

# Translocation Monitoring

Annual Report – 2017

Pacific Highway Upgrade: Woolgoolga to Ballina  
Sections 1, 2 & Early Works Soft Soil Treatment Areas

# **TRANSLOCATION MONITORING**

Sections 1 and 2 and Early Works Soft Soil  
Treatment Areas

Annual Report 2017

Woolgoolga to Ballina Pacific Highway Upgrade



Landmark Ecological Services Pty Ltd  
PO Box 100, Suffolk Park 2481  
Phone 02 6685 4430  
Email [landmark@landmarkonline.com.au](mailto:landmark@landmarkonline.com.au)

For  
NSW Roads and Maritime  
Services

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## EXECUTIVE SUMMARY

New South Wales Roads and Maritime Services (Roads and Maritime) is required to implement translocation strategies for threatened flora species, where translocation is assessed as feasible, for a construction stage incorporating Sections 1 and 2 and Soft Soils Early Treatment Works of the Woolgoolga to Ballina Pacific Highway upgrade. In accordance with the translocation strategies, material has been removed from the construction corridor for direct transplants and/or seeds and cuttings have been collected for nursery propagation and growing on. In addition, the strategies set out requirements for monitoring and reporting. This 2017 annual report for Year 2 includes the results of formal monitoring inspections conducted in spring 2016 and autumn 2017, with earlier baseline and monitoring results included for comparison.

Nine flora species have been translocated, or prepared for translocation. These are:

Green-leaved rose walnut	<i>Endiandra muelleri</i> subsp. <i>bracteata</i> (now discontinued)
Hairy joint-grass	<i>Arthraxon hispidus</i>
Moonee Creek Quassia	<i>Quassia</i> sp Moonee Creek (now discontinued)
	<i>Lepidosperma</i> Coaldale
Noah's false chickweed	<i>Lindernia alsinoides</i>
Slender screw-fern	<i>Lindsaea incisa</i>
Square-fruited ironbark	<i>Eucalyptus tetrapleura</i>
Square-stemmed spike-rush	<i>Eleocharis tetraquetra</i> (now discontinued)
Tall knotweed	<i>Persicaria elatior</i>

Nine receiving sites have been employed to date, some with multiple species. Methods have included direct transplant (plants, soil slabs including plants and/or soil-stored propagules) and planting out of nursery raised cuttings, seedlings or grown on harvested seedlings. Monitoring locations have been established at each receiving site for each species present.

Initial translocation actions are complete for some species while intermediate steps (propagule collection and nursery production) are still underway for others. Seed from Square-fruited ironbark has proved difficult to collect. Adaptive actions have been implemented where the results of initial translocations have been unsatisfactory (as a result of adverse climatic conditions, non-optimal timing of translocations and marsupial/cattle grazing). Success has been mixed and further supplementary actions have been undertaken where prospects for achieving targets can realistically be improved.

The translocations have been formally evaluated against targets. Generally, the ecological processes of development of the translocated populations are slow in relation to the timeframe of the monitoring program. Translocation has been discontinued for three species (removal of species not required or no feasible opportunities for advancement towards targets). For those species for which actions and monitoring are continuing, progress

Hairy joint-grass	Reasonable progress towards targets at Trustums Hill
<i>Lepidosperma</i> Coaldale	No formal targets set but propagation and establishment stages satisfactory
Noah's false chickweed	Recent re-plantings conducted successfully
Slender screw-fern	Limited establishment, but useful trials of experimental techniques
Square-fruited ironbark	Good early establishment for a small number of plants, propagation continuing
Tall knotweed	Large seed inputs into an existing populations, results of translocation actions will be difficult to separate from ongoing population development.



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# 1. Introduction

## 1.1 Project background

New South Wales Roads and Maritime Services (Roads and Maritime) has approval for the Woolgoolga to Ballina (W2B) Pacific Highway upgrade project under Part 5.1 of the NSW Environmental Planning and Assessment Act 1979 (EP and A Act) and the Commonwealth Environment Protection and Biodiversity Act 1999 (EPBC Act). In accordance with the NSW Minister's Conditions of Approval (MCoA) D7, Flora Translocation Strategies have been prepared and partly implemented, in stages.

The project is divided into 11 sections, of which Section 1, from Woolgoolga to Halfway Creek (17 km), and Section 2, from Halfway Creek to Glenugie (15 km), have been the subjects of a Flora Translocation Strategy for Sections 1 and 2 (Roads and Maritime 2015a). In addition, due to the presence of soft soils in the vicinity of the Clarence River and Richmond Floodplains, initial works have been required in advance of the main construction of the highway. A second Flora Translocation Strategy specifically addresses Early Works Soft Soil Treatments Works (Roads and Maritime 2015b) and includes threatened flora species occurring in parts of Sections 4, 5 and 8.

A total of nine species were identified for translocation (Table 1). Eight species were identified in the translocation strategies. An additional undescribed species, *Lepidosperma* "Coaldale", not currently listed as threatened, was located in pre-clearing surveys and also identified for translocation. *Lepidosperma* "Coaldale" was located at Wells Crossing in Section 2.

**Table 1:** Flora species identified for translocation

Common name	Scientific name	TSC Act	EPBC Act	Section 1	Section 2	Soft Soils
Green-leaved rose walnut	<i>Endiandra muelleri</i> subsp. <i>bracteata</i>	E				x
Hairy joint-grass	<i>Arthraxon hispidus</i>	V	V	x		x
Moonee Creek Quassia	<i>Quassia</i> sp Moonee Creek	E	E	x		
	<i>Lepidosperma</i> Coaldale				x	
Noah's false chickweed	<i>Lindernia alsinoides</i>	E		x		
Slender screw-fern	<i>Lindsaea incisa</i>	E		x	x	
Square-fruited ironbark	<i>Eucalyptus tetrapleura</i>	V	V	x*	x	
Square-stemmed spike-rush	<i>Eleocharis tetraquetra</i>	E		x		
Tall knotweed	<i>Persicaria elatior</i>	V	V			x

\* Square-fruited ironbark was detected in Section 1 during pre-clearing surveys and is additional to documentation in the relevant translocation strategy.

The strategies set out methods to be used for translocation, receiving sites suited to establishment of new populations and performance targets, including no net loss of plants, establishment of self sustaining populations and the generation of new knowledge about translocation techniques. It was acknowledged that translocation would be difficult or experimental for some species and that appropriate seasonal conditions would be necessary for a reasonable chance of success.

A monitoring and status report (Landmark Ecological Services 2017) was prepared to document the results of Year 1 translocation actions. Further inspections have been undertaken during Year 2.

## 1.2 Project roles

Bushland Restoration Services Pty Ltd undertook site- and species-specific planning from the broad strategies, prepared the receiving sites, carried out translocation actions and undertook maintenance. Landmark Ecological Services Pty Ltd carried out monitoring inspections, evaluation and reporting.



### 1.3 Monitoring schedule

The strategies require that monitoring inspections are conducted quarterly for the first year; every six months in the second year and once a year thereafter. Informal inspections were also undertaken in conjunction with management actions. In Year 2, formal monitoring inspections were conducted in spring 2016 (overview November followed up with detailed observations during December) and May 2017. Planting continued into June–July 2017 (July plantings included here although beyond Year 2 reporting period) and baseline data were collected and included with this report. Cumulative results are presented.

### 1.4 Translocation progress

Translocation actions have continued during Year 2, achieving some limited successes. Difficulties in Year 1, including sub-optimal timing of translocation actions resulting from delayed access to donor sites and extreme dry conditions, had resulted in generally poor survivorship. The translocation of soil containing stored seed and shedding of seed from translocated plants had, however, produced potential for new seedling emergence during Year 2. Monitoring continued wherever there was potential for seed survival in the soil. Hence, observations of apparently unsuccessful translocation actions have continued since resprouting from rhizomes (Square-stemmed spike-rush) and germination from soil-stored seeds (Noah's false chickweed, Tall knotweed) has been considered possible.

In Year 2, adaptive actions for under-performing translocations have been undertaken where assessed as feasible to advance towards targets.

New plantings have been successfully established for Square-fruited ironbark, *Lepidosperma* "Coaldale" and Noah's false chickweed – the latter replacing plants that have suffered from adverse climatic conditions and grazing. Translocation actions for Square-fruited ironbark remain incomplete as a result of difficulties in obtaining seed, but plantings have been successfully conducted. Slender screw-fern has persisted with low survivorship through a prolonged dry period and has been augmented with new plantings of nursery material. Slender screw-fern is known to die back in dry conditions and resprout when soil moisture improves. There are early signs that actions undertaken for Tall Knotweed and Hairy joint-grass have achieved seed input into existing populations.

Weather conditions have been unusually dry for much of the translocation period, delaying plantings and producing poor conditions for development. Many translocated plants are wetland species. In contrast, brief wet periods have produced severe flooding events which have delayed some plantings and restricted access to some sites.

Weed management has been conducted and fencing erected where required (Kangaroo Trail Road).

As noted for Year 1, Green-leaved rose walnut, prepared for a translocation event that later was not required, is no longer subject to monitoring, although some weed management has been continued at the site.

A summary of the progress of the translocations is provided in Table 3 and full details provided in Appendices 1 and 2. Appendices 1 and 2 also include details of methods used for each translocation.

An evaluation of the progress of the translocations is included in Section 5.

**Table 2 Translocation and monitoring actions July 2016 – June 2017**

Sp = site preparation, PI = planting, Mo = monitoring, Ma = Management, iM = informal monitoring (also conducted in conjunction with management) Management and monitoring prior to July 2016 is reported in Landmark (2017), see also Appendix 1.

Donor site	Receiving site	Methods	Planting history	2017																		
				J	A	S	O	N	D	J	F	M	A	M	J							
<b>Section 1</b>																						
<b>Square-stemmed spikerush</b>	Redbank Creek	Halfway Creek Crossing	Soil slabs (stored)					Ma	Mo	Mo										Mo	Ma	
<b>Hairy joint-grass</b>	Redbank Creek	Kangaroo Trail	Soil slabs (stored)					Ma	Ma	Mo	Ma									Mo	Ma	
<b>Noah's false chickweed</b>	Redbank Creek	Kangaroo Trail	Nursery plants					Ma	Ma	Mo	Ma									Sp	PI, Ma	
<b>Noah's false chickweed</b>	Redbank Creek	Halfway Creek	Nursery plants					Ma	Mo	Mo	Mo									Mo, Sp	PI	
<b>Noah's false chickweed</b>	Redbank Creek	Halfway Creek	Soil slabs (stored)					Ma	Mo	Mo	Ma									Mo	Ma	
<b>Noah's false chickweed</b>	Redbank Creek	Yurraygir SCA	Slabs					iM	Mo	Mo										Mo		
<b>Slender screw-fern</b>	Redbank Creek		Nursery raised plants						Mo	Mo	Ma									iM	PI, Mo	Ma
<b>Slender screw-fern</b>	Redbank Creek	Kangaroo Trail	Slabs/plants					Ma	Ma	Mo	Mo									Mo	Ma	Ma
<b>Moonee Quassia</b>	Dirty Creek	Dirty Creek road reserve	Nursery cuttings (no strike)																			
<b>Section 2</b>																						
<b>Square-fruited ironbark</b>		Mahogany Drive	Nursery, raised from seed																		Sp, PI	
<b>Lepidosperma "Coaldale"</b>	Wells Crossing	Pillar Valley	Nursery, plants					PI	Mo											Mo		
<b>Soft Soils</b>																						
<b>Tall knotweed</b>	Macleean Interchange	Yaegl NR south	Nursery raised plants from seedlings					Ma	Ma	Mo	Ma									Mo		
<b>Green-leaved rose-walnut</b>	Macleean Interchange	Macleean Interchange road reserve	Single small tree (direct transplant)								Ma									Mo	iM, Ma	
<b>Hairy joint-grass</b>	Trustums Hill	Trustums Hill road reserve	Slabs/plants directly transplanted					Ma	Ma	Mo	Mo									Mo	Ma	Ma



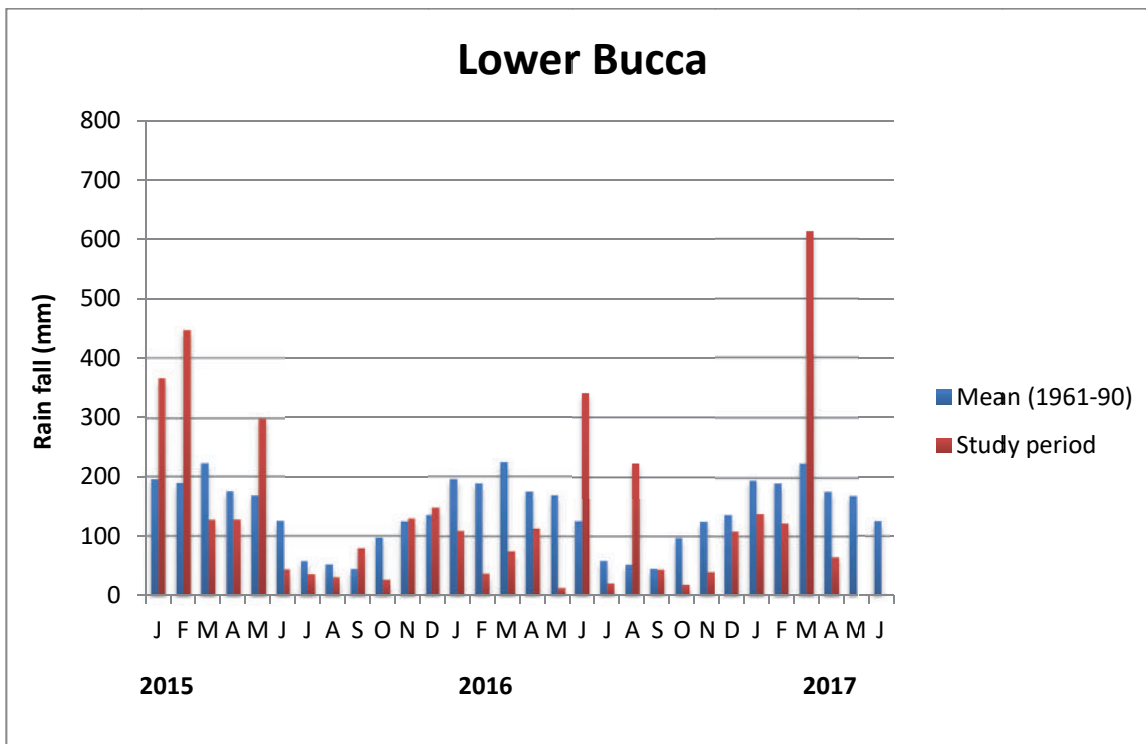


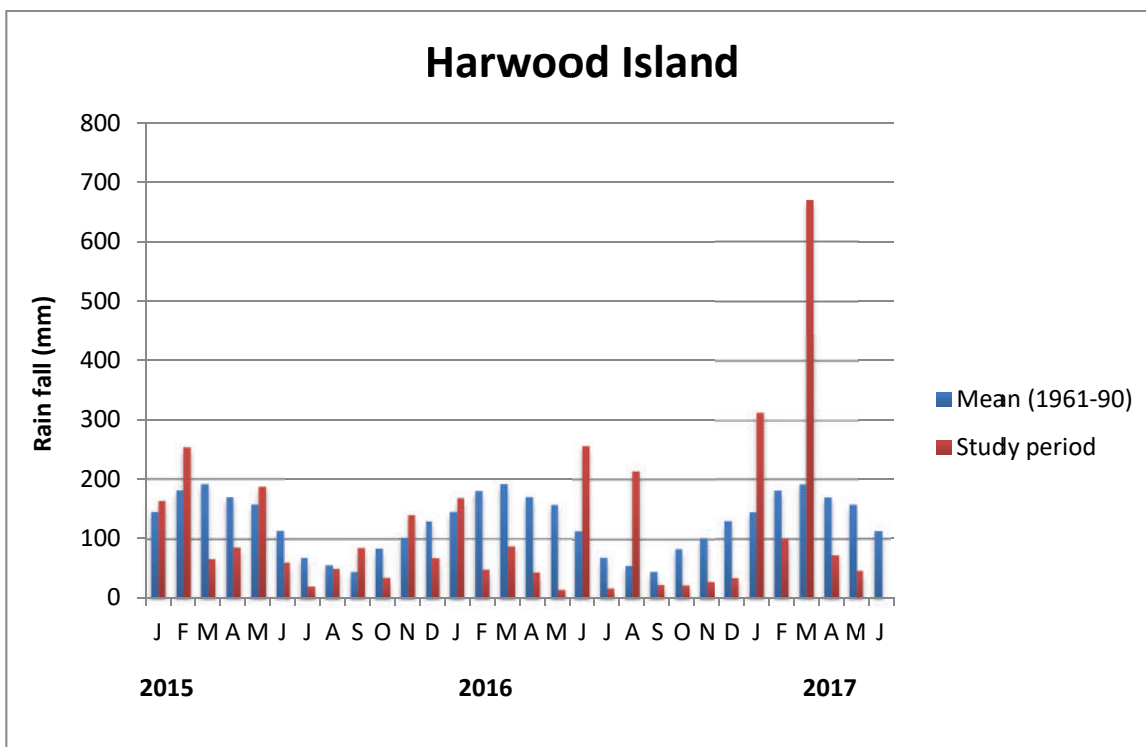
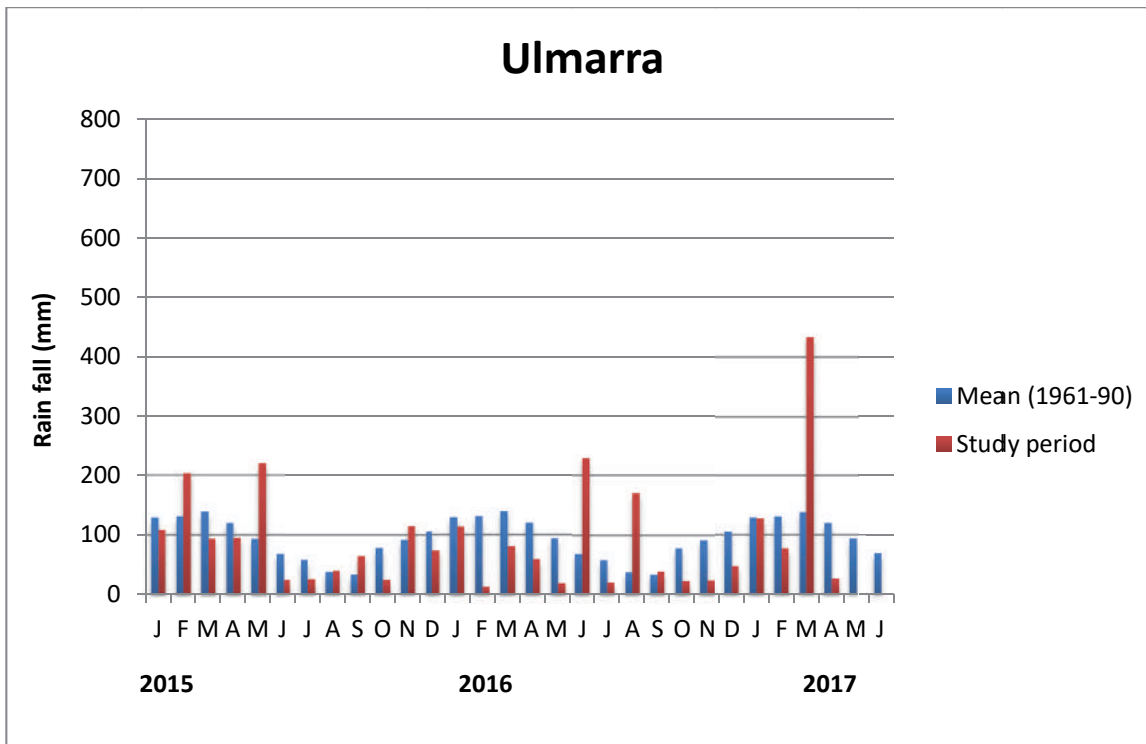
Donor site	Receiving site	Methods	Summary of current status	Recommendations and proposed future actions
<b>SECTION 2</b> <b>Square-fruited ironbark</b>	Pillar Valley	Nursery, seed	79 plants recently established. Additional seed collected, transferred to nursery and sown.	Difficult to judge whether sufficient seed has been collected. Maintenance and monitoring according to schedule.
<b>SOFT SOILS</b> <b>Tall Knotweed summary</b>		Slabs, plants, Nursery, seed	A lot of material has been transplanted and includes slabs, plants and nursery stock. Translocated plants have died back. A small number of seedlings observed in spring 2016 have not persisted, but additional seedlings had emerged by autumn 2017. (Applies to all Tall Knotweed operations)	Interpretation of the results will be difficult as this is an ephemeral species and the translocations augment an existing population. Maintenance and monitoring according to schedule.
<b>Tall knotweed</b>	Yaegl north	Soil	Completed	
<b>Tall knotweed</b>	Yaegl central east	Soil	Completed	
<b>Tall knotweed</b>	Yaegl central west	Plants	Completed	
<b>Tall knotweed</b>	Yaegl NR south	Nursery plants, plants	Completed	
<b>Green-leaved rose-walnut</b>	Maclean Interchange	Single small tree has been prepared for translocation	Translocation not required	Weed management continuing
<b>Hairy joint-grass</b>	Trustums Hill	Trustums Hill road reserve	Large amounts of material (slabs and clods) were moved in two operations to sites in the adjacent road reserve. Some of the plantings were in a power line easement (Site 1), no plants were surviving competition with biomass in Year 1. Biomass now reduced.	Ongoing removal of biomass at the power line site (Site Ongoing removal of <i>Casuarina glauca</i> seedlings required at Site 2. Monitoring according to schedule.
	Trustums Hill road reserve	Slabs/plants	Additional material was moved to the east of power line (Site 2) – plants established and persisting, but represented by dead material only in autumn (as expected for time of year).	

