	0	3	3	18	0	0	0	0	0	18	0	0	0
SR04	Q25	<5	None	None	0	6	6	51.3	0	0	0	0	0	51.3	0	0	0
SR04	Q30	10	None	None	0	5	5	26	0	0	0	0	0	26	0	0	0
SR04	Q35	<5	None	Kangaroo	0	4	4	17	0	0	0	0	0	17	0	0	0
SR04	Q40	<5	None	None	0	3	3	22	0	0	0	0	0	22	0	0	0
SR04	Q45	<5	None	None	0	3	3	29	0	0	0	0	0	29	0	0	0
SC01	Q00	5	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SC01	Q05	20	None	None	0	1	1	35	0	0	0	0	0	35	0	0	0
SC01	Q10	<5	Ant holes	None	0	1	1	0.1	0	0	0	0	0	0.1	0	0	0
SC01	Q15	10	None	None	0	1	1	15	0	0	0	0	0	0	15	0	0
SC01	Q20	10	Ants	None	0	4	4	3.2	0	0	0	0	0	1.2	0	2	0
SC01	Q25	20	Ants	None	0	2	2	15	0	0	0	0	0	5	10	0	0
SC01	Q30	20	Ant holes	None	0	3	3	6.1	0	0	0	0	0	5.1	1	0	0
SC01	Q35	50	Ant holes	None	0	1	1	1	0	0	0	0	0	0	1	0	0
SC01	Q40	80	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SC01	Q45	90	Ants	None	0	2	2	30	0	0	0	0	0	0	0	20	10
SC02	Q00	15	None	None	0	2	2	65	0	0	0	0	15	0	0	0	50
SC02	Q05	15	None	None	0	1	1	20	0	0	0	0	20	0	0	0	0
SC02	Q10	10	Bungarra	None	0	2	2	30	0	0	0	0	25	0	0	0	5
SC02	Q15	15	None	None	0	2	2	35	0	0	0	0	25	0	10	0	0
SC02	Q20	15	None	None	0	2	2	15	0	0	0	0	5	0	0	0	10
SC02	Q25	10	None	None	0	4	4	48	0	0	0	0	10	20	0	18	0
SC02	Q30	10	None	None	0	2	2	15.1	0	0	0	0	15	0.1	0	0	0
SC02	Q35	20	None	None	0	5	5	59.2	0	0	0	0	5	4.2	0	50	0
SC02	Q40	40	None	None	0	4	4	34	0	0	0	0	3	0	8	23	0
SC02	Q45	30	None	None	0	3	3	35.2	0	0	0	0	0.1	0	35.1	0	0
SC03	Q00	20	Ants	None	0	2	2	16	0	0	0	0	0	0	15	1	0
SC03	Q45	10	None	None	0	1	1	2	0	0	0	0	0	0	2	0	0
SC03	Q40	25	None	None	0	5	5	53	0	0	0	0	0	8	5	40	0
SC03	Q35	15	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SC03	Q30	90	None	None	0	4	4	95.1	0	0	0	0.1	0	0	25	0	70
SC03	Q25	10	None	None	0	5	5	35.1	0	0	0	0.1	0	12	3	20	0
SC03	Q20	10	None	None	0	4	4	87.1	0	0	0	2	0	0.1	0	85	0

Site	Quadrat	Litter cover	Animal sightings	Faecal material	Count annual taxa	Count perennial taxa	Count total taxa	Total perennial cover	Total annual cover	Total herb cover	Total sedge cover	Total tussock grass cover	Total hummock grass cover	Total low shrub cover	Total mid shrub cover	Total tall shrub cover	Total tree cover
SC03	Q15	5	None	None	0	4	4	19.1	0	0	0	0.1	0	2	17	0	0
SC03	Q10	90	None	None	0	1	1	0.1	0	0	0	0.1	0	0	0	0	0
SC03	Q05	<5	Ants	None	0	3	3	22	0	0	0	0	0	12	0	10	0
SC04	Q00	<5	None	None	0	3	3	4.2	0	0	0	0.1	0	4.1	0	0	0
SC04	Q05	5	None	None	0	2	2	8	0	0	1	0	0	0	7	0	0
SC04	Q10	40	None	None	0	3	3	85.1	0	0	0	0	0	15.1	0	0	70
SC04	Q15	80	None	None	0	5	5	126	0	0	0	0	0	6	0	60	60
SC04	Q20	40	None	None	0	6	6	108.2	0	0	0	0	0	1.2	27	0	80
SC04	Q25	<5	None	None	0	4	4	21	0	0	0	0	0	1	8	12	0
SC04	Q30	90	None	None	0	3	3	110	0	0	0	0	0	15	0	95	0
SC04	Q35	80	None	None	0	3	3	85	0	0	0	0	0	15	20	50	0
SC04	Q40	50	None	None	0	3	3	55	0	0	0	0	0	0	55	0	0
SC04	Q45	80	None	None	0	3	3	72	0	0	0	0	0	1	1	70	0
SC05	Q00	30	None	None	0	3	3	8.1	0	0	0	0	0	8.1	0	0	0
SC05	Q05	30	None	None	0	1	1	70	0	0	0	0	0	0	0	0	70
SC05	Q10	20	None	None	0	4	4	49.1	0	0	0	0	0	9.1	0	0	40
SC05	Q15	<5	None	None	0	2	2	0.2	0	0	0	0	0	0.2	0	0	0
SC05	Q20	35	None	None	0	7	7	32.3	0	0	0	0	0	4.3	8	20	0
SC05	Q25	10	None	None	0	5	5	50.3	0	0	0	0	0	0.3	20	30	0
SC05	Q30	80	None	None	0	3	3	59	0	0	0	0	0	9	0	0	50
SC05	Q35	<5	None	None	0	0	0	0	0	0	0	0	0	0	0	0	0
SC05	Q40	15	None	None	0	2	2	9	0	0	0	0	0	1	0	8	0
SC05	Q45	<5	None	None	0	1	1	8	0	0	0	0	0	8	0	0	0

