

Department of Health and  
Department of Finance  
Building Management and Works

## **Tuart Forest Revegetation Management Plan**

January 2013



99 C Lord St  
Whiteman 6068

Ph: (08) 9209 2767

Fax: (08) 9209 2768

Email:  
[consulting@naturalarea.com.au](mailto:consulting@naturalarea.com.au)

[www.naturalareaconsulting.com.au](http://www.naturalareaconsulting.com.au)

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**Report prepared for:** Department of Health and Department of Finance  
**Report prepared by:** Natural Area Consulting  
99c Lord St  
Whiteman, WA 6068  
[consulting@naturalarea.com.au](mailto:consulting@naturalarea.com.au)

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## Executive Summary

Natural Area Holdings Pty Ltd T/A Natural Area Consulting (NAC) were engaged to prepare a revegetation management plan for the Tuart Forest Rehabilitation Offset Site required as an approval condition by the Department of Sustainability, Environment, Water, Population and Communities for the Busselton Health Campus redevelopment works. The revegetation management plan was commissioned by the Department of Finance (Building Management and Works) on behalf of the Department of Health Western Australian Country Health Service. Preliminary works such as seed collection, plant propagation, weed control, rubbish removal and fencing will occur during 2013, with planting occurring in 2014. Monitoring and maintenance will occur for a further three years until management of the site reverts back to the Department of Environment and Conservation.

The site is located approximately 10.5 km east of the Busselton town centre and will be rehabilitated to offset the loss of habitat utilised by the Western Ringtail Possum (*Pseudocheirus occidentalis*) at the Busselton Health Campus site. The Western Ringtail Possum is listed as vulnerable under both the *Wildlife Conservation Act 1950* (WA) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).

The site is an approximately 4.1 ha area within a currently degraded portion of State Forest No. 2. The aim of the rehabilitation works will primarily be the restoration of the Tuart (*Eucalyptus gomphocephala*) and Peppermint (*Agonis flexuosa*) Forest such that it can be included within the adjacent Tuart Forest National Park. A minimum of 15,000 plants including 1000 Tuart and 1000 Peppermints will be planted within the rehabilitation site boundary and will receive a fertiliser treatment to ensure survival rates are at 75% or above. If survival rates are not 75% or higher infill planting and other measures as described in this document will be required.

The weed presence at the site means that revegetation activities could be compromised if they are not controlled, thus weed management will take place before and after planting to reduce the density and diversity of weeds, with ongoing weed management eventually being incorporated into normal site maintenance activities.

The Rabbit (*Oryctolagus cuniculus*) occur within the site boundary, with the presence of foxes also likely. Control of these populations will occur through a 1080 baiting program. Temporary fencing will also assist with preventing access by the rabbit as well as keeping kangaroos (*Macropus fuliginosus*) to a minimum during the first few years of plant growth.

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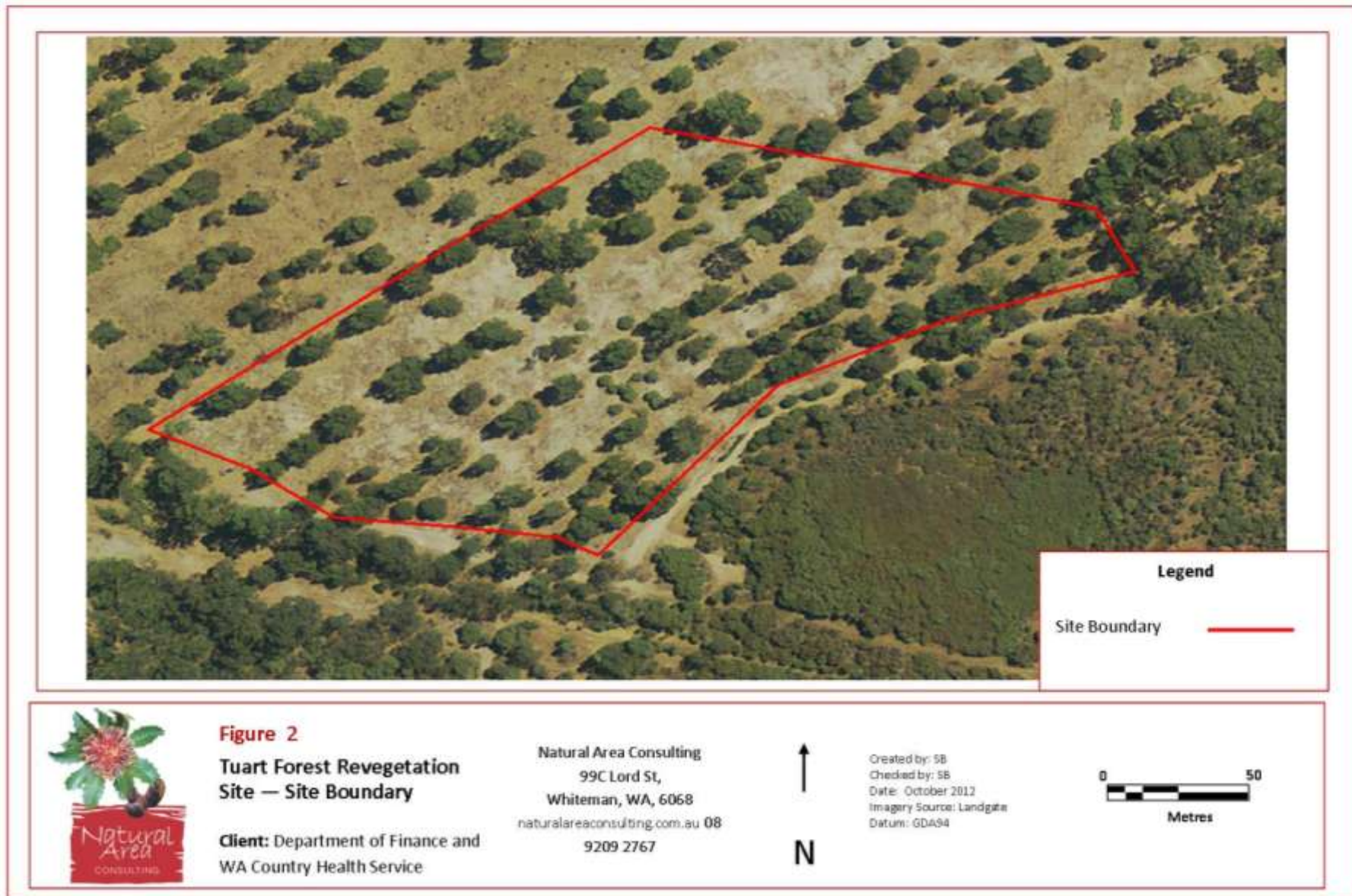
## 1.0 Introduction

Natural Area Holdings Pty Ltd T/A Natural Area Consulting (NAC) were commissioned by the Department of Finance (Building Management and Works) on behalf of the Department of Health WA Country Health Services to prepare a revegetation management plan for a 4 ha area in Tuart Forest to offset the loss of Peppermint trees (*Agonis flexuosa*) and associated habitat for the Western Ringtail Possum (*Pseudocheirus occidentalis*) removed from the Busselton Health Campus development site as an environmental approval condition issued by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). The Plan has been prepared in consultation with the Department of Environment and Conservation (WA).

The site is located approximately 10.5 km east of Busselton within State Forest No 2, with the intention of it being incorporated into the Tuart Forest National Park immediately adjacent to the site and north of Bussell Highway (Figures 1 and 2). It is accessible only by 4WD vehicles via a series of tracks and fire access ways from Tuart Drive.







