Transforming our landscapes

Beechmont Road *Macadamia integrifolia* and *Cupaniopsis newmanii* Translocation and Ecosystem Rehabilitation Plan

Project No. 230/2020/1

Transport and Main Roads – Jan 2011

Greening Australia

our vision
A healthy, diverse and productive environment treasured by the whole community.

our mission
To engage the community in vegetation management to protect and restore the health, diversity and productivity of our unique Australian landscapes.

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EXECUTIVE SUMMARY

This plan aims to support the conservation of wild Queensland nut (***M. integrifolia***) and long leaved tuckeroo (***Cupaniopsis newmanii***) by establishing and maintaining a self sustaining, coexisting population that has the capacity to survive in the short and long term. The translocation is necessary in order to offset the unavoidable impact of a road infrastructure project.

Beechmont Road is constructed in mountainous terrain with steep escarpments and deep gullies along the entire length of the road. The geometry is steep and curvilinear with many tight blind curves. The route traverses through geotechnical and environmentally sensitive terrain. A commitment has been made by the Premier, Anna Bligh, to have several sections of Beechmont Road upgraded for motorist safety. This priority project involves upgrading the narrow carriageway from Chainage 8.23 to 8.82 km.

Barrier protection and road widening of this section of Beechmont Road includes the following works:

- Widening of the carriageway on the left to provide two sealed 3.25 m wide traffic lanes, plus shoulders and verges;
- Excavation of the escarpment (1.77 ha);
- Installation of w-section steel beam guardrail and terminal sections;
- Installation of v-channel and associated drainage infrastructure;
- Installation of rock protection chain mesh fencing;
- Upgrade of cross drainage facilities;
- Pavement construction;
- Signage and pavement marking.

Flora surveys were undertaken as part of the environmental approval process. The surveys identified the presence of 23 mature and six (6) juvenile Queensland nut (***Macadamia integrifolia***) listed under the ***Environment Protection and Biodiversity Conservation Act 1999*** (EPBC Act) and ***Nature Conservation Act 1992*** (NC Act) as Vulnerable; and 37 mature and 22 juvenile long-leaved tuckeroo (***Cupaniopsis newmanii***) listed under the NC Act as Near Threatened.

This plan has been developed to prepare a rehabilitation site on the adjacent Canungra Field Training Area (CFTA) in the vicinity of the recorded specimens of ***M. integrifolia*** and directly opposite the impact site where several specimens of ***M. integrifolia*** were recorded. Suitable sites that are currently infested with lantana (***Lantana camara***) have been identified as having the same geology (tertiary basalt). The land is used primarily as a buffer for military training activities. Permission to use the land has been granted by the CFTA Environmental Officer (Mr

Nicholas Lawler. Pers. Comm. June 2010), and official written permissions shall be gained upon acceptance of this plan.

The project shall successfully establish no less than 102 ***M. integrifolia*** (V - NC Act ratio 1:3.5 = 29 x 3.5 = 101.5) and 177 ***C. newmanii*** (NT - NC Act) ratio 1:3 = 59 x 3 = 177) all propagated from local provenance material.

The plan specifies propagation of each individual as identified at the impact site – 29 ***M. integrifolia***– by cuttings, to maintain genetic diversity. Seeds shall be collected from the ***C. newmanii*** at the impact site and in close proximity to establish 177 plants. This shall be undertaken by suitably qualified and experienced specialists.

Planting of 2573 Least Concern and co-occurring species at the rehabilitation site for ***M. integrifolia*** and ***C. newmanii*** shall be undertaken***.*** This will help to ensure stability and productive capability of the rehabilitation project and help to protect the ***M. integrifolia*** and ***C. newmanii*** from damage.

Long-term monitoring and maintenance shall be undertaken with a minimum of five years weed control throughout the rehabilitation site and annual detailed monitoring reports. Canopy development is expected within five years, thereby reducing the impact of ***L. camara*** on the long-term success of the project. Maintenance and monitoring shall continue until the project success indicators have been met.