Species Data

Site	Quadrat	Species	Cover	Count	Stratum	Reproductive material	Perennial/annual
SR01	Q00	*Acacia merrallii*	2	1	Low shrub (<1 m)	None	Perennial
SR01	Q00	*Poaceae* sp. (inadequate material)	2	6	Tussock grass	None	Perennial
SR01	Q00	*Ptilotus nobilis*	0.1	Annual	Herb	Flower	Annual
SR01	Q00	*Sclerolaena diacantha*	3	5	Low shrub (<1 m)	Fruit	Perennial
SR01	Q05	*Lawrencia diffusa*	0.1	Annual	Herb	None	Annual
SR01	Q05	*Ptilotus nobilis*	0.1	Annual	Herb	Flower	Annual
SR01	Q05	*Sclerolaena diacantha*	10	9	Low shrub (<1 m)	Fruit	Perennial
SR01	Q10	*Eucalyptus* sp. 1 (inadequate material, glaucous foliage)	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SR01	Q10	*Lawrencia diffusa*	0.1	Annual	Herb	None	Annual
SR01	Q10	*Sclerolaena cuneata*	1	1	Low shrub (<1 m)	Fruit	Perennial
SR01	Q10	*Sclerolaena diacantha*	20	12	Low shrub (<1 m)	Fruit	Perennial
SR01	Q15	*Atriplex nummularia*	3	Overhang	Low shrub (<1 m)	Flower	Perennial
SR01	Q15	*Ptilotus nobilis*	0.1	Annual	Herb	None	Annual
SR01	Q15	*Sclerolaena diacantha*	0.1	13	Low shrub (<1 m)	Fruit	Perennial
SR01	Q20	*Ptilotus nobilis*	0.1	Annual	Herb	Flower	Annual
SR01	Q20	*Sclerolaena diacantha*	20	36	Low shrub (<1 m)	Fruit	Perennial
SR01	Q20	*Templetonia smithiana*	0.1	1	Low shrub (<1 m)	None	Perennial
SR01	Q25	*Atriplex nummularia*	0.1	1	Low shrub (<1 m)	None	Perennial
SR01	Q25	*Austrostipa trichophylla*	0.1	1	Tussock grass	Fruit	Perennial
SR01	Q25	*Ptilotus nobilis*	0.1	Annual	Herb	Flower	Annual
SR01	Q25	*Sclerolaena diacantha*	0.1	1	Low shrub (<1 m)	Fruit	Perennial
SR01	Q30	*Austrostipa trichophylla*	15	60	Tussock grass	Fruit	Perennial
SR01	Q30	*Ptilotus nobilis*	0.1	Annual	Herb	Flower	Annual
SR01	Q30	*Sclerolaena diacantha*	1	2	Low shrub (<1 m)	Fruit	Perennial
SR01	Q35	*Austrostipa trichophylla*	70	100	Tussock grass	Fruit	Perennial
SR01	Q35	*Poaceae* sp. (inadequate material)	10	4	Tussock grass	None	Perennial
SR01	Q35	*Ptilotus nobilis*	0.1	Annual	Herb	Flower	Annual
SR01	Q35	*Sclerolaena diacantha*	8	4	Low shrub (<1 m)	Fruit	Perennial
SR01	Q40	*Acacia merrallii*	8	1	Low shrub (<1 m)	None	Perennial
SR01	Q40	*Austrostipa trichophylla*	0.1	12	Tussock grass	Fruit	Perennial
SR01	Q40	*Poaceae* sp. (inadequate material)	5	3	Tussock grass	None	Perennial
SR01	Q40	*Ptilotus nobilis*	0.1	Annual	Herb	Flower	Annual
SR01	Q45	*Austrostipa trichophylla*	0.1	1	Tussock grass	Fruit	Perennial
SR01	Q45	*Eremophila drummondii*	2	Overhang	Low shrub (<1 m)	Flower	Perennial
SR01	Q45	*Poaceae* sp. (inadequate material)	0.1	3	Tussock grass	None	Perennial