## 1.5 Rainfall

The monthly rainfall data for weather stations close to the south (Lower Bucca) and north (Ulmarra) of Sections 1 and 2 and representative of the Soft Soils Treatment Areas (Harwood Island) was extracted in June 2017 from the Bureau of Meteorology website. Weather stations for which data was available at least from 1960 to present were selected for illustration purposes.

Summer and autumn 2015-16 were unusually dry, but were followed by very heavy rain during an east coast low in early June 2016. Soil moisture conditions improved dramatically in the short term, but a further dry summer period followed. January 2017 rain was heaviest in the north of the study area. Cyclone Debbie produced major flooding in March 2017, resulting in good, though seasonally late, planting conditions once flooding had abated sufficiently to permit site access.





Source <http://www.bom.gov.au/climate/data/index.shtml> extracted 1 June 2016

## 2 Methods

Data collection for monitoring was consistent with the methods identified in the threatened flora translocation strategies (Roads and Maritime Services 2015a and b), and followed the interpretation of Jacobs (2014) where appropriate.

Data collected, as relevant to site and species, included:

Genus, species and subspecies.

Identifier – unique plant number.

Location – location; easting, northing & description.

General condition – score on a scale of 0 to 5, where 0 is dead and 5 is excellent.

Leaf condition – healthy/unhealthy, colour, vigour.

Flower/fruit – flower/fruit presence.

Length of new shoots – average length of new shoots (estimate) and abundance of new shoots (counts or basic scale).

Disease symptoms – evidence of disease (including presence / absence of Myrtle Rust, Cinnamon Fungus)

Recruitment.

Evidence of any other damage or disturbance.

Plant community type.

Canopy cover.

Mid-storey cover.

Ground-layer cover and composition.

Weed abundance and composition.

Recruitment of canopy and mid-storey species.

Climatic events (e.g. drought, flood, unusually cold winter temperatures etc.).

Maintenance carried out – when and what kind of maintenance carried out at the site since the last monitoring

Any other ecological impacts.

Habitat monitoring transects (following Jacobs 2014) were set up in central locations within each planting area. Transects were 20m long, oriented N-S and marked with double pink flags on tree trunks or stakes.

Habitat data collected included:

- Dominant flora species in each structural layer
- Prevailing site conditions and (ie soil moisture, climate, and water levels and flow)
- Landscape parameters (ie landform, drainage, slope and aspect)

Cover of vegetation layers was recorded using the 20 metre transect with the canopy and midstorey (greater than one metre high) cover recorded as percentage foliage cover every five metres (four points) along the transect.

Groundcover attributes were recorded at every metre (20 points) as either forb, grass, shrub (less than one metre high), bare/water, litter or exotic

For species with growth forms not suited to counts and measurements of individual stems, eg Hairy joint-grass and Slender screw fern, area- and cover abundance-based measurements were preferred in order to track growth and development.



Photographs were taken at each location including:

- Habitat view from north point of transect
- Individual plants and/or clusters of plants, insect attack, dieback and habitat conditions.

Where populations or individuals of the translocated threatened flora species were present in the vicinity of the receiving site, a sample of a reference population was identified at the time of translocation and marked in order to compare the growth and development of plants that have been translocated.

## 3 Results

### 3.1 Monitoring locations

The strategies set out details of flora species to be translocated, including locations of donor populations and of receiving sites (Table 3). Multiple options for receiving sites are generally provided. In some instances, plants had been shared between two receiving sites to spread risks or to optimise use of best-suited habitat.

Multiple species were translocated to some of the receiving sites, in which case habitat monitoring transects were usually set up for each species. Monitoring locations were established at eight receiving sites, summarized as follows (Table 4) and mapped (Figure 1). Most monitoring locations include marked habitat transects.

Table 4 Summary of receiving sites and monitored threatened species

Location	Species
Kangaroo Trail	Noahs false chickweed, Slender screw fern, Hairy joint-grass
Halfway Creek Crossing	Noahs false chickweed, Square-stemmed spike-rush
Yuraygir SCA	Noahs false chickweed
Mahogany Drive	Lepidosperma "Coaldale"
Pillar Valley	Square-fruited ironbark
Yaegl NR south	Tall knotweed
Yaegl NR central	Tall knotweed
Trustums Hill	Hairy joint-grass

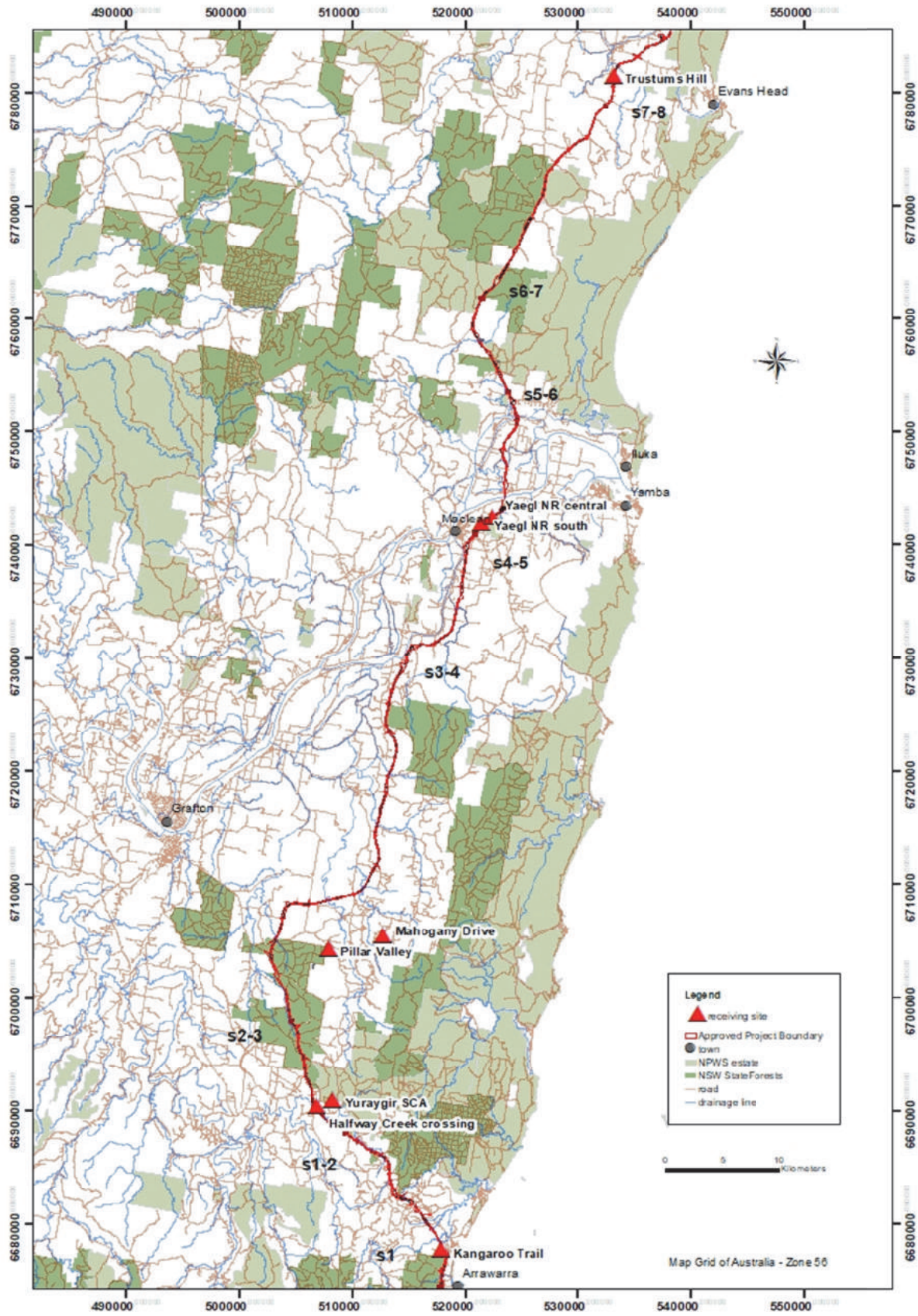


Figure 1 Locations of receiving sites

### 3.2 Species-specific results

The results, including location, habitat conditions, details of individuals of each threatened species are summarized in Table 5 with details, including a selection of photographs, provided in Appendix 1 for species for which translocation plantings have been undertaken.

Table 5 Translocation results

Donor site	Receiving site	Methods	Results Autumn 2016	Spring 2016	Autumn 2017	
<b>SECTION 1</b>						
<b>Noah's false chickweed</b>	Redbank Creek	Yuraygir SCA	Slabs/plants	6 plants remaining of original 22. Flowers on 2 plants, seed capsules on 1	3 plants	no plants observed
	Halfway Creek crossing	Soil slabs stored	no plants observed	no plants observed	no plants observed	no plants observed
	Halfway Creek crossing	Nursery plants	n/a, not yet planted out	n/a, not yet planted out	~ 500 plants newly planted	
	Kangaroo Trail	Nursery plants	30 plants remaining of original 350. Flowers on 17 plants, seed capsules on 11	1 plant remaining	no plants observed	
	Kangaroo Trail	Nursery plants				
<b>Slender screw-fern</b>	Cassons Creek	Kangaroo Trail	Nursery plants	Plants at 17 of original 45 planting points. 19 plants from nursery planted May 2017	10 plants	~ 500 plants newly planted 20 plants in total
	Redbank Creek	Kangaroo Trail	Stored soil	no plants observed	no plants observed	no plants observed
<b>Hairy joint-grass</b>	Redbank Creek	Halfway Creek Crossing	Soil slabs stored	no plants observed	no plants observed	no plants observed
<b>Square-stemmed spikerush</b>	Redbank Creek	Halfway Creek Crossing	Soil slabs stored	no plants observed	no plants observed	no plants observed
<b>Moonee Quassia</b>	Dirty Creek	Dirty Creek road reserve	Nursery cuttings	No strike		
<b>SECTION 2</b>						
<b>Lepidosperma "Coaldale"</b>	Wells Crossing	Mahogany Drive	Nursery, plants	n/a, not yet planted out	35 plants including one previously scored as dead	20 plants recorded – underestimates survivorship as others maybe found when shading ground ferns are removed.
<b>Square-fruited ironbark</b>	Franklins Road and vicinity	Pillar Valley	Nursery, seed	80 plants retained in nursery	80 plants retained in nursery	79 planted and baseline data collected seed collected and sown in nursery
	Pillar Valley	Pillar Valley				
<b>SOFT SOILS</b>						
<b>Tall Knotweed summary</b>		Yaegl NR	Slabs, plants, Nursery, seed	44 plants present, including dead stems with retained seed in process of shedding	Plants died back, 4 seedlings observed but did not establish. Seedlings also at controls.	All plants died back, including controls Occasional seedlings (cotyledon stage) present.
<b>Green-leaved rose-walnut</b>	Maclean Interchange	Maclean Interchange road reserve?	Single small tree has been prepared for translocation	Uncertain if translocation is required	Translocation not required	

Donor site	Receiving site	Methods	Results Autumn 2016	Spring 2016	Autumn 2017
Hairy joint-grass	Trustrums Hill road reserve Site 1	Slabs/plants	Though one plant was observed by bush regenerators in February, none was observed during monitoring	Non observed, biomass high	Non observed (biomass under management)
	Trustrums Hill road reserve Site 2	Slabs/plants		Dead transplants observed, no retained seed observed, probably shed	Dead material still present. (Live material not expected in autumn.)

## 4 Discussion

In Year 1, factors including a very dry summer and autumn period delayed some translocation actions and affected the success of others. Similarly dry conditions affected survival and development during Year 2. In addition, flood events caused damage to some sites, in particular at Kangaroo Trail.

In Year 1, standard nursery techniques were employed to successfully raise seedlings of Square-fruited ironbark, to grow on seedlings transplanted from the field (Tall knot-weed), to grow on plants from rhizome division (*Lepidosperma* "Coaldale") and to strike and grow on cuttings (Noah's false chickweed). These techniques were used in Year 1 where additional plants were required e.g. further seed collection for Square-fruited ironbark, cutting propagation for Noah's false chickweed. Seed collection and propagation were continued in Year 2 for Square-fruited ironbark. Low levels of seed production, and the limited proportion of fertile seed found within the chaff, may contribute to the threatened status of Square-fruited ironbark.

The technique of transplanting slabs of soil containing clumps of plants had been moderately successful in Year 1, where it had been employed for Noah's false chickweed, Slender screw-fern, Hairy joint-grass and Tall knotweed.

Noah's false chickweed has transplanted successfully. The species has a short lifecycle, producing flowers and seeds within a growing season (some plants were flowering when planted), so it will be worth continuing observations at sites where success has been short-lived, since seeds may have been incorporated into the soil seed bank and may germinate and develop in subsequent seasons. Adverse climatic conditions and grazing damage have resulted in poor outcomes, but new plantings have good prospects.

For Slender screw-fern, the slab/ clump transplant technique has produced limited success, despite the recognised difficulty of transplanting the species. Disturbance generally kills the plants, so taking a large soil mass that minimises root disturbance appears to be key. Direct transplant to the field has had limited success (dry conditions), and small clumps have established in the nursery, with early establishment satisfactory.

Hairy-joint grass was transplanted with reasonable success in the short term. Maintaining suitable conditions (removal of competing biomass) will be necessary for persistence along with a suitable soil moisture regime and management of encroaching saplings.

Tall knotweed was transplanted successfully. Young plants developed through their lifecycle while the transplant of over-mature plants was also worthwhile as capsules developed and shed seed. Limited seedling emergence presumed from seed shed by transplants is promising.

### Development from soil-stored propagules

No success has been achieved to date where slabs of soil from sites containing soil-stored seed of the target species were transplanted. In Year 1, the technique was used for Noah's false chickweed, Square-stemmed spike-rush, Hairy joint-grass and Tall knotweed (dead plants with soil at their bases were also employed in the latter species). Observations continued in Year 2 but no plants were recorded. Continuing observations will be carried out in line with monitoring schedules.

All species have seeds which are capable of survival in dormant condition in the soil. Rhizome fragments of Square-stemmed spike-rush may also be present in soil.

This technique was employed to supplement other methods, or, in instances where plants could not be located at the survey locations provided. The technique was a means of maximising the potential for capture of material from a recorded location. Survey records were two years old or older, environmental conditions may have changed and altered the natural occurrence of the plants. In addition, locations were approximate, having been recorded with hand-held GPS (usually +/- 3-5m). In some instances, (Redbank Creek area) searches and propagule collection were conducted in non-optimal seasonal conditions due to access problems and the construction schedule.

Failure to achieve seedling emergence from the transplanted soil may be due to:

- Uncertain seed density. In the case of Hairy joint-grass at Redbank Creek, soil was collected from the approximate location of two plants located in Biosis' (2014) survey. Soil-stored seed was likely to have been low in density or may have been absent.
- A short delay between collection and planting (due to access problems, construction schedule and logistics) was necessary for some translocations conducted in Year 1.
- Dry conditions. The target species require swamp or seasonally wet habitats. Dormancy-breaking requirements for seeds are not known in detail for the target species but may include soil disturbance, a specific light regime, temperature fluctuations and wet/dry cycling. The wet conditions required for development have been intermittent.

Continuing monitoring may detect germination and development in subsequent seasons. The potential for success of the method is difficult to gauge, but may be successful and cost-effective when seed soil density is adequate and environmental conditions are suited.

#### Development and maintenance stages

A new fence at Kangaroo Trail is likely to significantly improve prospects for plants within the enclosure. Weed management, mainly exotic grasses, has been ongoing. All sites have been managed successfully for weeds and encroaching vegetation as required.

