# Woolgoolga to Ballina Threatened Flora Translocation Project (Sections 3-11)

# Annual Monitoring Report – Year 1


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# Contents

# Executive Summary

This Year-1 annual monitoring report documents the implementation and results of threatened flora translocations conducted for the Woolgoolga to Ballina (W2B) upgrade of the Pacific Highway, Sections 3-11, between August 2016 and June 2017. General procedures, guidelines and performance targets for the translocation project were set out in RMS (2015). Sixteen threatened plant species and two species of vine that support threatened species of butterfly or moth are being translocated, as follows:-

Threatened Species

- Yellow-flowered King of the Fairies (*Oberonia complanata*)
- Slender Screw Fern (*Lindsaea incisa*)
- Singleton Mint Bush (*Prostanthera cineolifera*)
- Weeping Paperbark (*Melaleuca irbyana*)
- Tall Knotweed (*Persicaria elatior*)
- Four-tailed Grevillea (*Grevillea quadricauda*)
- Stinking Cryptocarya (*Cryptocarya foetida*)
- Rusty Green-leaved Rose Walnut (*Endiandra muelleri ssp. bracteata*)
- Red Lilly Pilly (*Syzygium hodgkinsoniae*)
- White Laceflower (*Archidendron hendersonii*)
- Rough-shelled Bush Nut (*Macadamia tetraphylla*)
- Hairy Joint Grass (*Arthraxon hispidus*)
- Square-fruited Ironbark (*Eucalyptus tetrapleura*)
- Hairy Melichrus (*Melichrus hirsutus*)
- Lindernia (*Lindernia alsinoides*)
- Rotala (*Rotala tripartita*)

Species Associated with Threatened Insects

- Richmond Bird Wing Vine (*Aristolochia pravevenosa*)
- Pink Underwing Moth Vine (*Carronia multisepala*)

Threatened species were translocated to eleven (11) receival sites using a combination of salvage transplanting and introduction of plants propagated from locally collected seed or cuttings. A technique using the soil seedbank to propagate plants was trialled for the first time for three species – Singleton Mint Bush, Four-tailed Grevillea and Tall Knotweed.

Year 1 of the translocation project was successful for 13 of the 15 threatened species translocated, meeting project aims and objectives, and achieving translocation targets. Results fell short for two species – *Cryptocarya foetida* and *Lindernia alsinoides*. The survival rate of *C. foetida* transplants was low, although propagation was more successful. Poor transplanting results were attributed to unsuitable soil type at the receival site and the extreme heat event in Feb/17. The Lindernia translocation also had poor results due to construction related changes in hydrology and water quality at the receival site. Corrective actions are proposed for both these species as well as more input to rainforest restoration at the BOS22 rainforest receival site at Lumley's Lane, Wardell.

# 1.0 INTRODUCTION

This report documents the implementation and results of threatened flora translocations conducted for the Woolgoolga to Ballina (W2B) upgrade Sections 3-11, a 110 km section of the Pacific Highway upgrade on the NSW North Coast. The translocations were carried out by Ecos Environmental for Pacific Complete, the management alliance for the W2B project. Implementation of the threatened species translocations was based on RMS (2015) - *Flora Translocation Strategy Pacific Highway Upgrade Sections 3-11 excluding Early Works Soft Soil Treatment Areas Woolgoolga to Ballina - Version 2 November 2015* (the 'Translocation Strategy').

Sixteen threatened plant species and two species of vine that support threatened species of butterfly and moth are being translocated on W2B Sections 3 to 10:-

Threatened Species

- Yellow-flowered King of the Fairies (*Oberonia complanata*)
- Slender Screw Fern (*Lindsaea incisa*)
- Singleton Mint Bush (*Prostanthera cineolifera*)
- Weeping Paperbark (*Melaleuca irbyana*)
- Tall Knotweed (*Persicaria elatior*)
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Species Associated with Threatened Insects

- Richmond Bird Wing Vine (*Aristolochia pravevenosa*)
- Pink Underwing Moth Vine (*Carronia multisepala*)

This is the first annual monitoring report and describes the implementation and results of the W2B Threatened Flora Translocation project (Sections 3-11) from August 2016 to June 2017. Section 2 presents an overview of translocation methods. More detail may be found in the sections on each species and in the Translocation Strategy. Section 3 describes the implementation and results of the translocation program on a species by species basis. Section 4 assesses the outcomes of Year 1 of the translocation project in terms of performance criteria and thresholds specified in the Translocation Strategy. Finally, Section 5 identifies any corrective measures considered necessary to achieve the translocation projects aims and objectives. An extensive photo record documents the progress of the translocation project.

# 2.0 METHODS

## 2.1 Aims and Objectives

The aims of the translocation project as defined by the Translocation Strategy include:

- Create self-sustaining populations.
- Maintain or enhance existing demographic function and genetic variability
- Generate increased knowledge of the threatened plant species.
- Achieve no net loss in local plant populations being impacted by the project.
- Make the best possible use of all plant material with potential conservation

- Value.

Objectives addressing the above aims include:

- Plants improve in condition so that flowering fruiting and regeneration is successful.
- Relevant project results and observations documented.
- Original number of individuals re-established.
- Available cutting material and seed harvested, and plants transplanted to the best extent practical.
- Create or augment small sub-populations with diffuse connectivity to metapopulations conserving existing genetic variability.
- Maintain or create a self-sustaining population (or augment an existing patch).

## 2.2 Target Species and Numbers of Individuals

The Translocation Strategy identifies twelve threatened species for translocation. Three additional threatened plant species (unexpected finds) were found during pre-clearing surveys and these were included in the translocation program (Table 1). Two species of vine that support threatened insect species are also being translocated (Table 1). As the key aim of the translocation project is 'no net loss', or maintenance of populations at levels recorded before the start of construction, the target number of individuals to be translocated is the number of individuals impacted by clearing (RMS 2015).

**Table 1:** Threatened species translocated for the W2B project on Sections 3-11 and the target number of 'individuals' to be translocated as specified in the Translocation Strategy, plus unexpected finds and species associated with threatened insects.

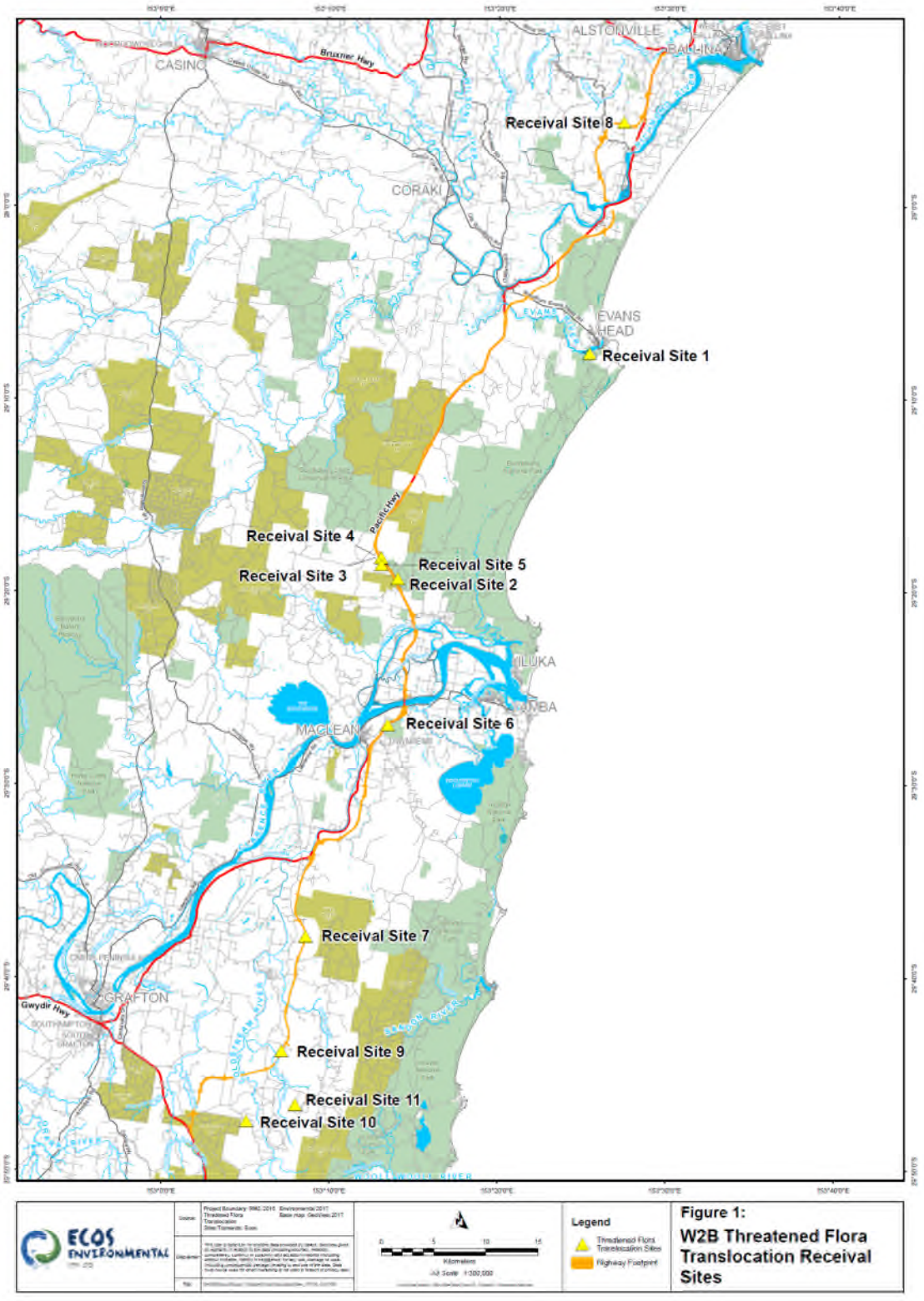
| **Species** | **Translocation Target** |
|---|---|
| Threatened Species - Translocation Strategy | |
| Yellow-flowered King of the Fairies (*Oberonia complanata*) | 18 |
| Slender Screw Fern (*Lindsaea incisa*) | 6295 (0.370ha) |
| Singleton Mint Bush (*Prostanthera cineolifera*) | 609 (0.424) |
| Weeping Paperbark (*Melaleuca irbyana*) | 1721 (2.761 ha) |
| Tall Knotweed (*Persicaria elatior*) | 20 |
| Four-tailed Grevillea (*Grevillea quadricauda*) | 3 |
| Stinking Cryptocarya (*Cryptocarya foetida*) | 41 |
| Rusty Green-leaved Rose Walnut (*Endiandra muelleri ssp. bracteata*) | 3 |
| Red Lilly Pilly (*Syzygium hodgkinsoniae*) | 6 |
| White Laceflower (*Archidendron hendersonii*) | 1 |
| Rough-shelled Bush Nut (*Macadamia tetraphylla*) | 10 |
| Hairy Joint Grass (*Arthraxon hispidus*) | 348 (1.3ha) |
| Threatened Species - Unexpected Finds | |
| Square-fruited Ironbark (*Eucalyptus tetrapleura*) | 5 |
| Hairy Melichrus (*Melichrus hirsutus*) | 1 |
| Lindernia (*Lindernia alsinoides*) | 5 |
| Rotala (*Rotala tripartita*) | 50 |
| Species Associated with Threatened Insects | |
| Richmond Bird Wing Vine (Aristolochia pravevenosa) | 3 |
| Pink Underwing Moth Vine (*Carronia multisepala*) | 5 |

## 2.3 Receival Sites

Translocation receival sites for each species are described and mapped in the Translocation Strategy. There is some provision for flexibility in the final selection of sites as two or more alternative sites are described for several species. Prior to translocation work commencing, inspections of the receival sites were conducted to assess the suitability of terrain, soil type, exposure and other environmental and logistical factors likely to affect species survival and establishment during translocation. The latter assessment was detailed in Ecos Environmental (2016) "W2B Flora Translocation Project - Site Selection and Validation Report". Eleven translocation receival sites were subsequently finalised for the 16 threatened species and two vines as shown on Fig. 1.

**Table 2:** Translocation receival sites used for each species.

| **Species** | **Location of Receival Sites** |
|---|---|
| Yellow-flowered King of the Fairies (*Oberonia complanata*) | Site 1- Bundjalung National Park – same general area as Strategy, but less exposed site and different host trees. |
| Slender Screw Fern (*Lindsaea incisa*) | Site 2 - Bundjalung National Park – as per Strategy |
| Singleton Mint Bush (*Prostanthera cineolifera*) | Site 3 - RMS property at Tabbimoble Ck as per Strategy |
| Weeping Paperbark (*Melaleuca irbyana*) | Site 4 - RMS property at Tabbimoble Ck.<br>Site 5 - RMS offset property to the south of Tabbimoble Ck. |
| Tall Knotweed (*Persicaria elatior*) | Site 6 - Yaegl Nature Reserve – receival site shifted to more open location further north in the Reserve |
| Four-tailed Grevillea (*Grevillea quadricauda*) | Site 7 - Within project boundary as per Strategy |
| Stinking Cryptocarya (*Cryptocarya foetida*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |
| Rusty Green-leaved Rose Walnut (*Endiandra muelleri ssp. bracteata*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |
| Red Lilly Pilly (*Syzygium hodgkinsoniae*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |
| White Laceflower (*Archidendron hendersonii*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |
| Rough-shelled Bush Nut (*Macadamia tetraphylla*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |
| Hairy Joint Grass - Section 10 (*Arthraxon hispidus*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |
| Hairy Joint Grass - Mitchell Rd Section 3 (*Arthraxon hispidus*) | Site 9 - Within road reserve at Mitchells Rd (site in Strategy at Kangaroo Rd Corindi too far away) |
| Species Additional to Translocation Strategy | |
| Square-fruited Ironbark (*Eucalyptus tetrapleura*) | Site 10 - Offset land, Sunnyside Rd |
| Weeping Paperbark (*Melaleuca irbyana*) Transplant | Site 10 Offset land, Sunnyside Rd |
| Hairy Melichrus (*Melichrus hirsutus*) | Site 11 - Offset land, Pillar Valley |
| Lindernia (*Lindernia alsinoides*) | Site 9 - Within road reserve at Mitchells Rd |
| Richmond Bird Wing Vine (*Aristolochia pravevenosa*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |
| Carronia (*Carronia multisepala*) | Site 8 - Lumley's Lane Wardell, BOS22 - RMS property preferred to private property sites in Strategy |


ALSTONVILLE
CASINO
Bruxner Hwy
Receival Site 8
CORAKI
EVANS HEAD
Receival Site 1
Pacific Hwy
Receival Site 4
Receival Site 5
Receival Site 3
Receival Site 2
ILUKA
MACLEAN
Receival Site 6
Receival Site 7
GRAFTON
Gwydir Hwy
Receival Site 9
Receival Site 11
Receival Site 10
ECOS ENVIRONMENTAL
Legend
Threatened Flora Translocation Sites
Highway Footprint
Figure 1:
W2B Threatened Flora Translocation Receival Sites

## 2.4 Translocation Methods

General translocation methods were based on the Translocation Strategy (RMS 2015) and involved either salvage transplanting from the construction footprint and/or propagation of species from locally collected seed or cuttings (Table 3).