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1 INTRODUCTION

1.1 Project Background

The Greening Australia Extension Officer based with the Department of Transport and Main Roads South Coast Region was engaged to prepare a Translocation Plan for 23 mature and six (6) juvenile Queensland nut (***Macadamia integrifolia***) and 37 mature and 22 juvenile long leaved tuckeroo (***Cupaniopsis newmanii***) for a road safety improvement project on Beechmont Road, Lower Beechmont. The plan follows the recommendations as outlined in the flora survey for the impact site (Reynolds, 2010) and aims to fulfill the requirements set by the Department of Environment and Resource Management (DERM) and Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) for offsetting a Vulnerable species listed under the ***Nature Conservation and Act 1992*** (NC Act) and ***Environment Protection and Biodiversity Act 1999*** (EPBC Act). Recommendations from McConachie (2010) made after an investigation of the impact site and proposed translocation will also be addressed in this plan.

1.2 Project Objectives

The objective of the translocation plan is to establish a self-sustaining vegetation community, including affected threatened and least concern species within five years from commencement of the project.

1.2.1 Project Aims

This plan aims to support the conservation of wild Queensland nut (***M. integrifolia***) and long leaved tuckeroo (***Cupaniopsis newmanii***) by establishing and maintaining a self-sustaining, coexisting population that has the capacity to survive in the short and long term. The plan aims to fulfill the requirements for offsetting a vulnerable species as listed under the ***Environment Protection and Biodiversity Conservation Act 1999*** and the ***Nature Conservation Act 1992.***

1.3 Consultation and Review

The following people and organizations were consulted prior to and during the preparation of this plan:

- Ian McConachie (Managing Director, Macadamia Consultants)
- Dr Michael Powell (PhD, Predicting the Geographic Distributions of ***Macadamia integrifolia*** and ***Macadamia ternifolia***)

- Maria Matthes (Australia Macadamia Society)
- David Bell (Hidden Valley Plantations)
- Martin Soutar (Parks Coordinator, Lismore City Council)
- Kim Wilson (Gray Plantations)
- Mark Ross (Gecko Regen. Nursery)
- The Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC)
- The Department of Environment and Resource Management (DERM)

The following documents were reviewed prior to and during the preparation of this plan:

- Tugun Bypass Translocation Plan for Threatened and Rare Plant Species (Ecos Environmental, 2006)
- Tugun Bypass Translocation Project for Rare and Threatened Plants: Monitoring Report 2010 (SMEC, 2010)
- Translocation Plan for the Ballina Bypass (Greenloaning Biostudies, 2008)
- Translocation of Threatened Plant Species for the Ballina Bypass Project: Monitoring Report 1 (Ecos Environmental, 2009)
- Translocation Plan, ***Macadamia tetraphylla*** (James Warren and Associates, 2009)
- Conservation Management Plan for ***Macadamia tetraphylla*** on the Otmoor Farm (Greening Australia, 2005)
- Propagation and Translocation Program and Plan for Flora Species of National Environmental Significance (Hinze Dam Alliance 2008)
- Hinze Dam Stage 3 PTP Monitoring Framework (Hinze Dam Alliance 2010)
- Use of Environmental Offsets Under the ***Environment Protection and Biodiversity Conservation Act 1999***, Discussion Paper (Department of Environment and Water Resources 2007a)
- Draft Policy Statement: Use of Environmental Offsets under the ***Environment Protection and Biodiversity Conservation Act 1999***, (Department of Environment and Water Resources 2007b)
- Offset Rules for the Clearing of Protected Plants under ***the Nature Conservation Act 1992,*** Attachment one (Department of Environment and Resource Management n.d.)