Site	Quadrat	Species	Cover	Count	Stratum	Reproductive material	Perennial/annual
SR01	Q45	*Sclerolaena diacantha*	5	26	Low shrub (<1 m)	Fruit	Perennial
SR02	Q00	*Austrostipa trichophylla*	0.1	1	Tussock grass	Fruit	Perennial
SR02	Q00	*Chenopodiaceae* sp. (inadequate material)	0.1	1	Low shrub (<1 m)	None	Perennial
SR02	Q00	*Keraudrenia integrifolia*	0.1	1	Low shrub (<1 m)	None	Perennial
SR02	Q00	*Monotaxis luteiflora*	0.1	Annual	Herb	Flower	Annual
SR02	Q05	*Acacia cylindrica*	0.1	1	Low shrub (<1 m)	None	Perennial
SR02	Q05	*Keraudrenia integrifolia*	0.1	1	Low shrub (<1 m)	None	Perennial
SR02	Q05	*Sonchus oleraceus*	0.1	Annual	Herb	Flower	Annual
SR02	Q05	*Trachymene ceratocarpa*	0.1	Annual	Herb	Fruit	Annual
SR02	Q10	No species	0	0			
SR02	Q15	No species	0	0			
SR02	Q20	No species	0	0			
SR02	Q25	No species	0	0			
SR02	Q30	*Sonchus oleraceus*	0.1	Annual	Herb	Flower	Annual
SR02	Q35	*Keraudrenia integrifolia*	0.1	1	Low shrub (<1 m)	None	Perennial
SR02	Q35	*Poaceae* sp. (inadequate material)	0.1	1	Tussock grass	None	Perennial
SR02	Q40	*Gonocarpus confertifolius* var. *helmsii*	0.1	1	Low shrub (<1 m)	None	Perennial
SR02	Q45	*Monotaxis luteiflora*	0.1	Annual	Herb	None	Annual
SR03	Q00	*Maireana* sp.	5	19	Low shrub (<1 m)	Fruit	Perennial
SR03	Q00	*Sclerolaena cuneata*	0.1	1	Low shrub (<1 m)	Fruit	Perennial
SR03	Q00	*Sonchus oleraceus*	3	Annual	Herb	Flower	Annual
SR03	Q05	*Acacia burkittii*	0.1	1	Low shrub (<1 m)	None	Perennial
SR03	Q05	*Hannafordia bissillii* subsp. *latifolia*	7	1	Low shrub (<1 m)	Fruit	Perennial
SR03	Q05	*Maireana* sp.	1	3	Low shrub (<1 m)	None	Perennial
SR03	Q05	*Sclerolaena cuneata*	1	3	Low shrub (<1 m)	Fruit	Perennial
SR03	Q05	*Sclerolaena diacantha*	3	17	Low shrub (<1 m)	Fruit	Perennial
SR03	Q05	*Sonchus oleraceus*	5	Annual	Herb	Flower	Annual
SR03	Q10	*Acacia burkittii*	0.1	1	Low shrub (<1 m)	None	Perennial
SR03	Q10	*Maireana* sp.	0.1	1	Low shrub (<1 m)	None	Perennial
SR03	Q10	*Sonchus oleraceus*	2	Annual	Herb	Flower	Annual
SR03	Q15	*Maireana* sp.	0.1	1	Low shrub (<1 m)	None	Perennial
SR03	Q15	*Sclerolaena diacantha*	0.1	3	Low shrub (<1 m)	Fruit	Perennial
SR03	Q15	*Sonchus oleraceus*	5	Annual	Herb	Flower	Annual
SR03	Q20	*Austrostipa elegantissima*	1	1	Tussock grass	Flower/Fruit	Perennial
SR03	Q20	*Maireana* sp.	0.1	2	Low shrub (<1 m)	None	Perennial
SR03	Q20	*Sonchus oleraceus*	5	Annual	Herb	Flower	Annual
SR03	Q25	*Poaceae* sp. (inadequate material)	0.1	1	Tussock grass	None	Perennial