Salvage transplanting was limited to smaller plants up to sapling size able to be transplanted manually. Larger individuals were replaced with propagated plants. Transplanting can ensure that locally adapted genotypes are preserved, but propagation may be a more cost-effective where large numbers of individuals are impacted, as in the case of Weeping Paperbark and Singleton Mint Bush, or transplanting with heavy machinery is logistically complex. Seed propagation was generally preferred over cutting propagation as previous projects found that cutting propagation of most rainforest species had a low strike rate and the plants often had weak root systems and lacked vigour (Ecos Environmental 2011a). Cutting propagation was attempted only if a seed source was not available. Translocations of the fern *Lindsaea incisa* and the orchid *Oberonia complanata*) were limited to transplanting, as propagation from spore or seed would have required specialised methods and transplanting of these species had previously had good results (Ecos Environmental 2016 and 2011b).

A new method of propagation using the soil seedbank was used with Singleton Mint Bush, Four-tailed Grevillea and Tall Knotweed. Topsoil was collected from beneath mature plants on the assumption it would contain dormant seed. For the first two species, the soil was placed on sheets of tin then dry leaf was spread on top and burnt to remove germination inhibitors. The treated soil was placed into trays and the seedbank germinated in a nursery (further details below). This proved to be an effective means of propagation, particularly as seed and cuttings were either difficult to propagate, of poor quality or unavailable at the time. Using the same approach, but without fire, mud was collected under old Tall Knotweed plants and spread in plots at the receival site.

**Table 3:** Method of translocation applied to impacted threatened species involving either salvage transplanting and/or propagation from seed or cuttings.

| Species | Transplant | Propagate | Comment |
|---|---|---|---|
| Yellow-flowered King of the Fairies (*Oberonia complanata*) | + | - | Transplanted |
| Slender Screw Fern (*Lindsaea incisa*) | + | - | Transplanted |
| Singleton Mint Bush (*Prostanthera cineolifera*) | - | + | Propagated from seed in soil seedbank |
| Weeping Paperbark (*Melaleuca irbyana*) | - | + | Propagated from seed |
| Tall Knotweed (*Persicaria elatior*) | + | + | Transplanted and propagated from soil seedbank |
| Four-tailed Grevillea (*Grevillea quadricauda*) | + | + | Transplanted and propagated from soil seedbank |
| Stinking Cryptocarya (*Cryptocarya foetida*) | + | + | Transplanted and propagated from seed |
| Rusty Rose Green Walnut (*Endiandra muelleri ssp. bracteata*) | + | + | Transplanted and propagated from seed |
| Red Lilly Pilly (*Syzygium hodgkinsoniae*) | + | + | Transplanted and propagated from seed |
| White Laceflower (*Archidendron hendersonii*) | + | + | Transplanted and propagated from seed |
| Rough-shelled Bush Nut (*Macadamia tetraphylla*) | - | + | Propagated from seed |
| Hairy Joint Grass - Section 10 (*Arthraxon hispidus*) | + | - | Transplanted |
| Hairy Joint Grass - Mitchell Rd Sect 3 (*Arthraxon hispidus*) | + | - | Transplanted |

| Species | Transplant | Propagate | Comment |
|---|---|---|---|
| Additional Species | | | |
| Square-fruited Ironbark (*Eucalyptus tetrapleura*) | + | - | Transplanted |
| Hairy Melichrus (*Melichrus hirsutus*) | + | - | Transplanted |
| Lindernia (*Lindernia alsinoides*) | + | - | Transplanted |
| Richmond Bird Wing Vine (*Aristolochia pravevenosa*) | - | + | Propagated from cuttings |
| Carronia (*Carronia multisepala*) | - | + | Propagated from cuttings |

### 2.5 Monitoring

Monitoring was conducted every 3-months in Year 1. As different species and different tranches of the same species were translocated at different times, time since the start of translocation at the end of Year 1 varied from 12 to 6 months (see Table 4).

Data fields recorded at each monitoring event included ID No. of individual plant/plot, date, number of individuals/crown-cover, evidence of disease or grazing, new shoot growth, flowering, seedling, recruitment and physical site conditions (e.g. soil moisture, recent rainfall, water depth when flooded) and overall plant condition. Condition was recorded on a scale of 0 to 5 where '0' is dead and '5' is reproductively mature.

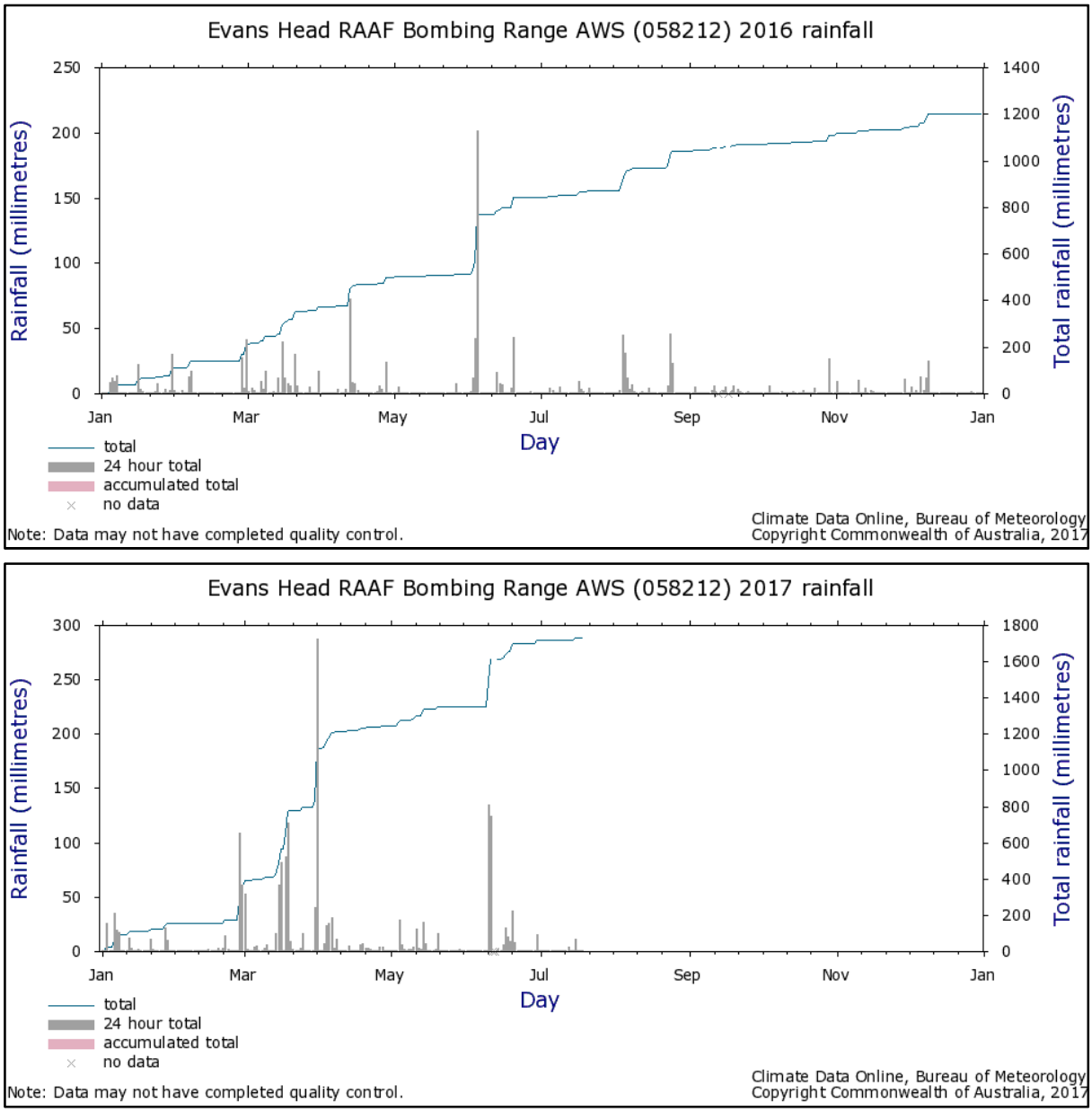
### 2.6 Data Entry and Storage

Monitoring results were entered in an Excel spreadsheet after each monitoring event. See the file titled "W2B Translocation Monitoring – 12 month_ 20170718" appended to this report.

## 3.0 TRANSLOCATION IMPLEMENTATION AND RESULTS

### 3.1 Weather Conditions

The first year of the translocation project coincided with stressful soil moisture conditions during a long, hot dry season that ended abruptly at the end of February with heavy rain and flash flooding. Between September 2016 and February 2017 rainfall was well below average (see Fig 2). Temperatures were also above average and the hot, dry conditions necessitated additional watering of the receival sites. Most of the Far North Coast region recorded the highest maximum daily temperature on record on 11/2/2017 (mid to high 40s). This extreme temperature event resulted in leaf damage, wilting and some mortality amongst the transplants. A few weeks later at the end of February the rainy season started and low lying sites were hit by flash flooding. Between 27/2/17 and 31/3/2017, 800-1000 mm of rain fell from Ballina to Maclean causing flash floods and prolonged flooding of receival sites located on the coastal floodplain. Four spikes of rainfall in 2017 can be seen in Figure 2, corresponding with flash flooding events at the receival sites. Rainfall for March was more than three times the average for this month. Wet conditions persisted to the end of June 2017.



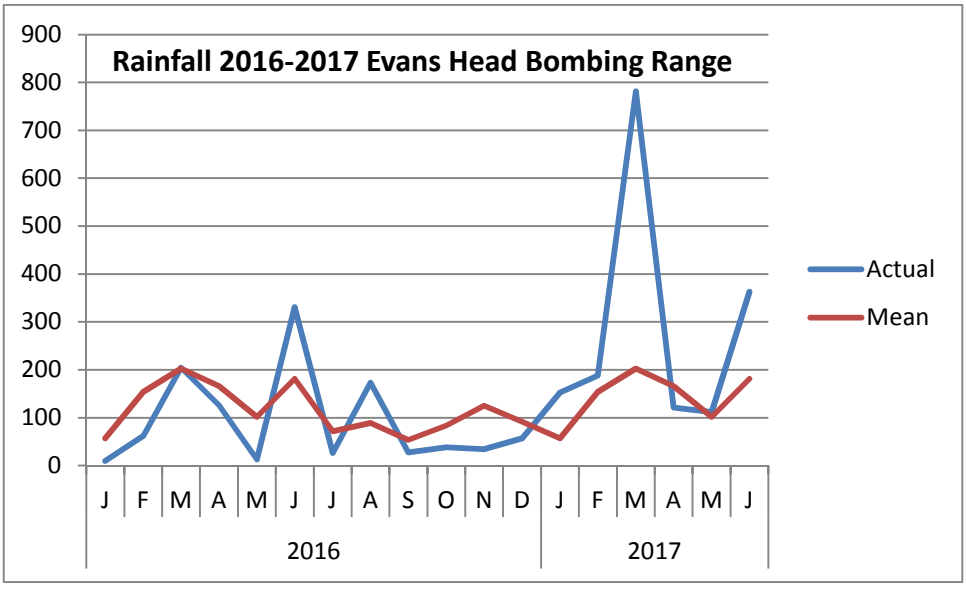




**Fig 2:** Daily and monthly rainfall in 2016-2017 recorded at Evans Head representative of W2B.

**Table 4: W2B SECTIONS 3-11, THREATENED FLORA TRANSLOCATIONS - 12-MONTH MONITORING RESULTS**

| **Species** | **Start Date (time since start of translocation)** | **No. of Plants Translocated (transplanted/propagated)** | **Percent Survival to July/2017** | **Propagation** | **Comment** |
|---|---|---|---|---|---|
| Yellow-flowered King of the Fairies (*Oberonia complanata*) | Transplanted Aug/2016 (~12 months) | Transplanted - 11 | 91% (10/11) | No propagation. | Transplanted individuals flowered & produced seed pods during Year 1. |
| Slender Screw Fern (*Lindsaea incisa*) | Transplanted Sept (most), Nov, Dec 2016 (~11 months) | Transplanted:<br>Line A – 25 trays/plots<br>Line B – 44 trays/plots<br>Line C – 15 trays/plots<br>Line D – 18 trays/plots<br>5 patches (5 trays/plots ea.)<br>Total trays=127 trays<br>Total plants/fronds=~6530 | Line A – 100%<br>Line B – 100%<br>Line C – 100%<br>Line D – 100%<br>patches – 100% | No propagation | Survival 100% in terms of 10+ *L.incisa* fronds in most plots, but number difficult to assess end of year as most stems flattened by flash flooding. |
| Singleton Mint Bush (*Prostanthera cineolifera*) | Soil seedbank collected Aug/2016 ( ~12 months) | Propagated (soil seedbank)<br>No.planted (at same site)<br>1. 700 tubestock<br>2. 300 tubestock<br>3. 200 tubestock | 1.~40%<br>2.- 50%<br>3 – recently planted | Propagated from the soil seedbank.<br>(Note - cuttings were also propagated during early works in 2016 and are intended for introduction) | Approximately 650 tubestock alive in translocation area in July 2017 |
| Weeping Paperbark (*Melaleuca irbyana*) | Seed collected Aug/2016 ( ~12 months) | Propagated (seed)<br>No.planted (different sites)<br>1. 700 tubestock<br>2. 500 tubestock<br>3. 500 tubestock | 1. ~80%<br>2. ~80%<br>3 – recently planted | Propagated from seed | One individual transplanted on Sec. 3 |
| Tall Knotweed (*Persicaria elatior*) – salvage transplanting trialled at different stages of life cycle (1) – (3) | | | | | |
| Tall Knotweed (1) old plants and soil seedbank | Old plants transplanted &soil seedbank collected Aug/Sept 2016 (~12 months) | Transplants – 7<br>Soil seedbank (SSB) applied to 27 plots. | transplants – 0%<br>% of SSB plots with surviving recruits:<br>Oct/16 51.9%,<br>Jan/17 - 29.6%, | No propagation | Translocation of soil seedbank resulted in recruitment in approx. half the plots and growth to maturity in approx.. quarter |