The site was used some ten years ago as a pine plantation, with vegetation allowed to regrow after that use was discontinued. Currently, the site contains pockets of native vegetation along with an understorey of grassy and broadleaf weeds (Figure 3) and pockets of Arum Lily (*Zantedeschia aethiopica*) and Trachyandra (*Trachyandra divaricata*) (Figure 4). Also located within the site are numerous tree stumps left when the pines were removed ten or more years ago, some of which have decayed to a greater degree than others (Figure 5).



**Figure 3:** Tuart Forest Revegetation Site





**Figure 4:** Arum Lily and Trachyandra at the Revegetation Site



**Figure 5:** Tree Trunks within Revegetation Area

The success of revegetation activities can be closely linked to the effective management of other activities, particular the presence of weeds and pests.

Accordingly, this plan will:

- describe the site, including its location and description of key characteristics,
- outline management aims and objectives for the site,
- describe rehabilitation activities, their rationale, and methodology,
- provide success criteria, monitoring and reporting requirements,
- describe contingency plans if success criteria are not met,
- outline weeds and pest control activities,
- provide an indicative implementation schedule, and
- describe roles and responsibilities.

## 2.0 Management Plan Objectives

The aims and objectives of the rehabilitation activities within the Tuart Forest rehabilitation site, as described in this management plan include:

- rehabilitate the site with species and communities typical of the Tuart forest that will enable its inclusion as part of the adjacent Tuart Forest National Park in the future,
- introduce variation in the age-structure within the Tuart trees, and
- define and guide the short term management of the revegetation site during the establishment of the plants until ongoing management is returned to the Department of Environment and Conservation.

The Southern Swan Coastal Plain *Eucalyptus gomphocephala* (Tuart) and *Agonis flexuosa* (Peppermint) Woodlands of the Tuart Forest are listed as a priority 3 ecological community on the current (April 2012) listing of priority ecological communities. Accordingly, the rehabilitation of the Tuart Forest offset site will result in an increase in area for this ecological community.

A secondary aim of the rehabilitation activities is to offset the loss of Western Ringtail Possum (*Pseudocheirus occidentalis*) habitat from the Busselton Health Campus development site. The Possum is listed as vulnerable under both the *Wildlife Conservation Act 1950* (WA) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).

### **3.0 Site Location and Land Use**

The Tuart Forest rehabilitation site is located approximately 10.5 km east of the Busselton town centre in State Forest number 2, Lot number 9 (Figure 2). The land is currently zoned as a reserve and is managed by the Department of Environment and Conservation. It is accessed by a series of tracks and fire access ways off Tuart Drive, and is located approximately 500 m north west of Bussell Highway and 700 m south east of Tuart Drive (Figure 6). In the longer term, it is expected that the site will be incorporated into the adjacent Tuart Forest National Park to the south east.



## 4.0 Site Description

In order to manage the site and determine the most appropriate revegetation activities, it is necessary to describe its key characteristics. The site has an area of approximately 4.14 ha, which primarily consists of degraded Tuart (*Eucalyptus gomphocephala*) forest, with a sparse middle storey of Peppermint trees (*Agonis flexuosa*) and a weed dominated understorey. The site is immediately adjacent to a portion of the Tuart Forest National Park which include nearby wetland areas (Figure 6).

### 4.1 Climate

According to the Bureau of Meteorology (2011), the climate of the Busselton region is typical of the Swan Coastal Plain. It can be described as Mediterranean, characterised by cool, wet winters and hot, dry summers. Statistics available from the Bureau of Meteorology (2011) indicate the following:

- average maximum temperatures range from 16.3 °C in winter to 28.5 °C in summer,
- average minimum temperatures range from 7.5 °C to 14.0 °C,
- average rainfall is 810 mm per year, with approximately half of that falling during winter months, and
- average humidity ranges from 50% in summer to 81% in winter.

Potential climate change impacts in the vicinity of the site include:

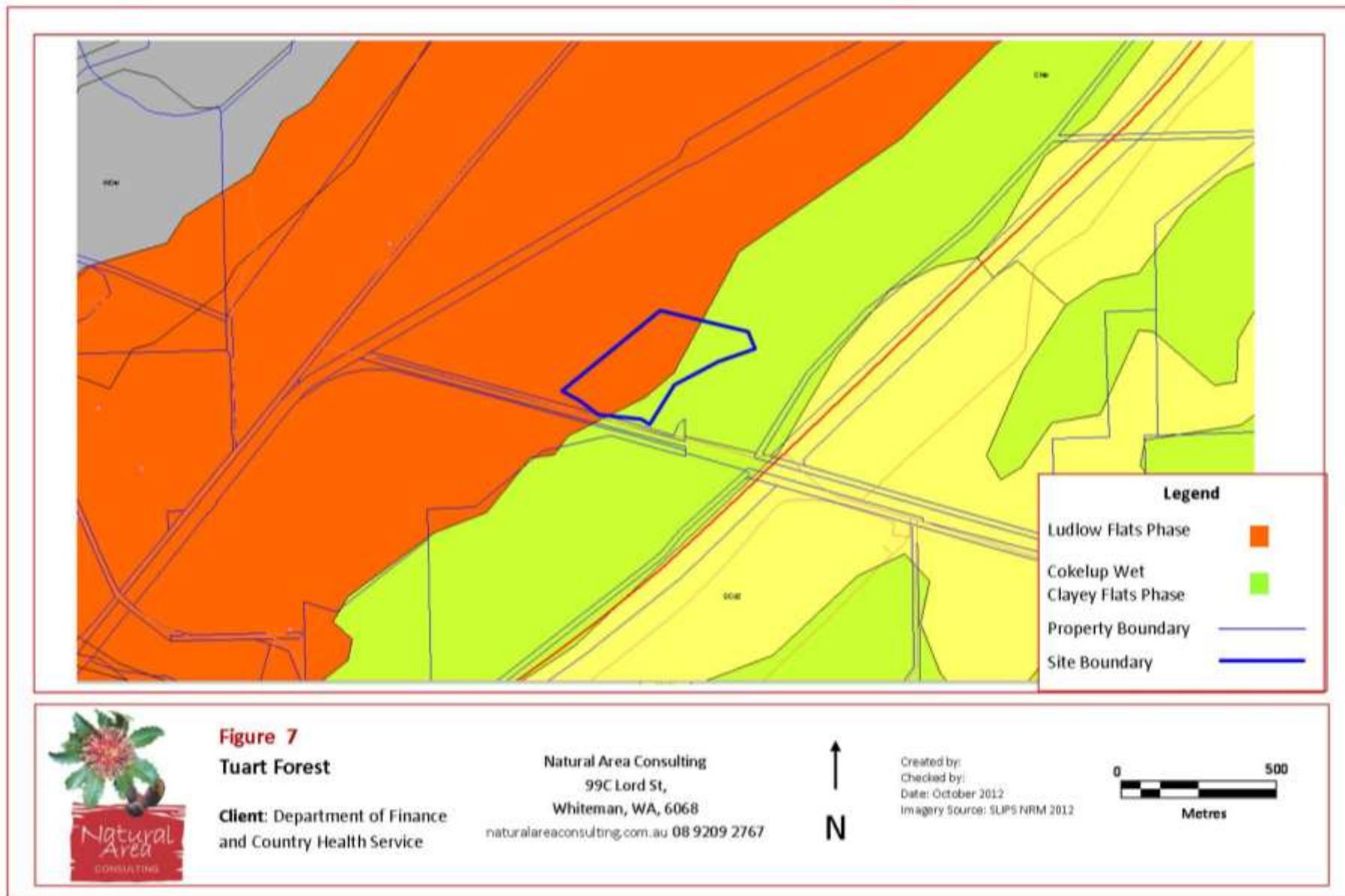
- a drying climate with the potential to result in declines in groundwater levels, and
- increased frequency of storm events.