## 5 Evaluation

Formal evaluation of translocation progress, follows translocation planning set out in Sections 2.6 of the respective translocation strategies.

One aim of the translocations is to achieve no net loss of the flora species for which translocation was assessed as feasible. The extent of direct impacts to the plants had been assessed in 2014 surveys and tabulated in the translocation strategies (reproduced in Table 6). Quantities had been expressed as counts of individuals and, for some species, areas of occurrence.

A number of issues arise when the survey results are used for evaluation, but :

- Some species are ephemeral and their abundance and distribution vary seasonally;
- Count data is difficult to replicate for species such as Slender screw fern and Noah's false chickweed, for which individual plants will be delineated differently by different observers; (generally an area and cover abundance measure has been preferred for such species)
- Methods for collection of original survey data are not documented in a form that will facilitate consistent replication.

The targets were reviewed in the process of pre-translocation planning. Limitations including seasonal variation in abundance remain.

Table 6 Abundance and area targets  
Based on 2014 survey results  
# later survey results

Section	Location	Species	Clearing Area		Revised targets
			No individuals	Area (ha)	
1	Cassons Creek (formerly referred to as Corindi Creek)	Slender screw fern	2820	0.013	Counts provided are unlikely to represent individuals. Area target with typical cover of 5-10% is preferred.
1	Redbank Creek	Square-stemmed rush	spike- 185	0.041	Species not detected at the time of translocation
1	Redbank northern tributary	Hairy joint-grass	2		Very low abundance of limited relevance as a target. Plants not observed at the time of translocation.
1	Redbank northern tributary	Noahs false chickweed	1811		Count of number of individuals accepted as a target although plants layer and are difficult to separate into individuals. ~1000 plants have been planted and will expand laterally, rooting along stems to produce more individuals.
1	Redbank northern tributary	Square-stemmed rush	spike- 68	0.774	Species not detected at the time of translocation
1	Dirty Creek Range north	Moonee Quassia	73	0.080	Difficult to delineate individuals of this clonal species. Translocation attempt using cuttings has failed, target is of limited relevance.
2	Wells Crossing	Square-fruited ironbark	302	4.355	No of individuals accepted as target
2	Wells Crossing north	Square-fruited ironbark	7	0.022	No of individuals accepted as target
2	# Wells Crossing north	<i>Lepidosperma</i> Coaldale	16		Count of 16 rhizomes accepted as target. 35 plants produced (intact rhizomes and divided rhizomes).
2	Bald Knob Tick Gate Road south	Square-fruited ironbark	170	5.045	No of individuals accepted as target
2	Bald Knob Tick Gate	Square-fruited ironbark	3	0.215	No of individuals accepted as target
2	Glenugie south	Square-fruited ironbark	2	0.341	No of individuals accepted as target
2	Glenugie	Square-fruited ironbark	83	7.128	No of individuals accepted as target
2	Franklins Road	Square-fruited ironbark	205	3.320	No of individuals accepted as target
2	Franklins Road north	Square-fruited ironbark	52	0.426	No of individuals accepted as target
4	South Arm north	Tall knotweed	6	0.087	No of individuals accepted as target
4	South Arm north	Tall knotweed	6	0.087	No of individuals accepted as target
4	Maclean interchange	Tall knotweed	12	0.022	No of individuals accepted as target
4	Maclean interchange	Green-leaved rose walnut	0	0	n/a (not translocated)
5	Yaegl south	Tall knotweed	1	0.001	No of individuals accepted as target
5	Yaegl central east	Tall knotweed	5	0.023	No of individuals accepted as target
5	Yaegl central west	Tall knotweed			No of individuals accepted as target
5	Yaegl north	Tall knotweed	7	0.071	No of individuals accepted as target
8	Trustums Hill	Hairy joint-grass	38	0.256	Difficult to delineate individuals of this clumping species. No of individuals accepted as target

## Evaluation – Sections 1 and 2

Species	Hairy joint-grass	Moonee Creek Quassia	Noah's false chickweed	Slender screw-fern	Square-fruited ironbark	Square-stemmed spike-rush
Aim	Create a self-sustaining population	Maintain a self-sustaining population (augment remainder of an existing self-sustaining population by expanding and linking existing patches)	Create a self-sustaining population	Maintain or create a self-sustaining population (augment an existing patch)	Maintain a self-sustaining population (expand existing population)	Maintain or create a self-sustaining population (augment existing small patch or create new population)
Objectives	Plants complete their lifecycle and regenerate successfully	Patches are expanded and linked	Plants complete their lifecycle and regenerate successfully	Plants complete their lifecycle and regenerate successfully	Cleared land adjacent to existing forest is vegetated	Plants complete their lifecycle and regenerate successfully
Performance criteria	At least 50 plants germinate and set seed each year	At least 20 plants are established in each identified section of the receiving sites	At least 100 plants germinate and set seed each year	Spore production observed each year (compare with control populations). Lateral vegetative growth observed from all transplants.	At least 500 plants are established	At least 20 plants germinate and set seed each year
Threshold	Less than 30 plants germinate and set seed in any one year	>10 plants are established in any identified section of the receiving sites	Less than 50 plants germinate and set seed in any one year	No spore production, lateral growth from <50% of transplants	< 300 plants are established by Year 3, similar lack of progress towards targets in subsequent years	Less than 10 plants germinate and set seed in any one year
Corrective action	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.	Transplant additional specimens from seed collected in later years of the project.	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.	Undertake searches for suitable local donor populations, clump/slab transplant. Re-evaluate site moisture gradients to best target suitable planting sites.	Propagate additional seedlings from stored seed	Undertake searches for suitable local donor populations, clump transplant. Re-evaluate site hydrology for best planting site selection or modify hydrology..
Evaluation and actions	Reasonable attempts to translocate soil stored seed (questionable density). No further action feasible..	No strike from cuttings, no alternative sources of propagation material. Corrective actions not possible.	Flowers and fruit observed, though no seedlings to date. Original plantings now died back or damaged. New plantings from nursery-sourced cuttings now planted.	Reasonable survivorship from transplants and limited lateral expansion. Sori not observed. Further transplant of local material is likely to result in unacceptable impacts to source populations, corrective actions not recommended.	~80 plants established, seed collection and propagation ongoing.	Translocations undertaken as best possible with material of questionable value– no plants established. Corrective actions unlikely as propagation material is limited.



Species	Hairy joint-grass	Moonee Creek Quassia	Noah's false chickweed	Slender screw-fern	Square-fruited ironbark	Square-stemmed spike-rush
Aim	Increased knowledge of the threatened plant species	Increased knowledge of the threatened plant species	Increased knowledge of the threatened plant species	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.	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 seeding periods and results of nursery tasks.	Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks.	Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks.	Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks.	Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks.	Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks.
Threshold	Reporting incomplete	Reporting incomplete	Reporting incomplete	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	Project manager to address with sub-contractors	Project manager to address with sub-contractors	Project manager to address with sub-contractors
Evaluation and actions	Reported in 2016 and current annual reports	Reported in 2016 and current annual reports	Reported in 2016 and current annual reports	Reported in 2016 and current annual reports	Reported in 2016 and current annual reports	Reported in 2016 and current annual reports
Aim	Development of new management techniques					
Objectives	Stem and root cutting trials conducted with at least 10 cuttings x 2 types (root/stem) x 3 treatments (2 hormone treatments, 1 control)					
Performance criteria	Sufficient material collected, treated and set up in specialist nursery facilities					
Threshold	Less than 60 cuttings set up					
Corrective action	Re-collect if practical					
Evaluation and actions	No strike from cuttings, re-collection not practical					

Species	Hairy joint-grass	Moonee Creek Quassia	Noah's false chickweed	Slender screw-fern	Square-fruited ironbark	Square-stemmed spike-rush
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	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	Original number of individuals and area re-established	Original number of individuals and area re-established	Original number of individuals and area re-established	Original number of individuals and area re-established	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 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 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 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 planted out and established by year 4, 100% by Year 5	Compare with donor site: 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 cover of plants established over an area equivalent to original in Year 1 or similar levels below target in subsequent year	>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 cover of plants established over an area equivalent to original in Year 1 or similar levels below target in subsequent year	>50% individuals planted out and established by year 4 or similar levels below target in subsequent year	>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	Undertake searches for suitable local donor populations, collect seed, nursery propagate or clump transplant.	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	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	Evaluate options for sourcing more propagation material from neighbouring patches, collect additional seed, following guidelines for sampling
Evaluation and actions	Reasonable attempts to translocate soil stored seed (questionable density). No further action feasible.	No strike from cuttings, no alternative sources of propagation material. Corrective actions not possible.	Less than 70% cover has been achieved. The recently planted ~ 1000 plants require time to spread and layer to increase both the number of plants and their cover.	Low cover has been achieved. This species is known to be difficult to transplant and slow growing and there are no practical options for supplementary collection.	~ 80 plants established, seed collection and propagation ongoing. Early indications are that prospects are good for meeting Year 4 targets.	Translocations undertaken as best possible with material of questionable value— no plants established. Corrective actions unlikely as propagation material is limited.

Species	Hairy joint-grass	Moonee Creek Quassia	Noah's false chickweed	Slender screw-fern	Square-fruited ironbark	Square-stemmed spike-rush
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	Make the best possible use of all plant material with potential conservation value		
Objectives	Soil associated with above-ground plants transplanted.	All available seeds collected, stems harvested and roots excavated to best extent practical	Above-ground plants transplanted together with associated soil likely to contain soil-stored seeds.	All available plants harvested and transplanted to best extent practical		
Performance criteria	No unsalvaged material present on ground inspection	No unsalvaged material present on ground inspection	No unsalvaged material present on ground inspection	No unsalvaged material present on ground inspection		
Threshold	More than 10% of the original material present.	More than 10% of the original material present.	More than 10% of the original material present.	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	Project manager to address with contractors		
Evaluation and actions	No further action feasible	No seeds present, all stems were collected for cuttings	All material collected bar small fragments	All material collected bar small fragments		

## Evaluation – Soft Soils

Species	Hairy joint-grass	Tall knotweed
<b>Aim</b>	Create a self-sustaining population	Maintain a self-sustaining population.
<b>Objectives</b>	Plants complete their lifecycle and regenerate successfully	Plants complete their lifecycle and regenerate successfully
<b>Performance criteria</b>	At least 50 plants germinate and set seed each year	At least 30 plants germinate and set seed each year
<b>Threshold</b>	Less than 30 plants germinate and set seed in any one year	Less than 20 plants germinate and set seed in any one year
<b>Corrective action</b>	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.	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.
<b>Evaluation and actions</b>	<p>Site 1</p> <p>No germination observed as biomass management is required to re-instate suitable conditions for germination</p> <p>Site 2</p> <p>New plants have developed, difficult to count germinants but judged as meeting performance criterion in Year 2.</p>	<p>Plants have died back and two short-lived seedlings observed. Findings are difficult to interpret since the translocation augments an existing population. The species is ephemeral and control plants have also died back. The addition of substantial amounts of seed to the system has been documented and is likely to have positive medium to long term impacts on the population.</p> <p>Further observation during the coming growing season is recommended before any corrective actions are considered.</p>
<b>Aim</b>	Increased knowledge of the threatened plant species	Increased knowledge of the threatened plant species
<b>Objectives</b>	Relevant project results and observations documented.	Relevant project results and observations documented.
<b>Performance criteria</b>	Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks.	Reporting to include e.g. detail of growth and seeding periods and results of nursery tasks.
<b>Threshold</b>	Reporting incomplete	Reporting incomplete
<b>Corrective action</b>	Project manager to address with sub-contractors	Project manager to address with sub-contractors
<b>Evaluation and actions</b>	Reported in 2016 and current annual reports	Reported in 2016 and current annual reports
<b>Aim</b>	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
<b>Objectives</b>	Original number of individuals and area re-established	Original number of individuals and area re-established
<b>Performance criteria</b>	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 cover of plants established over an area equivalent to original in Year 1, increasing to 100% cover by Year 5
<b>Threshold</b>	>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 cover of plants established over an area equivalent to original in Year 1 or similar levels below target in subsequent year
<b>Corrective action</b>	Undertake searches for suitable local donor populations, collect seed, nursery propagate or clump transplant.	Evaluate options for sourcing more propagation material from neighbouring patches, collect additional seed, following guidelines for sampling
<b>Evaluation and actions</b>	<p>Site 1 Plants not established but biomass has been reduced and may stimulate germination. A further season of observation is recommended before corrective actions are considered.</p> <p>Site 2 Plants well established and approaching threshold. A further season's observation is recommended before considering corrective actions.</p>	<p>Plants have died back, observations difficult to interpret (see above).</p> <p>Further observation during the coming growing season is recommended before any corrective actions are considered.</p>
<b>Aim</b>	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

<b>Objectives</b>	Soil associated with above-ground plants transplanted	All available plants and associated soil harvested and transplanted to best extent practical
<b>Performance criteria</b>	No unsalvaged material present on ground inspection	No unsalvaged material present on ground inspection
<b>Threshold</b>	More than 10% of the original material present.	More than 10% of the original material present
<b>Corrective action</b>	Project manager to address with contractors	Project manager to address with contractors
<b>Evaluation and actions</b>	All large clumps of plants transplanted, together with associated soil. Plants sparsely dispersed within exotic grasslands were not completely recovered – these constituted a small proportion of the total plant material.	All plants and associated soil translocated.

## 6 Recommendations

### Hairy joint-grass

Continue observation at Kangaroo Trail

Continued maintenance at Trustrums Hill. Biomass reduction at Site 1 to be repeated in winter 2017. Weed management and thinning of encroaching native trees to be continued at Site 2.

### Moonee Creek Quassia

Further translocation actions not considered feasible.

### *Lepidosperma* “Coaldale”

Maintain plantings at Mahogany Drive. Monitor straying cattle.

### Noah’s false chickweed

Continue to maintain existing plantings and monitor for seedling emergence during next growing season. Maintain fencing at Kangaroo Trail Road.

### Slender screw-fern

Continue to maintain existing transplants, including recently planted nursery stock, at Kangaroo Trail Road. Maintain fencing.

### Square-fruited ironbark

Continue to monitor plantings at Pillar Valley (unfenced, protection may be required e.g. if marsupial grazing is observed.) Follow development of current nursery sowings. Continue to collect seed from the receiving site at Pillar Valley for plantings to augment the existing population (as difficult to judge the adequacy of existing collections).

### Square-stemmed spike rush

Monitor for seedling emergence during next growing season, continue to maintain site. (Unlikely that propagation material will be available in the vicinity).

### Tall knotweed

Monitor for seedling emergence during next growing season, continue to maintain site.

## References

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## Appendix 1 Receiving site details

# Kangaroo Trail Road

Noah's false chickweed *Lindernia alsinoides*  
Slender screw-fern *Lindsea incisa*  
Hairy joint-grass *Arthraxon hispidus*

## Layout



Fenced planting areas for three species



## Translocation methods

### **Noah's false chickweed *Lindernia alsinoides***

Area of fenced area 0.306 ha

Approximately 350 well grown plants (nursery stock) were planted on 28 January 2016. Plant locations were marked with a spike label. Additional trays of plants were retained in the nursery as sources of cutting material in the event that additional plants were required.

Points were re-numbered and marked during May 2016 monitoring inspections. Surviving plants were numbered on white spike labels La 1-30. At points where plants could not be detected, labels were replaced with temporary markers (flagged bamboo stakes).

It was recommended that the temporarily marked points be retained for close inspection during next growing season in case they have re-sprouted, or in case seedlings have developed from seed shed close to the points.

A further 1,000 plants were raised from stock held in the nursery, taking care to sample from all available individual plants to maximize diversity. Tubestock were planted in clumps of about 20 plants (half on 6 May and half on 2 July 2017).

### **Slender screw fern *Lindsaea incisa***

Area of fenced area 0.023 ha

Slabs 30cm x 30cm x 10cm deep were dug from donor site and transplanted. Slabs were transplanted directly to receiving site at seven locations on 10 September 2015. Central points were marked with spike labels. Slabs were planted in a square around a central point, 6 – 8 slabs.

A small number of additional plants (15) were held in the nursery and were planted out when conditions were suited (May 2017), filling gaps in the original planting layout.

### **Hairy joint-grass *Arthraxon hispidus***

Area of fenced area 0.008 ha

No plants were observed at the donor site and soil from the locations of the two documented records was used as a likely source of soil-stored seed.

Eight slabs 30cm x 30cm x 10cm deep were dug from the donor site and transplanted on 10 September 2015.

## Kangaroo Trail Road – receiving site details

<b>Species</b>	<i>Lindernia alsinoides</i>	<i>Lindernia alsinoides</i>	<i>Lindernia alsinoides</i>
<b>Common name</b>	Noah's false chickweed	Noah's false chickweed	Noah's false chickweed
<b>Date</b>	04-May-16	30-Nov-16/15-Dec-2016	30-May-2017
<b>Marker</b>	II on trunks, pink	II on trunks, pink	II on trunks, pink
<b>Location</b>	North of Section 1 depot on RMS land	North of Section 1 depot on RMS land	North of Section 1 depot on RMS land
<b>Location 2</b>			
<b>Easting</b>	517854	517854	517854
<b>Northing</b>	6677752	6677752	6677752
<b>Transect orientation</b>	N-S	N-S	N-S
<b>Climate previous</b>	dry	dry	dry
<b>Climate current</b>	dry, sunny	dry, sunny	dry, clear
<b>Landform</b>	flat	flat	flat
<b>Drainage</b>	good	good	good
<b>Slope</b>	flat	flat	flat
<b>Aspect</b>	flat	flat	flat
<b>Soil moisture</b>	dry	dry	moist
<b>Water levels</b>	dry	dry	
<b>Water flow</b>	dry	dry	
<b>Plant condition (0-5)</b>	4-5	4 (1 plant)	4-5
<b>Height</b>			
<b>Width</b>	Small to large clumps		
<b>DBH</b>			
<b>Leaf cond</b>	4-5		
<b>Length new shoots</b>			Up to 30 cm
<b>Flowers</b>	Present		
<b>Fruit</b>	Present		
<b>Recruitment</b>	Vegetative spread		
<b>Disease/insect</b>	Possible insect damage or bruising of plants		
<b>Dieback</b>			
<b>Threats</b>	Marsupial grazing	Marsupial grazing, cattle, flooding	Earlier threats alleviated
<b>VegComm</b>	<i>Eucalyptus resinifera</i> forest	<i>Eucalyptus resinifera</i> forest	<i>Eucalyptus resinifera</i> forest
<b>Canopy species</b>	<i>Eucalyptus resinifera</i>	<i>Eucalyptus resinifera</i>	<i>Eucalyptus resinifera</i>
<b>Midstorey species</b>	<i>Lophostemon suaveolens</i>	<i>Lophostemon suaveolens</i>	<i>Lophostemon suaveolens</i>
<b>Understorey species</b>	<i>Imperata cylindrica</i>	<i>Imperata cylindrica</i>	<i>Imperata cylindrica</i>
<b>Canopy</b>	42	45	50
<b>Midstorey</b>	0	0	5
<b>Forb</b>	30	30	20
<b>Grass</b>	60	40	70
<b>Shrub (&lt;1m)</b>	5	5	0
<b>litter</b>	35	10	5
<b>bare/water exotic</b>	15	20	5
<b>Weed Species</b>	<i>Cuphea carthagenensis</i> occasional, <i>Andropogon virginicus</i> , other exotic grasses, all sparse	<i>Andropogon virginicus</i> , other exotic grasses, all sparse	exotic grasses, sparse
<b>Weed abundance</b>	Low	Low	Low
<b>Recruitment</b>	occasional saplings	occasional saplings	occasional saplings
<b>Disturbance</b>	Dead exotic grasses (sprayed)	Marsupials, cattle, flooding	None evident
<b>Comments</b>	Wallaby-proof fencing required	Wallaby-proof fencing now in place, cattle also excluded	Fencing in good order. <i>Imperata cylindrica</i> becoming dominant
<b>Abundance summary</b>	30 plants/clumps	1 plant	428 plants



Habitat transect 04-May-16



Habitat transect May 2017



Flowering plant – Plant 6 04-May-16



New planting May 2017



Possible insect damage or deterioration of bruised plants 04-May-16

#### **Notes and recommendations**

(Individual plant/clump data see following page)

#### May 2016

Survivorship has been low as a result of very dry conditions, probable marsupial grazing and insect damage. Several of the surviving plants were flowering and producing capsules, mostly empty, indicating that seed had been shed into the surrounds. It is likely that recruitment from seeds will take place in the next growing season, along with further vegetative spread. Progression through the plant's lifecycle represents an early approach towards a target for the species. Planning is in place for supplementary plantings and fencing repair/upgrade for marsupial exclusion is to be undertaken urgently.