| **Species** | **Start Date (time since start of translocation)** | **No. of Plants Translocated (transplanted/propagated)** | **Percent Survival to July/2017** | **Propagation** | **Comment** |
|---|---|---|---|---|---|
| | | | April/17 - 22..2%<br>June/17 – 0% | | of plots. |
| Tall Knotweed (2)<br>transplant young plants (0.5-0.7m) | Young plants transplanted Nov/2016<br>(~9 months) | 27 clumps/48 plants | April/17 - 66.7%<br>June/17 – 11.1% | No propagation | A few large plants still alive in June/17 growing as floating aquatic plants. To be expected as this species is primarily an annual. Seed produced. |
| Tall Knotweed (3)<br>field seedlings grown-on in nursery as tubestock then introduced | Field seedlings collected Nov/16, introduced Feb/17<br>(~6 months) | 15 plots with 20 tubestock per plot (=300 plants) | % of plots with 3 or more plants:<br>April/17 – 100%<br>June/17 – 86.6% | Salvage-propagation - seedlings salvaged from donor site and grown in nursery (avoiding drought) before planting out. | 86.6% of plots with at least some plants; 46.7% of plots already with seedling recruitment from the introduced tubestock. |
| Four-tailed Grevillea (*Grevillea quadricauda*) | Transplanted&soil seedbank collected Aug/Sept<br>(~12 months) | Smaller plants transplanted to 12 inch pots and grown in nursery for ~6 months.<br>15 plants introduced to receival site in March/17. | 85% survived transplanting to pots;<br>100% survived since planting out | Also propagated from the soil seedbank – not planted out yet. | All potted transplants have survived since planting out. Condition very good, all individuals in flower or with flower buds in June/17 |
| Stinking Cryptocarya (*Cryptocarya foetida*) | Transplanted&seed collected Aug/Sept<br>(~12 months) | Transplanted – 24 saplings | Jan/17 - 62.5%<br>Mar/17 - 26.9%<br>June/17 – 26.9% | ~30 propagated from seed.; currently being grown on in pots | Transplant reshooting rate reasonable but regrowth not vigorous; high mortality during Feb extreme heat event. |
| Rusty Rose Green Walnut (*Endiandra muelleri ssp. bracteata*) | Transplanted&seed collected Aug/Sept<br>(~12 months) | Transplanted – 3 saplings;<br>3 seedlings to pots | Jan/17 - 66.6%<br>Mar/17 - 66.6%<br>June/17 – 66.6% | ~15 propagated from seed; currently being grown on in pots | |
| Red Lilly Pilly (*Syzygium hodgkinsoniae*) | Transplanted&seed collected Aug/Sept<br>(~12 months) | Transplanted - 4 juveniles to pots | 100% survival in pots | ~50 propagated from seed.; currently being grown on in pots | 11 planted out at rainforest species receival site in June |
| White Laceflower | Transplanted&seed | Transplanted – 1 sapling; | transplant 100% | ~4 propagated from seed.; | |

| **Species** | **Start Date (time since start of translocation)** | **No. of Plants Translocated (transplanted/propagated)** | **Percent Survival to July/2017** | **Propagation** | **Comment** |
|---|---|---|---|---|---|
| (*Archidendron hendersonii*) | collected Aug/Sept (~12 months) | 4 seedlings to pots | (1/1) pots – 100% | currently being grown on in pots | |
| Rough-shelled Bush Nut (*Macadamia tetraphylla*) | Seed collected Jan – Feb/2017 (~6 months) | under propagation | | ~30 seed collected from about 15 trees in local rainforest, germination slow | |
| Square-fruited Ironbark (*Eucalyptus tetrapleura*) | Transplanted Oct/2016 ~6 months | Transplanted - 8 | 75% | | Some probably not E. tetrapleura |
| Hairy Melichrus (*Melichrus hirsutus*) | Transplanted Oct/2016 (~9 months) | Transplanted - 2 | 100% | | One plant was split into two during transplanting |
| Hairy Joint Grass (*Arthraxon hispidus*) Mitchell Rd Section 3 | Placed in trays Sept/2016 plant out – Dec/2016 (~12 months) | Transplanted – 20 trays (~1000 plants) | 100% | nil | Plants seeded and died off in April |
| Hairy Joint Grass (*Arthraxon hispidus*) Section 10 | Transplanted Nov/2016 (~9 months) | Transplanted - 43 trays (~2150 plants) | 100% | nil | Plants seeded died off in May (later than Mitchell Rd) |
| Lindernia (*Lindernia alsinoides*) | Transplanted Dec/2016 (~6 months) | Transplanted - 5 patches | Aprii/17 – 50% June/17 – 0% | | Site flooded, Thick iron precipitate in run-off from earthworks. |
| Richmond Bird Wing Vine (*Aristolochia pravevenosa*) | Cuttings collected Oct, Nov/2016 (~9 months) | Propagated 10 in pots | 100% | Propagated from cuttings | Still in pots; new receival site to be considered at Randles Creek |
| Pink Underwing Moth Vine (*Carronia multisepala*) | Cuttings collected in June/2017 | under propagation | | | |

## 3.2 Slender Screw Fern (*Lindsaea incisa*)

### 3.2.1 Target Number

6295 (0.370ha). 'Number' here refers to a count or estimate of the number of fern fronds rather than individual plants. *L. incisa* fronds grow from network of thin rhizomes or stolons so cannot be counted as discrete individuals. Area in brackets (3700 m2) refers to the area covered by the fern plants at the time of survey (2014).

The distribution shown in the Translocation Strategy (Fig A5.14, Mororo SF, p. 97) is similar to that recorded by Ecos Environmental (2007), indicating little change in the population in 10 years. The Translocation Strategy is conflicting as it states that very few plants were recorded in March 2014 (wet season) by Jacobs, but the Aeon survey of the same year recorded 0.370 ha in 12 discrete sub-populations (p. 69). However, *L. incisa* populations generally do not fluctuate greatly in number within one year, except perhaps during an extreme drought or fire. In Sept/2017 when the translocation was carried out, the population appeared to have contracted substantiallyi since 2007. Plants were found in two linear bands along the Road Reserve fence line north of the highway rest area, north and south of a wet swale, plus a few small outliers. The cause of population contraction since 2007 may have been increased competition and shading or moisture stress during dry intervals. The coordinates of the donor population recorded during translocation can be found in the Excel spreadsheet appended to this report – see the "Lindsaea donor" tab.

### 3.2.2 Number Translocated

127 trays or ~6350 fronds based on an estimate of 50 fern fronds per tray on average (50 x 127 = 6350).

### 3.2.3 Translocation Method

Sods containing fern fronds and rhizomes were dug out to a depth of 6-8cm and placed in 40cm square trays, watered and transported to the receival site in Bundjalung National Park. The trays of fern were planted in plots with the plots laid out in lines roughly parallel with the contour, although the site was on the bottom of a shallow, flat-bottomed valley and the slope hardly perceptible (a degree or two or less). The plots were about 2 metres apart and each plot received one tray of *L.incisa* (Plate 9). In addition, 5 larger patches were planted with 5 trays/patch. The overall planting layout was as follows:
Lines A-D:
Line A – 25 trays/plots
Line B – 44 trays/plots
Line C – 15 trays/plots
Line D – 18 trays/plots
Patches 1– 5 (5 trays/patch)

Total trays/plots = 127. Total number of fronds based on an av. of ~50 per tray = 6350

The plots were watered regularly to keep the soil moist; no fertilisers were applied. The plastic trays have an open grid base and were inverted over the plots to protect the fern plants from animal disturbance and to define the plots for monitoring. They also proved useful in catching leaf fall during the dry season and preventing the fern from being smothered by a build-up of leaf litter. Additional watering was necessary about every month to the end of February to prevent wilting during hot dry weather and maintain healthy condition.

### 3.2.4 Survival

The survival rate, defined as the number of plots with 10+ *L. incisa* stems, was 98% at the end of Year 1. However, the number fronds per plot had decreased during the rainy season due to repeated disturbance of fern regrowth by flash floods. Most fronds had been flattened by flash flooding so crown-cover as recorded earlier was difficult to measure again. Overall, the number of fronds per plot

was estimated to be 25-50% less than before the onset of the wet season. Some fern regrowth was evident in all plots after flash floods, including after the last one in June, the fourth for the season.

## 3.3 Yellow-flowered King of the Fairies (*Oberonia complanata*)

### 3.3.1 Target Number

Eighteen (18). This is the number in the Translocation Strategy which must refer to the number of plants within the clearing footprint. All these plants were apparently translocated during early works (see Excel spreadsheet, 'Oberonia donor' tab). Information on the outcome of the latter translocation was not available. Eleven plants remained on an old dead *Casuarina glauca* on the edge of clearing and the decision was made to translocate these plants given the increased exposure of the site (Plate 15) and state of decay of the dead Casuarina host tree.

### 3.3.2 Number Translocated

The eleven plants were translocated to a receival site in Bundjalung National Park, near the Gumma Garra picnic area, Evans Head. This is the same general area described in the Translocation Strategy but in a slightly different location and on a different host tree species.

### 3.3.3 Translocation Method

Rather than prising the orchid plant away from the bark substrate as described in the Translocation Strategy, the whole plant including bark substrate were removed intact. A hand saw was used to incise the bark so the bark layer could be removed in sections with one or more orchid plants (Plate 16). The roots grow on the surface of the bark and extend for at least 30cm from the leaf tuft. The piece of bark was attached to a host tree in a sheltered location with ribbon and wire. The aim was to enable the orchid to continue growing on the bark substrate separately of the host tree that would function primarily as support and seed produced by the orchids would disperse through the surrounding habitat.

Twenty small (1-2cm long) orchid recruits growing next to one of the larger plants (Plate 18) were separated and planted in small pots filled with ground up bark from the host Casuarina tree. All these plantlets gradually died over the next 6 months. This species appears to be very sensitive to coverage of the surface roots by any type of soil medium and to drainage. The few plants producing leaf growth arched downwards from the upright position they were planted in, which appear to indicate preference for planting or attachment to a vertical surface rather than upright in pots.

### 3.3.4 Survival

91%. One plant died due to moss padding being placed too close to the leaf tuft. The orchids continued to flower and seed without apparent interruption of their normal growth rhythm.

## 3.4 Singleton Mint Bush (*Prostanthera cineolifera*)

### 3.4.1 Target Number

609. The Translocation Strategy is inconsistent regarding the number of impacted individuals as the target number is considerably more than recorded in the most recent targeted surveys: "Aecom (2014) found that Singleton Mintbush was confined to the banks of Tabbimoble Creek….. Approximately 200 individuals were recorded across two sub-populations found either side of the highway. Jacobs (2014a) confirmed the location with no major changes." p.68).

### 3.4.2 Number Translocated

Approximately 1200 tubestock or twice the target number was introduced to the receival site in Year 1. The was necessary to replace losses from the first plantings (three in all) and to bring the net number of live plants up to 600 by the end of Year 1.

### 3.4.3 Translocation Method

The Translocation Strategy specified that Singleton Mint Bush would be translocated by propagation and introduction. Ecos Environmental (2007) noted that Single Mint Bush has a "single stemmed growth form which is typical of sclerophyll shrubs with an obligate seeder life history. Obligate seeder species regenerate from seed after fire or disturbance, tend to be short-lived (<15yrs) and persist by soil-stored seed."(p. 37). Most seeders build up a store of dormant seed in the soil and regenerate from this seed when a fire goes through. In 2017, the Tabbimoble population consisted mainly of over-mature and senescent individuals and many were falling over as they approached the end of their life span (Plate 21). As seed and cuttings in the quantity required were either of poor quality or not available until later in the year, it was decided to trial a new method of propagation using the soil seedbank.

Topsoil was collected to a depth of 1-3cm from under *P. cineolifera* bushes within the clearing footprint. The soil was spread on sheets of tin and covered by a 5cm layer of dry leaves and twigs which was burnt to simulate the effects of bushfire, including heating of the topsoil and release of combustion compounds that trigger germination of dormant seed (Plate 22). The burnt soil was placed in trays and germinated in a nursery. To clarify the effect of the fire treatment, the topsoil material was divided into three lots and seed germination recorded in response to three treatments: (i) high fire, (ii) low fire and (iii) no fire (control). High fire was simulated by doubling the amount of fuel. Results were recorded three months after the treatments. It was obvious by inspection that seedling density was much higher under the high fire treatment and much lower in the control. Ten trays were selected at random from the high fire and control treatments and counts made of the number of seedlings of each species, including Singleton Mint Bush.

Seedlings of *P. cineolifera* were potted into native tubes in October/16 after recording the results of the soil treatments. Standard nursery potting mix from Go-Grow in Ballina was used and Seasol liquid fertiliser applied at intervals as the mix had no added fertiliser. There were no disease problems and minor grazing by caterpillars in the nursery. Tubestock were >30cm in height and hardened off before planting out. Plantings were conducted in Feb/17, Apri17 and June/17, as described below.

Three plantings of *P. cineolifera* were introduced to the 'Tabbimoble Triangle' receival site:
In the first planting (23/3/2017) 600 tubestock were planted across the whole receival site at roughly even spacing (a few metres apart). The site was about 80 metres long (N-S) by 60 metres wide (E-W) and was fenced to exclude grazers. Vegetation varied from forest in the south to open woodland in the north. A soil texture and drainage gradient extends across the site from north to south with increasing sand content and better drainage to the south towards Tabbimoble Creek, and more poorly drained, clayey soil to the north. Sand is transported by the creek from sandstone hills upstream and during floods spills out on the edge of the clay soil floodplain.

An inspection of the site three weeks after planting found that most tubestock in the northern half to two-thirds of the site were dead or dying from a wilt disease (probably a root fungus), whereas plants in the southern half to one third of the site were still healthy. This indicated that *P. cineolifera* is very sensitive to soil texture and likely to establish only on higher sand content soil closer to Tabbimoble Creek.

To examine the effect of sub-habitat type (specifically soil texture and drainage) on the performance of *P. cineolifera* more closely, and to discount possible effects due to flash flooding current and pre-planting herbicide, we conducted a more controlled experimental planting three weeks later (12/4/2017). Five transects were placed at intervals along the north-south canopy cover/soil texture gradient within the same fenced site, including a minor gully that crosses the site north-south and connects with the main creek (Plate 28). Three 1m x 1m plots were placed on each transect, divided into quarters and each quarter planted with four tubestock (16 per plot). The two quarters closest to the creek received 12 month slow release fertiliser and the other two no fertiliser. No herbicide was applied. Results after two months showed that plants on the two transects at the northern end of the site furthest from the creek were showing the same wilt symptoms of disease, whilst plants on the transect closest to the creek were healthy, as were plants in the side gully. On the remaining transect in an intermediate position, about half the plants were healthy and half were wilting. There was no discernible difference in performance due to the fertiliser treatment. These results confirmed the initial

observations that *P. cineolifera* is sensitive to soil texture and drainage and requires soil with visible sand content. Further flash flooding occurred which did not affect survival on the sandier transects.