1.4 Legislative Requirements

1.4.1 *Macadamia integrifolia*

M. integrifolia is listed as Vulnerable under the EPBC Act, the NC Act and ***Nature Conservation Wildlife Regulation 2006*** (NCWR). Under the EPBC Act an impact deemed significant to a Vulnerable species must be referred to DSEWPaC as it is considered a Matter of National Environmental Significance (MNES). Several significant impact criteria for Vulnerable species as listed by DEWHA (2009) are relevant to this project (Reynolds, 2010). Therefore, this translocation and rehabilitation plan will form part of the referral to DSEWPaC as a MNES.

The NC Act states that it is an offence to "take" a Vulnerable plant from the wild without a permit. The exemption and species management plan (DERM 2009) granted to the Department of Main Roads (TMR) only includes Least Concern species. Therefore, a permit issued by DERM to clear Vulnerable flora species is required prior to clearing activities taking place. An offset plan is required by DERM prior to the issuing of a permit to take Vulnerable flora. Therefore, this translocation and rehabilitation plan will form part of the application for a permit to take Vulnerable flora species as listed under the NCWR.

1.4.2 *Cupaniopsis newmanii*

C. newmanii is listed as Near Threatened under the NC Act and NCWR. The NC Act states that it is an offence to "take" a Near Threatened plant from the wild without a permit. The exemption and species management plan (DERM, 2009) granted to TMR only includes Least Concern species. Therefore, a permit issued by DERM to clear Near Threatened flora species is required prior to clearing activities taking place. DERM requires an offset plan or mitigation measure to be prepared prior to the issuing of a permit to take Near Threatened flora. Therefore, this translocation and rehabilitation plan will form part of the application for a permit to take Near Threatened flora species as listed under the NCWR.

1.4.3 *Co-occurring Flora (Least Concern Species)*

TMR is currently exempt from applying for a clearing permit under the exemption and species management plan (DERM 2009) granted to TMR. Clause 5.1.13 of the exemption states that the exemption does not apply to patches of vegetation mapped as essential habitat under the ***Vegetation Management Act 1999*** (VM Act) or patches mapped as critical habitat under the NC Act. The impact site is not mapped as remnant vegetation, essential habitat or critical habitat; therefore, no clearing permit for Least Concern species is required for this project. However, the long-term viability and

success of this translocation plan is likely to be compromised if co-occurring species were not planted with the ***M. integrifolia*** and ***C. newmanii***. Therefore planting the co-occurring species with the ***M. integrifolia*** and ***C. newmanii*** shall form a component of this plan, with the aim of establishing a self-sustaining ecosystem. Encouragement of natural regeneration of co-occurring species is also a focus of this plan.

2 SPECIES DESCRIPTIONS

2.1 Macadamia integrifolia

Macadamia integrifolia belongs to the Proteaceae family, grows up to 20 m tall and is usually associated with drier subtropical rainforest in Queensland from Currumbin Valley to Mt Bauple (Harden ***et al.,*** 2006: 79). The adult leaves are predominantly in whorls of three with 1 – 2 cm long petioles, obovate to oblong – ovate leaf blades with entire margins sometimes with a few teeth, and juvenile leaves are usually found with a coarsely serrate margin (Stanley & Ross 2002: 15). The white inflorescence grows from 10 – 30 cm long and is followed by a follicle fruit in December to March which is edible (Stanley & Ross, 2002: 15; Cribb, 1990: 102; Costello, 2009). This species is grown as a commercial food and is the only Australian native species cultivated on a large scale for the domestic and international market (Cribb, 1990:102).

2.2 Cupaniopsis newmanii

Cupaniopsis newmanii belongs to the Sapindaceae family and grows as a small unbranched tree up to 6 m tall with alternate, pinnate leaves with 16 – 24 toothed leaflets (Floyd, 2008: 387). Pink inflorescences in panicles 10 – 38 cm long are followed by three lobed capsules containing three shiny black seeds from October to November (Floyd, 2008: 387).