Site	Quadrat	Species	Cover	Count	Stratum	Reproductive material	Perennial/annual
SR03	Q25	*Sclerolaena diacantha*	0.1	1	Low shrub (<1 m)	None	Perennial
SR03	Q25	*Sonchus oleraceus*	0.1	Annual	Herb	Flower	Annual
SR03	Q30	*Sonchus oleraceus*	0.1	Annual	Herb	Flower	Annual
SR03	Q35	*Sonchus oleraceus*	0.1	Annual	Herb	None	Annual
SR03	Q40	No species	0	0			
SR03	Q45	No species	0	0			
SR04	Q00	*Melaleuca* sp.	3	1	Low shrub (<1 m)	None	Perennial
SR04	Q05	*Acacia burkittii*	4	1	Low shrub (<1 m)	None	Perennial
SR04	Q05	*Grevillea didymobotrya* subsp. *didymobotrya*	20	1	Low shrub (<1 m)	Flower	Perennial
SR04	Q05	*Hannafordia bissillii* subsp. *latifolia*	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SR04	Q05	*Keraudrenia integrifolia*	2	1	Low shrub (<1 m)	None	Perennial
SR04	Q10	*Acacia burkittii*	15	2	Low shrub (<1 m)	None	Perennial
SR04	Q10	*Grevillea didymobotrya* subsp. *didymobotrya*	25	2	Low shrub (<1 m)	Fruit	Perennial
SR04	Q10	*Melaleuca* sp.	1	2	Low shrub (<1 m)	None	Perennial
SR04	Q10	*Phebalium canaliculatum*	1	1	Low shrub (<1 m)	None	Perennial
SR04	Q15	*?Hibbertia* sp. (inadequate material)	0.1	1	Low shrub (<1 m)	None	Perennial
SR04	Q20	*Grevillea didymobotrya* subsp. *didymobotrya*	15	1	Low shrub (<1 m)	Fruit	Perennial
SR04	Q20	*Hannafordia bissillii* subsp. *latifolia*	2	1	Low shrub (<1 m)	None	Perennial
SR04	Q20	*Melaleuca* sp.	1	2	Low shrub (<1 m)	None	Perennial
SR04	Q25	*Acacia burkittii*	0.1	1	Low shrub (<1 m)	None	Perennial
SR04	Q25	*Acacia sibina*	0.1	1	Low shrub (<1 m)	None	Perennial
SR04	Q25	*Grevillea didymobotrya* subsp. *didymobotrya*	40	2	Low shrub (<1 m)	Fruit	Perennial
SR04	Q25	*Hannafordia bissillii* subsp. *latifolia*	3	1	Low shrub (<1 m)	Fruit	Perennial
SR04	Q25	*Keraudrenia integrifolia*	8	2	Low shrub (<1 m)	Flower	Perennial
SR04	Q25	*Melaleuca* sp.	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SR04	Q30	*Acacia burkittii*	1	Overhang	Low shrub (<1 m)	Flower	Perennial
SR04	Q30	*Grevillea didymobotrya* subsp. *didymobotrya*	5	Overhang	Low shrub (<1 m)	Fruit	Perennial
SR04	Q30	*Hannafordia bissillii* subsp. *latifolia*	8	1	Low shrub (<1 m)	None	Perennial
SR04	Q30	*Keraudrenia integrifolia*	10	Overhang	Low shrub (<1 m)	Flower	Perennial
SR04	Q30	*Melaleuca* sp.	2	3	Low shrub (<1 m)	Fruit	Perennial
SR04	Q35	*Acacia sibina*	8	1	Low shrub (<1 m)	None	Perennial
SR04	Q35	*Baeckea elderiana*	1	Overhang	Low shrub (<1 m)	Fruit	Perennial
SR04	Q35	*Grevillea didymobotrya* subsp. *didymobotrya*	5	2	Low shrub (<1 m)	None	Perennial
SR04	Q35	*Keraudrenia integrifolia*	3	1	Low shrub (<1 m)	None	Perennial
SR04	Q40	*Acacia sibina*	8	2	Low shrub (<1 m)	None	Perennial
SR04	Q40	*Grevillea didymobotrya* subsp. *didymobotrya*	10	4	Low shrub (<1 m)	Fruit	Perennial
SR04	Q40	*Hannafordia bissillii* subsp. *latifolia*	4	3	Low shrub (<1 m)	Fruit	Perennial