Based on the results of the experimental planting, the receival site was extended further south into the sandy belt closer to Tabbimoble Creek, fenced and planted with another 200 tubestock at the start of July 2017.

Cutting propagation of *P. cineolifera* was also carried out during early works from a few young plants growing on the edge of forest at the Tabbimoble Creek bridge (Only a small amount of good quality cutting material was present on these plants when inspected in August 2016.) The propagation was successful and these plants are presently being grown-on by Ecos Environmental in super tubes for later planting around the new bridge, at the request of Pacific Complete.

### 3.5.4 Survival

| Plantings | Survival |
|---|---|
| 1. 700 tubestock (first planting across site) | 1.~40% |
| 2. 300 tubestock (experimental planting) | 2.- 50% |
| 3. 200 tubestock (extension planting) | 3 – recently planted |

The net number of live plants in July 2017 after three plantings was approximately 650.

## 3.5 Weeping Paperbark (*Melaleuca irbyana*)

### 3.5.1 Target Number

1721. This is the number of individuals in the population at New Italy impacted by clearing (RMS 2015).

### 3.5.2 Number Translocated

1700 tubestock were propagated and planted at three sites in Year 1.
Offset land 1a- 700
Offset land 1b - 500
Tabbimoble Creek - 500

### 3.5.3 Translocation Method

The Translocation Strategy specifies that Weeping Paperbark is to be translocated by seed or cutting propagation and introduction to two receival sites. No transplanting of the New Italy population was carried out although a single small tree on Section 3 (an unexpected find) was transplanted to a receival on the offset property at Sunnyside Drive, Glenugie.

Seed of Weeping Paperbark was readily available as this species stores seed in woody capsules amongst the tree canopy. Seed capsules were collected from trees along a 100 metre transect across the New Italy population (see Excel spreadsheet, donor tab). The capsules were dried to release the seed which were sprinkled onto trays of commercial seed raising mix and germinated in a nursery under sprinklers. Seedlings were potted into native tubes when 1-2 cm high and grown in standard nursery potting mix from Go-Grow in Ballina. Several applications of dilute Seasol liquid fertiliser were applied as the soil mix had no added fertiliser. Tubestock were grown to at least 30cm in height and hardened off before planting. Propagation took 8 months to complete.

The two receival sites for Weeping Paperbark were located on the offset property south of Tabbimoble owned by RMS and in the Tabbimoble Triangle on the northern side of Tabbimoble Creek. The receival site on offset land was divided into two planting areas with more open vegetation allowing for better tree establishment. All the planting areas were fenced to exclude grazers. The sites were on waterlogging prone, heavy clay soil typical of Weeping Paperbark habitat and the vegetation was relatively open with low tree density. Competition from native sapling regrowth will require removal during maintenance.

Tubestock were planted out in March/17 on the offset site and July/17 in the Tabbimoble Triangle. The two enclosures on the offset land were planted using 12 month slow release fertiliser. To examine the effect of fertiliser, two plots of 10 plants received no fertiliser. Tubestock in the Tabbimoble Triangle were planted without fertiliser. As there were scattered large trees at this site, use of fertiliser could attract tree roots and inhibit the growth of tubestock. Fertiliser can be added at a later date if required.

### 3.5.4 Survival

Survival of tubestock planted in March/17 was ~80% at the end of Year 1.

## 3.6 Tall Knotweed (*Persicaria elatior*)

### 3.6.1 Target Number

Twenty (20).
More plants were found during pre-clearing surveys by Pacific Complete and added to the translocation program (see below).

### 3.6.2 Number Translocated

Approximately 350 Tall Knotweed were translocated, which included 300 field seedlings salvaged and grown-on in the nursery then planted-out at maturity (in flower/seed). All plants came from the swampy area north of Goodwood St adjacent to the Pacific Highway at Maclean.

| Translocations 1-3 | Number |
|---|---|
| (1) old plants and soil seedbank | 7 old plants and soil seedbank (26 plots) |
| (2) young plants (0.5-0.7m tall) | 27 clumps of plants/~48 individuals. |
| (3) field seedling grown-on in nursery then introduced | 300 tubestock, mature plants in flower/seed |

### 3.6.3 Translocation Method

Translocation methods were developed as more plants were found by Pacific Complete during pre-clearing surveys and added to the translocation project. A receival site had already been established in Yaegl Nature Reserve during early works, but this site inside paperbark forest was considered too shaded for Tall Knotweed, which usually grows in more open habitat. A replacement receival site was selected in Yaegl Nature Reserve a few hundred metres north on the edge of paperbark forest. A few in situ Tall Knotweed plants were present at this site at the start of the translocation. Three translocations were conducted using slightly different methods according to the age and size of Tall Knotweed plants to be salvaged and environmental conditions at the time:-
Translocation 1 - transplant old plants and soil seedbank.
Translocation 2 - transplant young plants (0.5-0.7m tall).
Translocation 3 - salvage seedlings, grow-on in nursery then introduce.

For the first translocation in August 2016, old Tall Knotweed plants and soil seedbank were translocated from the donor site north of Goodwood St to the receival site in Yaegal Nature Reserve. Seven old Tall Knotweed plants were transplanted (one per plot) and 20 plots were seeded with soil seedbank collected from the Goodwood St donor site.

The main stem and branches of the old plants had collapsed and were lying underwater. Branches with leaves and flowers projected 30-40cm above water. Whole plants were up to 3m long standing upright (Plate 43). There was little root connection with the flooded substrate and roots had sprouted from the submerged stems. The plants were gathered up, placed in tubs and relocated to standing water at the receival site. Several bins of muddy substrate were collected around the old plants as this was likely to contain Tall Knotweed seed. The mud was spread in 1m x 1m cleared plots on the north facing margin of paperbark forest where the paperbark trees were more widely spaced and the ground layer consisted of wetland grasses and sedges. These were removed by hand before

spreading the mud. More than half the plots had shallow standing water ~10cm deep and were dug over with a spade to remove sedges and grass (mainly *Eleocharis acuta* and *Paspalum distichum*) and make gaps for germination of Tall Knotweed seed, if present. The mud seedbank plots were placed at slightly different elevation in the Couch Grass zone (higher – no standing water) and the Water Couch zone (lower – shallow standing water) along about 200 metres of swamp edge. The plots were tagged for monitoring.

In November 2016 more Tall Knotweed plants were found during pre-clearing surveys north of Goodwood St and translocated to the receival site. These plants had grown from seed in the last few months and were 0.5-0.7m high. The plants were dug up and transported to the receival site in Yaegl National Park where they were planted further into the swamp as it was drying out. Twenty seven clumps containing approximately 48 plants were transplanted and tagged for monitoring.

While conducting the second translocation of young plants in Nov/16, several hundred recently germinated Tall Knotweed seedlings were found. The seedlings were collected and grown-on at the nursery for introduction to the receival site. The seedlings grew rapidly and had to be pruned back twice after exceeding ~1m in height. Tall Knotweed is an exceptionally fast growing plant. Planting was delayed until late February due to a long period of hot, dry weather. By this stage tubestock were reproductively mature with flowers and seed. Three hundred (300) tubestock were planted in fifteen 4m x 4m plots, 20 plants per plot. Additional plants were grown in the nursery and used for seed collection in case seed was needed for propagation in Year 2. The 15 plots were tagged for monitoring.

### 3.6.4 Survival

Translocation 1- transplanted old plants and soil (mud) seedbank
The old plants survived for ~about 2 months and continued to flower sparingly, producing a small amount of seed, then died off as the swamp dried out.
Seedling recruitment in the mud seedbank plots included small numbers of Tall Knotweed in some plots. Most seedling recruitment consisted of common weedy species. Tall Knotweed seedlings were readily identified by their sticky, scented first true leaves. Seed germination occurred mainly in plots in the Couch Grass (*Cynodon dactylon*) zone which is slightly higher than the Water Couch (*Paspalum distichum*) zone.

Overall, the mud seedbank translocation resulted in some Tall Knotweed seedling recruitment, but the timing coincided with the onset of a long dry period and most seedlings died. In slightly damper microsites, the seedlings grew on to maturity, flowered and set seed. All recruits were dead by June 2017 due to the species annual life cycle).

Translocation 2 – transplanted young plants (0.5-0.7m)
Most of these transplants survived and reached reproductive maturity. The site dried out during the dry season and watering was necessary to prevent wilting and die-off. Although the plants were fairly large, flowering and seeding did not start until the wet season. A few plants were still alive at the end of June 2017. These had grown to a large size by producing branches and roots underwater. They appeared to growing as floating aquatic plants with little attachment to substrate and were still producing flowers and seed in winter.

Translocation 3 - field seedling grown-on in nursery then introduced
The 15 plots planted with tubestock were flooded about a week after introduction at the end of February 2017. More than half the plants were submerged by flooding and died. Although Tall Knotweed can grow in quite deep water, it appears that some leaves must remain above water or the plant dies. All plants were in flower and producing seed when planted out (Plates55 & 56) so they would have seeded the plots. By June 2017, 87% of plots still have at least three live plants and where the water had receded from the plots, seedlings had recently germinated, mostly likely from seed produced by the translocated plants. The seedlings, which are mostly 5-10cm tall, will need to survive the coming dry season and kangaroo grazing (plots are unfenced) to reach reproductive maturity which may not be until early next summer. More germination may occur during the spring-summer growing season from seed produced by the translocated plants.

The translocations and follow-up recruitment showed that Tall Knotweed seed requires a moist substrate exposed to the air for germination. There was no evidence that Tall Knotweed seed germinates underwater even though mature plants often shed seed into standing water. Germination occurs when receding water leaves exposed damp ground. Seed may germinate within a few months of being shed from the parent plant, depending on water level. The seed does not appear to have strong innate dormancy that requires a long 'after-ripening' period, rather dormancy is enforced by standing water (submergence) or dry soil conditions. Survival to reproductive maturity depends on the soil or microsite remaining moist during the dry season, up the start of the next rainy season. Sites that appear to be suitable in the wet season may completely dry out in spring-summer so that seedlings die off before reaching reproductive maturity. Tall Knotweed is a rapidly growing species that can grow to well over a metre in height and begin flowering in 3 months under good conditions.

## 3.7 Four-tailed Grevillea (*Grevillea quadricauda*)

### 3.7.1 Target Number

Three (3).
About 25 plants of *Grevillea quadricauda* were recorded in flagged off areas within the clearing footprint at two locations in August/2016. These included about 10 large mature bushes and 15 juveniles.

### 3.7.2 Number Translocated

Fifteen (15) juveniles were transplanted juveniles to the receival site and 15 seedlings propagated from the soil seedbank for introduction.

### 3.7.3 Translocation Method

Rather than transplanting direct to the receival site, it was decided to transplant smaller plants to pots and grow them on before introduction, as transplanting direct to the receival site was likely to be difficult because of the coarse sandy soil. The soil was also likely to dry out quickly as the dry season was approaching. The plan was to grow the transplants in pots until stabilised and plant-out in the designated receival site in the road reserve after the road corridor had been cleared.

*Grevillea quadricauda* has the typical single-stemmed growth form of a seeder species, which are usually difficult to transplant, particularly larger individuals. Seeders often don't regenerate well after root disturbance and heavy pruning, unlike resprouter species which are better adapted to recovering from setbacks. Transplanting to pots was therefore limited to small individuals 20-40 cm tall. Large 30cm pots were used so there was less disturbance of the plant root system. The plants were grown in soil from the donor site. Care was taken not to over-water the pots and the soil was allowed to dry out a few times. A few pellets of organic fertiliser were applied once. The transplants were held in pots for about six months.

To compensate for the loss of larger individuals that were considered too large to transplant, more plants were propagated using the same soil seedbank method applied to Singleton Mint Bush. Soil was again collected from under and next to mature *G. quadricauda* bushes. Seedlings germinated in much lower number compared to the Mint Bush. A total of 15 tubestock have been grown on to a size suitable for planting out. *G. quadricauda* flowers and seeds fairly sparingly which may be one reason for the small number of seedlings and apparent small soil seedbank. Another reason may be seed is dispersal away from the parent plant (where seed was collected), as the seed is winged for wind dispersal.

Seed collection was also undertaken in spring but very little seed was found. Summer may be a better time to collect seed. Only one plant was propagated from seed.

### 3.7.4 Survival

Proteaceae such as Grevillea can be difficult to grow and problems were expected, particularly with root disease, but transplants grew well in pots and seemed to thrive in the infertile sandy soil. They continued to grow well after planting-out with no fertiliser. After 3 months all plants were thriving and producing flowers (Plate 76).

## 3.8 Stinking Cryptocarya (*Cryptocarya foetida*)

### 3.8.1 Target Number

Forty-one (41). This number is apparently based on a survey by the Australian Museum in 2014 (Translocation Strategy, p. 71). The Strategy states that more than half were juveniles and their identification was difficult to confirm and that a conservative approach was taken to identification. Juveniles were assumed to be *C. foetida* for purposes of estimating the number of impacted individuals. It is unclear if the 41 were all within the clearing footprint as report states the 41 were recorded within the 'study area'.

### 3.8.2 Number Translocated

Only 28 individuals were found within the clearing footprint during translocation. Twenty-four (24) of these were sapling sized individuals (1-4m tall) which were transplanted. The other four were too large to transplant manually. All transplants came from the Randles Creek area north of Coolgardie Rd area. A few tagged individuals had been misidentified and were either *C. microneura* or *C. triplinervis*.

### 3.8.3 Translocation Method

Saplings were dug out manually with spade, mattock and crow-bar. Most were removed from the ground with an intact soil-root ball. The transplants were pruned to remove most foliage and transported to the receival site for planting. After planting the saplings were mulched, fertilised and watered regularly to maintain high soil moisture.

The BOS22/Lumley's Lane receival site was the only potential site available for rainforest species on RMS land in the Translocation Strategy. Two types of habitat were available on the BOS (Biodiversity Offset Site) 22 land; either cleared pasture or hillside rainforest regrowth dominated by privet and camphor laurel. A site near the only dam on the land was the obvious choice for a receival site because of the importance of regular watering. Most of the ground in the hillside forest was covered by cobble to boulder sized rocks, which are derived from weathering of the basalt layer capping the top of the slope. It was impossible to make planting holes amongst the rocks, so the open pasture habitat immediately below the forest, closer to the dam was selected as the receival site. The soil type consisted of heavy yellow clay with little topsoil formed on metasediment (below the basalt) with a long history of cattle grazing. Although the site was not ideal for translocating rainforest species due to poor soil and exposure, previous translocations of local rainforest species to similar soil and topography have been reasonably successful (e.g. Brunswick Heads to Yelgun).