November-December 2017

Locations of plants 1-30 were searched on 30 November 2016. None were present. One plant was observed at the location of a previous planting, but was no longer present on 15 December 2016.

The poor survival rate was attributed to marsupial grazing, cattle, some disturbance from overland waterflow during a heavy rain event and a prolonged dry spell. A new fence was put in place during spring 2016.

May 2017

New plantings and fencing now in place. Monitor for watering requirements in coming spring.

**Details of plants observed May 2016**

Plant no	Easting	Northing	General condition	Leaf condition	Flowering/ fruiting	Shoot length	Notes
1	517866	6677746	4	5		compact clump in active growth	grazed?
2	517862	6677745	5	5		small clump in active growth	
3	517860	6677744	5	5		small clump in active growth	
4	517860	6677744	5	5			
5	517861	6677748	5	5		small clump in active growth	
6	517864	6677748	5	5	fl/fr	medium clump	photo
7	517859	6677746	4	4			grazed
8	517859	6677746	4	4	fl/fr	small clump in active growth	grazed
9	517860	6677746	5	4		small clump in active growth	
10	517860	6677747	5	5	fl	spreading	
11	517863	6677753	5	5	fl/fr	spreading	
12	517867	6677747	5	5	fl/fr		
13	517867	6677742	4	4		spreading	
14	517866	6677742	4	4		spreading	grazed
15	517867	6677739	4	4		very small	
16	517859	6677752	5	5	fl/fr	small	
17	517844	6677739	5	5	fl/fr	big clump spreading	
18	517844	6677733	5	5	fr	small spreading clump	
19			5	4		small spreading clump	
20	517842	6677734	5	5	fl/fr	small clump in active growth	
21	517843	6677717	5	5	fl	small spreading clump	
22	517830	6677732	5	5	fl	small spreading clump	
23	517827	6677716	5	5	fl	very small plant	
24	517828	6677713	5	5	fl/fr	big patch	
25	517828	6677724	5	5	fl	medium patch	
26	517831	6677714	5	5	fl/fr	big patch	
27	517822	6677720	5	5	fl	small spreading patch	
28	517828	6677715	5	5	fl/fr	very big patch, spreading	
29	517841	6677710	5	5		small patch	
30			5	4		medium patch, spreading	grazed



Fence bounding translocation receiving site November 2016

Planting date: 6 May 2017 Baseline data collection: 30 May 2017

Clump no	Clump diameter (m)	No plants	Easting	Northing	Flowers present
31	2	22	517867	6677751	fl
32	2	17	517868	6677746	fl
33	1.5	20	517871	6677745	fl
34	1	18	517860	6677751	fl
35	1.5	21	517850	6677750	fl
36	1.5	12	517869	6677756	fl
37	1	17	517862	6677749	fl
38	1	17	517864	6677737	fl
39	1.5	17	517860	6677727	fl
40	1.5	17	517872	6677745	fl

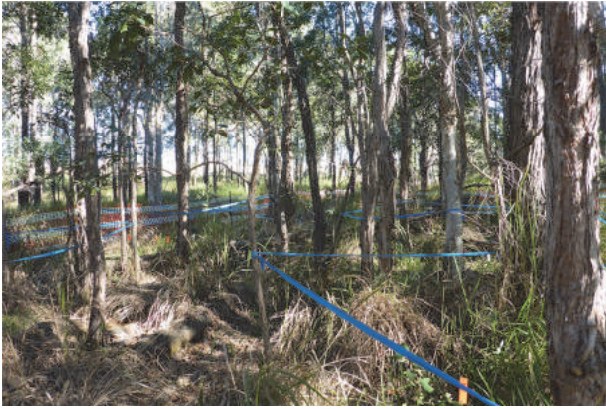
Planting date: 2 July 2017 Baseline data collection: 14 July 2017

Clump no	Clump diameter (m)	No plants	Easting	Northing	Flowers present
41	1	25	517831	6677710	n
42	1	25	517838	6677714	fl
43	1	25	517837	6677715	fl
44	1	25	517837	6677709	fl
45	1	25	517837	6677708	fl
46	1	25	517834	6677705	n
47	1	25	517834	6677705	fl
48	1	25	517837	6677705	fl
49	1	25	517835	6677705	fl
50	1	25	517831	6677707	fl

All plants were in good condition (score 4-5), with trailing stems up to 30cm long. Average cover 5-10%

## Kangaroo Trail Road – receiving site details

<b>Species</b>	<i>Lindsaea incisa</i>	<i>Lindsaea incisa</i>	<i>Lindsaea incisa</i>
<b>Common name</b>	Slender screw fern	Slender screw fern	Slender screw fern
<b>Date</b>	04-May-16	30-Nov-16/15-Dec-16	30-May-17
<b>Marker</b>	ll on trunks, pink	ll on trunks, pink	ll on trunks, pink
<b>Location</b>	North of Section 1 depot on RMS land	North of Section 1 depot on RMS land	North of Section 1 depot on RMS land
<b>Location 2</b>			
<b>Easting</b>	517879	517879	517879
<b>Northing</b>	6677768	6677768	6677768
<b>Transect orientation</b>	N-S	N-S	N-S
<b>Climate previous</b>	dry	dry	dry
<b>Climate current</b>	dry, sunny	dry, sunny	dry, sunny
<b>Landform</b>	flat to gentle slope	flat to gentle slope	flat to gentle slope
<b>Drainage</b>	good	good	good
<b>Slope</b>	slight	slight	slight
<b>Aspect</b>	south	south	south
<b>Soil moisture</b>	dry	dry	wet
<b>Water levels</b>	dry	dry	
<b>Water flow</b>	dry	dry	none
<b>Plant condition (0-5)</b>	3-5	2-5	3-5
<b>Height</b>			
<b>Clump diameter (cm)</b>	2-30	5-25	5-30
<b>DBH</b>			
<b>Leaf cond</b>			
<b>Length new shoots</b>			
<b>Flowers</b>			
<b>Fruit</b>			
<b>Recruitment</b>			Some vegetative expansion
<b>Disease/insect</b>		Ferns very sparse	
<b>Dieback</b>			
<b>Threats</b>	Exotic grass (sparse)	Exotic grass (sparse)	Exotic grass (sparse)
<b>VegComm</b>	<i>Eucalyptus resinifera</i> - <i>Lophostemon</i> <i>suaveolens</i> - <i>Melaleuca</i> <i>quinquenervia</i>	<i>Eucalyptus resinifera</i> - <i>Lophostemon</i> <i>suaveolens</i> - <i>Melaleuca</i> <i>quinquenervia</i>	<i>Eucalyptus resinifera</i> - <i>Lophostemon</i> <i>suaveolens</i> - <i>Melaleuca</i> <i>quinquenervia</i>
<b>Canopy species</b>	<i>Eucalyptus resinifera</i> , <i>Lophostemon suaveolens</i> , <i>Melaleuca quinquenervia</i>	<i>Eucalyptus resinifera</i> , <i>Lophostemon suaveolens</i> , <i>Melaleuca quinquenervia</i>	<i>Eucalyptus resinifera</i> , <i>Lophostemon suaveolens</i> , <i>Melaleuca quinquenervia</i>
<b>Midstorey species</b>	<i>Lophostemon suaveolens</i>	<i>Lophostemon suaveolens</i>	<i>Lophostemon suaveolens</i>
<b>Understorey species</b>	<i>Imperata cylindrica</i>	<i>Imperata cylindrica</i>	<i>Imperata cylindrica</i>
<b>Canopy</b>	44	44	35
<b>Midstorey</b>	38	38	45
<b>Forb</b>	10	10	5
<b>Grass</b>	60	60	20
<b>Shrub (&lt;1m)</b>	5	5	5
<b>litter</b>	70	70	80
<b>bare/water</b>	0	0	10
<b>exotic</b>	0	0	0
<b>Weed Species</b>	<i>Paspalum wettsteinii</i> and other exotic grasses	<i>Paspalum wettsteinii</i> and other exotic grasses	<i>Paspalum wettsteinii</i> and other exotic grasses
<b>Weed abundance</b>	sparse	very sparse	very sparse
<b>Recruitment</b>	Limited vegetative spread	not observed	Very limited vegetative spread
<b>Disturbance</b>			
<b>Comments</b>		Apparently undamaged by grazing and cattle but dry conditions have been deleterious	
<b>Abundance summary</b>	17 clumps	10 clumps	21 clumps



Habitat transect 04-May-16



Habitat transect 30-May-17



Clump 7.1, 04-May-16



Established clump May 2017

### **Notes and recommendations**

(Individual plant/clump data see following page)

#### May 2016

Survivorship has been low as a result of very dry conditions, with 17 clumps surviving from an original 45 clumps. Further vegetative spread is likely, if probably slow, when soil moisture conditions are suitable. Ongoing low level weed maintenance required.

Supplementary plantings are generally not recommended as sources of transplant material are limited and would cause depletion of wild populations. Successful establishment requires optimal conditions. A small number of nursery-held plants will be planted out when suitable conditions prevail.

No sign of grazing damage but the species will benefit from upgraded protective fencing planned for the site.

#### Nov- December 2016

Continue weed management and plant nursery stock when conditions are suitable. The species is known to die back during dry conditions and re-sprout when soil moisture improves.

#### May 2017

Fencing in place, new plantings will require monitoring for water requirements. Continue weed management. Original plantings can also be expected to re-sprout when soil moisture increases.



### Details of plants observed May 2016

(red spike labels)

No	General condition	Leaf condition	Diameter of clump (cm)	Count new shoot	Threats	Other
1.1	5	5	20			quite strong growth in small clumps
1.2	5	5	5			quite strong growth in small clumps
1.3	5	5	5			quite strong growth in small clumps
1.4	5	5	10			quite strong growth in small clumps
2.2	4	4	5			
3.1	4	4	10			small fronds
3.2	4	4	10			small fronds
3.3	4	4	10		grass	small fronds
3.4	3	3	2			small fronds
3.5	4	4	10			small fronds
4.1	5	5	30			
4.2	5	5	10			
4.3	5	5	5			
5.1	5	5	20			
6.1	5	5	20			
6.2	5	5	9			
7.1	5	5	20			

### Details of plants observed Nov-Dec 2016

(red spike labels)

No	General condition	Leaf condition	Diameter of clump (cm)	Count new shoot	Threats	Other
1.1	5	5	20			small fronds to 10cm
1.2	5	5	10			small fronds to 6cm
1.3						missing
1.4	5	5	20			small fronds to 8cm
2.2						missing
3.1	4	4	10			small fronds to 6cm
3.2	3	3	2			v small fronds to 8cm
3.3		4	15		grass	small fronds
3.4						missing
3.5	4	4	25			small fronds to 8cm
4.1	5	5	30			
4.2						missing
4.3						missing
5.1						missing
6.1	4	4	25			small fronds to 6cm
6.2	4	4	10			small fronds to 6cm
7.1	2	2	5			Weak and withering

## Details of plants observed 30 May 2017

\* = newly planted (May 2017) , yellow spike labels

No	General condition	Leaf condition	Diameter of clump (cm)	Count new shoot	Threats	Other
1						All plants missing
2						All plants missing
3.1	5	5	5			small fronds
3.2	5	5	4			small fronds
3.3						missing
3.4						missing
3.5						missing
3.6*	5	4	20			Tall leaning fronds
3.7*	4	4	20			Tall leaning fronds
3.8*	3	3	20			Tall leaning fronds
4						All plants missing
5.1	5	5	20			low-growing, apparently resprouted since previous inspection
5.2						missing
5.3	5	5				
5.4*	4	4	15			Tall leaning fronds
5.5						missing
5.6*	4	4	15			Tall leaning fronds
6.1						missing
6.2	5	5	20			fronds sparse
6.3	4	4	5			Very small, apparently resprouted since previous inspection
6.4	4	4	20			sparse
6.5*	4	4	10			Tall leaning fronds
6.6*	4	4	10			Tall leaning fronds
7.1	5	5	30			Low growing, sparse
7.2*	5	5	5			Very small
7.3*	4	4	10			Very small
7.4*						missing
7.5*						missing
7.6*	4	4	10			Tall leaning fronds
7.7*	4	4	10			Tall leaning fronds
8.1*	4	4	10			Tall leaning fronds
8.2*	4	4	10			Tall leaning fronds

\* newly planted ferns generally have tall fronds, resulting from growth in nursery conditions, to about 25cm tall.

## Kangaroo Trail Road – receiving site details

<b>Site code</b>	KT Ah
<b>Species</b>	<i>Arthraxon hispidus</i>
<b>Common name</b>	Hairy joint-grass
<b>Date</b>	04-May-16
<b>Marker</b>	
<b>Location</b>	North of Section 1 depot on RMS land
<b>Location 2</b>	
<b>Easting</b>	
<b>Northing</b>	
<b>Transect orientation</b>	
<b>Climate previous</b>	dry
<b>Climate current</b>	dry, sunny
<b>Landform</b>	flat to gentle slope
<b>Drainage</b>	good
<b>Slope</b>	slight
<b>Aspect</b>	south
<b>Soil moisture</b>	dry
<b>Water levels</b>	dry
<b>Water flow</b>	dry
<b>Plant condition (0-5)</b>	
<b>Height</b>	
<b>Width</b>	
<b>DBH</b>	
<b>Leaf cond</b>	
<b>Length new shoots</b>	
<b>Flowers</b>	
<b>Fruit</b>	
<b>Recruitment</b>	
<b>Disease/insect</b>	
<b>Dieback</b>	
<b>Threats</b>	
<b>VegComm</b>	<i>Melaleuca quinquenervia</i> - <i>E. resinifera</i> - <i>Corymbia intermedia</i> forest
<b>Canopy species</b>	<i>Melaleuca quinquenervia</i> , <i>E. resinifera</i> , <i>Corymbia intermedia</i>
<b>Midstorey species</b>	
<b>Understorey species</b>	
<b>Canopy</b>	
<b>Midstorey</b>	
<b>Forb</b>	
<b>Grass</b>	
<b>Shrub (&lt;1m)</b>	
<b>litter</b>	
<b>bare/water</b>	
<b>exotic</b>	
<b>Weed Species</b>	<i>Paspalum wettsteinii</i> and other exotic grasses
<b>Weed abundance</b>	sparse
<b>Recruitment</b>	
<b>Disturbance</b>	
<b>Comments</b>	
<b>Comments 2</b>	
<b>Abundance summary</b>	No emergence from soil-stored seed



General habitat view from N corner of planting area looking south



Typical soil distribution area

### Notes and recommendations

No formal habitat transect established, planting area too small. Similar to KT La adjacent. No seedling emergence was observed in May 2016, Nov-Dec 2016 or May 2017. Soil seed density is likely to be low in soil from a donor site where two plants had been documented, successful emergence and establishment was always considered of low likelihood.