3 CONSERVATION IMPORTANCE

3.1 Macadamia integrifolia

Australia is a signatory of the International Treaty on Plant Genetic Resources for Food and Agriculture (Cooper 2002). The treaty was written to ensure the ***in-situ*** conservation of wild agriculturally important species. Therefore, Australia is obligated under the treaty to ensure ***in-situ*** conservation of wild ***M. integrifolia.***

Macadamia integrifolia occur naturally, east of the Great Dividing Range in or on rainforest margins from Mt Bauple near Gympie to the Currumbin Valley in the Gold Coast Hinterland, and were described in the decade 1850-60 in northern New South Wales (Costello ***et al,.*** 2009; DEWHA, 2008). DEWHA (2008) estimates that 2,500

mature trees in 20 populations are left in the wild, over a 10,000 km² radius. This is in contrast to another estimate of 1,000 mature individuals in 50 populations consisting of 10 – 25 mature individuals (Costello ***et al.,*** 2009). Population estimates from Costello ***et al.*** (2009) indicate that a population of more than ten (10) mature and regenerating ***M. integrifolia*** would be considered significant. Therefore, the population at the impact site should be considered significant as indicated in the 2009 and 2010 flora survey results for the impact site (Reynolds, 2009 & 2010). ***Macadamia integrifolia*** are capable of maintaining small wild populations, providing connectivity is maintained through gene flow between small populations within a region (Costello ***et al.,*** 2009). Therefore, conservation of the germ plasm from the impact site and re-establishing the population in close proximity is potentially significant in terms of maintaining gene flow to other populations in the region.

3.2 Cupaniopsis newmanii

Cupaniopsis newmanii is listed as having a distribution range of less than 100 km, and therefore is considered rare. However, there are no specific threats identified other than a small natural habitat range, and the species is found in at least one national park or conservation reserves (Briggs & Leigh, 1995: 171). Therefore, the species is not currently considered to be at a substantial risk of severe decline. However, the NC Act and NCWR list ***C. newmanii*** as Near Threatened, which is most likely also due to NC Act Clause 79/1/a where the population or distribution is considered small.

3.3 Co-occurring Species

The co-occurring species are those that were identified in the flora surveys for the impact site (Reynolds, 2009 & 2010), and those species that are generally associated with ***M. integrifolia*** and ***C. newmanii***. Species listed as occurring in Regional Ecosystem 12.8.3, which is the dominant Regional Ecosystem indicated to have been present (Pre-clearing Regional Ecosystem data) at the impact and translocation sites prior to clearing shall be deemed the co-occurring species. No co-occurring species at the impact site were identified as having a conservation value higher than Least Concern. However, a significant population of rough shelled nut (***Macadamia tetraphylla***)***,*** also listed as Vulnerable under the EPBC Act and NC Act, were found on the adjacent property, and mature ***M. integrifolia*** were found directly opposite and adjacent to the proposed translocation site (Appendices 1 & 2).

4 GENERAL REQUIREMENTS

4.1 Qualifications and Experience of Project Team

This translocation and rehabilitation plan has been prepared with the intention that the project will be coordinated by qualified and experienced personnel with minimum qualifications in Certificate III in Horticulture, Conservation and Land Management (CaLM) or equivalent experience. The project shall be undertaken by nurseries and conservation land management specialists who have experience in the collection, propagation and translocation of threatened flora species with particular experience in ***Macadamia*** species or species belonging to the family Proteaceae. Site maintenance and monitoring shall be undertaken by bush regeneration specialists with minimum qualifications in Certificate III Conservation and Land Management or equivalent and several years of practical ecological rehabilitation experience. Monitoring reports shall be prepared by consultants experienced in preparing ecological monitoring reports according to DSEWPaC and DERM requirements.

4.2 Permits

The following required permits shall be obtained by TMR prior to undertaking this project:

- Clearing permit for clearing of protected plants under Section 89 (1) b of the ***Nature Conservation Act 1992*** (Ecoaccess)
- General permit to take threatened species and ecological communities under Section 201 ***Environment Protection and Biodiversity Conservation Act 1999***

4.3 Access to Site

The translocation and rehabilitation site is situated on the Canungra Field Training Area (CFTA). As required by the Commonwealth Department of Defence, a “Permit to Occupy” for the duration of the project shall be arranged through TMR.