### 3.8.4 Survival

The transplants started to reshoot four weeks after transplanting. Short leafy shoots grew from dormant buds on the main stem and pruned branches. No root suckers or basal stem shoots were produced. Regrowth was very slow and organic pelleted fertiliser and Seasol were applied to stimulate growth. By January 2017, ~6 months after transplanting, 62.5% (15/24) of the transplants had reshot and were alive. Two more had reshot then died off soon after. Recovery from transplanting was slow but appeared to be progressing satisfactorily until two extremely hot days in Feb/2017 which caused leaf scorching, tissue damage and consequent die-off of half the plants. Heat damage was accentuated by the open, unshaded site conditions. One of the days was the hottest on record for most of the Far North Coast. At the end of Year-1 the survival rate was 26.9%. Basal reshooting occurred in two individuals that had died back after the heat event.

*Cryptocarya foetida* did not perform well on the receival site at Lumley's Lane (nominated in the Translocation Strategy), even though other common rainforest species as well as two other

threatened species transplanted to the site with *C. foetida* survived and performed reasonably well. The BOS 22 site has a shallow, heavy clay soil, whereas the original/donor site on Randles Creek (North of Coolgardie Rd) was on alluvium, close to the creek. No vigorous saplings or regrowth trees of *C. foetida* have been observed on the Blackwall Range, only the occasional seedling or small sapling, which indicates hill slopes similar to the receival site are marginal habitat for *C. foetida*. An alternative receival site for this species with a soil type closer to the donor site is probably necessary to achieve a successful translocation of this species. Seedlings of *C. foetida* are currently being propagated for introduction to a receival site. A more suitable receival site with alluvial soil exists downstream of the donor site on Randles Creek in a habitat island within the project boundary, between the new highway and the existing Pacific Highway.

Approximately 30 *C. foetida* have been propagated from seed. These are being grown at the nursery and should be ready for planting next summer.

## 3.9 Rusty Green-leaved Rose Walnut (*Endiandra muelleri ssp. bracteata*)

### 3.9.1 Target Number

Three (3). This appears to be an underestimate as six individuals were translocated. Two large trees were not translocated.

### 3.9.2 Number Translocated

Three saplings were transplanted directly to the receival site and three juveniles were transplanted to pots for growing-on at the nursery.

### 3.9.3 Translocation Method

Saplings were dug out manually as described for *C. foetida.*

Approximately 20 plants have been propagated from seed collected on the Blackwall Range and are growing slowly.

### 3.9.4 Survival

Only one of the three transplanted saplings reshot. This individual survived after one year. The three juveniles in pots all survived and grew very slowly.

Seed propagated plants may be ready for planning out next summer or autumn.

## 3.10 Red Lilly Pilly (Syzygium hodgkinsoniae)

### 3.10.1 Target Number

Six (6).

### 3.10.2 Number Translocated

Six juveniles were transplanted to pots for growing-on at the nursery. One large tree was not translocated.

### 3.10.3 Translocation Method

This species is being translocated by salvage of juvenile plants collected under to the large tree to be cleared, and additional plants are being propagated from seed.

### 3.10.4 Survival

All six juveniles salvaged from under the large tree survived and are growing slowly at the nursery. They should be ready for planting out next summer.

About 50 plants have been propagated from locally collected seed. Eleven have been introduced to the Lumley's Lane receival site and were alive at the end of Year 1. The others will be introduced in Year 2.

## 3.11 White Laceflower (*Archidendron hendersonii*)

### 3.11.1 Target Number

One (1). Apparently an underestimate as 7 individuals were transplanted.

### 3.11.2 Number Translocated

Two saplings were transplanted directly to the receival site and five juveniles were transplanted to pots for growing-on at the nursery.

### 3.11.3 Translocation Method

Saplings were dug out manually as described for *C. foetida.*

### 3.11.4 Survival

The two transplants and five juveniles in pots survived at the end of Year 1.

Four seed were collected from locally growing trees and have been germinated.

## 3.12 Rough-shelled Bush Nut (*Macadamia tetraphylla*)

### 3.12.1 Target Number

Ten (10)

### 3.12.2 Number Translocated

Propagation in progress.

### 3.12.3 Translocation Method

Translocation by seed propagation. Approximately 50 seed collected from about ten parent trees in regrowth rainforest on the Blackwall Range adjacent to the highway footprint.

## 3.13 Square-fruited Ironbark (*Eucalyptus tetrapleura*)

### 3.13.1 Target Number

Eight (8)

### 3.13.2 Number Translocated

Eight (8)

### 3.13.3 Translocation Method

Direct transplanting

#### 3.13.4 Survival

75%. Growth slow on poor soil and impeded drainage.

### 3.14 Hairy Melichrus (*Melichrus hirsutus*)

#### 3.14.1 Target Number

One (1)

#### 3.14.2 Number Translocated

One (1).

#### 3.14.3 Survival

100%. Flower buds in June/2017.

### 3.15 Hairy Joint Grass (*Arthraxon hispidus*)

Lumley's Lane to Coolgardie Rd (Section 10)

#### 3.15.1 Target Number

348

#### 3.15.2 Number Translocated

Trays from 50 donor points in the Coolgardie Rd south and Lumley's Lane west areas of the alignment (see Excel spreadsheet). Planted into 43 plots at Lumley's Lane receival site, approximately 50 plants per plot. 43 x 50 = 2150 plants.

#### 3.15.3 Translocation Method

Direct transplanting.

#### 3.15.4 Survival

100%

Mitchell Rd (Section 3)

#### 3.15.5 Target Number

Not specified. One mapped point in Translocation Strategy.

#### 3.15.6 Number Translocated

20 trays; 50 x 20 = 1000 plants.

#### 3.15.7 Translocation Method

Transplanted to 20 trays in Sept/16. Held in trays until planted out in adjacent road reserve in Dec/16.

#### 3.15.8 Survival

100%. Plants flowered, set seed and died off in April-May 2017.

## 3.16 Lindernia (*Lindernia alsinoides*)

### 3.16.1 Target Number

Thirty (30) – number of sods with Lindernia plants

### 3.16.2 Number Translocated –

Thirty (30) – number of sods with Lindernia plants

### 3.16.3 Translocation Method

Direct transplanting.

### 3.16.4 Survival

Probably nil at the end of the Year due to inappropriate site.

## 3.17 Rotala (*Rotala tripartita*)

### 3.17.1 Target Number

This species is not included in the Translocation Strategy apart from a brief mention in one of the tables. Occurrences have been recorded from the western and eastern sides of the existing Pacific Highway adjacent to the Jackybulbin Rd intersection north of Tabbimoble Creek. The occurrence on the western side of the highway was recorded for the first time in 2015. The occurrence on the eastern side of the highway was first recorded in 2007 (L. Weber pers.comm.). Rotala is a semi-aquatic herbaceous plant which appears to be perennial although it may die back completely in winter-spring under dry cold conditions.

The western population failed to reappear in 2017/2018 and a quantity of soil possibly containing the seed of this species was collected at the previously recorded locations (GPS ) to spread later at the receival site. Approximately 50 plants growing in a linear drainage depression on the eastern side of the highway were salvaged and grown-on in pots at Ecos Environmental's nursery.

A receival site has been selected on RMS offset land south of Tabbimoble Creek for introduction of the salvaged plants and soil material later in 2017.

### 3.17.2 Number Translocated

To be completed.

### 3.17.3 Transplant Survival

To be completed.

## 3.18 Richmond Bird Wing Vine (*Aristolochia pravevenosa*)

### 3.18.1 Target Number

Five (5)

### 3.18.2 Number Translocated

Ten plants propagated.

### 3.18.3 Translocation Method

Propagated from cuttings – to be planted out.

## 3.19 Summary of implementation and results

A summary of translocation results for each species is presented in Table 4 including the start date, number of plants translocated, percent survival, recruitment and propagation. Species by species results are presented in the following sections.

Translocation results in Year 1 met the project aims and objectives for all species except *Cryptocarya foetida* and *Lindernia alsinoides*. Only about a quarter of the *C. foetida* transplants were still alive at the end of Year 1. The low survival rate for this species was due to the soil type at the BOS22 receival site, which proved to be unsuitable for *C. foetida,* although within the tolerance range of other rainforest species translocated to the site. More plants are being propagated from seed and as a corrective action it is recommended they be introduced to a receival site with an alluvial soil type similar to the donor site, as described below.

The receival site for Lindernia is located on the same drainage line as the donor site on the opposite side of the alignment. Transplanting of *Lindernia alsiinoides* appears to have failed due to poor water quality emanating from earthworks run-off (Plate 106). The donor site population is restricted to a small area of peaty soil formed in a small seepage swamp on a minor drainage lines in sandstone terrain. This is a very specific type of habitat which is rare in the surrounding environment. There is a chance regrowth may occur in the dry season after floodwater recedes.

As indicated above, some adaption of translocation methods and receival sites was considered necessary following review and field validation of the Translocation Strategy. Details of alternative methods and locations trialled to increase the likelihood of achieving performance aims and objectives are set out in Table 6 below.

**Table 5:** Details of alternative methods and locations trialled during threatened flora translocations on Sections 3-11 that increased the likelihood of achieving the performance aims and objectives in the Translocation Strategy (RMS 2015).

| Species | Alternative Methods | Alternative Locations |
|---|---|---|
| Yellow-flowered King of the Fairies (*Oberonia complanata*) | Rather than prising the orchid plant and roots away from the bark substrate of the host tree, as described in the Strategy, the substrate was cut away in a slab using a saw and chisel, so plant was moved intact with its bark substrate. The bark and plant was reattached to a host tree at the receival site. | Proposed host Casuarina trees on Gummigurrah Walk were too exposed; replaced with other rainforest understorey trees in denser bush closer to Evans Head, still in Bundjalung National Park. |
| Singleton Mint Bush (*Prostanthera cineolifera*) | As (i) species not expected to seed for several months, (ii) seed likely to be of poor quality due to senescent population; and (iii) cuttings of poor quality, species propagation was trialled using the soil seedbank salvaged from underneath bushes on the footprint. Fire was applied to stimulate germination. Experiments/trial planting were also conducted to find the most suitable location for species within preferred receival site, given sensitivity to soil texture/ drainage. | Two of the three receival sites proposed in Strategy were assessed as unsuitable habitat due to soil type, dryness and indicator species. Tabbimoble Triangle selected as only suitable site. |
| Weeping Paperbark (*Melaleuca irbyana*) | Species propagated from seed only, as seed was readily available from capsules on tree branchlets and seed propagation was simpler to implement than cuttings, with fewer | Proposed receival sites either with unsuitable habitat or access impractical due to flooding. Alternative site found on RMS |

| Species | Alternative Methods | Alternative Locations |
|---|---|---|
| | potential problems. | offset land south of Tabbimoble Creek western side of highway. Propagated plants also introduced to Tabbimoble Triangle receival site used for Mint Bush. |
| Tall Knotweed (*Persicaria elatior*) | Three methods trialled – (i) translocation using mud seedbank from donor/impact site salvaged and spread directly at the receival site, (ii) direct transplanting/salvage of large plants and (iii) salvage of seedlings grown on to an established size in pots before planting into the receival site. | Receival site used for early works translocation assessed as unsuitable, as inside Paperbark forest where translocation plants grew poorly before dying. Alternative receival site on edge of Paperbark forest found further north, also in Yaegal Nature Res. |
| Four-tailed Grevillea (*Grevillea quadricauda*) | Translocation trialled using the soil seedbank collected from underneath large bushes, too large to transplant. Juvenile plants were salvaged to pots and grown-on at the nursery before planting out, as weather conditions in spring-summer were hot and dry. | |
| Stinking Cryptocarya (*Cryptocarya foetida*)<br>Rusty Rose Green Walnut (*Endiandra muelleri ssp. bracteata*)<br>Red Lilly Pilly (*Syzygium hodgkinsoniae*)<br>White Laceflower (*Archidendron hendersonii*)<br>Rough-shelled Bush Nut (*Macadamia tetraphylla*) | Saplings were translocated manually by direct transplanting. Juvenile plants were transplanted to pots and grown-on for 10 months before planting out, to improve resilience and survival rate. Transplanting of larger trees not carried as not specified in Brief, discouraged in Strategy and difficult to organise retrospectively with management. | BOS 22 receival site on RMS land was the only practical receival site (ie. with available water source) and with reasonable, looking habitat proposed in the Strategy. Translocations implemented to this site in Year 1 performed poorly for four of the five species due to shallow, heavy clay soil. A second receival site for rainforest threatened species was selected at Randles Creek near Coolgardie Rd and translocations using propagated plants are currently underway. |
| Hairy Joint Grass Section 10 (*Arthraxon hispidus*) | Hairy Joint was transplanted from the Coolgardie South and Lumleys Lane south donor sites to the BOS 22 receival site at Lumleys Lane. Well in excess of the 348 individuals that required translocation in the Flora Translocation Strategy were translocated. A total of forty three (43) plots of translocated Hairy Joint Grass were established at the BOS 22 receival site at Lumleys Lane. A section of this site with very few existing Hairy Joint Grass plants was selected as the receival site. Approximately 500 individuals were transplanted. | Proposed receival site unsuitable as too low lying and inundated for long periods during rainy season. Replacement site found in section of BOS22 land with low number of HJG. |
| Hairy Joint Grass Mitchell Rd Sect 3 (*Arthraxon hispidus*) | Large population found to be present at site when only one point mapped in Strategy. 20 trays of approx. 1000 plants translocated to receival site in road reserve next to the receival site. | Receival site on Section 1-2 proposed in Strategy considered too far away (~50km) |
| Additional Species | | |
| Square-fruited Ironbark (*Eucalyptus tetrapleura*) | Direct transplanting to receival site at Sunnyside Rd, Glenugie, RMS offset property. | |
| Hairy Melichrus (*Melichrus hirsutus*) | Direct transplanting to receival site at Tallowwood Dv, Pillar Valley, RMS offset | |

| Species | Alternative Methods | Alternative Locations |
|---|---|---|
| | property. | |
| Lindernia (*Lindernia alsinoides*) | Direct transplanting to receival site in Road Reserve opposite the donor site, south of Mitchell Rd. | |
| Richmond Bird Wing Vine (*Aristolochia pravevenosa*) | Propagated from cuttings. | |
| Carronia (*Carronia multisepala*) | Propagated from cuttings. | |

## 4.0 Performance Criteria and Compliance

Table 5 below addresses compliance of the W2B Threatened Flora Translocation Project (Sections 3-11) with the Performance Criteria and Thresholds as set out in Table 6 of the Translocation Strategy (p.25). Compliance is assessed in Table 5 below in the row labelled 'Compliance' below each Aim. The Performance Criteria relate to Aims and Objectives in Table 6 of the Strategy.