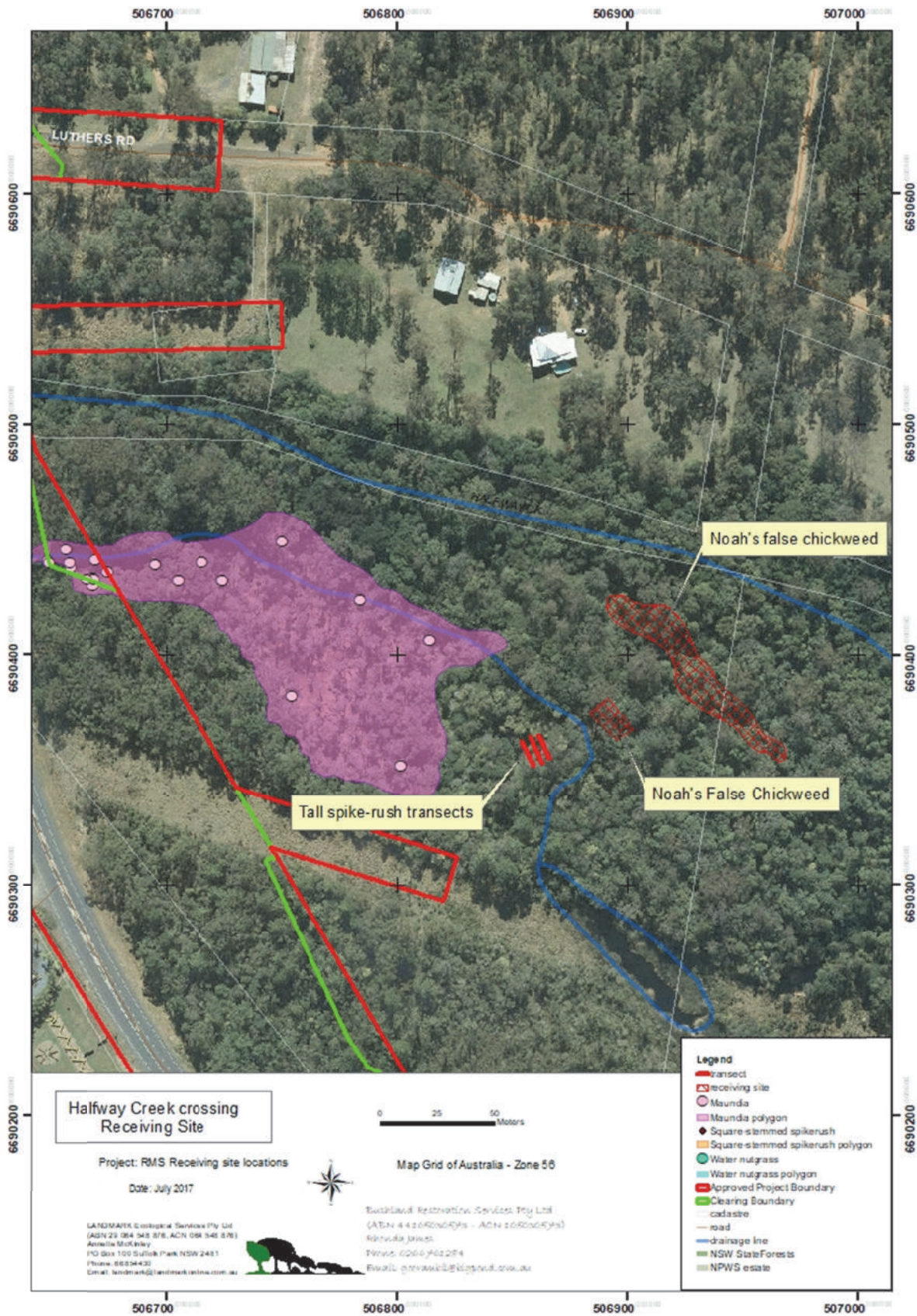
Blady Grass *Imperata cylindrica* has become increasingly dominant at this site.

## Halfway Creek crossing

Noah's false chickweed *Lindernia alsinoides*

Square-stemmed spike-rush *Eleocharis tetraquetra*

# Layout



Locations of receiving sites at Halfway Creek Crossing

## Translocation methods

### Noah's false chickweed *Lindernia alsinoides*

#### Northern site

Slabs 30 x 30 x 10cm were collected on 31 August 2015 and stored in crates for transplanting as access to Halfway Creek Crossing was delayed. As a result, plants were in poor condition, but as soil-stored seed was likely to be present in the collected slabs, the translocation proceeded.

10-12 slabs were planted (10 September 2015) at each of eight plots.

Nursery stock was raised simultaneously for supplementary plantings if required.

The centre of each plot was marked with a spike label.

#### Plot locations

Plot no	Easting	Northing
1	0506879	6690368,
2	0506871	6690378
3	0506873	6690374
4	0506880	6690363
5	0506883	6690361
6	0506875	6690357
7	0506879	6690348
8	0506890	6690358



Typical planting layout for *Lindernia alsinoides* slabs

## Southern site

Nursery grown stock was planted on 4 July 2017.

Tubestock was planted in 25 clumps each of 20 plants. Clumps varied in dimensions to allow placement between existing vegetation. Each clump was marked with a spike label numbered 1-25.

Baseline data were collected on 17 July 2017. Some of the plants showed signs of possible marsupial grazing. Accordingly, about half the clumps were lightly covered in twigs and branches for protection.

Plot no	Easting	Northing	Grazing protection	Notes
1	506895	6690419		
2	506910	6690417		
3	506910	6690416	Y	
4	506915	6690413	Y	
5	506920	6690410		
6	506923	6690406	Y	
7	506924	6690402		
8	506925	6690397		
9	506924	6690394	Y	
10	506928	6690396		
11	506929	6690394		
12	506926	6690392	Y	
13	506929	6690390		
14	506933	6690393		
15	506933	6690390		
16	506932	6690389	Y	
17	506938	6690383		
18	506934	6690381	Y	
19	506933	6690376	Y	
20	506939	6690375	Y	
21	506946	6690374	Y	
22	506949	6690372	Y	
23	506951	6690371	Y	Flowers present
24	506953	6690363		
25	506964	6690358		

## Square-stemmed spike-rush – *Eleocharis tetraquetra*

Slabs 30 x 30 x 10 cm were collected on 31 August 2015 and stored in crates for transplanting as access to Halfway Creek Crossing was delayed. No plants were observed above ground at the donor site, but soil was collected from the documented locations of the species where soil-stored seeds and rhizomes were likely to be present.

75 slabs were planted (10 September 2015) at each of three transect planting locations, ends marked with flagged trunks or stakes. Slabs were placed at 1m intervals.

Location of transects

<b>Transect no</b>	<b>Easting</b>	<b>Northing</b>
<b>1</b>	506813	6690348
<b>2</b>	506821	6690350
<b>3</b>	506834	6690353



## Halfway Creek crossing – receiving site details

### Northern site

<b>Species</b>	<i>Lindernia alsinoides</i>
<b>Common name</b>	Noah's false chickweed
<b>Date</b>	12-May-16
<b>Marker</b>	ll on trunks, pink
<b>Location</b>	South of channel, east of highway
<b>Easting</b>	506875
<b>Northing</b>	6690354
<b>Transect orientation</b>	N-S
<b>Climate previous</b>	dry
<b>Climate current</b>	dry, sunny
<b>Landform</b>	flat, edge of swamp
<b>Drainage</b>	periodically inundated
<b>Slope</b>	flat
<b>Aspect</b>	flat
<b>Soil moisture</b>	dry
<b>Water levels</b>	dry
<b>Water flow</b>	dry
<b>Plant condition (0-5)</b>	None observed
<b>Height</b>	
<b>Width</b>	
<b>DBH</b>	
<b>Leaf cond</b>	
<b>Length new shoots</b>	
<b>Flowers</b>	
<b>Fruit</b>	
<b>Recruitment</b>	
<b>Disease/insect</b>	
<b>Dieback</b>	
<b>Threats</b>	
<b>VegComm</b>	<i>Eucalyptus tereticornis</i> , <i>Melaleuca alternifolia</i> forest
<b>Canopy species</b>	<i>Eucalyptus tereticornis</i> , <i>Melaleuca alternifolia</i>
<b>Midstorey species</b>	<i>Acacia floribunda</i> , <i>Melaleuca alternifolia</i>
<b>Understorey species</b>	<i>Lomandra longifolia</i> , <i>Dichondra repens</i> , <i>Oplismenus imbecillis</i> , <i>Hypolepis muelleri</i>
<b>Canopy</b>	47.5
<b>Midstorey</b>	10
<b>Forb</b>	80
<b>Grass</b>	90
<b>Shrub (&lt;1m)</b>	0
<b>litter</b>	5
<b>bare/water</b>	0
<b>exotic</b>	0
<b>Weed Species</b>	none (some e.g. Pinus in vicinity)
<b>Weed abundance</b>	
<b>Recruitment</b>	
<b>Disturbance</b>	
<b>Abundance summary</b>	No emergence from soil stored seed



Habitat transect, 12-May-16

### **Notes and recommendations**

No plants observed

(Individual soil translocation photos see following page).

Access to this site during Year 1 for maintenance and inspection following planting was restricted by construction.

No emergence from soil-stored seeds was observed in May 2016 (dry conditions), nor in Nov-December 2016 or May 2017, but observations will be continued according to monitoring schedule.

Habitat conditions have not changed in any observable manner during the monitoring period.

## Southern site

<b>Species</b>	<i>Lindernia alsinoides</i>
<b>Common name</b>	Noah's false chickweed
<b>Date</b>	14-7-17
<b>Marker</b>	ll on trunks, pink
<b>Location</b>	South of channel, east of highway
<b>Easting</b>	506925
<b>Northing</b>	6690411
<b>Transect orientation</b>	N-S
<b>Climate previous</b>	dry
<b>Climate current</b>	dry, clear
<b>Landform</b>	flat, edge of swamp
<b>Drainage</b>	periodically inundated
<b>Slope</b>	flat
<b>Aspect</b>	flat
<b>Soil moisture</b>	Moist-wet
<b>Water levels</b>	Fairly high in adjacent swamp
<b>Water flow</b>	None
<b>Plant condition (0-5)</b>	4-5
<b>Height</b>	Up to 10 cm
<b>Width</b>	
<b>DBH</b>	
<b>Leaf cond</b>	4-5
<b>Length new shoots</b>	Up to 30 cm
<b>Flowers</b>	Plants flowering in 5 patches
<b>Fruit</b>	
<b>Recruitment</b>	
<b>Disease/insect</b>	
<b>Dieback</b>	
<b>Threats</b>	Possible marsupial grazing
<b>VegComm</b>	Swamp sclerophyll forest
<b>Canopy species</b>	<i>Lophostemon suaveolens</i> , <i>Eucalyptus tereticornis</i> , <i>Melaleuca alternifolia</i>
<b>Midstorey species</b>	<i>Acmena smithii</i> , <i>Morinda jasminoides</i>
<b>Understorey species</b>	<i>Lomandra longifolia</i> , <i>Dichondra repens</i> , <i>Oplismenus imbecillis</i> , <i>Pteridium esculentum</i>
<b>Canopy</b>	46
<b>Midstorey</b>	12
<b>Forb</b>	30
<b>Grass</b>	15
<b>Shrub (&lt;1m)</b>	5
<b>litter</b>	20
<b>bare/water</b>	25
<b>exotic</b>	0
<b>Weed Species</b>	none
<b>Weed abundance</b>	
<b>Recruitment</b>	
<b>Disturbance</b>	
<b>Abundance summary</b>	500 newly planted



Habitat transect 14 July 2017



Plot 25 newly planted 14 July 2017

Northern site Noah's false chickweed  
soil translocation centre points. Photos taken from 2m from centre facing south, 12-May-16.



Plot 1



Plot 2



Plot 3



Plot 4



Plot 5



Plot 6



Plot 7



Plot 8

**Details of *Lindernia alsinoides* at southern site**

Planted 2 July 2017 Baseline data 17 July. Some plants appeared to have been damaged, perhaps by grazing, Average cover within plot 3-5%.

Plot no	Easting	Northing	Patch size (m)	Max shoot length (cm)	Max height (cm)	Flowers	Grazing protection	Notes
1	506910	6690417	2x1	30	10			Small, healthy, sprawling
2	506910	6690416	2x1	20	6		Y	Small, healthy, sprawling
3	506895	6690419	2x1	30	10			Small, healthy, sprawling
4	506915	6690413	3x1	20	6		Y	Small, healthy, sprawling
5	506920	6690410	2x1	20	6			Smaller plants, healthy wing
6	506923	6690406	2x1	15	5		Y	Small, healthy, sprawling
7	506924	6690402	1.5x1.5	30	6	fl		Small, healthy, sprawling
8	506925	6690397	2x1	30	6	fl		Small, healthy, sprawling
9	506924	6690394	2x1	30	10	fl	Y	Small, healthy, sprawling
10	506928	6690396	2x1	20	8			Small, healthy, sprawling
11	506929	6690394	1.5x1.5	15	6			Smaller plants, healthy
12	506926	6690392	2x1	20	8	fl	Y	Smaller plants, healthy
13	506929	6690390	1.5x1.5	20	5	fl		Smaller plants, healthy
14	506933	6690393	1.5x1.5	20	10			Small, healthy, sprawling
15	506933	6690390	2x2	25	5			Smaller plants, healthy
16	506932	6690389	1.5x1.5	20	5		Y	Smaller plants, healthy
17	506938	6690383	1.5x1.5	25	5			Small, healthy, sprawling
18	506934	6690381	1.5x1.5	25	5		Y	Small, healthy, sprawling
19	506933	6690376	1.5x1.5	25	6		Y	Small, healthy, sprawling
20	506939	6690375	1.5x1.5	30	10		Y	Small, healthy, sprawling
21	506946	6690374	1.5x1.5	30	6		Y	Small, healthy, sprawling
22	506949	6690372	2x1	20	6		Y	Small, healthy, sprawling
23	506951	6690371	1.5x1.5	20	6	fl	Y	Small, healthy, sprawling
24	506953	6690363	2x1	20	8			Small, healthy, sprawling
25	506964	6690358	1.5x1.5	25	8			Small, healthy, sprawling

## Halfway Creek crossing – receiving site details

<b>Species</b>	<i>Eleocharis tetraquetra</i>
<b>Common name</b>	Square-stemmed spikerush
<b>Date</b>	12-May-16
<b>Marker</b>	ll on trunks, pink
<b>Location</b>	South of channel, east of highway
<b>Location 2</b>	
<b>Easting</b>	506820
<b>Northing</b>	6690352
<b>Transect orientation</b>	N-S
<b>Climate previous</b>	dry
<b>Climate current</b>	dry, sunny
<b>Landform</b>	flat
<b>Drainage</b>	n/a
<b>Slope</b>	flat
<b>Aspect</b>	flat
<b>Soil moisture</b>	standing water in small shallow pools shallow
<b>Water levels</b>	
<b>Water flow</b>	
<b>Plant condition (0-5)</b>	
<b>Height</b>	
<b>Width</b>	
<b>DBH</b>	
<b>Leaf cond</b>	
<b>Length new shoots</b>	
<b>Flowers</b>	
<b>Fruit</b>	
<b>Recruitment</b>	
<b>Disease/insect</b>	
<b>Dieback</b>	
<b>Threats</b>	
<b>VegComm</b>	
<b>Canopy species</b>	<i>Melaleuca alternifolia</i>
<b>Midstorey species</b>	<i>Acacia</i> sp
<b>Understorey species</b>	<i>Imperata cylindrica</i> , sedge ( <i>Carex</i> sp? no fertile material)
<b>Canopy</b>	50
<b>Midstorey</b>	0
<b>Forb</b>	65
<b>Grass</b>	40
<b>Shrub (&lt;1m)</b>	
<b>litter</b>	
<b>bare/water</b>	
<b>exotic</b>	
<b>Weed Species</b>	none along transect
<b>Weed abundance</b>	
<b>Recruitment</b>	
<b>Disturbance</b>	
<b>Comments</b>	
<b>Abundance summary</b>	None



Habitat transect, 12-May-16



Location of soil distribution Transect 1, 12-May-16



Location of soil distribution Transect 2, 12-May-16

### Notes and recommendations

*Maundia triglochoides* has been noted on the transect lines.

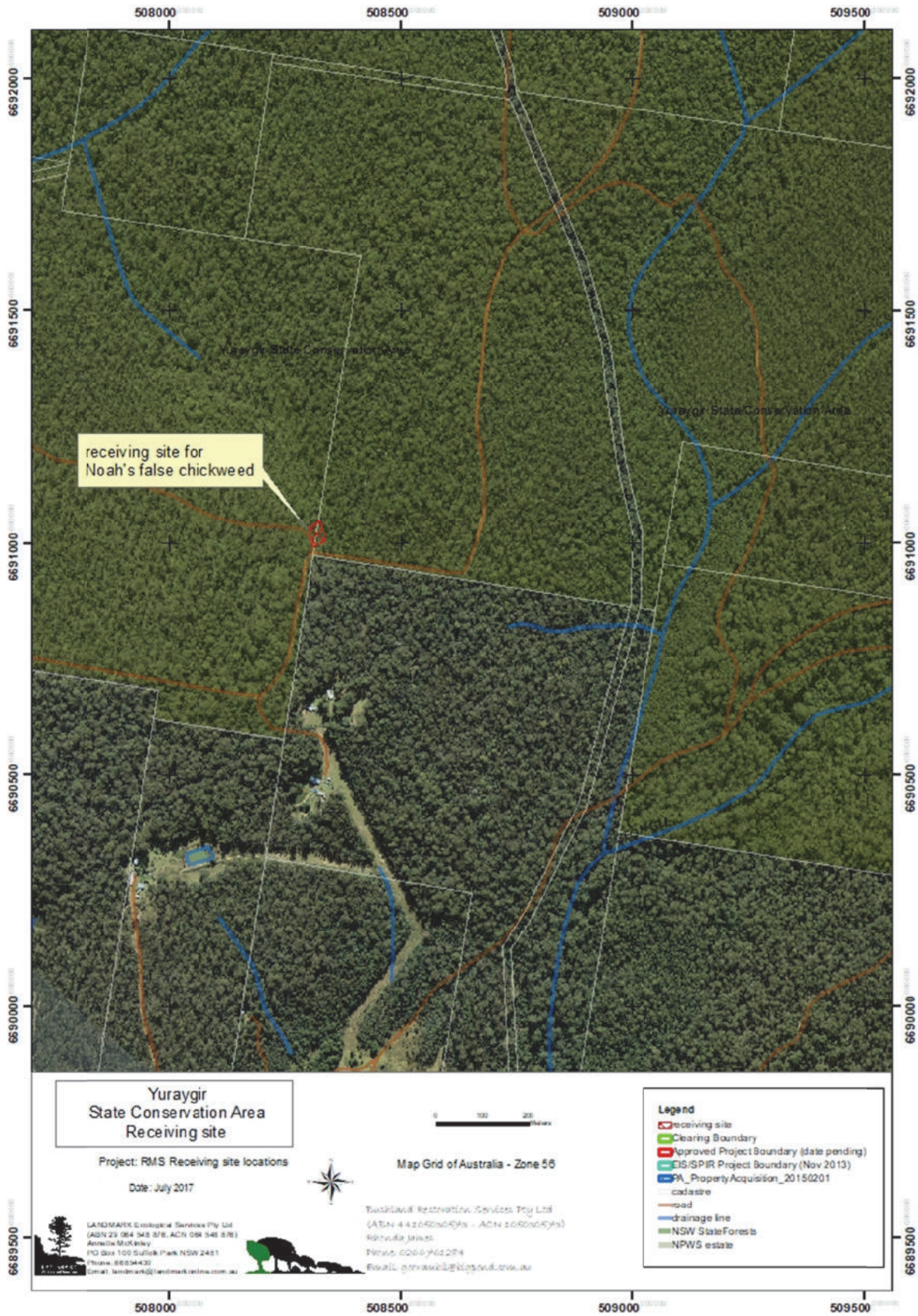
Access to this site for maintenance following planting has been restricted by construction. Habitat conditions have not changed appreciably during the observation period, apart from some changes to soil moisture. In May 2017 the whole area was under 30-40 cm of water. No emergence from soil stored seed was observed (dry conditions in early stages, unknown soil propagule density). Observation to continue according to the monitoring schedule.

# Yuraygir SCA

Noah's false chickweed *Lindernia alsinoides*

## Layout and translocation methods

21 plants/clumps were directly transplanted, 15 August 2015, to the Yuraygir SCA receiving site, placing plants/clumps into natural gaps in the native vegetation. The planting area was approx. 30 x 40m.