### 4.2 Topography

The Tuart Forest revegetation site is located at the southern end of the Swan Coastal Plain, a long coastal strip running from Dunsborough in the south to Gingin in the north, and is bounded by the ocean to the west and the Darling fault to the east. It is characterised by a series of low sand dunes made up of marine sediments laid down during various geological times and which run parallel with the coast. The site is relatively flat with an elevation of approximately 9 – 10 m AHD.

### 4.3 Soils

According to the Department of Agriculture and Food (2012), the soils of the Tuart Forest rehabilitation site are consistent with those of the Ludlow flats and Cokelup wet clayey flats systems (Figure 7) within the Spearwood Dunes. The Ludlow flats phase is comprised of deep yellow to brown grainy siliceous sands over limestone typical of the Spearwood dune system, which is highly porous and poorly drained. However the Cokelup wet clayey flats are comprised of wet to semi wet or wet saline soils, with shallow grey sandy loam duplexes and hard cracking clays.





## 4.4 Vegetation and Flora

Flora refers to the individual plant species that are found in an area, while vegetation refers to the broader assemblage of plants associated with a particular habitat and ecosystem. Many Western Australian plants have a close association with particular soils, and as a result may be found nowhere else. Desktop searches were undertaken to determine whether or not declared rare flora and/or threatened or priority listed ecological communities were likely to be found at the site.

The SLIPs NRM Portal (Department of Agriculture and Food, 2012), NatureMap (Department of Environment and Conservation, 2012) and the Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population and Communities, 2012) indicated that no rare flora was likely to occur on site. The SLIPs NRM Portal (Department of Agriculture and Food, 2012) indicated that there are no threatened or priority ecological communities present at the site.

The Tuart Forest revegetation site was traversed by NAC scientists to:

- ground-truth desktop information,
- assess the vegetation type and condition,
- assess the type and extent of weeds, and
- develop a floristic species list for use in revegetation activities.

Outcomes of the various assessments are provided in this section.

### 4.4.1 Vegetation

The vegetation and flora at the Tuart Forest revegetation site is dominated by the Tuart (*Eucalyptus gomphocephala*). The site contains an open Tuart woodland with some scattered Peppermint (*Agonis flexuosa*) and Marri (*Corymbia calophylla*) trees. The middle story is comprised of *Acacia* species with some Bull Banksia (*Banksia grandis*), however Paperbark (*Melaleuca sp.*) occur nearer the wetlands on the Cokelup soils. The understory is dominated by grassy and broad-leafed weed species (Figure 8), but also contains a few orchids, sedges and rushes in the wetland/dryland transition zone.



Open Tuart (*Eucalyptus gomphocephala*) woodland with middle storey of Acacia and Peppermint (*Agonis flexuosa*) in dryland areas and Kunzea in wetland areas and a grassy weed understorey, and an understorey of Hibbertia and Zamia Palms with *Gahnia trifida* in the wetland transition zone

**Figure 8:** Examples of Vegetation Types at the Project Site

#### 4.4.2 Vegetation Communities

Two broad vegetation community types are found within the Tuart Forest revegetation site boundaries (Figure 9) and which will form the basis of the rehabilitation activities. These are the:

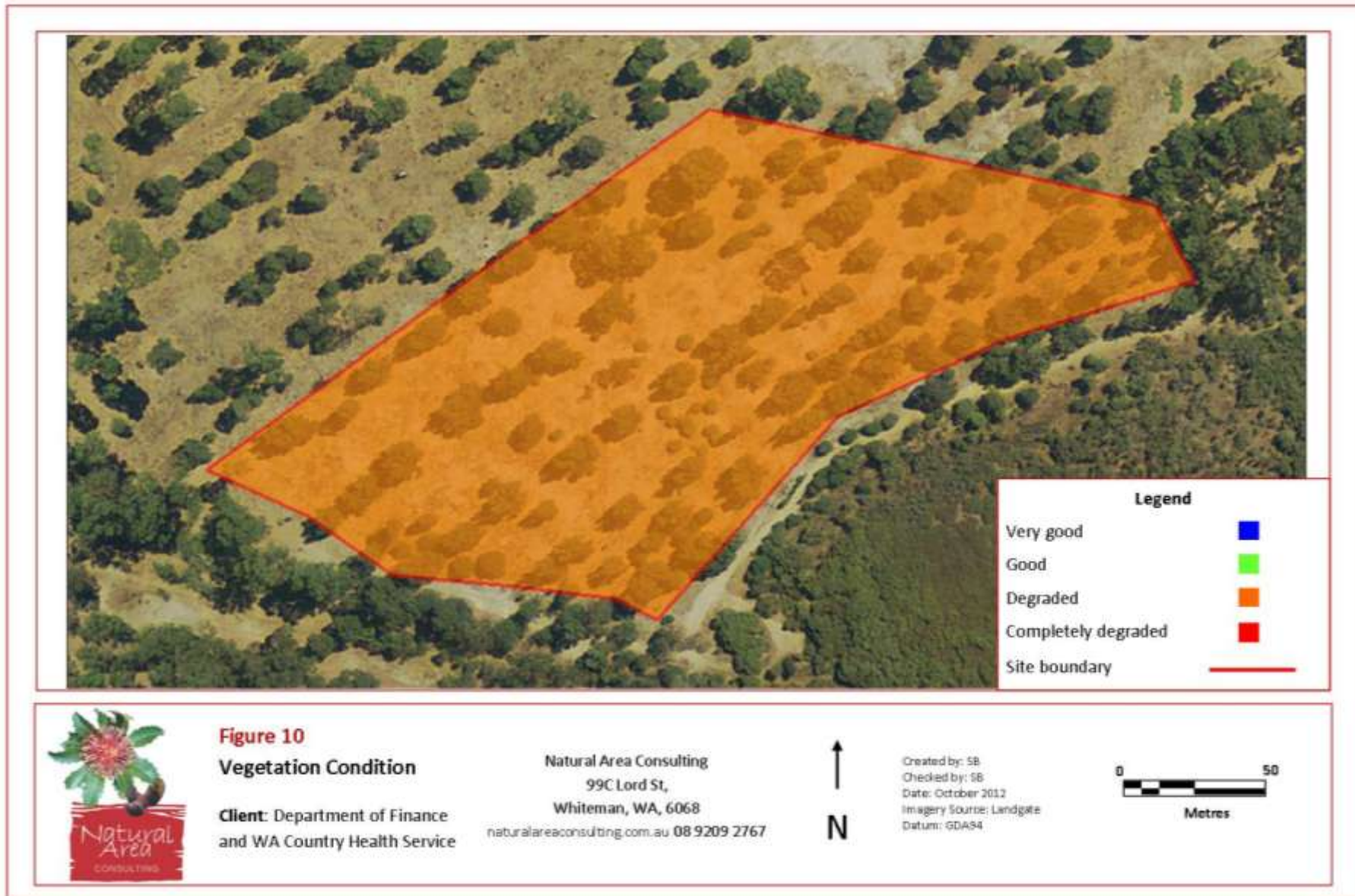
- open Tuart (*Eucalyptus gomphocephala*) forest over a lower tree area of Peppermint (*Agonis flexuosa*) on the Spearwood sandy soils, and
- dryland to wetland transition vegetation with associated middle and understorey species.

Vegetation communities at the site are consistent with those described in (Webb, Keighery, Keighery, Longman, Black, and O'Connor, 2009).

#### 4.4.3 Vegetation Condition

Vegetation condition at the Tuart Forest rehabilitation site was assessed using the vegetation condition rating scale attributed to Keighery in the Bush Forever documents (Government of Western Australia, 2000). The methodology assigns a rating according to the vegetation structure present at a nominated location (Appendix 1). The clearing associated with the former pine plantation and the prevalence of invasive weed species means that the entire site is considered to be degraded (Figure 10).