Site	Quadrat	Species	Cover	Count	Stratum	Reproductive material	Perennial/annual
SR04	Q45	*Acacia burkittii*	6	1	Low shrub (<1 m)	None	Perennial
SR04	Q45	*Acacia sibina*	15	6	Low shrub (<1 m)	None	Perennial
SR04	Q45	*Grevillea didymobotrya* subsp. *didymobotrya*	8	1	Low shrub (<1 m)	Fruit	Perennial
SC01	Q00	No species	0	0			
SC01	Q05	*Atriplex nummularia*	35	4	Low shrub (<1 m)	None	Perennial
SC01	Q10	*Atriplex nummularia*	0.1	1	Low shrub (<1 m)	None	Perennial
SC01	Q15	*Eremophila scoparia*	15	Overhang	Mid shrub (1-2m)	Flower	Perennial
SC01	Q20	*Atriplex nummularia*	0.1	1	Low shrub (<1 m)	None	Perennial
SC01	Q20	*Eremophila drummondii*	1	1	Low shrub (<1 m)	Flower	Perennial
SC01	Q20	*Eremophila scoparia*	0.1	2	Low shrub (<1 m)	None	Perennial
SC01	Q20	*Melaleuca pauperiflora* subsp. *fastigiata*	2	Overhang	Tall shrub (>2m)	Fruit	Perennial
SC01	Q25	*Eremophila drummondii*	5	1	Low shrub (<1 m)	None	Perennial
SC01	Q25	*Eremophila scoparia*	10	1	Mid shrub (1-2m)	Flower	Perennial
SC01	Q30	*Eremophila drummondii*	0.1	2	Low shrub (<1 m)	None	Perennial
SC01	Q30	*Eremophila scoparia*	1	Overhang	Mid shrub (1-2m)	Flower	Perennial
SC01	Q30	*Olearia muelleri*	5	1	Low shrub (<1 m)	None	Perennial
SC01	Q35	*Eremophila scoparia*	1	Overhang	Mid shrub (1-2m)	Flower	Perennial
SC01	Q40	No species	0	0			
SC01	Q45	*Acacia merrallii*	20	Overhang	Tall shrub (>2m)	None	Perennial
SC01	Q45	*Eucalyptus longicornis*	10	Overhang	Tree	None	Perennial
SC02	Q00	*Eucalyptus yilgarnensis*	50	1	Tree	Fruit	Perennial
SC02	Q00	*Triodia tomentosa*	15	8	Hummock grass	Fruit	Perennial
SC02	Q05	*Triodia tomentosa*	20	4	Hummock grass	Fruit	Perennial
SC02	Q10	*Eucalyptus yilgarnensis*	5	Overhang	Tree	Fruit	Perennial
SC02	Q10	*Triodia tomentosa*	25	7	Hummock grass	Fruit	Perennial
SC02	Q15	*Thryptomene urceolaris*	10	1	Mid shrub (1-2m)	None	Perennial
SC02	Q15	*Triodia tomentosa*	25	8	Hummock grass	Fruit	Perennial
SC02	Q20	*Eucalyptus yilgarnensis*	10	Overhang	Tree	None	Perennial
SC02	Q20	*Triodia tomentosa*	5	2	Hummock grass	None	Perennial
SC02	Q25	*Melaleuca hamata*	15	1	Tall shrub (>2m)	Fruit	Perennial
SC02	Q25	*Santalum acuminatum*	3	Overhang	Tall shrub (>2m)	None	Perennial
SC02	Q25	*Thryptomene urceolaris*	20	2	Low shrub (<1 m)	None	Perennial
SC02	Q25	*Triodia tomentosa*	10	7	Hummock grass	None	Perennial
SC02	Q30	*?Hakea* sp. (inadequate material)	0.1	1	Low shrub (<1 m)	None	Perennial
SC02	Q30	*Triodia tomentosa*	15	6	Hummock grass	None	Perennial
SC02	Q35	*Acacia longispinea*	0.1	1	Low shrub (<1 m)	None	Perennial
SC02	Q35	*Grevillea haplantha* subsp. *haplantha*	50	1	Tall shrub (>2m)	None	Perennial