## Yuraygir SCA La – receiving site details

<b>Species</b>	<i>Lindernia alsinoides</i>	<i>Lindernia alsinoides</i>	<i>Lindernia alsinoides</i>
<b>Common name</b>	Noah's false chickweed	Noah's false chickweed	Noah's false chickweed
<b>Date</b>	12-May-16	30 Nov, 15/12/16	28-May-17
<b>Marker</b>	ll on trunks, pink	ll on trunks, pink	ll on trunks, pink
<b>Location</b>	SW section of SCA	SW section of SCA	SW section of SCA
<b>Location 2</b>			
<b>Easting</b>	508328	508328	508328
<b>Northing</b>	6691033	6691033	6691033
<b>Transect orientation</b>	N-S	N-S	N-S
<b>Climate previous</b>	dry	Hot, dry	wet
<b>Climate current</b>			Grey, overcast, light rain
<b>Landform</b>	dry, sunny side of shallow gully	Hot, stormy side of shallow gully	side of shallow gully
<b>Drainage</b>	poor	poor	poor
<b>Slope</b>	very gentle	very gentle	very gentle
<b>Aspect</b>	NE	NE	NE
<b>Soil moisture</b>	dry to slightly moist	dry	wet
<b>Water levels</b>	dry		
<b>Water flow</b>	none	none	none
<b>Plant condition (0-5)</b>	Mostly 5	5	n/a
<b>Height</b>	2-10 cm	6-12 cm	n/a
<b>Clump diameter (cm)</b>	Up to 20 cm	10-20 cm	n/a
<b>DBH</b>			
<b>Leaf cond</b>	4-5		
<b>Length new shoots</b>			
<b>Flowers</b>	present		
<b>Fruit</b>	empty capsules	present	
<b>Recruitment</b>		vegetative spread (limited)	
<b>Disease/insect</b>	vegetative spread		
<b>Dieback</b>			
<b>Threats</b>			
<b>VegComm</b>	<i>Eucalyptus robusta</i> forest	<i>Eucalyptus robusta</i> forest	<i>Eucalyptus robusta</i> forest
<b>Canopy species</b>	<i>Eucalyptus robusta</i>	<i>Eucalyptus robusta</i>	<i>Eucalyptus robusta</i>
<b>Midstorey species</b>	<i>Melaleuca</i> sp	<i>Melaleuca sieberi</i>	<i>Melaleuca sieberi</i>
<b>Understorey species</b>		<i>Sedges</i> ( <i>Lepidosperma</i> sp.), <i>Xanthorrhoea fulva</i> , <i>Banksia oblongifolia</i>	<i>Sedges</i> ( <i>Lepidosperma</i> sp.), <i>Xanthorrhoea fulva</i> , <i>Banksia oblongifolia</i> , <i>Banksia spinulosa</i>
<b>Canopy</b>	2.5	2.5	2.5
<b>Midstorey</b>	10	10	20
<b>Forb</b>	95	10	30
<b>Grass</b>	0	0	0
<b>Shrub (&lt;1m)</b>	80	20	50
<b>litter</b>	0	10	0
<b>bare/water</b>	0	0	10
<b>exotic</b>	0	0	0
<b>Weed Species</b>	none	none	none
<b>Weed abundance</b>	0	0	0
<b>Recruitment</b>			Occasional eucalypt saplings
<b>Disturbance</b>	n	Occasional	
<b>Comments</b>			
<b>Comments 2</b>			
<b>Abundance summary</b>	6 plants/clumps	3 plants/clumps	none





Habitat transect, 12-May-16



Flowering plant – Plant 19, 12-May-16

**Notes and recommendations**

(Individual plant/clump data see following page)

Year 1 Survivorship has been low as a result of very dry conditions, with six plants surviving out of 22 plantings. Several of the surviving plants were flowering. Only a small number of plants were surviving by December 2016.

It is possible that recruitment from seeds will take place in following growing seasons, along with vegetative spread once plants are well established. Locations of dead plants to be checked according to monitoring schedule.

This site is not recommended for further supplementary plantings as apparently drier than the alternatives at Kangaroo Trail and Halfway Creek Crossing.

### Monitoring observations May 2016

Plant/clump no	Easting	Northing	Description Aug 2015	Condition general	Condition leaf	Diameter (cm)	Stems (cm)	Height (cm)	flowering/fruiting	Notes
1	508316	6690997	1 small clump	0						
2	508326	6691003	2 plants	5	5	7	5	4		shrinking at clod margins, dry
3	508320	6691006	1 small clump	0						
4	508325	6691011	1 small clump	0						shrinking at clod margins, dry
5	508323	6691014	1 small clump	5	5	10	10	10		less dry
6	508318	6691014	2 small clumps	0						
7	508321	6691018	2 plants	4	4	3	2	2		small, fairly dry
8	508317	6691017	2 plants	0						
9	508324	6691022	medium clump	0						
10	508318	6691020	medium clump	0						
11	508332	6691025	1 small clump	0						
12	508313	6691017	2 small clumps	5/5	5	6/4	6/3	6/4	fl	two small clumps, one with flowers
13	508310	6691027	1 plant	5	5	6	6	6		
14	508316	6691029	4 plants	0						
15	508320	6691030	medium clump	0						
16	508326	6691029	1 small clump	0						shrinking at clod margins, dry
17	508329	6691030	1 small clump	0		3x3	3x2	3x10		3 small plants, fairly dry
18	508329	6691034	1 plant	0						
19	508325	6691035	medium clump	5	5	20	10	8	fl/fr	
20	508325	6691035	2 plants	0						
22	508323	6691041	1 small clump	0						

### Monitoring observations 15 Dec 2016 (surviving plants only shown)

Plant/clump no	Easting	Northing	Description Aug 2015	Condition general	Condition leaf	Diameter (cm)	Stems (cm)	Height (cm)	flowering/fruiting	Notes
12	508313	6691017	2 small clumps	5/5	5	10/10	8/6	8/6		
13	508310	6691027	1 plant	5	5	15	12	12		
19	508325	6691035	medium clump	5	5	20	10	6		fr

Monitoring observations May 2017 No plants surviving

# Pillar Valley

Square-fruited ironbark *Eucalyptus tetrapleura*

## Layout and translocation methods

Donor sites identified in Section 2 were searched for seed following pre-construction clearing when freshly felled trees were windrowed. No seed was present at many locations as a result of recent fires and generally unpredictable seed availability. In addition, some fruits displayed indications of hybrid origin (rounded angles on fruit)– no collections were made from suspected hybrids.

Most seed was collected from the Franklins Road area, with collections taking place between July 2015 and February 2016. 77 plants were held in the nursery awaiting suitable planting conditions and arrangements. Planting and baseline data collection took place on 28 May 2017 and followed site preparation (spraying of pasture grass). All plants were numbered with spike labels.

Habitat is flat, well-drained pasture with some eucalypt regrowth. Pasture grasses, dominated by Narrow-leaved carpet grass *Axonopus fissifolius* occupied about 80% cover. Other exotic species: Whisky grass *Andropogon virginicus* and Fireweed *Senecio madagascarensis*.

### Baseline data

All plants were in good condition. Planting spacing 4-5m but variable.

Tree no	Easting	Northing	Height (cm) 28 May 2017
1	6704135	508160	65
2	6704139	508159	75
3	6704147	508157	60
4	6704134	508154	64
5	6704139	508152	65
6	6704133	508148	65
7	6704132	508146	55
8	6704128	508142	55
9	6704125	508143	50
10	6704119	508146	60
11	6704114	508141	58
12	6704115	508135	60
13	6704115	508132	60
14	6704122	508140	48
15	6704123	508135	70
16	6704128	508139	50
17	6704131	508137	65
18	6704135	508138	60
19	6704138	508143	55
20	6704144	508147	45
21	6704150	508151	70
22	6704149	508145	60
23	6704144	508139	50
24	6704152	508138	50
25	6704146	508135	55
26	6704137	508132	65
27	6704131	508131	55
28	6704131	508128	60
29	6704126	508126	60
30	6704123	508129	40
31	6704120	508128	45
32	6704113	508127	45
33	6704112	508124	55
34	6704115	508118	45
35	6704119	508121	60

<b>Tree no</b>	<b>Easting</b>	<b>Northing</b>	<b>Height (cm) 28 May 2017</b>
36	6704124	508123	60
37	6704127	508120	40
38	6704129	508122	50
39	6704134	508124	70
40	6704138	508125	85
41	6704141	508128	65
42	6704146	508130	50
43	6704143	508126	50
44	6704151	508128	55
45	6704158	508129	58
46	6704153	508122	55
47	6704146	508120	45
48	6704140	508119	58
49	6704139	508114	60
50	6704134	508117	48
51	6704131	508112	55
52	6704126	508114	58
53	6704129	508116	55
54	6704119	508111	70
55	6704131	508107	35
56	6704135	508106	55
57	6704138	508108	45
58	6704144	508111	50
59	6704150	508116	50
60	6704157	508116	50
61	6704157	508113	70
62	6704158	508107	58
63	6704153	508108	68
64	6704151	508104	50
65	6704147	508104	55
66	6704141	508103	55
67	6704135	508100	35
68	6704130	508099	50
69	6704133	508096	60
70	6704137	508099	65
71	6704138	508094	65
72	6704143	508095	65
73	6704151	508097	65
74	6704157	508101	50
75	6704162	508101	55
76	6704162	508094	65
77	6704157	508095	55



Tree 50 newly planted May 2017



# Mahogany Drive

## *Lepidosperma* “Coaldale”

### Layout and translocation methods

Plants of *Lepidosperma* sp. Coaldale were removed from the donor site at Wells Crossing on 20 July 2015. The plants were dug up shovel deep and the placed in plastic bags with the sandy soil kept around the rhizomes. The plants were removed from 17 separate locations, some of which were single plants while others were clumped and connected underground to the same rhizome. The rhizomes were shiny black in appearance, straight and brittle. Few lateral roots were apparent.

Plants were transferred to the car and covered in wet hessian for transport to Mullumbimby Creek Native Plant Nursery, where they were potted up on 21 July 2015. The plants with local soil were potted up in 12 inch pots in a mix of 2 parts potting mix 1 part coarse sand 1 part peat moss. The plants were then placed in a shady part of the nursery.

A total of 36 plants were removed and tagged and numbered to indicate their relationship to connecting rhizomes. Rhizomes were numbered 1-17 and, where multiple plants arose from the same rhizome, the numbers were assigned alphabetical suffixes from a up to f.

Plants are numbered as follows:

1, 2 a-c, 3 a-b, 4, 5 a-c, 6 a-f, 7 a-b, 8 a-c, 9, 10 a-b, 11, 12 a-d, 13 a-b, 14, 15 a-b, 16 and 17.

Plants developed successfully in the nursery, with the exception of the two divisions from rhizome 15. Plants were held in the nursery for planting in appropriate conditions. The plants were planted on 12 September 2016 in four plots on gully lines at the Mahogany Drive biodiversity offset property.

#### Habitat description

Plots 1 and 2 on edge of paperbark swamp

	<b>Species</b>	<b>Height (m)</b>	<b>Cover (%)</b>
Canopy	<i>Banksia serrata</i> , <i>Casuarina littoralis</i> , <i>Melaleuca quinquenervia</i>	18	30
Mid	<i>Leptospermum polygalifolia</i> , <i>Elaeocarpus reticulatus</i>	3	5
Lower	<i>Xanthorrhoea fulva</i> , <i>Pteridium esculentum</i>	0-1	60

Aspect N and S, sand substrate, slope moderate

#### Plot 3

	<b>Species</b>	<b>Height (m)</b>	<b>Cover (%)</b>
Canopy	<i>Banksia aemula</i>	15	20
Mid	<i>Leucopogon</i> sp, <i>Persoonia</i> sp, <i>Elaeocarpus reticulatus</i>	3	20
Lower	<i>Melichrus</i> sp, <i>Lomandra longifolia</i>	0-1	20%

Aspect NE, sand substrate

#### Plot 4

	<b>Species</b>	<b>Height (m)</b>	<b>Cover (%)</b>
Canopy	<i>Persoonia</i> sp. <i>Banksia serrata</i> , <i>Ceratopetalum gummiferum</i>	18	30
Mid	<i>Melastoma affine</i> , <i>Lantana camara</i>	2	5

Lower	Ground ferns	0-1	20
-------	--------------	-----	----

Aspect S, gentle slope, sand substrate

Habitat characteristics were not significantly altered during the monitoring period.

#### Monitoring (nursery and field)

Plants were given a condition score (0-5) and clumps were placed in size classes based on the diameter of the base of the clump at soil level:

Large = >10cm

Medium = 5-10

Small = 2-5

V small = <2

The length of the longest culm was noted.

A rapid assessment monitoring inspection was conducted during December and a full formal monitoring inspection was conducted in May 2017 with additional checking 8 July 2017.

#### Results

In a number of instances, plants that were assessed as dead were observed to reshoot at later inspections. The assessment of survivorship in the nursery and the field was therefore not reliable at any one time. A number of plants developed flowers, both in the nursery and in the field.

#### Threats

A dense ground fern layer in some sections of the planting area became competitive for light and its thinning or removal is recommended. The fern layer also obscured plants, so that higher survival rates are likely to be evident once ferns are thinned or removed and *Lepidosperma* plants are uncovered. Lantana is occasional in the surrounds.

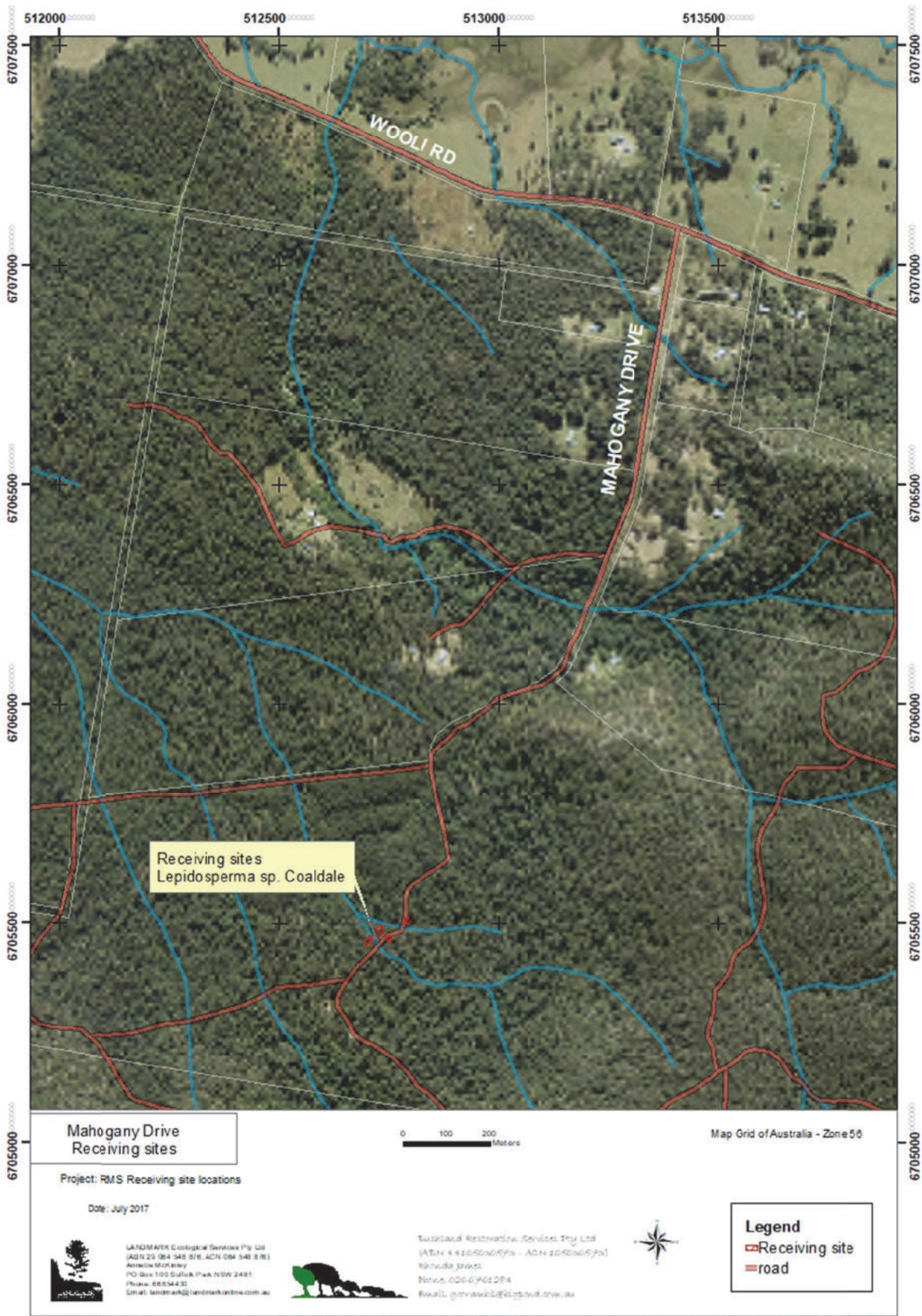
Stock incursions observed at the time of the most recent monitoring inspection, and later in July 2017 may have damaged plants and have dislodged labels, making re-location of plants difficult. While incursions are minor at the planting site, evidence of heavy cattle traffic adjacent was observed.