#### 4.4.4 Flora Species

The Tuart Forest rehabilitation site was walked by NAC scientists to identify species occurring at the time of the assessment. Nearby Tuart forest areas were also walked to determine species that could occur at the site but which were probably absent due to its degraded nature. A total of 35 native flora species were identified during the site assessment activities undertaken by Natural Area Consulting, with outcomes summarised in Table 1. Species are consistent with those described by Webb *et al* (2009) as occurring in the area. A number of weeds were also identified, as indicated in Table 2.

Two pine trees remain within the rehabilitation site boundary from the old pine plantation. These will be removed in the lead up to revegetation works.

**Table 1: Flora Species Found at the Site**

Species Name	Common Name
<i>Acacia pulchella</i>	Prickly Moses
<i>Acacia saligna</i>	Orange Wattle
<i>Agonis flexuosa</i>	Peppermint
<i>Banksia grandis</i>	Bull Banksia
<i>Billardiera fusiformis</i>	Australian Bluebell
<i>Caladenia flava</i>	Cowslip Orchid
<i>Caladenia latifolia</i>	Pink Fairies
<i>Conostylis aculeata</i>	Prickly Conostylis
<i>Corymbia calophylla</i>	Marri
<i>Dianella revoluta</i>	Dianella
<i>Dichopogon capillipes</i>	
<i>Drosera sp.</i>	Sundew
<i>Eucalyptus gomphocephala</i>	Tuart
<i>Eucalyptus rudis</i>	Flooded Gum
<i>Gahnia trifida</i>	Coast Saw Sedge
<i>Grevillea vestita</i>	
<i>Hakea prostrata</i>	Harsh Hakea
<i>Hardenbergia comptoniana</i>	Native Wisteria
<i>Hibbertia cuneiformis</i>	Cut leaf Hibbertia
<i>Hibbertia racemosa</i>	Stalked Guinea Flower
<i>Jacksonia furcellata</i>	Grey Stinkwood
<i>Juncus pallidus</i>	Pale Rush
<i>Kennedia prostrata</i>	Scarlet Runner
<i>Kunzea glabrescens</i>	Spearwood
<i>Lepidosperma gladiatum</i>	Coastal Sword Sedge
<i>Macrozamia riedlei</i>	Zamia Palm
<i>Melaleuca incana</i>	Grey Honeymyrtle
<i>Melaleuca raphiophylla</i>	Swamp Paperbark
<i>Phyllanthus calycinus</i>	False Boronia
<i>Pimelea ferruginea</i>	

Species Name	Common Name
<i>Pinus radiata</i>	Pine
<i>Rhagodia baccata</i>	Berry Saltbush
<i>Solanum symonii</i>	
<i>Sowerbaea laxiflora</i>	Purple Tassels
<i>Spyridium globulosum</i>	Basket Bush
<i>Viminaria juncea</i>	Swishbush
<b>Total Species: 35</b>	

**Table 2:** Key Weed Species Observed on Site

Species	Common Name
<i>Trachyandra divaricata</i>	Dune Onion Weed
<i>Zantedeschia aethiopica</i>	Arum Lily
<b>Total Species: 2</b>	

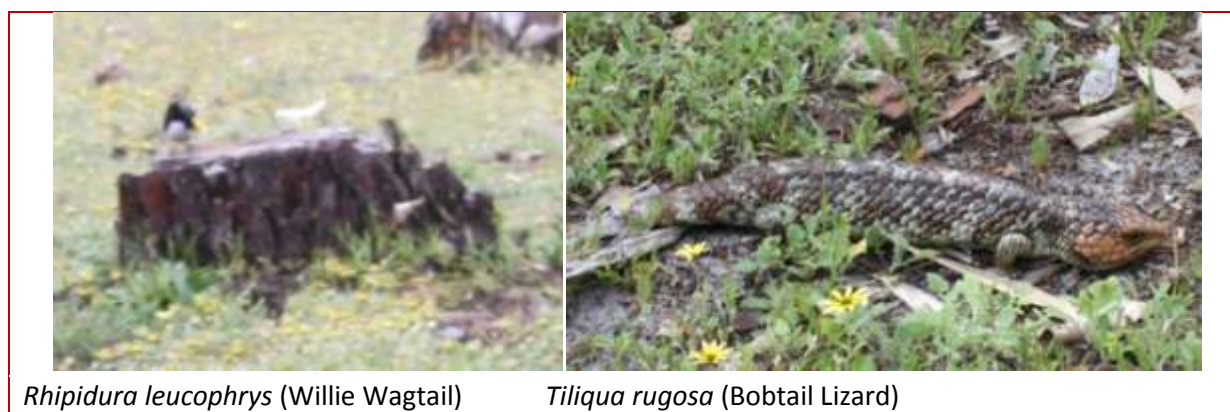
Note: these were not the only weeds present, but are the two that need to be considered differently from the others

## 4.5 Fauna

The presence of fauna species is linked to the flora and vegetation of a particular location. The degraded nature of the Tuart Forest rehabilitation site meant that the presence of fauna species was limited, with only a small number of species observed during site assessments (Table 3 and Figure 11), none of which were listed as threatened or in need of protection. As the major aim of the rehabilitation process is to replace habitat lost due to the development at the Busselton Health Campus, revegetation activities will have the added effect of improving habitat for a range of fauna species, including the Western Ringtail Possum (*Pseudocheirus occidentalis*).

**Table 3:** Fauna Observed on Site

Species	Common Name	Life Form
<i>Macropus fuliginosa</i>	Western Grey Kangaroo	Marsupial
<i>Rhipidura leucophrys</i>	Willie Wagtail	Bird
<i>Tiliqua rugosa</i>	Bobtail	Reptile
<i>Hieraaetus morphnoides</i>	Little Eagle	Bird
<b>Total Species: 4</b>		



*Rhipidura leucophrys* (Willie Wagtail)      *Tiliqua rugosa* (Bobtail Lizard)

**Figure 11:** Examples of Fauna Observed Onsite

#### 4.5.1 European Rabbit (*Oryctolagus cuniculus*)

Species on site include the European Rabbit (*Oryctolagus cuniculus*), which is considered to be a pest as they compete for habitat and resources with native fauna as well as contribute to onsite degradation. One warren was noted within the rehabilitation site, as were diggings. Another burrow was noted close by within the wetland area immediately to the south east of the site. The presence of the rabbit will be actively managed to ensure rehabilitation objectives and completion criteria are met. Locations where signs of the rabbit were observed are provided in Figure 12.



**Figure 12:** Rabbit Warren and Diggings

#### 4.5.2 Kangaroo (*Macropus fuliginosa*)

While not an introduced species, kangaroo populations can increase to large numbers and result in degradation within vegetation communities and compromise the success of revegetation activities through herbivory of the seedlings and/or tubestock. While the population of kangaroos is unknown in and around the rehabilitation site, they were observed on site and there are secondary signs of their presence in the form of kangaroo runs where vegetation is absent (Figure 13). In order to ensure the success of the rehabilitation program at the site, the presence of the kangaroo will be discouraged through temporary fencing while the plants become established. The fencing will be removed after a minimum of two years when the size of the seedlings are sufficient to withstand grazing pressures associated with the kangaroo.



**Figure 13:** Kangaroo Runs

#### **4.5.3 Fox (*Vulpes vulpes*)**

While no signs of the fox were noted during site assessment activities, the nature of the surrounding vegetation and the presence of rabbits as a food source mean their presence is possible and will be considered in the revegetation management plan.

#### **4.6 Aboriginal Heritage**

A desktop Aboriginal heritage survey that included a field inspection with traditional owners with considerable experience in artefact recognition was carried out by Brad Goode and Associates during October 2012. The search of the Department of Indigenous Affairs (DIA) Aboriginal Sites Register and the site inspection found no Aboriginal heritage sites or cultural material within the Tuart Forest Rehabilitation Offset Site.