Site	Quadrat	Species	Cover	Count	Stratum	Reproductive material	Perennial/annual
SC02	Q35	*Micromyrtus ?sulphurea*	0.1	2	Low shrub (<1 m)	None	Perennial
SC02	Q35	*Phebalium canaliculatum*	4	2	Low shrub (<1 m)	None	Perennial
SC02	Q35	*Triodia tomentosa*	5	7	Hummock grass	None	Perennial
SC02	Q40	*Acacia longispinea*	15	2	Tall shrub (>2 m)	None	Perennial
SC02	Q40	*Grevillea haplantha* subsp. *haplantha*	8	Overhang	Tall shrub (>2 m)	Flower	Perennial
SC02	Q40	*Phebalium canaliculatum*	8	1	Mid shrub (1-2m)	None	Perennial
SC02	Q40	*Triodia tomentosa*	3	2	Hummock grass	None	Perennial
SC02	Q45	*Acacia longispinea*	0.1	Overhang	Mid shrub (1-2m)	None	Perennial
SC02	Q45	*Thryptomene urceolaris*	35	4	Mid shrub (1-2m)	None	Perennial
SC02	Q45	*Triodia tomentosa*	0.1	1	Hummock grass	None	Perennial
SC03	Q00	*Allocasuarina acutivalvis* subsp. *acutivalvis*	1	Overhang	Tall shrub (>2m)	fruit	Perennial
SC03	Q00	*Baeckea elderiana*	15	Overhang	Mid shrub (1-2m)	Flower	Perennial
SC03	Q05	*Baeckea elderiana*	2	Overhang	Mid shrub (1-2m)	Flower	Perennial
SC03	Q10	*Acacia tetragonophylla*	4	1	Mid shrub (1-2m)	None	Perennial
SC03	Q10	*Eremophila clarkei*	1	1	Mid shrub (1-2m)	None	Perennial
SC03	Q10	*Grevillea georgeana*	40	1	Tall shrub (>2m)	None	Perennial
SC03	Q10	*Hibbertia exasperata*	3	1	Low shrub (<1 m)	None	Perennial
SC03	Q10	*Scaevola spinescens*	5	Overhang	Low shrub (<1 m)	None	Perennial
SC03	Q15	No species	0	0			
SC03	Q20	*Austrostipa elegantissima*	0.1	1	Tussock grass	None	Perennial
SC03	Q20	*Eucalyptus loxophleba* subsp. *lissophloia*	70	Overhang	Tree	None	Perennial
SC03	Q20	*Hibbertia exasperata*	5	Overhang	Mid shrub (1-2m)	None	Perennial
SC03	Q20	*Rinzia carnosa*	20	1	Mid shrub (1-2m)	None	Perennial
SC03	Q25	*Acacia tetragonophylla*	20	1	Tall shrub (>2m)	None	Perennial
SC03	Q25	*Amphipogon caricinus* var. *caricinus*	0.1	1	Tussock grass	None	Perennial
SC03	Q25	*Grevillea georgeana*	3	Overhang	Mid shrub (1-2m)	None	Perennial
SC03	Q25	*Hibbertia exasperata*	5	1	Low shrub (<1 m)	None	Perennial
SC03	Q25	*Rinzia carnosa*	7	Overhang	Low shrub (<1 m)	None	Perennial
SC03	Q30	*Acacia burkittii*	80	2	Tall shrub (>2m)	None	Perennial
SC03	Q30	*Allocasuarina acutivalvis* subsp. *acutivalvis*	5	Overhang	Tall shrub (>2m)	fruit	Perennial
SC03	Q30	*Alyxia buxifolia*	0.1	1	Low shrub (<1 m)	None	Perennial
SC03	Q30	*Austrostipa elegantissima*	2	2	Tussock grass	None	Perennial
SC03	Q35	*Acacia burkittii*	2	Overhang	Mid shrub (1-2m)	None	Perennial
SC03	Q35	*Alyxia buxifolia*	15	1	Mid shrub (1-2m)	Flower	Perennial
SC03	Q35	*Amphipogon caricinus* var. *caricinus*	0.1	1	Tussock grass	None	Perennial
SC03	Q35	*Rinzia carnosa*	2	Overhang	Low shrub (<1 m)	None	Perennial
SC03	Q40	*Amphipogon caricinus* var. *caricinus*	0.1	1	Tussock grass	None	Perennial