Baseline and monitoring data, *Lepidosperma* "Coaldale"

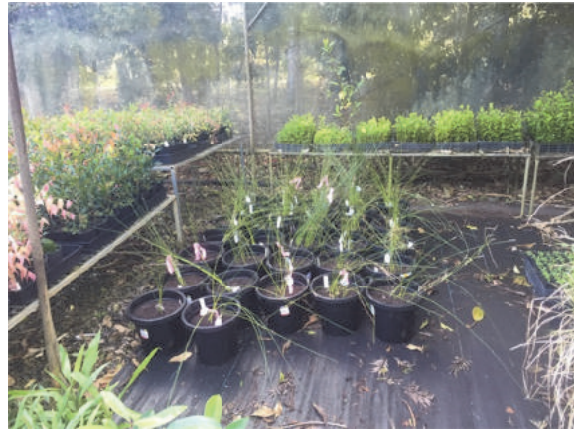
Plant no	Plot no	Easting	Northing	03/9/15 (nursery) Size of clump	Notes	05/11/15 (nursery) Notes	18/8/16 (nursery) Size of clump	Height of longest culm (m)	Condi-tion 0-5	16/12/16 (field) Notes	31/5/17 (field) Size of clump	Height of longest culm (m)	Condi-tion 0-5	Notes
1	1	512699	6705454	large	mostly green culms, possible new growth	many green culms, flowers	large	0.8	5	not found	large	0.8	5	
4	1	512702	6705452	small	green with some old culms	moderate green	small	0.8	5	present	small	0.6	4	2 green culms, one flowering
9	2	512728	6705478	med	most culms green	moderate green	med	1	5	not found	medium	0.8	5	
11	3	512790	6705509	small	dead	moderate green	small	0.8	5	present	small	0.6	5	
14	4	512747	6705465	med	green with some old culms	moderate green	med	0.6	5	not found	medium	0.8	5	5 green and dense
16	4	512748	6705467	med	green with some old culms	many green culms, several flowers	large	1	5	present	large	0.6	5	numerous green culms, several flowering
17	4	512747	6705468	large	most culms green	many green culms	large	0.8	5	present	large	0.7	5	numerous green culms, dense
10a	3	512785	6705508	med	green with some old culms	moderate green	med	0.8	5	present	med	0.4	5	
10b	3	512786	6705509	small	green with some old culms	moderate green	small	0.8	5	present	small	0.4	4	green culms sparse
10c	3	512794	6705510	small	green with some old culms	moderate green	med	0.8	5	present	small	0.5	3	green but sparse
12a	4	512747	6705462	small	green with some old culms	4 green culms	small	0.5	5	present	medium	0.8	5	flowering
12b	4	512748	6705462	small	green with some old culms	moderate green	small	0.7	5	present	medium	0.4	5	numerous green culms
12c	4	512748	6705463	small	green with some old culms	moderate green	small	1	5	present	dead			shaded by ferns
12d	4	512747	6705463	small	dead	2 green culms	small	0.7	5	present	dead			shaded by ferns
13a	4	512747	6705466	med	green with some old culms	moderate green	med	0.7	5	present	dead			dead culms only
13b	4			small	dead	1 green culm	dead			present	missing			missing previously, no sign
2a	1	512699	6705455	small	green with some old culms	1 green culm	v small	0.3	4	not found	missing			
2b	1	512699	6705456	small	green with some old culms	moderate green	med	0.6	5	present	medium	0.6	4	numerous green culms, two flowering

Plant no	Plot no	Easting	Northing	03/9/15		05/11/15		18/8/16		31/5/17 - 8/7/17				
				(nursery) Size of clump	Notes	(nursery) Notes	(nursery) Size of clump	Height of longest culm (m)	Condi-tion 0-5	(field) Notes	(field) Size of clump	Height of longest culm (m)	Condi-tion 0-5	Notes
2c	1	512698	6705458	small	dead	2 slightly green	small	0.5	5	present	small?	0.6?	?	5 green culms - uncertain, label knocked over
3a	1	512700	6705457	small	green with some old culms	moderate green, 2 flowering stems	med	1.2	5	present	missing			tag knocked over, replaced in approx location. No sign
3b	1	512700	6705457	small	green with some old culms	moderate green	small	0.8	5	present	small	0.6	4	missing previously
5a	1	512704	6705464	small	dead	2 green culms	med	0.5	4	not found	missing			missing previously
5b	1	512703	6705462	small	green with some old culms	moderate green	small	0.5	5	not found	medium	0.4		missing previously, now has numerous green culms
5c	1	512706	6705459	small	green with some old culms	many green culms	small	0.6	5	not found	dead			not found
5d	1	512704	6705463	med	green with some old culms	moderate green	med	0.7	5	not found	small	0.6	4	missing previously, green culms now present
6a	2			med	green with some old culms	moderate green	med	0.1	2	not found	missing			not found
6b	2	512725	6705483	2 small	1 dead, 1 with some old culms	moderate green	2 small	0.6	5	present	missing			not found
6c	2	512727	6705486	small	green with some old culms	4 green culms	small	0.8	5	present	medium	0.4		numerous green culms
6d	2	512725	6705485	small	green with some old culms	4 green culms	small	0.8	5	present	small	0.4	4	culms sparse
6e	2	512727	6705480	med	green with some old culms	lots of green	small	0.4	5	present	small	0.5	4	sparse green culms
6f	2	512727	6705480	med	green with some old culms	lots of green	med	0.6	4	present	medium	0.5	5	numerous green culms
7a	2	512728	6705489	small	green with some old culms	lots of green	med	0.8	5	present	small	0.8	3	4 green culms, numerous dead
7b	2	512727	6705489	small	almost all dead	2 green culms	small	0.7	5	present	small	0.6	5	7 green culms including flowering
8a	2	512723	6705478	small	green with some old culms	moderate green	v small	0.7	5	present	v small	0.4	3	sparse green culms
8b	2	512723	6705478	med	green with some old culms	moderate green	small	0.4	4	present	missing			missing previously
8c	2			small	dead	4 green culms	dead			present	missing			missing previously





Newly dug clump of *Lepidosperma* "Coaldale" with multiple shoots from a single rhizome.



Nursery – newly planted



Plant no 16, May 2017

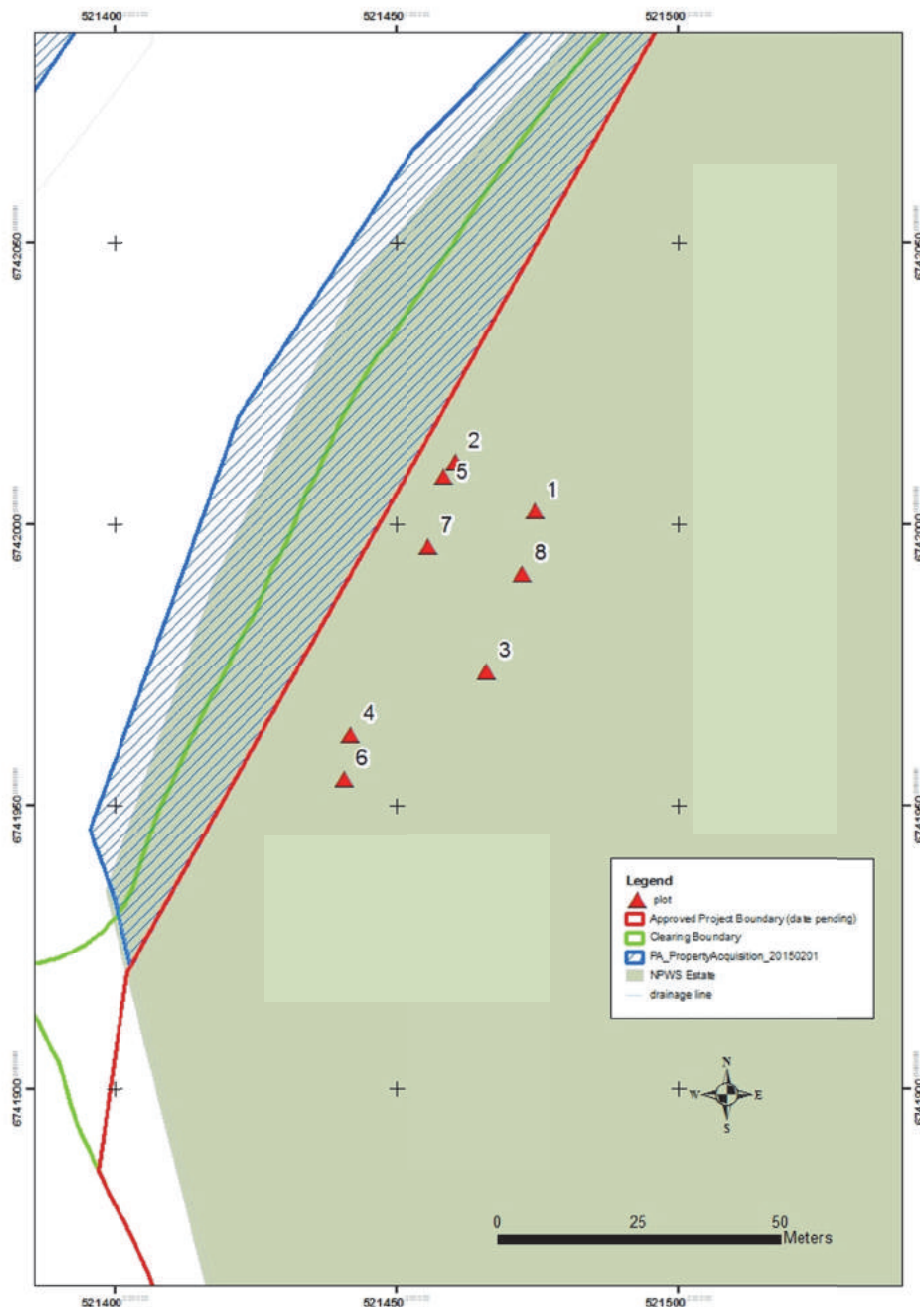


Flowering culm, plant no 16, May 2017

# Yaegl NR south

Tall knot-weed *Persicaria elatior*

## Layout



Location of translocation plots at Yaegl NR south

## Translocation methods

A number of separate operations were undertaken, using direct transplant of live plants, dead plants with capsules and seeds retained, and soil assumed to contain soil-stored seeds. In addition, small seedlings were dug, potted and grown on in a nursery and later planted. The methods used at each plot are reported with the monitoring observations.

## Yaegl NR south – receiving site details

<b>Species</b>	<i>Persicaria elatior</i>	<i>Persicaria elatior</i>	<i>Persicaria elatior</i>
<b>Common name</b>	Tall knotweed	Tall knotweed	Tall knotweed
<b>Date</b>	15-May-16	15-Dec-16	31-May-17
<b>Marker</b>	II on trunks, pink	II on trunks, pink	II on trunks, pink
<b>Location</b>	East of highway on SW edge of reserve	East of highway on SW edge of reserve	East of highway on SW edge of reserve
<b>Location 2</b>			
<b>Easting</b>	521457	521457	521457
<b>Northing</b>	6741998	6741998	6741998
<b>Transect orientation</b>	N-S	N-S	N-S
<b>Climate previous</b>	dry	dry	wet
<b>Climate current</b>	dry, sunny	dry, sunny	dry, clear
<b>Landform</b>	flat	flat	flat
<b>Drainage</b>	poor	poor	poor
<b>Slope</b>	flat	flat	flat
<b>Aspect</b>	flat	flat	flat
<b>Soil moisture</b>	dry	dry	wet
<b>Water levels</b>			Occasional shallow standing water
<b>Water flow</b>	dry	dry	low
<b>Plant condition (0-5)</b>	mostly 0 - seasonal dieback expected	0 - seasonal dieback expected	0 – dead material mostly removed by flood water
<b>Height</b>	up to 0.9m		
<b>Width</b>			
<b>DBH</b>			
<b>Leaf cond</b>			
<b>Length new shoots</b>			
<b>Flowers</b>	two flowers observed	none	none
<b>Fruit</b>	Dead capsules shedding seeds	none	none
<b>Recruitment</b>	none observed	none	none
<b>Disease/insect</b>			
<b>Dieback</b>	seasonal dieback expected	seasonal dieback expected	seasonal dieback expected
<b>Threats</b>			
<b>VegComm</b>	<i>Melaleuca quinquenervia</i> forest	<i>Melaleuca quinquenervia</i> forest	<i>Melaleuca quinquenervia</i> forest
<b>Canopy species</b>	<i>Melaleuca quinquenervia</i>	<i>Melaleuca quinquenervia</i>	<i>Melaleuca quinquenervia</i>
<b>Midstorey species</b>	none	none	none
<b>Understorey species</b>			
<b>Canopy</b>	32.5	32.5	30
<b>Midstorey</b>	0	0	0
<b>Forb</b>	25	0	5
<b>Grass</b>		10	2
<b>Shrub (&lt;1m)</b>			
<b>litter</b>	100	90	80
<b>bare/water</b>			10
<b>exotic</b>			
<b>Weed Species</b>	none	none	none
<b>Weed abundance</b>			
<b>Recruitment (canopy, mid)</b>	Occasional <i>Melaleuca quinquenervia</i> saplings	Occasional <i>Melaleuca quinquenervia</i> saplings	Occasional <i>Melaleuca quinquenervia</i> saplings
<b>Disturbance</b>			Recent floodwaters
<b>Comments</b>			
<b>Comments 2</b>			
<b>Abundance summary</b>	44 plants, mostly died back	Dead material still present	none



Habitat transect, 15-May-16



Habitat transect, May-2017



Plant with live material present, Plot 3, 15-May-16

### **Notes and recommendations**

(Individual plant/clump data see following page)

#### May 2016

A mix of transplanted soil, plant clumps with soil and planting of nursery stock at this site is likely to have resulted in considerable seed inputs to this site. As this operation is an augmentation of an existing population of ephemeral plants scattered in the general vicinity, and seed will be washed both from the site and into the site with floodwater, it will be difficult to evaluate the progress of population development. Observations will continue in the next growing season, no additional augmentation is considered necessary in the short term.

Control plants at Yaegl NR Central receiving site will aid interpretation of the development of translocations.

#### Nov-Dec 2016

While difficult to demonstrate, it is likely that considerable seed has been released into this site. A small number of seedlings have been observed.

#### May 2017

Seedlings observed during previous inspection do not appear to have established following a hot dry period. Flooding has removed dead plant material and presumably both removed and brought in seeds. Monitoring to continue according to the schedule,

## Monitoring observations

Heights of sprawling plants measured as though upright. fl = flower, fr = fruit

### Plot 1

<b>Easting</b>	<b>521475</b>	<b>Northing</b>	<b>6742002</b>
<b>Donor</b>	<b>Yaegl north</b>	<b>Planting date</b>	<b>9/9/15</b>
<b>Direct transplant, central point surrounded by plants at 2.5 and 5m at cardinal points, plus one central</b>			
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>

	15-May-16		30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	0.5	dead plant with seeds	-	
2	0.5	dead plant with seeds	-	
3	0.6	dead plant with seeds	dead material present	No plant material observed, standing water over 25% of plot
4	0.25	dead plant, no fl/fr	dead material present	
5	0.6	dead plant with seeds	dead material present	
6	0.25	dead plant, no fl/fr	dead material present	
7	0.8	dead plant with seeds	dead material present	
8	0.6	dead plant with seeds	-	
9	0.2	dead plant, no fl/fr	-	

### Plot 2

<b>Easting</b>	<b>521461</b>	<b>Northing</b>	<b>6742011</b>
<b>Donor</b>	<b>Yaegl north</b>	<b>Planting date</b>	<b>9/9/15</b>
<b>Direct transplant, central point surrounded by plants at 2.5 and 5m at cardinal points</b>			
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>

	15-May-16		30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	0.6	dead plant with seeds	-	
2	0.6	dead plant with seeds	dead material present	No plant material observed, water-logged, standing water over 50% of plot
3	0.3	dead plant with seeds	dead material present	
4	0.5	dead plant with seeds	dead material present	
5	0.4	dead plant with seeds	dead material present	
6	0.7	dead plant with seeds	dead material present	
7	0.4	dead plant with seeds	dead material present	
8	0.4	dead plant with seeds	dead material present	



Plot 3

<b>Easting</b>	<b>521466</b>	<b>Northing</b>	<b>6741974</b>
<b>Donor</b>	<b>Maclean Interchange</b>	<b>Planting date</b>	<b>29/11/15</b>
<b>Seedlings grown on in nursery and planted out, central point surrounded by plants at 2.5 and 5m at cardinal points</b>			
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>

15-May-16			30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	0.6	dead plant with seeds plus two live branches with flowers	dead material present	
2	0.7	dead plant with seeds	dead material plus seedling (h = 0.3m)	No plant material observed, water-logged but no standing water
3	0.8	dead plant with seeds	dead material present	
4	0.5	dead plant with seeds	dead material plus 2 small seedlings	
5	0.6	dead plant with seeds	-	
6	0.6	dead plant with seeds	-	
7	0.5	dead plant with seeds	Seedling (h = 0.1m)	
8	0.5	dead plant with seeds	dead material present	
Low grass more or less continuous, some leaf litter patches				

Plot 4

<b>Easting</b>	<b>521442</b>	<b>Northing</b>	<b>6741963</b>	<b>Easting</b>
<b>Donor</b>	<b>Yaegl north</b>	<b>Planting date</b>	<b>9/9/15</b>	
<b>Clods of soil transplanted at 5m from centre in cardinal directions</b>				
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>	

15-May-16			30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	-	No plant	No plant	No plant material observed, water-logged but no standing water
2	-	No plant	No plant	
3	-	No plant	No plant	
4	-	No plant	No plant	

Plot 5

<b>Easting</b>	<b>521458</b>	<b>Northing</b>	<b>6742008</b>
<b>Donor</b>	<b>Maclean Interchange</b>	<b>Planting date</b>	<b>29/11/15</b>
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>

	15-May-16		30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	0.4	dead plant with seeds	-	
2	0.5	dead plant with seeds	-	
3	0.4	dead plant with seeds	dead material present	No plant material observed, standing water over 50% of plot
4	0.6	dead plant with seeds	-	
5	0.5	dead plant with seeds	dead material plus small plant (h = 0.1m)	
6	0.4	dead plant with seeds	dead material present	
7	0.4	dead plant with seeds	dead material present	
8	0.8	dead plant with seeds	-	
9	0.5	dead plant with seeds	dead material present	
Ground bare with leaf litter				

Plot 6

<b>Easting</b>	<b>521441</b>	<b>Northing</b>	<b>6741955</b>
<b>Donor</b>	<b>Yaegl Central West</b>	<b>Planting date</b>	<b>18/1/16</b>
<b>Direct transplant, 5 m from central point in cardinal directions plus one plant at 2.5m</b>			
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>

	15-May-16		30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	0.3	dead plant with seeds	-	
2	0.3	dead plant no seeds	-	No plant material observed, waterlogged, no standing water
3	0.4	dead plant with seeds	-	
4	0.2	Small live plant with flowers	-	
5	-	No plant	-	

Plot 7

<b>Easting</b>	<b>521456</b>	<b>Northing</b>	<b>6741996</b>
<b>Donor</b>	<b>Yaegl North</b>	<b>Planting date</b>	<b>9/9/15</b>
<b>Direct transplant of clods, 5 m from central point in cardinal directions</b>			
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>

15-May-16			30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	-	-	-	
2	-	-	-	No plant material observed, shallow standing water over 25% of plot
3	-	Dead material present	-	
4	-	-	-	

Plot 8

<b>Easting</b>	<b>521472</b>	<b>Northing</b>	<b>6741991</b>
<b>Donor</b>	<b>Maclean Interchange</b>	<b>Planting date</b>	<b>29/11/15</b>
<b>Seedlings grown on in nursery and planted out, central point surrounded by plants at 2.5 and 5m at cardinal points</b>			
<b>Habitat</b>	<b>Paperbark</b>	<b>Threats</b>	<b>None evident</b>

15-May-16			30 Nov-15 Dec 2106	31-May-17
Point no	h (m)	Notes	Notes	Notes
1	0.9	dead plant with seeds	-	
2	0.8	dead plant with seeds plus several live branches with flowers	-	No plant material observed, standing water over 25% of plot
3	0.6	dead plant with seeds	-	
4		No plant	-	
5		dead plant no fl/fr	-	
6	0.3	dead plant with seeds plus small live branches with flowers	-	
7	-	No plant	-	
8	-	No plant	-	
Low grass, cover high, Melaleuca quinquenervia in overstorey				

# Yaegl NR central

Tall knotweed *Persicaria elatior*

## Layout and translocation methods

Planting date 2 July 2015

Direct transplant of dead plant material, with seeds, and soil slabs measuring 30 x 20 x 10cm  
Controls were selected from naturally occurring clumps of plants in the vicinity.