However, there is still the potential for archaeological material to be found, particularly during ground disturbing activities such as the removal of the Pines, dead trees and stumps, and fencing activities. During these activities, an Aboriginal observer will be employed to ensure there are no breaches of the *Aboriginal Heritage Act 1972 (WA)*. In the event that any archaeological material is found during these activities, work will cease immediately. The finding of skeletal material will be reported to the Department of Indigenous Affairs and the WA Police Department, and any artefacts found will be reported to the Heritage and Culture Division of the DIA.



## 5.0 Revegetation Plan

As previously indicated, the major aim of the revegetation plan is to describe and guide revegetation activities over a four year period from site preparation works, installation and plant establishment and two years post-installation monitoring and maintenance prior to the site being returned to the DEC for ongoing management. The focus of the plan revolves around the restoration of a *Eucalyptus gomphocephala* and *Agonis Flexuosa* woodland with an appropriate middle and understorey. The site has been zoned according to the soil type and presence of wetland/dryland transition species (Figure 9), with the dryland zone being somewhat larger than the wetland transition zone.

Plan development has included the following activities:

- identification of flora species present within the revegetation zone, including native and weed species;
- assessment of vegetation condition;
- consideration of tree health issues, the presence of waste materials, and pests that could reduce the success of rehabilitation outcomes; and
- development of success and monitoring criteria to be implemented after the initial installation of seedlings.

### 5.1 Flora Species

In addition to the Tuart Forest rehabilitation site, visits were also made to nearby areas with somewhat intact vegetation structures to provide an indication of species that may have been present at the Tuart Forest revegetation site, but have been lost over time as a result of clearing and other impacts. The outcomes of those assessments were used to develop the rehabilitation species list for the site that includes a total of 32 species for both the Tuart and the wetland transition zones. The species list is provided in Table 4.

It should be noted that not all of these species can be easily propagated from seed, while other species such as *Hibbertia racemosa* and *Pimelea ferruginea* grow best from cuttings and *Sowerbaea laxiflora* seems to only be obtained through salvage.

**Table 4:** Rehabilitation Dry Land Flora Species List

Species	Common Name	Plant Form	Zone	Minimum Numbers
<i>Acacia pulchella</i>	Prickly Moses	Shrub, middle storey	Both woodland and wetland	160
<i>Acacia saligna</i>	Orange/Black Wattle	Tree, middle storey	Tuart woodland	100
<i>Agonis flexuosa</i>	Peppermint	Tree, middle storey	Tuart woodland	1000
<i>Banksia grandis</i>	Bull Banksia	Tree, middle storey	Tuart woodland	600
<i>Conostylis aculeata</i>	Prickly Conostylis	Clumping plant, understorey	Tuart woodland	1000
<i>Corymbia calophylla</i>	Marri	Tree, upper storey	Both woodland and wetland	250
<i>Dianella revoluta</i>	Dianella	Clumping plant, understorey	Tuart woodland	600
<i>Dichopogon capillipes</i>		Clumping plant, understorey	Both	600
<i>Eucalyptus gomphocephala</i>	Tuart	Tree, over storey	Both	1000
<i>Grevillea vestita</i>		Shrub, middle storey	Tuart woodland	300
<i>Hakea prostrata</i>	Harsh Hakea	Shrub, middle storey	Tuart woodland	400
<i>Hardenbergia comptoniana</i>	Native Wisteria	Shrub, middle storey	Tuart woodland	400
<i>Hibbertia cuneiformis</i>	Cutleaf Hibbertia	Shrub, middle storey	Tuart woodland	300
<i>Hibbertia hypericoides</i>	Yellow Buttercups	Shrub, middle storey	Tuart woodland	400
<i>Hibbertia racemosa</i>	Stalked Guinea Flower	Shrub, middle storey	Both woodland and wetland	320
<i>Jacksonia furcellata</i>	Grey Stinkwood	Shrub, middle storey	Tuart woodland	400
<i>Kennedia prostrata</i>	Scarlet Runner	Shrub, middle storey	Tuart woodland	400
<i>Lepidosperma gladiatum</i>	Coastal Sword Sedge	Clumping plant, understorey	Tuart woodland	1200
<i>Macrozamia reidleyi</i>	Zamia Palm	Clumping plant, understorey	Both	600
<i>Phyllanthus calycinus</i>	False Boronia	Shrub, middle storey	Tuart woodland	400
<i>Rhagodia baccata</i>	Berry Saltbush	Shrub, middle storey	Tuart woodland	600
<i>Solanum symonii</i>		Shrub, middle storey	Tuart woodland	300
<i>Sowerbaea laxiflora</i>	Purple Tassels	Clumping plant, understorey	Both woodland and wetland	200
<i>Spyridium globulosum</i>	Basket Bush	Shrub, middle storey	Tuart woodland	600
<b>Total Species: 24</b>				<b>Total: 12130</b>

**Table 5:** Rehabilitation Wetland Flora Species List

Species	Common Name	Plant Form	Zone	Suggested Numbers
<i>Acacia pulchella</i>	Prickly Moses	Shrub, middle storey	Both wetland and woodland	40
<i>Billardiera fusiformis</i>	Australian Bluebell	Shrub, middle storey	Wetland transition	300
<i>Corymbia calophylla</i>	Marri	Tree, upper storey	Both wetland and woodland	150
<i>Eucalyptus rudis</i>	Flooded Gum	Tree, over storey	Wetland transition	400
<i>Gahnia trifida</i>	Coast Saw Sedge	Clumping plant, understorey	Wetland transition	1200
<i>Hibbertia racemosa</i>	Stalked Guinea Flower	Shrub, middle storey	Both wetland and woodland	80
<i>Juncus pallidus</i>	Pale Rush	Clumping plant, understorey	Wetland transition	1200
<i>Kunzea glabrescens</i>	Spearwood	Shrub, middle storey	Wetland transition	400
<i>Melaleuca incana</i>	Grey Honeymyrtle	Tree, middle storey	Wetland transition	400
<i>Melaleuca raphiophylla</i>	Swamp Paperbark	Tree, middle storey	Wetland transition	400
<i>Viminaria juncea</i>	Swishbush	Tree, middle storey	Wetland transition	400
<b>Total Species: 11</b>				<b>Total: 4970</b>

## 5.2 Vegetation Health

The general health of vegetation at the site was assessed qualitatively based on appearance with any obvious signs of disease, fungi, canopy decline, the presence of yellowing leaves, or other indications of poor health. While there are a small number of trees that have died (Figure 14) these tend to be isolated so it is not possible to determine whether or not *Phytophthora cinnamomi* or some other species of Dieback was the cause. Testing for *Phytophthora* is unlikely to be conclusive as the dead trees are individuals and those around them appear to be in good health. Another potential cause of individual tree death is the Australian Honey Fungus (*Armillaria luteobubalina*); however, no visible sign of this fungus was observed during site assessment activities.



**Figure 14:** Dead Trees within the Rehabilitation Site

The regular access and grazing by kangaroos and rabbits have meant that natural recruitment of native species from those that are already on site or regenerating from the any existing seed bank is low. Acacia's tend not to be a long-lived species, and a number of those on site appear to be mature and are probably close to the end of their life span (Figure 15).



**Figure 15:** Mature Acacia Tree

### **5.3 Site Preparation**

In order to maximise rehabilitation success, site preparation activities will be required during year one (expected to be 2013). These will include the following:

- removal of stumps and dead trees,
- burning of dead materials to assist with creation of ash layer for planting of Tuarts,
- ripping of site
- weed (Section 6) and pest control (Section 7), and
- fencing.