Site	Quadrat	Species	Cover	Count	Stratum	Reproductive material	Perennial/annual
SC03	Q45	*Acacia burkittii*	10	Overhang	Tall shrub (>2m)	None	Perennial
SC03	Q45	*Hibbertia exasperata*	2	Overhang	Low shrub (<1 m)	fruit	Perennial
SC03	Q45	*Petrophile seminuda*	10	Overhang	Low shrub (<1 m)	None	Perennial
SC04	Q00	*Allocasuarina campestris*	4	1	Low shrub (<1 m)	None	Perennial
SC04	Q00	*Amphipogon caricinus* var. *caricinus*	0.1	1	Tussock grass	None	Perennial
SC04	Q00	*Hibbertia exasperata*	0.1	1	Low shrub (<1 m)	Fruit	Perennial
SC04	Q05	*Lepidosperma lyonsii*	1	1	Sedge	Fruit	Perennial
SC04	Q05	*Phebalium filifolium*	7	Overhang	Mid shrub (1-2m)	Fruit	Perennial
SC04	Q10	*Allocasuarina acutivalvis* subsp. *acutivalvis*	70	1	Tree	Fruit	Perennial
SC04	Q10	*Alyxia buxifolia*	0.1	1	Low shrub (<1 m)	None	Perennial
SC04	Q10	*Eremophila ionantha*	15	2	Low shrub (<1 m)	Fruit	Perennial
SC04	Q15	*Allocasuarina campestris*	60	1	Tall shrub (>2m)	None	Perennial
SC04	Q15	*Eremophila* sp. Mt Jackson (G.J. Keighery 4372)	1	1	Low shrub (<1 m)	None	Perennial
SC04	Q15	*Eucalyptus loxophleba* subsp. *lissophloia*	60	Overhang	Tree	None	Perennial
SC04	Q15	*Olearia muelleri*	3	1	Low shrub (<1 m)	None	Perennial
SC04	Q15	*Phebalium filifolium*	2	1	Low shrub (<1 m)	Fruit	Perennial
SC04	Q20	*Allocasuarina campestris*	1	1	Low shrub (<1 m)	None	Perennial
SC04	Q20	*Alyxia buxifolia*	0.1	1	Low shrub (<1 m)	None	Perennial
SC04	Q20	*Eremophila* sp. Mt Jackson (G.J. Keighery 4372)	2	Overhang	Mid shrub (1-2m)	None	Perennial
SC04	Q20	*Eucalyptus loxophleba* subsp. *lissophloia*	80	1	Tree	Fruit	Perennial
SC04	Q20	*Grevillea zygoloba*	25	Overhang	Mid shrub (1-2m)	None	Perennial
SC04	Q20	*Hibbertia exasperata*	0.1	1	Low shrub (<1 m)	Fruit	Perennial
SC04	Q25	*Allocasuarina acutivalvis* subsp. *acutivalvis*	2	Overhang	Tall shrub (>2m)	Flower	Perennial
SC04	Q25	*Allocasuarina campestris*	10	Overhang	Tall shrub (>2m)	Fruit	Perennial
SC04	Q25	*Hibbertia exasperata*	1	Overhang	Low shrub (<1 m)	None	Perennial
SC04	Q25	*Melaleuca vinnula*	8	Overhang	Mid shrub (1-2m)	Fruit	Perennial
SC04	Q30	*Allocasuarina campestris*	80	5	Tall shrub (>2m)	Fruit	Perennial
SC04	Q30	*Hibbertia exasperata*	15	6	Low shrub (<1 m)	Fruit	Perennial
SC04	Q30	*Melaleuca vinnula*	15	1	Tall shrub (>2m)	Fruit	Perennial
SC04	Q35	*Allocasuarina campestris*	50	5	Tall shrub (>2m)	Fruit	Perennial
SC04	Q35	*Grevillea zygoloba*	20	Overhang	Mid shrub (1-2m)	None	Perennial
SC04	Q35	*Hibbertia exasperata*	15	8	Low shrub (<1 m)	Fruit	Perennial
SC04	Q40	*Allocasuarina campestris*	30	4	Mid shrub (1-2m)	Fruit	Perennial
SC04	Q40	*Baeckea elderiana*	15	1	Mid shrub (1-2m)	Fruit	Perennial
SC04	Q40	*Grevillea zygoloba*	10	1	Mid shrub (1-2m)	None	Perennial
SC04	Q45	*Allocasuarina campestris*	70	5	Tall shrub (>2m)	Fruit	Perennial
SC04	Q45	*Baeckea elderiana*	1	Overhang	Mid shrub (1-2m)	Flower	Perennial

Site	Quadrat	Species	Cover	Count	Stratum	Reproductive material	Perennial/annual
SC04	Q45	*Hibbertia exasperata*	1	2	Low shrub (<1 m)	Fruit	Perennial
SC05	Q00	*Acacia erinacea*	3	1	Low shrub (<1 m)	None	Perennial
SC05	Q00	*Eremophila scoparia*	5	1	Low shrub (<1 m)	None	Perennial
SC05	Q00	*Olearia muelleri*	0.1	1	Low shrub (<1 m)	None	Perennial
SC05	Q05	*Eucalyptus corrugata*	70	Overhang	Tree	Fruit	Perennial
SC05	Q10	*Acacia erinacea*	8	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q10	*Eucalyptus corrugata*	40	Overhang	Tree	Fruit	Perennial
SC05	Q10	*Grevillea ?beardiana*	1	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q10	*Olearia muelleri*	0.1	1	Low shrub (<1 m)	None	Perennial
SC05	Q15	*Acacia burkittii*	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q15	*Scaevola spinescens*	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q20	*Acacia burkittii*	2	1	Low shrub (<1 m)	None	Perennial
SC05	Q20	*Acacia erinacea*	2	1	Low shrub (<1 m)	None	Perennial
SC05	Q20	*Asteraceae* sp.	0.1	1	Low shrub (<1 m)	None	Perennial
SC05	Q20	*Eremophila* sp. Mt Jackson (G.J. Keighery 4372)	20	Overhang	Tall shrub (>2m)	Flower	Perennial
SC05	Q20	*Hakea* sp.	8	Overhang	Mid shrub (1-2m)	None	Perennial
SC05	Q20	*Hemigenia westringioides*	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q20	*Scaevola spinescens*	0.1	1	Low shrub (<1 m)	None	Perennial
SC05	Q25	*Eremophila* sp. Mt Jackson (G.J. Keighery 4372)	20	Overhang	Mid shrub (1-2m)	Flower	Perennial
SC05	Q25	*Grevillea ?beardiana*	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q25	*Olearia muelleri*	0.1	1	Low shrub (<1 m)	None	Perennial
SC05	Q25	*Scaevola spinescens*	30	Overhang	Tall shrub (>2m)	Fruit	Perennial
SC05	Q25	*Scaevola spinescens*	0.1	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q30	*Eucalyptus corrugata*	50	Overhang	Tree	Fruit	Perennial
SC05	Q30	*Grevillea ?beardiana*	5	1	Low shrub (<1 m)	None	Perennial
SC05	Q30	*Scaevola spinescens*	4	Overhang	Low shrub (<1 m)	None	Perennial
SC05	Q35	*No species*	0	0			
SC05	Q40	*Acacia burkittii*	1	1	Low shrub (<1 m)	None	Perennial
SC05	Q40	*Alyxia buxifolia*	8	Overhang	Tall shrub (>2m)	None	Perennial
SC05	Q45	*Cryptandra ?myriantha*	8	1	Low shrub (<1 m)	None	Perennial