5 TRANSLOCATION SITE ASSESSMENT

5.1 Proximity to Impact Site

The translocation and rehabilitation site is situated directly opposite the impact site on the CFTA land (Appendix 1).

5.1.1 Aspect and Similarity to Impact Site

The translocation site is situated on gently sloping and flat land facing west – north – west at an altitude averaging 385 m Australian Height Datum (AHD). The soil is derived from olivine tertiary basalt geology (Figure 1) and an inspection of the site recorded the presence of basalt scree and basalt derived soils. The Regional Ecosystem (RE) association is the same as for the impact site (Figure 2). Refer to Table 1 for a comparison between the impact and the translocation sites.

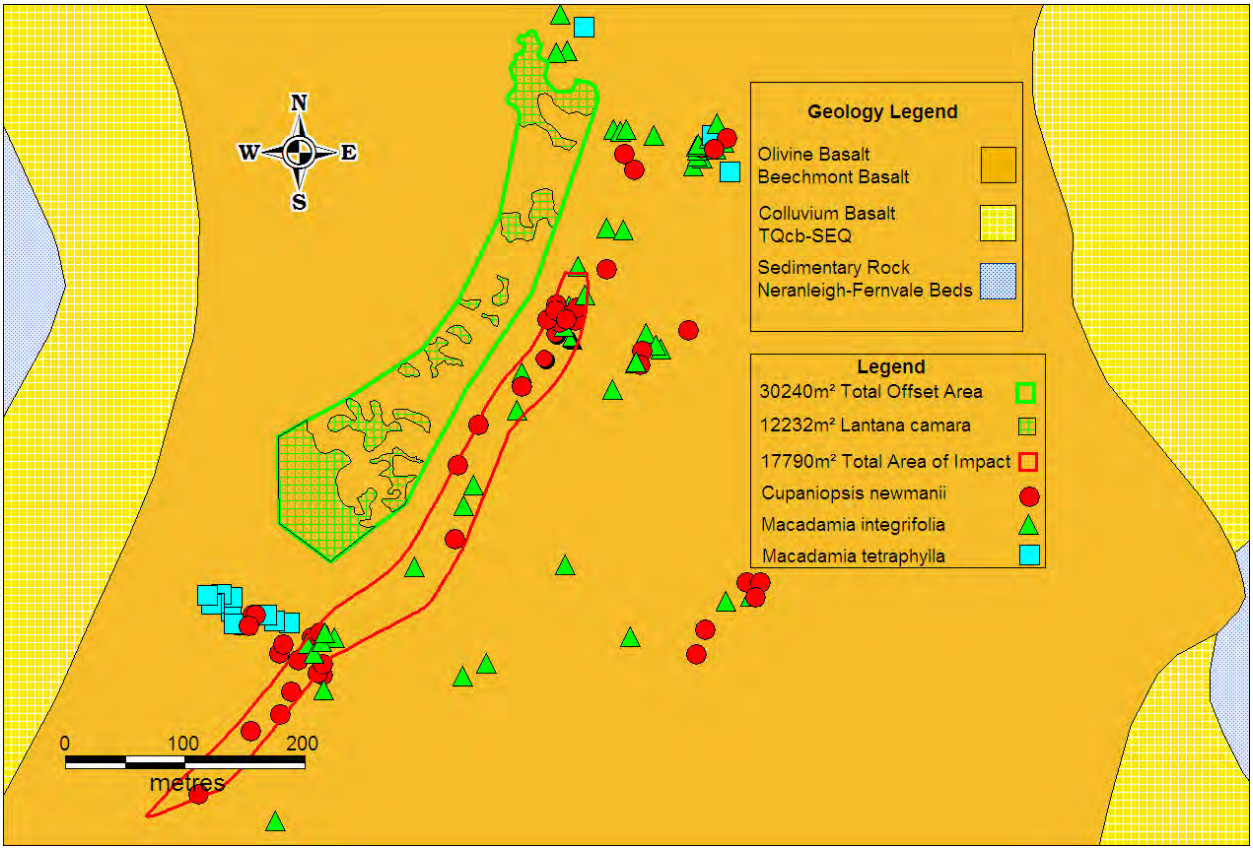


Figure 1: Geology map (1:100 000) showing impact and translocation sites (Department of Natural Resources and Mines 2002)