Plots and controls were marked with spike labels

Location of plots and controls

<b>Plot number</b>	<b>Easting</b>	<b>Northing</b>
<b>Plot 1</b>	522422	6742551
<b>Plot 2</b>	522434	6742541
<b>Control 1</b>	522425	6742548
<b>Control 2</b>	522432	6742545
<b>Control 3</b>	522437	6742528
<b>Control 4</b>	522424	6742564

## Yaegl NR central

<b>Species</b>	<i>Persicaria elatior</i>	<i>Persicaria elatior</i>	<i>Persicaria elatior</i>
<b>Common name</b>	Tall knotweed	Tall knotweed	Tall knotweed
<b>Date</b>	15-May-16	30 Nov-15 Dec-16	31 May-17
<b>Marker</b>	ll on trunk at S, on stake at N, pink	ll on trunk at S, on stake at N, pink	ll on trunk at S, on stake at N, pink
<b>Location</b>	East of highway, opposite drainline to west of highway	East of highway, opposite drainline to west of highway	East of highway, opposite drainline to west of highway
<b>Location 2</b>			
<b>Easting</b>	522423	522423	522423
<b>Northing</b>	6742572	6742572	6742572
<b>Transect orientation</b>	N-S	N-S	N-S
<b>Climate previous</b>	dry	dry	wet
<b>Climate current</b>	dry, sunny	dry, sunny	dry, clear
<b>Landform</b>	flat	flat	flat
<b>Drainage</b>	poor	poor	poor
<b>Slope</b>	flat	flat	flat
<b>Aspect</b>	flat	flat	flat
<b>Soil moisture</b>	dry	dry	none
<b>Water levels</b>	dry	dry	none
<b>Water flow</b>	dry	dry	none
<b>Plant condition (0-5)</b>	0	0	0
<b>Height</b>			
<b>Width</b>			
<b>DBH</b>			
<b>Leaf cond</b>			
<b>Length new shoots</b>			
<b>Flowers</b>			
<b>Fruit</b>			
<b>Recruitment</b>	new plants present but probably not from transplants	2 small seedlings	none
<b>Disease/insect</b>			
<b>Dieback</b>			
<b>Threats</b>			
<b>VegComm</b>	Exotic grassland on edge of <i>Casuarina glauca</i> - <i>Melaleuca quinquenervia</i>	Exotic grassland on edge of <i>Casuarina glauca</i> - <i>Melaleuca quinquenervia</i>	Exotic grassland on edge of <i>Casuarina glauca</i> - <i>Melaleuca quinquenervia</i>
<b>Canopy species</b>			
<b>Midstorey species</b>			
<b>Understorey species</b>			<i>Paspalum</i> replaced by other exotic grasses
	<i>Paspalum urvillei</i>	<i>Paspalum urvillei</i>	
<b>Canopy</b>	0	0	0
<b>Midstorey</b>	0	0	0
<b>Forb</b>	20	35	0
<b>Grass</b>	95	60	40
<b>Shrub (&lt;1m)</b>			
<b>litter</b>			
<b>bare/water</b>	10	5	60
<b>exotic</b>			40
<b>Weed Species</b>	Exotic grasses, <i>Ipomoea caraiica</i> occasional	Exotic grasses, <i>Ipomoea caraiica</i> occasional	Exotic grasses, <i>Ipomoea caraiica</i> occasional moderate
<b>Weed abundance</b>			
<b>Recruitment (canopy, mid)</b>			
<b>Disturbance</b>			
<b>Comments</b>			Flooding has changed structure and floristics of lower storey
<b>Comments 2</b>			
<b>Abundance summary</b>			



Habitat transect, 15-May-16



Habitat transect, May-2017



Large clump with live flowering material present, control point 3, 15-May-16



Flowering plant in the vicinity of the controls 15-May-16

### **Notes and recommendations**

(Individual plant/clump data see following page)

#### May 2016

So far no new seedlings have been observed where soil clods have been transplanted, but conditions have been dry.

This operation is an augmentation of an existing population of ephemeral plants scattered in the general vicinity, and seed will be washed both from the site and into the site with floodwater. It will be difficult to evaluate the progress of population development. Observations will continue in the next growing season, no additional augmentation is considered necessary in the short term. Controls will aid interpretation of the development of translocated plants. Absence of material at two out of four of the control points illustrates the transient nature of the species.

### Nov-Dec 2016

Small seedlings present, also present in association with translocated plants at Yaegl South. Illustrates, in a small way, some parallel development between the translocated plants and the general population in the Yaegl NR.

### May 2017

Small seedlings previously observed had not persisted, presumably as a result of a hot dry period. No plants at control points, indicating that failure for translocated plants to persist at Yaegl South and Yaegl Central is consistent with plants in the general population. A number of flowering plants were observed in the vicinity of the controls. Management of *Ipomoea cairica* is proposed (a minor threat to Hairy joint-grass).

## Monitoring observations

Planting date 2 July 2015

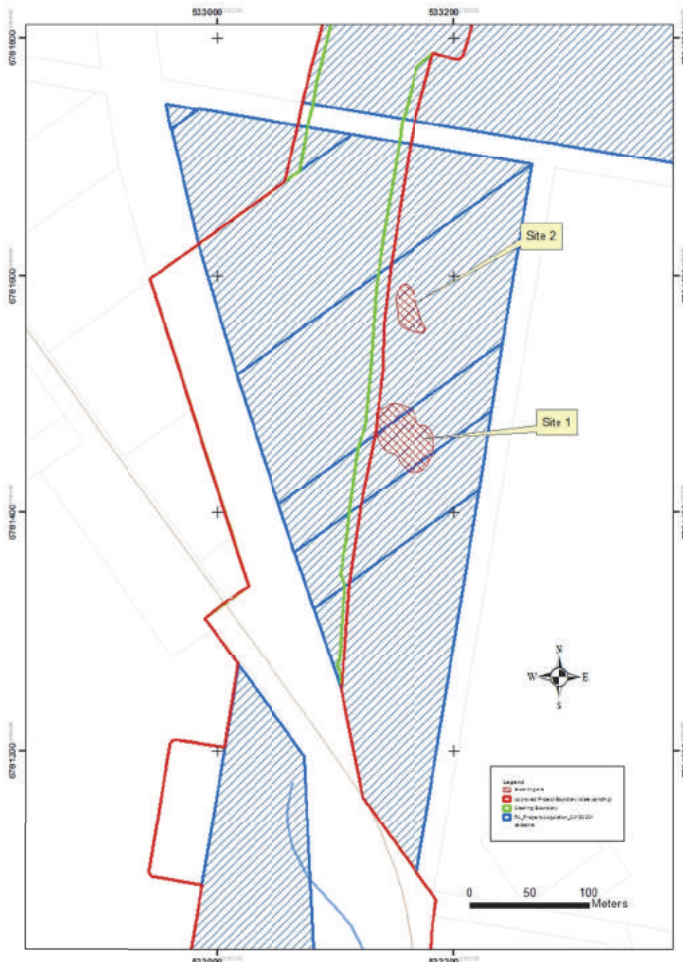
Direct transplant of dead plant and soil clods measuring 30x20x10cm

Plot number	Observations 2 Jul 2015	Observations 15 May 2016	Observations 30 Nov-15 Dec 2016	Observations 31 May 2017
<b>Plot 1</b>				
<b>Plot 2</b>				
<b>Control 1</b>	large clump of dead material	large clump dead material growing with exotic grasses	none	none
<b>Control 2</b>	large clump of dead material	none	none	none
<b>Control 3</b>	large clump of dead material	large clump dead and live (flowering) material	2 small seedlings	none
<b>Control 4</b>	large clump of dead material	none	none	none

# Trustrums Hill

Hairy joint-grass *Arthraxon hispidus*

## Layout



Locations of planting sites

## Translocation methods

### Site 1

29 July 2015 and 6 August 2015

The biggest clumps in the donor site were selected for translocation. The plants were all dead and no seed was observed on the plant material. Twenty five slabs of average area 0.5 m<sup>2</sup> and 10 cm deep, including clumps of plant material and topsoil, were transferred to crates. The slabs were transported to Site 1 and divided between three plots.

Location of plots at Site 1 (points at ne and sw corners)

Plot no	Easting	Northing
1.1 sw	533162	6781451
1.1 ne	533165	6781456
1.2 sw	533161	6781453
1.2 ne	533160	6781459
1.3 sw	533169	6781466
1.3 ne	533168	6781473





Digging of turf slab



Transport of slab

## Site 2

Planting date 18 April 2016

*Casuarina glauca* seedlings at receiving site removed and treated. Approx. 5 clumps of Hairy joint-grass (naturally occurring) were observed in receiving site.

64 slabs of Hairy joint-grass, dimensions as for Site 1, were dug from the donor site (new growth had occurred since Site 1 translocation). The slabs were transported to the receiving site and planted 1 slab at 1m in the cardinal directions from the central marker and 4 clumps in between the cardinal directions at 2 m. Centre marked with spike label.



Translocated Hairy joint-grass slab



Plot 2.4 planted 18 April 2016

## Trustrums Hill – details of receiving sites

Species	<i>Arthraxon hispidus</i>	<i>Arthraxon hispidus</i>	<i>Arthraxon hispidus</i>
<b>Common name</b>	Hairy joint-grass	Hairy joint-grass	Hairy joint-grass
<b>Date</b>	14-May-16	30 Nov/15 Dec-16	30-May-2017
<b>Marker</b>	ll tree at N, pink	ll tree at N, pink	ll tree at N, pink
<b>Location</b>	Site 1 south of RMS-owned land on east of highway. Site 2 at north of site adjacent to Swamp Oak forest	Site 1 south of RMS-owned land on east of highway. Site 2 at north of site adjacent to Swamp Oak forest	Site 1 south of RMS-owned land on east of highway. Site 2 at north of site adjacent to Swamp Oak forest
<b>Location 2</b>			
<b>Easting Site 1</b>	533162	533162	533162
<b>Northing Site 1</b>	6781451	6781451	6781451
<b>Easting Site 2</b>	533162	533162	533162
<b>Northing Site 2</b>	6781577	6781577	6781577
<b>Transect orientation Site 2</b>	N-S	N-S	N-S
<b>Climate previous</b>	dry	dry	wet
<b>Climate current</b>	dry, sunny	dry, sunny	dry, clear
<b>Landform</b>	flat	flat	flat
<b>Drainage</b>	poor	poor	poor
<b>Slope</b>	flat	flat	flat
<b>Aspect</b>	flat	flat	flat
<b>Soil moisture</b>	dry	dry	high
<b>Water levels</b>	dry	dry	low
<b>Water flow</b>	dry	dry	Not flowing
<b>Plant condition (0-5)</b>	0 (seasonal dieback expected)	5	0 (seasonal dieback expected)
<b>Height</b>		to 40 cm	
<b>Width</b>		to 40 cm	
<b>DBH</b>			
<b>Leaf cond</b>			
<b>Length new shoots</b>		to 40 cm	
<b>Flowers</b>			
<b>Fruit</b>			
<b>Recruitment</b>		uncertain	
<b>Disease/insect</b>			
<b>Dieback</b>			
<b>Threats</b>		Weeds, <i>Casuarina glauca</i> encroachment	
<b>VegComm Site 2</b>	Exotic grassland on edge of <i>Casuarina glauca</i> - <i>Melaleuca quinquenervia</i>	Exotic grassland on edge of <i>Casuarina glauca</i> - <i>Melaleuca quinquenervia</i>	Exotic grassland on edge of <i>Casuarina glauca</i> - <i>Melaleuca quinquenervia</i>
<b>Canopy species Site 2</b>			
<b>Midstorey species</b>	0	0	0
<b>Understorey species</b>	0	0	0
<b>Canopy</b>	5	5	0
<b>Midstorey</b>	25	0	0
<b>Forb</b>		70	20
<b>Grass</b>		25	30
<b>Shrub (&lt;1m)</b>	50		50
<b>litter</b>	35	5	20
<b>bare/water</b>			
<b>exotic</b>		high	high
<b>Weed Species</b>	Exotic grasses	Ragweed, goatweed, Giant Paspalum, Cuphea, Verbena sp., exotic grasses	Exotic grasses, Cuphea, Verbena sp
<b>Weed abundance</b>		High	High
<b>Recruitment</b>			
<b>Disturbance</b>			Clearing of Swamp Oak
<b>Comments</b>			
<b>Abundance summary</b>	Dead plant material present (seasonal dieback expected)	Dead plant material still present but small clumps of live plants also present.	Dead plant material present (seasonal dieback expected)



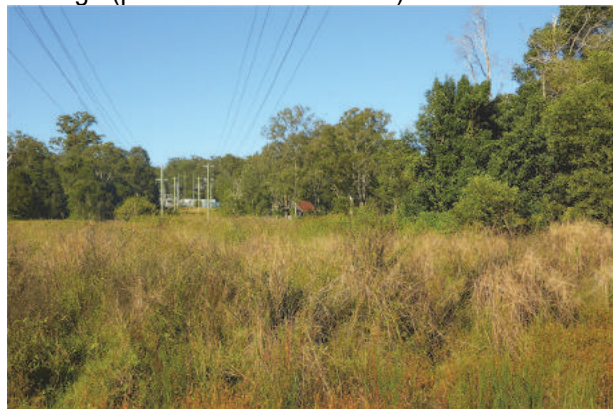
Site 1 following planting, Jul-Aug 2015



Site 1 May 2016, showing biomass development on planting site at right of photo, also vehicle damage (powerline maintenance)



Site 1 Dec 2016 showing competitive biomass



Site 1 May 2017 showing tall grasses dying back



Site 2 May 2016



Site 2 Typical planting site prior to weed management December 2016



Site 2 Typical planting site prior to weed management December 2016. Arthraxon plants mixed with weeds.



Site 2 Dead Arthraxon mixed with exotic grasses May 2017

### **Notes and recommendations**

(Individual plant/clump data see following page)

#### May 2016

Biomass reduction through fencing and grazing is currently under investigation by RMS, also inquiries re possible removal of phone lines. At Site 2, *Casuarina glauca* seedlings will require ongoing removal. Controls are available to guide interpretation of observations of translocated plants.

#### Nov-Dec 2016

Small clumps of new plants have developed. Weed management and Swamp Oak sapling thinning has been conducted effectively and continuation will be required at least in the short term. Grazing is no longer proposed.

#### May 2017

Floodwaters have affected the site. Dead material present as expected seasonally. Controls no longer available, but as Arthraxon is generally fairly regular in its seasonal development, the lack of controls does not materially affect interpretation of observations. Weed management and Swamp Oak sapling thinning has been conducted effectively and continuation will be required at least in the short term.

## Monitoring observations

### Controls

Plant/clump no	Easting	Northing	Method	Observations July 2015	Observations May 2016	Observations Dec 2016	Observations May 2017
<b>Control 1</b>	533152	6781530	search 5 m radius	fairly sparse	None present, overgrown with <i>Casuarina glauca</i> and exotic grasses, tall grasses to 1.5m high	None present, <i>Setaria</i> 2m high	Clearing of power easement, replacement of pole and removal of <i>Casuarina glauca</i> has produced disturbance and left piled debris which has made it difficult to re-locate control plots.
<b>Control 2</b>	533151	6781491	search 5 m radius	fairly sparse	None present, overgrown with <i>Casuarina glauca</i> and exotic grasses, tall grasses to 1.5m high	None present, now dense grass	
<b>Control 3</b>	533148	6781489	search 5 m radius	fairly sparse	present, sparse in low grass and herbaceous pasture weeds to 30 cm high	Small scattered patches of <i>Arthraxon</i> with some tall patches of <i>Giant Paspalum</i>	
<b>Control 4</b>	533147	6781503	search 5 m radius	fairly sparse	mid dense patch, dead weeds to 1.3m + tall grass, but with lower open patches	Small discrete dense patches of <i>Arthraxon</i> with exotic species	

### Translocations

#### Site 1

One plant detected in search February 2016

Grass has grown to 1m, but there are some open patches and lower grass, Hairy joint-grass material observed (May 2016). No further observations of *Arthraxon*. Tall exotic grasses have occupied the site until brushcut to remove biomass in winter 2017.

**Site 2**

<b>Plot</b>	<b>Northing</b>	<b>Eastings</b>	<b>Number of slabs translocated</b>	<b>Observations May 2016</b>	<b>Observations 2016</b>	<b>Nov-Dec</b>	<b>Observations May 2017</b>
2.1	533173	6781555	8	Dead clumps, recently translocated, are still in place but no retained seed observed	Sparse small clumps		Dead Arthraxon present, no seeds retained
2.2	533167	6781564	8	As above	Sparse small clumps		Dead Arthraxon present, no seeds retained
2.3	533164	6781561	8	As above	Sparse small clumps		Dead Arthraxon present, no seeds retained
2.4	533155	6781566	8	As above	Sparse small clumps		Dead Arthraxon present, no seeds retained
2.5	533163	6781574	8	As above	Sparse small clumps		Dead Arthraxon present, no seeds retained
2.6	533156	6781575	8	As above	Sparse small clumps		Dead Arthraxon present, no seeds retained
2.7	533160	6781587	8	As above	Sparse small clumps		Dead Arthraxon present, no seeds retained
2.8	533157	6781590	8	As above	Sparse small clumps		Dead Arthraxon present, no seeds retained

Ongoing weed management and thinning of Swamp Oak saplings has been effectively conducted. Weeds include Cuphea, Broad-leaved Paspalum and other exotic grasses, and Verbena.

## **Appendix 2 Additional translocation actions**

### **Preparation of Quassia Moonee Creek cuttings**

25 June 2015

Seven clusters of stems, possibly clonal, were recognised in the field. 120 cuttings of sizes ranging from 10cm to 50cm in length were taken and numbered by cluster.

Cuttings were placed in plastic bags and transported to Cutting Edge Nursery, proprietor Greg Lascalles, where they were placed in a specialised misting facility.

No strike was achieved.