Appendix D Overstorey Quadrat Data

Tree Data

Site type	Site	Species	Stratum	Foliage cover	Count
Rehabilitation	SR01	*Eucalyptus* sp. 1 (glaucous foliage)	Juvenile	1	16
			Seedling	0.1	10
		Eucalyptus sp. 2 (green shiny foliage)	Juvenile	0.1	4
			Seedling	0.1	1
	SR03	*Codonocarpus cotinifolius*	Juvenile	0.1	1
	SR04	*Eucalyptus* sp.	Juvenile	0.1	4
Control	SC01	*Eucalyptus corrugata*	Mature	8	13
		Eucalyptus longicornis	Mature	8	1
		Eucalyptus loxophleba subsp. *lissophloia*	Mature	30	43
	SC02	*Callitris preissii*	Mature	2	11
			Juvenile	0.1	2
			Seedling	0.1	1
		Eucalyptus corrugata	Mature	5	10
		Eucalyptus griffithsii	Juvenile	5	7
		Eucalyptus yilgarnensis	Mature	25	55
		Santalum acuminatum	Juvenile	0.1	2
	SC03	*Eucalyptus loxophleba* subsp. *lissophloia*	Mature	20	5
	SC04	*Eucalyptus corrugata*	Mature	15	3
		Eucalyptus loxophleba subsp. *lissophloia*	Mature	10	3
	SC05	*Eucalyptus corrugata*	Juvenile	10	11

Weed Data

Site type	Site	Species	Stratum	Foliage cover	Count
Rehabilitation	SR01	**Sonchus oleraceus*	Herb	<1	10
	SR02	**Sonchus oleraceus*	Herb	<1	10
		**Solanum hoplopetalum*	Herb	<1	50
	SR03	**Sonchus oleraceus*	Herb	4	200

Appendix E Photographic Monitoring Site Data

Site	Date	Perennial foliage cover	Animals	Fire	Weeds	Vegetation condition	Total rehabilitation condition	Blending	Weeds	Erosion	Disturbance	Rehabilitation year	Rehabilitation treatment
PR01	19/11/2015	5	None	Old burnt patches	None	n/a	7	4	1	1	1	2014	Ripping
PR02	19/11/2015	1	None	No sign	None	n/a	6	3	1	1	1	2014	Ripping
PR03	19/11/2015	1	None	No sign	None	n/a	7	3	1	1	2	2014	Ripping
PR04	19/11/2015	2	None	No sign	None	n/a	6	3	1	1	1	2014	Ripping
PR05	19/11/2015	1	None	No sign	None	n/a	7	4	1	1	1	2014	Ripping
PR06	19/11/2015	1	None	No sign	None	n/a	7	4	1	1	1	2014	Ripping
PC01	19/11/2015	45	None	Old burnt patches	None	Excellent	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PC02	19/11/2015	70	Birds	Old burnt patches	None	Excellent	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PC03	19/11/2015	50	None	No sign	None	Excellent	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PC04	19/11/2015	70	None	No sign	None	Excellent	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PC05	19/11/2015	70	None	No sign	None	Excellent	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PC06	19/11/2015	80	None	No sign	None	Excellent	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Photographic Monitoring Sites	
PR01	**PC01**
	
PR02	**PC02**
	
PR03	**PC03**
	
PR04	**PC04**
	

PR05	PC05
	
PR06	**PC06**
	

Appendix F Electronic Data

Data provided electronically:

C.1: Field Data

C.2: Site photos

C.3: Scanning Data