Table 1: Comparison of impact and translocation sites

Site	Aspect	Altitude	Geology	Vegetation (Pre-Clear)
Impact site	W-N-W	385 m	Tertiary Basalt	Regional Ecosystem 12.8.3/12.8.8 (60/40%)
Translocation site	W-N-W	420 m	Tertiary Basalt	Regional Ecosystem 12.8.3/12.8.8 (60/40%)

5.2 Regional Ecosystem Mapping

Pre-clearing RE data and the RE map (DERM 2010a) (Figure 2) indicate that the impact and translocation sites consist of non-remnant RE 12.8.3/12.8.8 (60/40%). The Regrowth Vegetation map indicates that the translocation site consists of high value regrowth vegetation (DERM 2010b) (Figure 3). Refer to Table 2 for a brief description of RE 12.8.3 and 12.8.8.

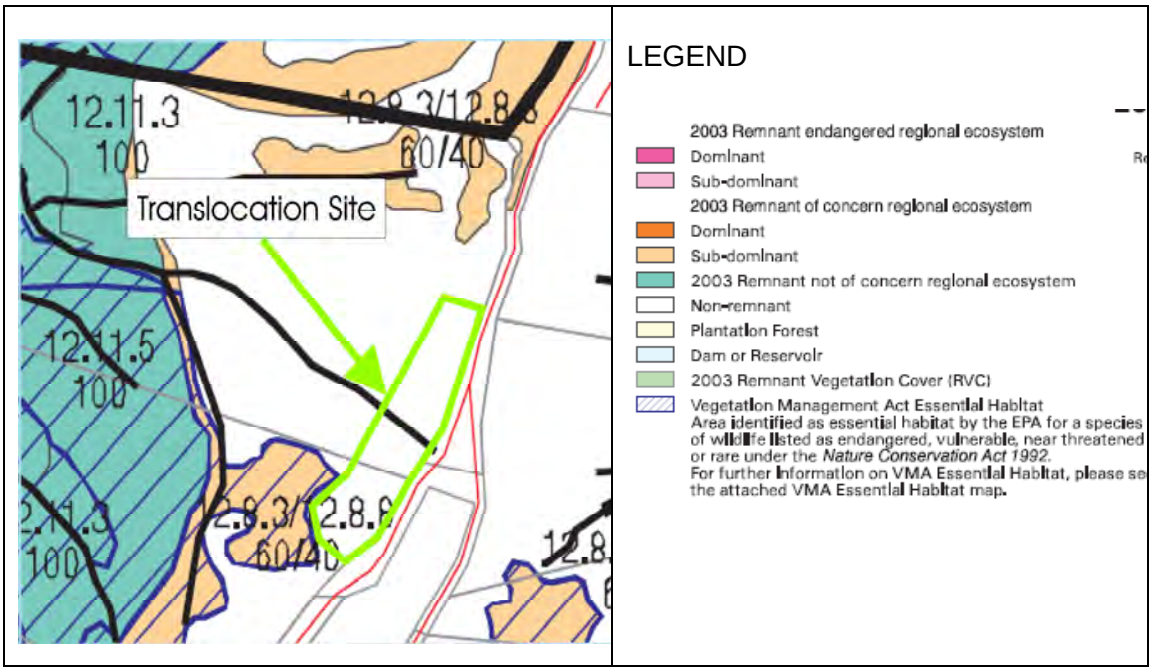


Figure 2: Regional Ecosystem Map – Beechmont area insert, including area of translacotion site (DERM 2010a).