#### **5.3.1 Removal of Tree Waste**

The Tuart Forest Rehabilitation site has historically been cleared and used as a Pine plantation, with many Pine and Tuart stumps remaining. All dead trees, stumps, and branches within the site boundary will be mechanically removed, stockpiled and burnt. Burning of dead material will be undertaken in consultation with the DEC and in accordance with City of Busselton burn off guidelines, and occur at an appropriate stage between May and August.

Two remnant Pine trees also exist near the south west border of the site. These will be felled, stumps removed, and wastes disposed of at the City of Busselton landfill site.

#### **5.3.2 Ripping**

Ripping the site will assist with removing any areas of compaction or other obstructions that could prevent root penetration of seedlings. The use of a winged tine will result in a rip line approximately 40 cm deep every second line and a microclimate that will contribute to seedling establishment. Seedlings planted into these rip lines will have some protection from wind and increased water retention due to the slope of the rip line. Ripping will occur twice before any planting activities, once in year one during initial site preparation activities and again prior to planting activities that will commence in year two.

#### **5.3.3 Fencing**

As grazing from rabbits and kangaroos is known to occur at the rehabilitation site, fencing will be installed to prevent their access and thus reduce impacts associated with their presence during the plant establishment period. The fence will be a 10-line Ringlock with 1.8 m steel posts at 8 m intervals, and will include appropriate strainer and bracing to maintain long term integrity of the fence. Galvanised metals (e.g.: Waratah or Cyclone) will be used to maintain fence integrity in the event of a fire, with an indicative example shown in Figure 16. Rabbit proof netting will be installed to prevent their entry to the site. The fence will include two 3.6 m gates located at opposite corners (i.e.: the south west and north east corners) to allow access by emergency response or other management vehicles, and will be padlocked with keys common to those issued by the DEC.



**Figure 16:** Indicative Example of Required Fencing

## 5.4 Revegetation Methodology

Revegetation activities will primarily involve infill planting at the site to restore the required species diversity. If seed is available, it will be used for direct seeding at the conclusion of all weed control activities to prevent non-target death of germinating seedlings. Age diversity of Tuarts will be provided through consideration of those plants already on site, along with the planting of tubestock and direct seeding (if sufficient seed is available). The largely cleared nature of the site means that an area of approximately 30,000 m<sup>2</sup> will need to be planted. The lead time associated with seed collection and plant propagation will mean that planting will not occur until 2014 at the earliest.

### 5.4.1 Revegetation – Tubestock

Revegetation areas will be treated for weeds prior to planting as part the weed control programme (Section 6.0). Plants should be installed as tubestock with a native plant fertiliser tablet, such as Typhoon or similar. In order to create a similar plant density to the adjacent Tuart Forest National Park, Tuart and Peppermint will be planted at a rate of one plant per 10 m<sup>2</sup>, with middle storey species being planted at a rate of one per 10 m<sup>2</sup> and understorey species at a rate of one per 5 m<sup>2</sup>. Minimum planting numbers per species in each zone are provided in Tables 4 and 5. As the location of the site will preclude watering during the establishment period, planting in excess of the final targets will assist with ensuring target completion criteria are achieved.

### 5.4.2 Revegetation – Tuart (*Eucalyptus gomphocephala*)

According to the Tuart Health Research Group (THRG) (2006) survival rates for Tuart seedlings increase if fire is used to create an ash bed that provides a germination medium with sufficient nutrients and a site that is safe from microorganisms, pathogens, and herbivores. However the degraded nature of the rehabilitation site will mean that the amount of waste material that could be burnt and the amount of seed set likely to occur from mature Tuarts would be limited.

For degraded areas, the THRG (2006) indicate that Tuart seedling survival can be maximised through:

- being at least 7 months old before being planted out,
- planted in locations away from established trees to prevent competition for light, water and nutrients,
- planted in May or June at the latest, or as soon as the soil moisture content is 3 – 5 % at a depth of 5 cm, and
- the root ball of the seedling will be buried to at least 2 cm below the soil surface, with soil being firmed down to prevent air pockets, and

- planted with a native fertiliser tablet (i.e.: one 7 g tablet per tubestock, slow release such as Typhoon®) to provide the nutrients needed for establishment.

Note: if a pottiputki planter is being used, then the fertiliser tablet can be installed at the same time as the tubestock.

### 5.4.3 Revegetation – Seed

Seed collection will be undertaken by collectors licensed by the DEC from approved areas. Written permission will be obtained from the relevant land owners or managers from species included on the revegetation list. The seed will be used to propagate the tubestock for the rehabilitation site.

Any seed left over after rehabilitation and the conclusion of weed control works will be direct seeded to provide further variation in the age structure of species present. The seeding will occur at a rate of 2 kg/ha. Seed will be treated according to the type collected, bulked and blended prior to distribution. Seed will be broadcast manually using a hand seeder in locations where tubestock planting has occurred.

## 5.5 Completion Criteria

In order to determine when desired revegetation outcomes have been achieved, it is necessary to formulate completion criteria and monitor those over time. Completion criteria for the rehabilitation of the Tuart Forest offset site two years post planting are as follows:

- a 75% survival rate for the Tuart and the Peppermint species (i.e.: 750 each),
- a 75% survival rate for all other species (i.e.: 11,325 plants), and
- reduction in the affected area and population density of *Zantedeschia aethiopica* (Arum Lily) and *Trachyandra divaricata* (Dune Onion Weed) by more than 80%.

During site visits whilst on ground works are being carried out, informal monitoring of the site will be carried out by the on-ground Project Managers (Natural Area Consulting), and the works contractor to ensure that any issue arising such as plant death or grazing can be attended to in a timely manner.

### 5.5.1 Contingency Measures

In the event monitoring indicates completion criteria have not been achieved, the following will be implemented:

- assessment of potential reasons why seedlings have failed (in consultation with DEC),
- infill planting, and
- further weed and/or pest control if required.

In the event Dieback (*Phytophthora cinnamomi* or some other species) is suspected as being the cause of the decline, discussions with the DEC and DSEWPaC will occur to review and refine the revegetation plan and completion criteria as appropriate.

## 5.6 Monitoring

Monitoring of revegetation activities within the rehabilitation site will occur twice annually in spring and autumn for a minimum of two years after planting, and will consider the survival of the Tuarts and Peppermints, along with the other native species. Monitoring will also include an assessment of

weeds present and signs of pest animal species such as rabbits and kangaroos. Follow up monitoring will also occur 5 and 10 years post construction to assess the level to which the revegetation has contributed to habitat for the Western Ringtail Possum.

Two monitoring methods will be implemented, namely:

- four photo monitoring points will be set up to enable comparison of the area over time, with photos taken from the north west corner towards the south east, and
- five 5 m x 5 m quadrats will be set up within the rehabilitated area placed evenly across the site, these will be traversed on foot with plant survival, vegetation health and community structure noted.

An annual report will be provided to the Department of Finance and Department of Health describing the monitoring outcomes, along with any recommendations on the need for infill planting, weed and/or pest control. This document will also contribute to reporting requirements associated with the Commonwealth environmental approvals process.



## 6.0 Weed Management

The degraded nature of the rehabilitation site and a history of grazing mean that the understorey is largely grassy and broadleaf weeds. A number of weed species were noted and all have the potential to impact on the success of rehabilitation activities if not treated. Of those noted on site, two are of particular concern, namely the Arum Lily (*Zantedeschia aethiopica*), which is listed as a weed of national significance (WONS) and listed as a declared plant under the *Agriculture and Related Resources Protection Act 1976* (WA), and the Dune Onion Weed (*Trachyandra divaricata*). Both species are listed as being of concern in the Environmental Weed Strategy of Western Australia (EWSWA). The Arum Lily and the Dune Onion Weed both occur in pockets across the site with densities ranging from very low to medium (Figures 17 and 18), and will need to be treated along with the grassy and broadleaf weeds that occur in the understorey prior to the planting of tubestock in 2014.