It is noted that some of the Objectives and Performance Criteria in Table 6 are inconsistent. For example, for Weeping Paperbark, the objective for making good use of plant material is "Available seed is harvested for nursery propagation." (p. 32). However, the performance criteria for this action is "Trees translocated and cutting material collected to best extent practical for nursery propagation (at least 20 cuttings)". "Trees translocated" presumably means trees transplanted, although the Strategy stipulates that no trees of *M. irbyana* are to be transplanted, and propagating cuttings is a different action from harvesting seed. Equally confusing is the Objective "Plants complete their lifecycle and regenerate successfully" where the corresponding Performance Criteria is: "At least 50 plants germinate and set seed each year from Year 2". This Criteria is considered impractical as Weeping Paperbark propagated from seed is unlikely to complete their life cycle in the sense of reaching reproductive maturity (ie flowering and producing seed) in 2 years. It is possible for transplanted trees, by the Strategy specifies no transplanting of this species.

In the absence of transplanting, it is suggested that for Weeping Paperbark, the Objectives and Performance Criteria be reworded to be consistent with translocation by seed propagation which is the most straightforward method for this species, as seed is always available stored in seed capsules on the branchlets. Cuttings have not been trialled as far as I am aware and carry various disadvantages as described above.

Overlooking these irregularities, the overarching aim of the Translocation Strategy is to achieve 'no net loss' in the size of local populations of threatened plant species. This means transplanting impacted individuals and/or introducing propagated plants to compensate for removal of individuals during highway construction, so that population numbers remain the same, or are augmented. Other aims include improving knowledge of the species, using local material to propagate the impacted species and adequate reporting. Vegetation rehabilitation to compensate for lost habitat and increase habitat viability for local populations of threatened species, relevant to threatened rainforest species on Section 10-11, receives relatively minor attention.

**Table 6:** Assessment of compliance with the Performance Criteria and Thresholds set out in the Translocation Strategy (Table 6, p.25). Compliance is assessed in the bottom row labelled 'Compliance' under each Aim.

| Species | Four-tailed Grevillea | Green-leaved rose walnut | Hairy joint-grass |
|---|---|---|---|
| Aim | Maintain or improve the functioning and condition of existing populations | Maintain or enhance existing demographic function and genetic variability | Create a self-sustaining population (Kangaroo Trail) or augment existing populations (Coolgardie-Wardell sites) |
| Objectives | Plants improve in condition so that flowering fruiting and regeneration is successful. | Create or augment small sub-populations with diffuse connectivity to meta population in the Coolgardie-Wardell area conserving existing genetic variability | Plants complete their lifecycle and regenerate successfully |
| Performance criteria | Threats identified and addressed. New growth documented on 80% of existing plants flowers and fruit observed by Year 3. Improvement maintained to Year 5. | Clumps of plants established numerically sufficient to replace or augment the number of affected individuals or sub-populations. Progeny from all translocated individuals is established by Year 3 and maintained to Year 5. | At least 50 plants germinate and set seed each year |
| Threshold | New growth on <50% of existing plants no flowers nor fruit by Year 3. Improvement not maintained to Year 5.* | Less than 80% of no of original clumps or individuals are established. Less than 80% of impacted plants represented by established progeny.* | Less than 30 plants germinate and set seed in any one year* |
| Corrective action | Re-assess threats and address. Consider augmentation from seed propagated plants from alternative donor sites. | Augment with nursery stock from (likely cutting grown) back up stock. | Undertake searches for suitable local donor populations (in case of isolated southern occurrence) or source from receiving site populations. Collect seed nursery propagate or clump transplant. Re-evaluate site moisture gradients to best target suitable planting sites. |
| Compliance | Salvaged plants in good condition, more than tripled in size, flowering 3 months after introduction Propagation progress satisfactory. | Population numbers and putative genetic diversity maintained by salvage from footprint and propagation. Assess threshold in Year 3-5. | Existing population augmented. Species life cycle completed in Year 1 and stand expected to be self-perpetuating with , recruitment occurring in winter. |

| Species | Four-tailed Grevillea | Green-leaved rose walnut | Hairy joint-grass |
|---|---|---|---|
| Aim | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species |
| Objectives | Relevant project results and observations documented. | Relevant project results and observations documented. | Relevant project results and observations documented. |
| Performance criteria | Reporting to include e.g. threat identification and amelioration detail of growth and seeding periods and results of nursery tasks. | Reporting to include observations of new growth on translocated trees results of nursery tasks. progress of seedling establishment as relevant. | Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks. |
| Threshold | Reporting incomplete | Reporting incomplete | Reporting incomplete |
| Corrective action | Project manager to address with sub-contractors | Project manager to address with sub-contractors | Project manager to address with sub-contractors |
| Compliance | Knowledge of species life cycle and translocation potential increased – e.g. obligate seeder, low seed output, low soil seedbank, young plants can be transplanted, capable of rapid growth etc horticultural potential | Knowledge of species life cycle and translocation potential increased – e.g. persistent species, increases in degraded habitat. Seed have high viability by difficult to find and slow growing. | Knowledge of species increased – e.g. species life cycle confirmed as annual. Sensitive to dominance by tall exotic grasses. Co-exists with native Foxtail Grass, one possible original habitat. |

| Species | Four-tailed Grevillea | Green-leaved rose walnut | Hairy joint-grass |
|---|---|---|---|
| Aim | Achieve no net loss in local plant populations being impacted by the project | Achieve no net loss in local plant populations being impacted by the project | Achieve no net loss in local plant populations being impacted by the project |
| Objectives | Original number of individuals and area re-established | Equivalent original number of individuals re-established. following guidelines for replacement of mature trees by seedlings/cuttings i.e ten seedlings established for any mature trees lost five seedlings established for any saplings lost. | Original number of individuals and area re-established |
| Performance criteria | Compare with donor site. 70% of original number of plants established in Year 1 increasing to 100% minimum by Year 5 | Compare with donor site. 70% of original number of plants established in Year 2 increasing to 100% minimum by Year 5 | Compare with donor site. 70% of original cover of plants established over an area equivalent to original in Year 1 increasing to 100% cover by Year 5 |
| Threshold | >50% of original number of plants established in Year 1 or similar levels below target in subsequent years* | >50% of original number of plants established in Year 2 or similar levels below target in subsequent years* | >50% of original cover of plants established over an area equivalent to original in Year 1 or similar levels below target in subsequent years* |
| Corrective action | Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling | Replace with nursery back up stock. Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling | Undertake searches for suitable local donor populations collect seed nursery propagate or clump transplant. |
| Compliance | Translocated number currently equal to or greater than target/impact number. | Translocated number currently equal to or greater than target/impact number. | Translocated number currently equal to or greater than target/impact number. |

| Species | Four-tailed Grevillea | Green-leaved rose walnut | Hairy joint-grass |
|---|---|---|---|
| Aim | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value |
| Objectives | All available cutting material and seed harvested and grown on for transplant to best extent practical. | Trees and saplings is transplanted. All potential cutting material (and seeds if available) harvested for nursery propagation. | Soil associated with above-ground plants transplanted |
| Performance criteria | No unsalvaged material present on ground inspection | Trees translocated and cutting material collected to best extent practical for nursery propagation | No unsalvaged material present on ground inspection |
| Threshold | More than 10% of the original material present | Tree not translocated. Less than 15 cuttings transferred to nursery facilities | More than 10% of the original material present. |
| Corrective action | Project manager to address with contractors | Project manager to address with contractors | Project manager to address with contractors |

| | | | |
|---|---|---|---|
| Compliance | Soil seedbank propagation successful. Target number exceeded. | Saplings and juveniles transplanted. Cutting propagation not undertaken as past results poor. Seed collected and propagated. | Target number well exceeded.<br>BOS22 offset site captures impacted HJG habitat area. |

| Species | Red lilly pilly | Rough-shelled bushnut | Singleton mintbush |
|---|---|---|---|
| Aim | Maintain or enhance existing demographic function and genetic variability | Maintain or enhance existing demographic function and genetic variability | Maintain a self-sustaining population adjacent to and in the vicinity of the Tabbimobile Creek donor population. |
| Objectives | Create or augment small sub-populations with diffuse connectivity to meta population in the Coolgardie-Wardell area conserving existing genetic variability | Create or augment small sub-populations with diffuse connectivity to meta population in the Coolgardie-Wardell area conserving existing genetic variability | Translocated plants complete their lifecycle and regenerate successfully |
| Performance criteria | Clumps of plants established numerically sufficient to replace or augment the number of affected individuals or sub-populations. Progeny from all translocated individuals is established by Year 3 and maintained through to Year 5. | Clumps of plants established numerically sufficient to replace or augment the number of affected individuals or sub-populations. Progeny from all translocated individuals is established. | At least 30 plants establish and set seed each year from Year 3 |
| Threshold | Less than 80% of no of original clumps or individuals are established. Less than 80% of impacted plants represented by established progeny.* | Less than 80% of no of original clumps or individuals are established. Less than 80% of impacted plants represented by established progeny.* | Less than 20 plants establish and set seed in any one year from Year 2* |
| Corrective action | Augment with nursery stock from (likely cutting grown) back up stock. | Augment with nursery stock from (likely cutting grown) back up stock. | Augment with nursery back up stock and if required collect additional seed and cuttings from seed; nursery propagate and plant out. |

| | | | |
|---|---|---|---|
| Compliance | Additional plants have been propagated from seed to maintain and augment population level | Propation progressing. Enough seed collected locallyi to maintain population level and genetic variability | Adequate number of seedling tubestock plants introduced and in healthy condition. |

| | | | |
|---|---|---|---|
| Aim | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species |
| Objectives | Relevant project results and observations documented. | Relevant project results and observations documented. | Relevant project results and observations documented. |
| Performance criteria | Reporting to Include observations of new growth on translocated trees results of nursery tasks. progress of seedling establishment as relevant. | Reporting to Include observations of new growth on translocated trees results of nursery tasks. progress of seedling establishment as relevant. | Reporting to Include e.g. detail of growth and seeding periods and results of nursery tasks. |
| Threshold | Reporting incomplete | Reporting incomplete | Reporting incomplete |
| Corrective action | Project manager to address with sub-contractors | Project manager to address with sub-contractors | Project manager to address with sub-contractors |

| | | | |
|---|---|---|---|
| Comp[liance | Knowledge of species life cycle and translocation potential increased | Knowledge of species life cycle and translocation potential increased | Knowledge of species life cycle and translocation potential increased |

| **Species** | **Red lilly pilly** | **Rough-shelled bushnut** | **Singleton mintbush** |
|---|---|---|---|
| Aim | Achieve no net loss in local plant populations being | Achieve no net loss in local plant populations being | Achieve no net loss in local plant populations being |
| | impacted by the project | impacted by the project | impacted by the project |
| Objectives | Equivalent original number of individuals re-established. following guidelines for replacement of mature trees by seedlings/cuttings i.e ten seedlings established for any mature trees lost five seedlings established for any saplings lost. | Equivalent original number of individuals re-established. following guidelines for replacement of mature trees by seedlings/cuttings i.e ten seedlings established for any mature trees lost five seedlings established for any saplings lost. | Original number of individuals re-established |
| Performance criteria | Compare with donor site. 70% of original number of plants established in Year 2 increasing to 100% minimum by Year 5 | Compare with donor site. 70% of original number of plants established in Year 2 increasing to 100% minimum by Year 5 | Compare with donor site. 70% of original number of plants established in Year 2 increasing to 100% minimum by Year 5 |
| Threshold | >50% of original number of plants established in Year 2 or similar levels below target in subsequent years* | >50% of original number of plants established in Year 2 or similar levels below target in subsequent years* | >50% of original number of plants established in Year 2 or similar levels below target in subsequent year* |
| Corrective action | Replace with nursery back up stock. Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling | Replace with nursery back up stock. Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling | Replace with nursery back up stock. Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed/cuttings following guidelines for sampling |

| | | | |
|---|---|---|---|
| Compliance | Translocated number currently equal to or greater than target/impact number. | Translocated number currently equal to or greater than target/impact number. | Translocated number currently equal to or greater than target/impact number. |

| Species | Red lilly pilly | Rough-shelled bushnut | Singleton mintbush |
|---|---|---|---|
| Aim | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value |
| Objectives | Trees and saplings is transplanted. All potential cutting material (and seeds if available) harvested for nursery propagation. | Trees and saplings is transplanted. All potential cutting material (and seeds if available) harvested for nursery propagation. | All available seed collected cutting material harvested to an extent predicted to cover predicted requirements x 2. |
| Performance criteria | Trees translocated and cutting material collected to best extent practical for nursery propagation | Trees translocated and cutting material collected to best extent practical for nursery propagation | No seed present on ground inspection |
| Threshold | Tree not translocated. Less than 15 cuttings transferred to nursery facilities | Tree not translocated. Less than 15 cuttings transferred to nursery facilities | Uncollected seed present on 10 or more plants |
| Corrective action | Project manager to address with contractors | Project manager to address with contractors | Project manager to address with contractors |

| | | | |
|---|---|---|---|
| Compliance | All available seed used, cutting material unsuitable for propagation. | All available seed used. | Soil seedbank used as source of seedlings. Number propagated adequate to achieve translocation target |

| Species | Slender screw fern | Stinking Cryptocarya | Tall knotweed |
|---|---|---|---|
| Aim | Create a self-sustaining population | Maintain or enhance existing demographic function and genetic variability | Maintain a self-sustaining population. |
| Objectives | Maintain or create a self-sustaining population (augment an existing patch) | Create or augment small sub-populations with diffuse connectivity to meta population in the Coolgardie-Wardell area conserving existing genetic variability | Plants complete their lifecycle and regenerate successfully |
| Performance criteria | Plants complete their lifecycle and regenerate successfully | Clumps of plants established numerically sufficient to replace or augment the number of affected individuals or sub-populations. Progeny from all translocated individuals is established by Year 3 and maintained through to Year 5. | At least 30 plants germinate and set seed each year |
| Threshold | Spore production observed each year (compare with control populations). Lateral vegetative growth observed from all transplants. | Less than 80% of no of original clumps or individuals are established. Less than 80% of impacted plants represented by established progeny.* | Less than 20 plants germinate and set seed in any one year.* |
| Corrective action | No spore production lateral growth from <50% of transplants | Augment with nursery stock from (seed or cutting grown) back up stock. | Undertake searches for suitable local donor populations collect seed nursery propagate or clump transplant. Re-evaluate site moisture gradients to best target suitable planting sites. |