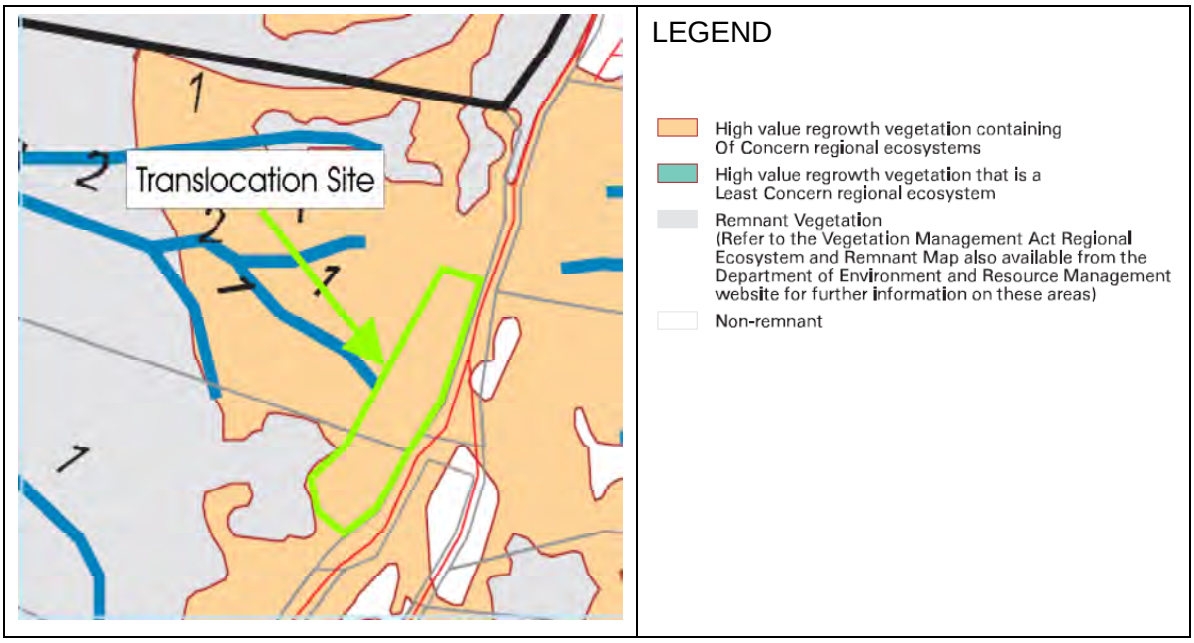


Figure 3: Regrowth Vegetation Map – Beechmont area insert, including area of translocation site (DERM 2010b).

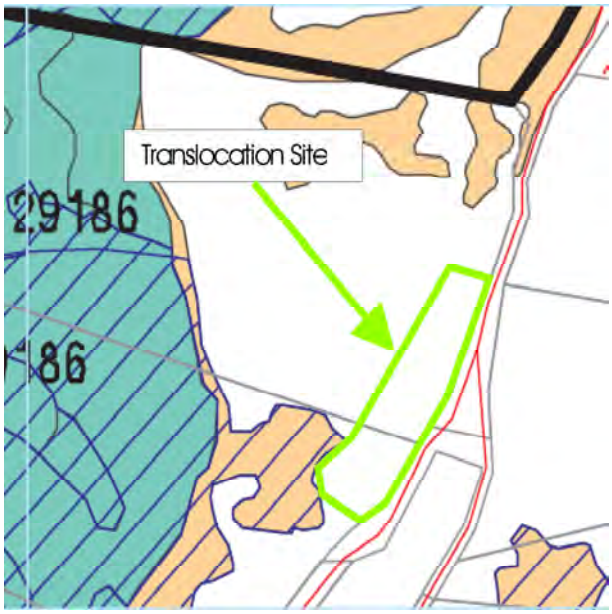
Table 2: Brief description and status of RE at translocation site (DERM 2009b).