### 6.1 Weed Control

Weed management activities will be implemented as a key component of the overall rehabilitation plan and undertaken by a reputable, licensed bushland weed control operator, with recommended treatments described in Table 6. Three initial treatments carried out by a licensed contractor will occur prior to planting with a further two visits per treatment type the year after planting, and twice yearly follow up visits as required beyond that time.

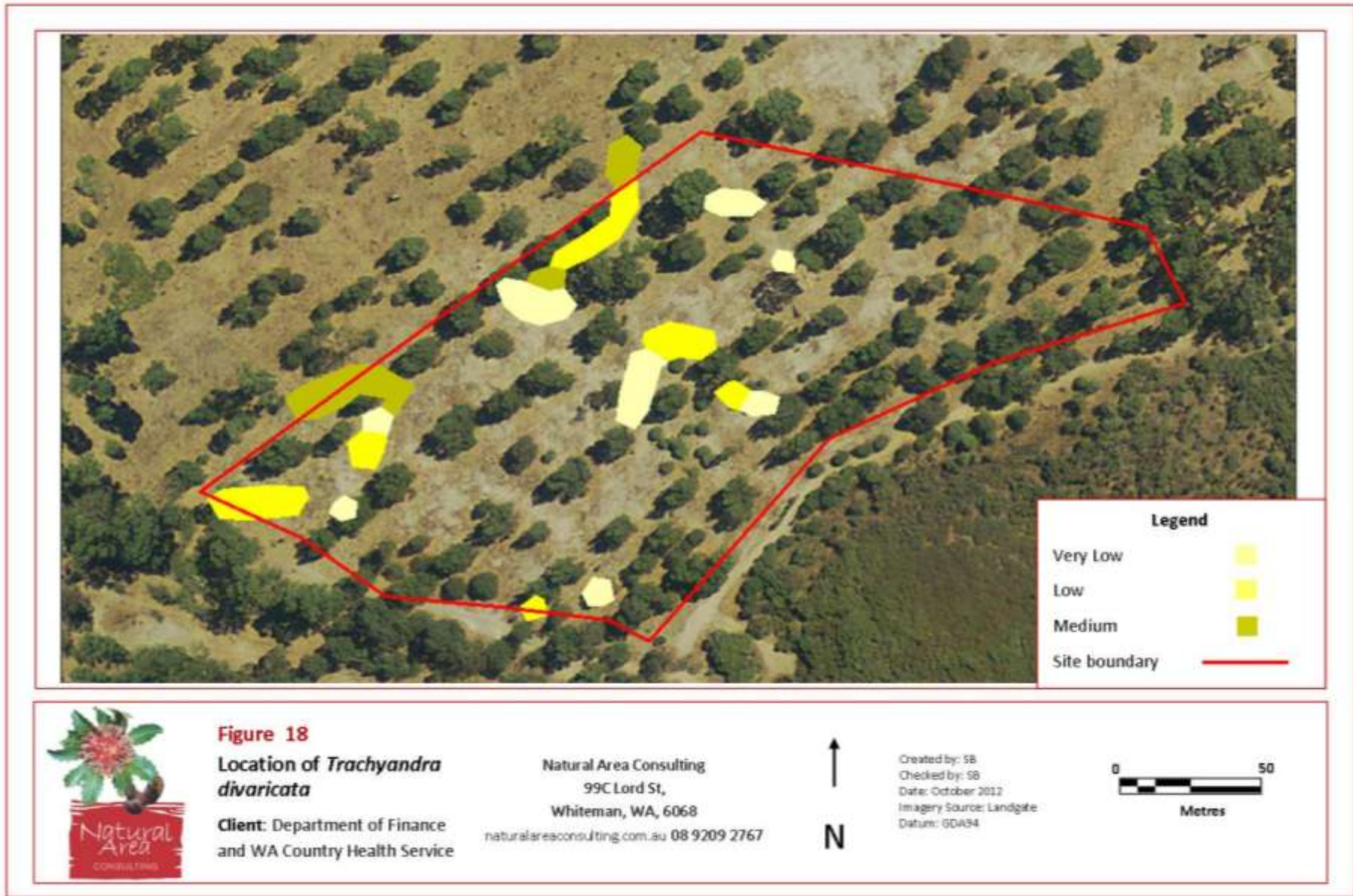
Initial weed control activities for grassy and broadleaf weeds will occur in winter and spring of 2013, and can occur using either a boom spray mounted or a hand spray unit (e.g.: motorised spray unit with hand lines). Further weed treatment will occur at least two weeks before tubestock planting, noting that the Tuart will be planted in May – June at the latest, with a follow up weed control visit in October.

Initial and follow-up spot spraying for both the *Trachyandra* and Arum Lily will occur in July and September each year, ensuring care is taken to avoid any native plants currently on site along with those that will be planted during 2014 and any infill planting in later years. After tubestock planting has occurred, weed spraying will be undertaken using a hand spray unit using treatment methods described in Table 6.

**Table 6:** Weed Control Methodology for Species Identified

Species	Common Name	Treatment	Treatment Timing
General grassy and broadleaf weed understorey		2% glyphosate plus adjuvants	July and October
<i>Trachyandra divaricata</i>	Dune Onion Weed	Spot spraying 20 g/ha chlorsulfuron (750g/kg) plus 10 mL wetting agent	July – September (before flowering)
<i>Zantedeschia aethiopica</i>	Arum Lily	Spot spraying 1 g chlorsulfuron (750 g/kg) plus 10 mL 2,4-D amine (500 g/L) plus 25 mL Pulse® per 10 L of water	July – September (before flowering)





## 7.0 Pest Management

The presence of a number of pest fauna species at the site mean that rehabilitation activities could be compromised if they are left unmanaged. This section describes the species present and their implications for the site.

### 7.1 European Rabbit (*Oryctolagus cuniculus*)

Rabbits are a highly invasive species due to their ability to reach sexual maturity in a short period of time, their short gestation period and ability to cope with environmental variability. The direct and indirect effects of rabbits pose a threat to the ecology of local areas and the viability of rehabilitation activities as they browse on young plants and tubestock due to their high palatability and nutrient content. The grazing activities of rabbits often alter the ecology of plant communities by selecting species that are resistant to regular cropping such as grasses and reducing natural regeneration. Rabbits also have the potential to exacerbate erosion, promote weed growth as well as competing for resources with native fauna. An indirect effect of rabbit populations is to provide an increased food supply to introduced predators which in turn predate native fauna (Pech & Hood, 1998). Rabbit warrens were observed during on site activities, along with secondary signs including evidence of diggings (Figure 19).



**Figure 19:** Indications of Rabbits

#### 7.1.1 Rabbit Control

The location of the site adjacent to the Tuart Forest National Park will mean that the use of 1080 baits can be used for the control of rabbits will not adversely affect any native fauna and is the best option for the area as there should be no domestic animal in or near the site. Two rounds of 1080 baiting by a licensed contractor will occur prior to planting and twice annually after seeding and planting. Baiting will occur within the rehabilitation site, at identified rabbit warrens, and in the nearby area to provide an added buffer that will assist with allowing tubestock to become established. Rabbit warrens will be destroyed (ripped) to prevent reuse.

### 7.2 Fox (*Vulpes vulpes*)

While clearly distinguishable signs of foxes were not apparent, the probability of their presence is high. The use of 1080 baits that target foxes will be used to control any present during rehabilitation works.

## 8.0 Wastes

A small number of locations within the rehabilitation site contain rubbish left behind from previous activities or that dumped by visitors to the site (Figure 20). This material will need to be collected and disposed of at the City of Busselton recycling/waste facility site prior to planting and weed control activities.