| | | | |
|---|---|---|---|
| Compliance | Plants established and healthy but set back by repeated flash floods between March and June. | Transplanting results poor due to marginal soil type. Number of plants propagated equal to target number. New receival site to be selected for introduction. | Initial introduction resulted in seed production, although much of this resulted from growth in the nursery. Recruitment for next generation occurring; will seedlings survive to maturity? |

| Species | Slender screw fern | Stinking Cryptocarya | Tall knotweed |
|---|---|---|---|
| Aim | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species |
| Objectives | Relevant project results and observations documented. | Relevant project results and observations documented. | Relevant project results and observations documented. |
| Performance criteria | Reporting to Include e.g. detail of growth and spore production. | Reporting to include observations of new growth on translocated trees results of nursery tasks. Progress of seedling establishment as relevant. | Reporting to Include e.g. detail of growth and seeding periods and results of nursery tasks. |
| Threshold | Reporting incomplete | Reporting incomplete | Reporting incomplete |
| Corrective action | Project manager to address with sub-contractors | Project manager to address with sub-contractors | Project manager to address with sub-contractors |
| Compliance | Knowledge of species life cycle and translocation potential increased | Knowledge of species life cycle and translocation potential increased | Knowledge of species life cycle and translocation potential increased |
| Aim | Achieve no net loss in local plant populations being impacted by the project | Achieve no net loss in local plant populations being impacted by the project | Achieve no net loss in local plant populations being impacted by the project |
| Objectives | Original number of individuals and area re-established | Equivalent original number of individuals re-established. following guidelines for replacement of mature trees by seedlings/cuttings i.e ten seedlings established for any mature trees lost five seedlings established for any saplings lost. | Original number of individuals and area re-established |
| Performance criteria | Compare with donor site: 70% of original cover of plants established over an area equivalent to original in Year 1 increasing to 100% cover by Year 5 | Compare with donor site. 70% of original number of plants established in Year 2 increasing to 100% minimum by Year 5 | Compare with donor site. 70% of original cover of plants established over an area equivalent to original in Year 1 increasing to 100% cover by Year 5 |
| Threshold | >50% of original cover of plants established over an area equivalent to original in Year 1 or similar levels below target in subsequent year.* | >50% of original number of plants established in Year 2 or similar levels below target in subsequent years.* | >50% of original cover of plants established over an area equivalent to original in Year 1 or similar levels below target in subsequent year.* |
| Corrective action | Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling | Replace with nursery back up stock. Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling | Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling |

| | | | |
|---|---|---|---|
| Compliance | Translocated number currently equal to or greater than target/impact number. | Translocated number currently equal to or greater than target/impact number. | Translocated number currently equal to or greater than target/impact number. |

| Species | Slender screw fern | Stinking Cryptocarya | Tall knotweed |
|---|---|---|---|
| Aim | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value |
| Objectives | All available plants and associated soil harvested and transplanted to best extent practical | Trees and saplings transplanted. Suitable cutting material for predicted requirements x 2 harvested seeds if available for nursery propagation. | All available plants and associated soil harvested and transplanted to best extent practical |
| Performance criteria | No unsalvaged material present on ground inspection | Trees translocated no seed left unharvested. | No unsalvaged material present on ground inspection |
| Threshold | More than 10% of the original material present | Trees not translocated. Less than 15 cuttings transferred to nursery facilities | More than 10% of the original material present |
| Corrective action | Project manager to address with contractors | Project manager to address with contractors | Project manager to address with contractors |

| | | | |
|---|---|---|---|
| Compliance | No propagation to be undertaken. | Propagation progress satisfactory. | No propagation to be undertaken at this stage. Seed collected in case propagation is required. |

| Species | Weeping paperbark | White laceflower | Yellow-flowered king of the fairies |
|---|---|---|---|
| Aim | Create self-sustaining populations (two sites) | Maintain or enhance existing demographic function and genetic variability | Maintain a self-sustaining population. |
| Objectives | Plants complete their lifecycle and regenerate successfully | Create or augment small sub-populations with diffuse connectivity to meta population in the Coolgardie-Wardell area conserving existing genetic variability | Translocated clumps and individuals establish on new hosts flower set seed. |
| Performance criteria | At least 50 plants germinate and set seed each year from Year 2 | Clumps of plants established numerically sufficient to replace or augment the number of affected individuals or sub-populations. Progeny from all translocated individuals is established. | At least 20 plants establish flower and set seed each year from Year 2 |
| Threshold | Less than 30 plants germinate and set seed in any one year from Year 2* | Less than 80% of no of original clumps or individuals are established. Less than 80% of impacted plants represented by established progeny.* | Less than 15 plants establish and set seed in any one year from Year 2* |
| Corrective action | Use stored seed or collect additional seed from remaining source population nursery propagate and plant out. Re-evaluate site conditions to best target suitable planting sites. | Augment with nursery stock from (likely cutting grown) back up stock. | Evaluate host sites of any plants not functioning as required and assess benefits of re-location. |

| | | | |
|---|---|---|---|
| Compliance | Performance criteria and threshold inappropriate to species. | No loss of transplants, small amount of propagation achieved | Loss of only one plant from those translocated. Some plants flowered in Year 1 |

| | | | |
|---|---|---|---|
| Aim | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species | Increased knowledge of the threatened plant species |
| Objectives | Relevant project results and observations documented. | Relevant project results and observations documented. | Relevant project results and observations documented. |
| Performance criteria | Reporting to include e g. results of nursery tasks records of establishment and development. | Reporting to include observations of new growth on translocated trees results of nursery tasks. progress of seedling establishment as relevant. | Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks. |
| Threshold | Reporting incomplete | Reporting incomplete | Reporting incomplete |
| Corrective action | Project manager to address with sub-contractors | Project manager to address with sub-contractors | Project manager to address with sub-contractors |

| | | | |
|---|---|---|---|
| Compliance | Knowledge of species life cycle and translocation potential increased | Knowledge of species life cycle and translocation potential increased | Knowledge of species life cycle and translocation potential increased |

| **Species** | **Weeping paperbark** | **White laceflower** | **Yellow-flowered king of the fairies** |
|---|---|---|---|
| Aim | Achieve no net loss in local plant populations being impacted by the project | Achieve no net loss in local plant populations being impacted by the project | Improve options for augmentation through seedling production |
| Objectives | Original number of individuals re-established | Equivalent original number of individuals re-established. following guidelines for replacement of mature trees by seedlings/cuttings i.e ten seedlings established for any mature trees lost five seedlings established for any saplings lost. | Research program for seed propagation established and propagation underway. |
| Performance criteria | Compare with donor site. 70% of original number of plants established in Year 2 increasing to 100% minimum by Year 5 | Compare with donor site. 70% of original number of plants established in Year 2 increasing to 100% minimum by Year 5 | Specialist propagation facility engaged and liaison with field personnel established. Consultation with OEH SOS program. |
| Threshold | >50% of original number of plants established in Year 2 or similar levels below target in subsequent years* | >50% of original number of plants established in Year 2 or similar levels below target in subsequent years* | Insufficient understanding of seedling production techniques achieved by Year 3 production not underway |
| Corrective action | Replace with nursery back up stock. Evaluate options for sourcing more propagation material from remaining plants adjacent to donor population collect additional seed following guidelines for sampling | Replace with nursery back up stock. Evaluate options for sourcing more propagation material from neighbouring patches collect additional seed following guidelines for sampling | Consider options for alternative research partners |

| | | | |
|---|---|---|---|
| Compliance | On track to achieve no net loss. Suggest recount of impacted individuals before clearing. | On track to achieve no net loss. | Small loss of population. There may be local recruitment. |

| Species | Weeping paperbark | White laceflower | Yellow-flowered king of the fairies |
|---|---|---|---|
| Aim | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value | Make the best possible use of all plant material with potential conservation value |
| Objectives | Available seed is harvested for nursery propagation. | Trees and saplings are transplanted. All potential cutting material (and seeds if available) harvested for nursery propagation. | All available plants translocated to new hosts |
| Performance criteria | Trees translocated and cutting material collected to best extent practical for nursery propagation (at least 20 cuttings) | Trees and saplings translocated and cutting material collected to best extent practical for nursery propagation | No unsalvaged material present on field inspection |
| Threshold | Tree not translocated. Less than 15 cuttings transferred to nursery facilities | Tree and saplings not translocated. Less than 15 cuttings transferred to nursery facilities | Plants remain on host trees |
| Corrective action | Project manager to address with contractors | Project manager to address with contractors | Project manager to address with contractors |

| | | | |
|---|---|---|---|
| Compliance | More than adequate quantity of seed collected from cross-section of population. | Some seed collected. | No propagation planned at this stage, although seed available. |

# 5.0 Corrective Actions

*Cryptocarya foetida*

Establish a second receival site in the island of habitat to be retained between the new highway and the local road along Randell's Creek near Coolgardie Road. Introduce propagated seedlings to this site.

*Lindernia alsinoides*

Search for a source of plants to collect propagation material from. Propagate and introduce to suitable receival site now that the habitat requirements of this species are better understood.

Increase rainforest restoration effort on the BOS22 site.

There is no specific commitment to restore degraded rainforest regrowth on the BOS22 site or other sections of the Blackwall Range to good quality rainforest and thereby improve the health and future prospects of threatened flora population in the local area. Although mapped as Lowland Rainforest, the entire forested escarpment adjacent to the highway alignment is heavily infested with Large-leaved Privet and to a lesser extent Camphor Laurel. Ballina Shire Council has identified the Blackwall Range as a priority area for rainforest restoration and conservation. The BOS22 represents a sizeable area of this habitat and would benefit greatly from more exotic species removal and rainforest planting. Ecos Environmental is currently working on the restoration of Lowland Rainforest to a 2 hectare area at the rainforest species receival site as part of our 'maintenance' program.

# 6.0 Photographs

Plates 1- 108

# Slender Screw Fern (*Lindsaea incisa*)

Plate 1: Transplanting Slender Screw Fern (*Lindsaea incisa*) 21.9.2016


Plate 2: Trays of sod containing *Lindsaea incisa* ready for transport to the receival site. 28.10.2016

Plate 3: *Lindasea incisa* donor site along boundary trail in Mororo State Forest. 21.9.2016

Plate 4: Digging out at *Lindsaea incisa* donor site on eastern side of highway at dry site. 4.11.2016

Plate 5: Planting line at receival site in Bundjalung NP with patches of planted sod. 21.9.2016

Plate 6: Close-up of planted sod with *Lindsaea incisa* fronds. 21.9.2016


Plate 7: Plot A4 (Line A). Plastic cover defined plot, caught litter & protected transplant. 6.2.2017


Plate 8 : Plot A14. Fern fronds have grown up through grid since transplanting in Sept/16. 6.2.2017


Plate 9 : Plot A21. Fern fronds have grown up through grid since transplanting in Sept/16. 6.2.2017

Plate 10: Line of plots/trays at the start of February at the end of long dry period. 6.2.2017

Plate 11: Patch 2. Five patches were planted in a addition to plot/trays. 6.2.2017


Plate 12 : Patch 5. Healthy regrowth during dry period maintained by watering. 6.2.2017

Plate 13: After flash flood. Debris shows height of water and current. Trays washed away in background. 15.3.2017

Plate14 : Scene after another flash flood. Bamboo stake marks a plot with *L. incisa* under water. Some plastic covers were washed more than 50 metres away. 4.4.2017

# Yellow-flowered King of the Fairies (*Oberonia complanata*)

Plate 15: *Oberonia complanata* donor site after early works vegetation clearing. The host tree is next to person. 15.8.2016

Plate 16: Removing section of bark with clumps of orchids. 15.8.2016

Plate 17: Bark removed with orchid plant intact including roots. Note flower spike. 15.8.2016

Plate 18: Oberonia seedlings. These were separated and an unsuccessful attempt made to grow them on at the nursery. All eventually died over a period of 6 months. 15.8.2016

Plate 19: Two orchid plants attached by wire and ribbon to host tree at receival site in Bundjalung National Park. Paperbark was packed between the tree and removed bark. 15.8.2016

Plate 20: The same plants below on 5.4.2017 in good condition. Note flower spike on lower orchid.

# Singleton Mint Bush (*Prostanthera cineolifera*)

Plate 21: Donor site with over-mature Singleton Mint Bush (the leaning stems). Soil was collected from beneath these bushes. 2.8.2016

Plate 22: Leaves and twigs were spread over the soil and burnt to stimulate seed germination.

Plate 23 : Seedling densities two months after control, low fire and high fire treatment (l-r). 27.10.2016

Plate 24: Close-up of seedlings in burnt tray, P.cineolifera seedling top centre . 27.10.2016

Plate 25: *P. cineolifera* tubestock growing in nursery, January 2017

Plate 26: *P. cineolifera* tubestock ready for planting, 23.3.2017.

Plate 27: *P. cineolifera* receival site - forest sub-habitat Tabbimoble Triangle, 23.3.2017.

Plate 28: *P. cineolifera* receival site - minor gully sub-habitat Tabbimoble Triangle, 23.3.2017.

Plate 29 : *P. cineolifera* receival site - open-woodland sub-habitat, 23.3.2017.

Plate 30: Planting one the experimental plots with 16 tubestock, 4 per quarter, bamboo staked marks the centre of 1m square plot. 12.4.2017.

Plate 31 : Experimental plot D12 (Transect D – sandy) with 16 tubestock, bamboo stakes mark the corners and centre of plot. 12.4.2017.

Plate 32: Planted *P. cineolifera* seedling 12.4.2017.

Plate 33 : P. cineolifera plant in the experiment (planting no. 2) showing wilt symptoms probably caused by a root pathogen on transect A, approx. 2 months after planting. 23.6.2017.

Plate 34: *P. cineolifera seedling* in the experimental planting (planting no. 2) on transect C in healthy condition with no wilt symptoms, approx. 2 months after planting. 23.6.2017.

# Weeping Paperbark (*Melaleuca irbyana*)

Plate 35 : Weeping Paperbark (*Melaleuca irbyana*) seed capsules, New Italy, 2.8.2016.

Plate 36 : Weeping Paperbark (*Melaleuca irbyana*) seedlings potted into tubes. 27.10.2016

Plate 37: Weeping Paperbark seedlings ready for planting. 20.4.2017

Plate 38: Weeping Paperbark receival site on offset land south of Tabbimoble Creek, area no. 1 fenced to keep grazing animals out (marsupials, horses). 20.4.2017

Plate 39: Weeping Paperbark receival site on offset land south of Tabbimoble Creek, area no.2. Fence in the background to excluder grazers. 20.4.2017

Plate 40: Weeping Paperbark – planted seedling tubestock. 20.4.2017

# Tall Knotweed (Persicaria elatior)

Plate 41: Transplanting old Tall Knotweed (*Persicaria elatior*) and collecting mud substrate to trial seedbank germination. Goodwood St North donor site. First translocation, 31.8.2016

Plate 42: Old Tall Knotweed (*Persicaria elatior*) underwater stem with adventitious roots, 1.9.2016

Plate 43: Old prostrate Tall Knotweed (*Persicaria elatior*) stem with emergent leaves and flowers would have been 3m high if standing up. First translocation, 1.9.2016


Plate 44: Transplanting advanced seedlings of Tall Knotweed. Second translocation, 8.11.2016.

Plate 45: Close up of lower stems with jointed aquatic growth form. Second translocation, 8.11.2016.

Plate 46: Tall Knotweed seedlings salvaged and grown-on for third translocation, 11.11.2016.

Plate 47: Tall Knotweed seedlings from plate above grown-on in nursery, a few starting to flower 29.1.2016.

Plate 48: Yaegl Nature Reserve, Tall Knotweed receival site from translocation 1 to 3. Bamboo stakes mark first translocation – old plants and soil seedbank. End of long dry spell. 6.2.2017.

Plate 49: Tall Knotweed receival site, soil seedbank plot no. 23 in Couch Grass zone. No Tall Knotweed. 6.2.2017

Plate 50: Tall Knotweed receival site, soil seedbank plot no. 15 in Water Couch zone. 6.2.2017

Plate 51: Tall Knotweed receival site, soil seedbank plot no. 17 in Water Couch zone. 6.2.2017

Plate 52: Tall Knotweed clumps from second translocation (planted 8.11.2016) at end of long dry spell. Black soil is from watering. 6.2.2017

Plate 53: Tall Knotweed clump no. T8 from plate above, end of long dry, very few flowers. 6.2.2017

Plate 54: Tall Knotweed tubestock grown from salvaged seedlings for third translocation . Planted 22.2.2017

Plate 55: Tall Knotweed translocation 3, plot planted with 20 tubestock in Paspalum conjugatum zone. Planted 22.2.2017.

Plate 56: Tall Knotweed translocation 3, close-up of tubestock in tray showing flower/seed spikes. 22.2.2017

Plate 57: Tall Knotweed translocation 3, plot flooded with Tall Knotweed tops above water. 4.4.2017.

Plate 58: Tall Knotweed translocation 2 (planted 8.11.2016). Water 50cm deep, plants in flower, 4.4.2017.

Plate 59: Tall Knotweed translocation 1 soil seedbank plot (spread 31.8.2016). Water 50cm deep. 4.4.2017.

Plate 60: Tall Knotweed translocation 1, soil seedbank plot (spread 31.8.2016) with emergent Tall Knotweed in flower, water 20cm deep. 4.4.2017.

Plate 62: Tall Knotweed, translocation no. 1, soil seedbank plot no. 22 (spread 31.8.2016). Emergent Tall Knotweed in flower, water 20cm deep. 4.4.2017.

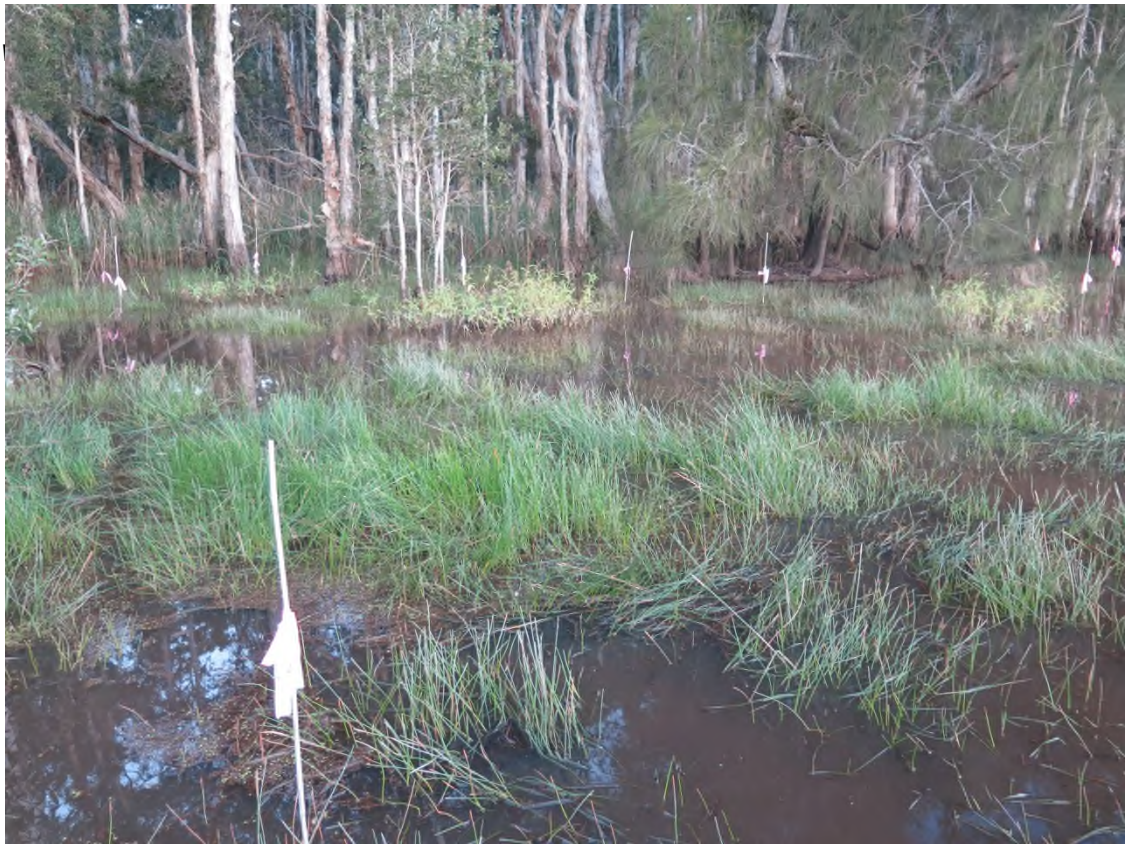


Plate 62: Tall Knotweed receival site, planting no. 2 (translplants), flooded from March to the end of June. 30.6.2017

Plate 64: Tall Knotweed receival site, planting no. 2. Transplant no. 8, over 2 metres wide, flowering, growing as a floating aquatic, roots in water not substrate (see below) 30.6.2017

Plate 65: Tall Knotweed, planting no. 2 (transplants). Some plants were still alive in winter and growing as a floating aquatic. Roots produced from bulbous stem joint (see Plate 41) 30.6.2017

Plate 66: Tall Knotweed receival site, planting no. 3 (tubestock planting). Plot no. 12 end of Year 1, still flooded with several emergent Tall Knotweed alive and flowering.

Plate 67: Tall Knotweed receival site, planting no. 3 (tubestock planting). Plot no. 11 end of Year 1. Recently germinated Tall Knotweed seedlings bottom right corner, receding water. 30.6.2017

Plate 68: Tall Knotweed receival site, planting no. 3 (tubestock planting). Plot 11, close-up of recently germinated seedlings in plate above. Water from recent rain. 30.6.2017

Plate 69: Tall Knotweed receival site, planting no. 3 (tubestock planting). Plot 10, recent seedling recruits 10-15cm tall grazed by kangaroos. 30.6.2017

# Four-tailed Grevillea (*Grevillea quadricauda*)

Plate 70 : Four-tailed Grevillea in flower at the donor site 11.10.2016.

Plate 71: Four-tailed Grevillea soil seedbank collected to apply fire treatment at nursery. 11.10.2016.

Plate 72: Four-tailed Grevillea propagation from soil seedbank. Soil in trays after fire. 27.10.2016.

Plate 73: Four-tailed Grevillea salvaged from footprint and grown-on in pots for 5 months before introduction to the receival site. Plants on site ready for planting. 24.3.2017.

Plate 74 : Four-tailed Grevillea receival site fenced and planted with 14 salvaged plants. 24.3.2017.

Plate 75: Four-tailed Grevillea individual planted at receival site. 24.3.2017.

Plate 76: Four-tailed Grevillea no. 12 over a metre high and flowering only 3 months after being planted at the receival site. 17.7.2017.

Plate 77: Four-tailed Grevillea receival site at the end of Year 1 (top of plant in the foreground) 17.7.2017.

# Stinking Cryptocarya (*Cryptocarya foetida*)

Plate 78: Stinking Cryptocarya (*Cryptocarya foetida*). Leaves of sapling transplant at Randle's Creek donor site north of Coolgardie Road, excavated root ball below. 27.10.2016

Plate 79: Stinking Cryptocarya (*Cryptocarya foetida*). Donor site at Randles Creek. Saplings dug out with root ball, pruned and ready for transport to the receival site at Lumleys Lane). 27.10.2016

Plate 80: Planting at the Lumleys Lane (BOS22) receival site, an open paddock with a few trees. Dam in background for watering. 27.10.2016

Plate 81: Stinking Cryptocarya (*Cryptocarya foetida*). Transplant no. 19, EMM field tag no.0009. Leafy shoots reshot from pruned branches and main stem. 3 months after transplanting 27.1.2017


Plate 82: Stinking Cryptocarya (*Cryptocarya foetida*). Transplant no. 3, EMM field tag 12. Leafy shoots reshot from the pruned main stem. Three months after transplanting. 27.1.2017


Plate 83: Stinking Cryptocarya (*Cryptocarya foetida*). Transplant no. 2, EMM field tag 179. Leafy shoots reshot from the pruned branches and main stem. Three months after transplanting. 27.1.2017

Plate 84: Rainforest species receival site at Lumleys Lane (BOS22) at the end of Year 1. As well as receiving five threatened rainforest species, the 2 ha site has been planted with tubestock and ten common rainforest species salvaged from the construction footprint. Wallaby guards have been installed around the plantings. The dead trees in the background are exotic Large-leaved Privet which is being removed from the adjoining rainforest regrowth by drilling and poisoning. 23.6.2017

# Rusty Green-leaved Rose Walnut (*Endiandra muelleri ssp. bracteata*)

Plate 85: Rainforest species receival site at Lumley's Lane (BOS22) upslope of dam. Blackwall Range hills behind with rainforest regrowth. Receival site for Rusty Green-leaved Rose Walnut and other rainforest species including Stinking Cryptocarya, Red Lilly Pilly, Bush Nut and White Laceflower.

Plate 86: Interior of rainforest regrowth dominated by exotic Large-leaved Privet (*Ligustrum sinense*) and occasional native species. This habitat is being rehabilitated as part of the translocation project.

Plate 87: Rusty Green-leaved Rose Walnut sapling transplant. Leafy shoots regrew from axils of pruned branchlets. 29.1.2017

Plate 88: Rusty Green-leaved Rose Walnut seeds and leaf specimens from the Blackwall Range. 3.2.2017

# Red Lilly Pilly (*Syzygium hodgkinsoniae*)

Plate 89: Red Lilly Pilly seedlings growing in the nursery. 29.1.2017

Plate 90: Red Lilly Pilly seedling planted at Lumleys Lane receival site, inside wallaby guard 23.6.2017

# White Laceflower (*Archidendron hendersonii*)

Plate 91: White Laceflower (*Archidendron hendersonii)* transplant at Lumleys Lane receival site 23.6.2017

# Rough-shelled Bush Nut

# (*Macadamia tetraphylla*)

Plate 92: A strongly coppicing growth-form of *M. tetraphylla* occurs along the alignment on Section 10. This individual had more than 40 stems from lignotuber-like root crown. Seeds were collected from the coppiced form and single-stemmed plants for propagation. 8.5.2017

Plate 93 : *Macadamia tetraphylla* seed germinating in a cow pat. 8.5.2017

# Hairy Melichrus (*Melichrus hirsutus*)

Plate 94: In situ Hairy Melichrus (*Melichrus hirsutus*) plant with pink flower buds. 5.4.2017

Plate 95: Transplanting Hairy Melichrus. The sprawling low bush was divided into two. 14.10.2017

Plate : Hairy Melichrus six months after transplanting, plant with pink flower buds. 5.4.2017

# Hairy Joint Grass (*Arthraxon hispidus*)

## Section 10 (Lumleys Lane to Coolgardie Rd)

## Section 3 (Mitchell Rd)

Plate 96: Hairy Joint Grass (*Arthraxon hispidus*) receival site at Lumley's Lane, BOS22 (Section 10). Plastic trays and bamboo stakes with pink tag mark transplanted clumps of Hairy Joint Grass.


Plate 97: Hairy  Joint Grass plot no. 5  27.1.2017. Plastic trays were inverted to mark out plot and to protect small plants from grazing, which then grew up through grid.


Plate 98: Hairy Joint Grass plot no. 7. Plant were watered through long dry spell to maintain good condition. 27.1.2017


Plate 99: Hairy Joint Grass. Plot no. 30. Yellowing was due to wilting between watering. 27.1.2017

Plate 100: Hairy Joint Grass (*Arthraxon hispidus*) receival site at Mitchell Rd (Section 3). Bamboo stakes with pink tag mark transplanted clumps of Hairy Joint Grass. 5.4.201

Plate 101: Hairy Joint Grass plot at Mitchell Rd. Plants growing in water and already seeding and dying off. This occurred a month earlier than at the Lumley's Lane site, possibly due to hydrology.

# Lindernia (*Lindernia alsinoides*)

Plate 102: *Lindernia alsinoides*, a trailing swamp herb with white and lilac flowers

Plate 103: *Lindernia alsinoides* donor site 1km north of Mitchell Rd;  a small swampy drainage line in sandy terrain. Transplanting 13.12.2016

Plate 104: Digging out sods of swamp vegetation containing Lindernia. 13.12.201

Plate 105: Lindernia was growing on a peaty sand substrate formed in the small swamp, with sedges, swamp grasses and sphagnum moss. 13.12.2016

Plate 106: Lindernia receival site on the same drainage line on the opposite side of the highway in the road reserve. The plots were flooded in the rainy season and leachate from earthworks produced thick brown iron precipitate, most Lindernia plants died back. 5.4.2017

# Rotala (*Rotala tripartita*)

Plate 107: *Rotalla tripartita*, a small swamp herb. At donor site opposite Tully Morgan Road. 3.5.2017

Plate 108: Rotalla habitat, a drainage line depression in a paddock with shallow water. At donor site Tully Morgan Road, eastern side of the highway. 3.5.2017

# 7.0 References

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