**Figure 20:** Rubbish within Rehabilitation Area Boundary

Tree stumps and other dead plant matter will remain on site and allowed to decay naturally (Figure 21). Larger tree trunks and branches will be cut up into approximately 1.5 m lengths to provide habitat for a range of fauna species. Standing trees will also remain and allowed to produce hollows over time that could potentially be used by Black Cockatoo species.



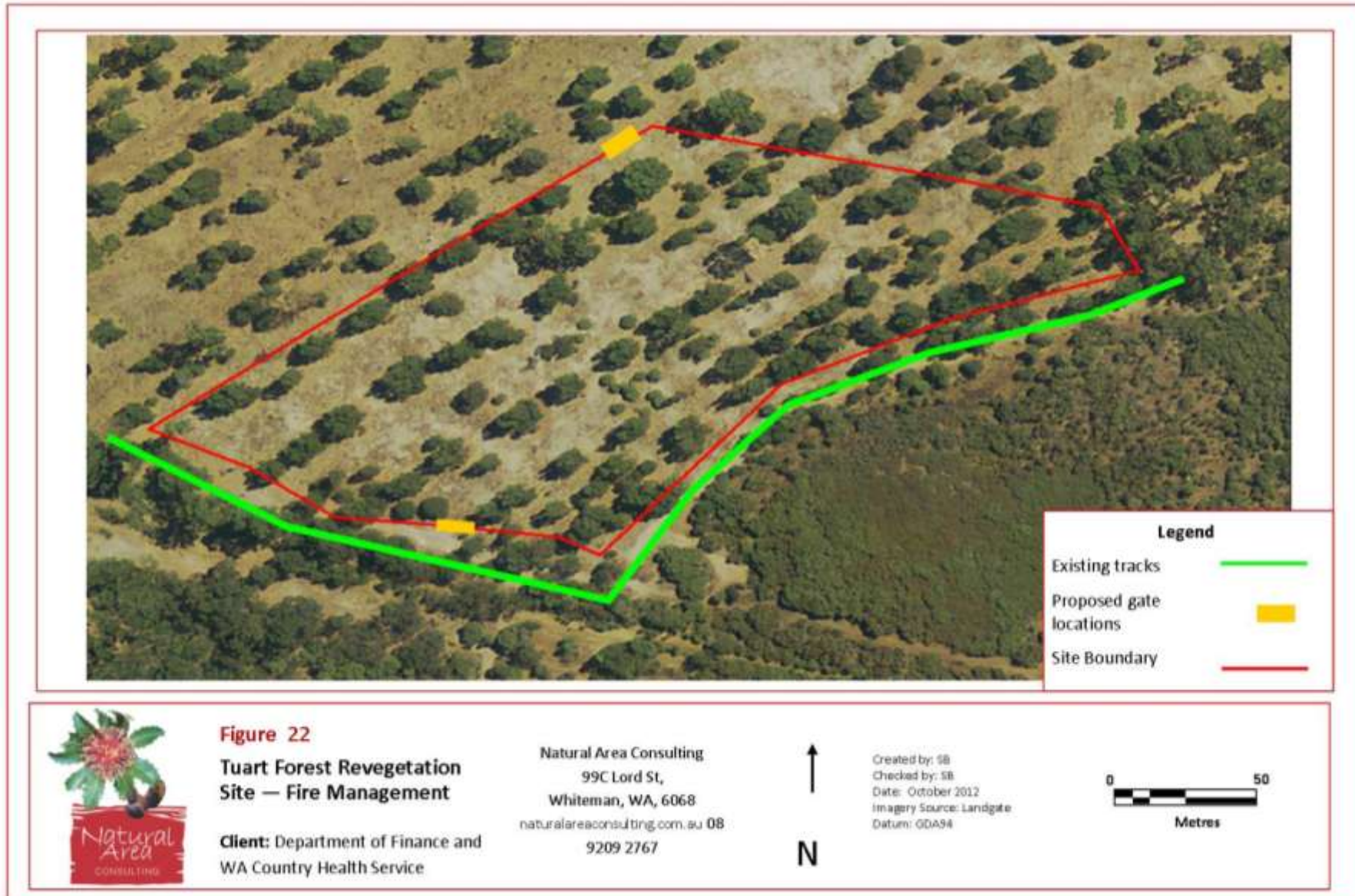
**Figure 21:** Dead Plant Matter

## 9.0 Fire Management

While fire is a natural part of the Western Australian landscape generally and the Tuart Forest, it has the potential to result in detrimental outcomes to rehabilitation works during the first few years after planting occurs. The degraded nature of the site means that fire is unlikely during this time period, however the risk will increase as the plants mature and ground and canopy cover increases.

In the short term, for the duration of this management plan, fire management will include:

- the preparation and implementation of a separate, site specific fire management plan,
- continue using existing fire tracks and access ways to the north east and north west just outside the boundary of the rehabilitation site as fire breaks,
- the clearing associated with the degraded area immediately adjacent to the remaining two sides mean that formal firebreaks are not warranted,
- some clearing of old tree stumps may be required in the vicinity of the remaining two sides to ensure adequate vehicle access is available when required,
- install gates that are a minimum of 3.6 m wide to allow emergency access to the site, with approximate locations shown on Figure 22, and
- fire response will occur from DFES in Busselton and/or the DEC fire responders.





## 10.0 Implementation Timeframe and Responsibilities

Initial on-ground works including rubbish removal, weed control, fencing and planting activities will occur during 2013 - 2014, with other associated activities such as infill planting and monitoring occurring in 2014 – 2015 and 2015 – 2016 and the two years following (Tables 7 and 8).

It should be noted that the photo monitoring points and quadrats to enable an assessment of the degree of rehabilitation success over time will be established prior to the commencement of on ground activities. Monitoring will continue to occur for two years post-construction to confirm the project has achieved its completion criteria and in accordance with approved management plan(s),

**Table 7:** Implementation Schedule for Preliminary and Other Works 2013 - 2014

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Tree and stump removal												
Burning of dead trees												
General weed spray												
Arum Lily spray												
Dune Onion Weed spray												
Rubbish removal												
Fence installation												
Rabbit control												
Fox control												
Planting												

Note: April general weed treatment refers to spraying a minimum of two weeks before planting

**Table 8:** Maintenance and Monitoring Schedule 2014 – 2015 and 2015 - 2016

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
General weed spray												
Arum Lily spray												
Dune Onion Weed spray												
Rubbish removal	As required											
Fence maintenance	As required											
Rabbit control												
Fox control												
Monitoring												
Infill planting												

## 10.1 Roles and Responsibilities

The roles and responsibilities of contractors and staff involved in the Tuart Forest Rehabilitation site are provided in Table 9. When selected, works carried out by the on ground contractor will be project managed by Natural Area Consulting.

**Table 9:** Roles and responsibilities

Stakeholder	Responsibility
WA Country Health Service	Ensure rehabilitation activities are carried out in accordance with environmental approvals, endorsed management plans, and contracts; ongoing maintenance and maintenance for a period of three years post planting until management reverts to the DEC
Natural Area Consulting	Manage revegetation, weed, pest and erosion control works in accordance with environmental approvals, management plans and contracts
Department of Environment and Conservation	Ongoing management of the rehabilitation site at the conclusion of on ground planting and monitoring activities, maintenance of tracks/fire access ways outside the boundaries of the rehabilitation site
On ground Environmental Contractor	Undertake on ground revegetation works in accordance with endorsed management plan(s)

## 11.0 References

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*Wildlife Conservation Act 1950 (WA)*

## Appendix 1 Bushland Condition Scale

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

(Source: Government of Western Australia, 2000)