Pre-clear RE (mapped as high value regrowth)	Short Description	VMA Status	Biodiversity Status
12.8.8	***Eucalyptus saligna*** or ***E. grandis*** tall open-forest often with vine forest understorey ('wet sclerophyll'). Other species include ***Eucalyptus microcorys, E. acmenoides, Lophostemon confertus, Syncarpia glomulifera*** subsp. ***glomulifera***. Occurs on Cainozoic igneous rocks and areas subject to local enrichment from Cainozoic igneous rocks. Major vegetation communities include: 12.8.8a: ***Eucalyptus siderophloia, E. microcorys, E. propinqua, Corymbia intermedia*** +/- ***Eucalyptus carnea*** open forest on Cainozoic igneous rocks. Occurs on Cainozoic igneous rocks and areas subject to local enrichment from Cainozoic igneous rocks.	Of concern	Of concern (Non-remnant at site)
12.8.3	Complex notophyll vine forest. Characteristic species include ***Argyrodendron trifoliolatum, Argyrodendron sp***. (Kin Kin W.D.Francis AQ81198), ***Olea paniculata, Castanospermum australe, Cryptocarya obovata, Ficus macrophylla*** forma ***macrophylla, Syzygium francisii, Diploglottis australis, Pseudoweinmannia lachnocarpa,***	No concern at present	Least concern (Non-remnant at site)

	Podocarpus elatus, Beilschmiedia obtusifolia, Neolitsea dealbata and ***Archontophoenix cunninghamiana***. Occurs on Cainozoic igneous rocks, especially basalt <600m altitude.		

5.2.1 Essential Habitat Mapping

The essential habitat mapping indicates the translocation and rehabilitation site to be non-essential habitat (Figure 4)



LEGEND

Sub-dominant

2003 Remnant not of concern regional ecosystem

Non-remnant

Vegetation Management Act Essential Habitat
Area identified as essential habitat by the EPA for a speci
of wildlife listed as endangered, vulnerable, near threaten
or rare under the *Nature Conservation Act 1992*.

29186 koala (***Phascolarctos cinereus***)

Figure 4: Essential Habitat Map – Beechmont area insert, including area of translocation site (DERM 2010c).

5.2.2 Flora Species Present

The 30240m² translocation site is dominated by 12232m² of ***L. camara*** (40%) (Appendices 1 & 2; Figures 5 & 6) with the remaining area containing emergent native species associated with RE 12.8.3 and 12.8.8 and approximately 10-20 % lantana coverage. The area is currently mostly impenetrable, with dense thickets of ***L. camara*** preventing a detailed investigation of the entire site. However emergent ***C. newmanii*** were observed protruding from the ***L. camara*** thickets and many of the species recorded at the impact site (Table 8) were recorded around the edges of the translocation site. There is potential for both ***M. integrifolia*** and ***M. tetraphylla*** to be present amongst the ***L. camara*** thickets. However their health and long term stability is highly compromised if the ***L. camara*** thickets are left unchecked. Therefore the implementation of this plan is likely to uncover additional ***M. integrifolia*** and ***M.***

tetraphylla and help to improve the long term stability of the species. This is supported by Turner ***et. al.*** (2010), having stated that ***L. camara*** control and management must be undertaken in areas where wild populations of many threatened flora species, including ***M. integrifolia,*** grow within the next five (5) years or the long stability of those species will be adversely affected.

Figure 5: Southern section of translocation site showing dominating ***L. camara*** coverage with some emgergent native species and Sydney blue gum (***Eucalyptus salignus***) on the boundaries of the site.

Figure 6: Northern section of translocation site showing dominating ***L. camara*** coverage with some emgergent native species.

5.2.3 Flora Species Adjacent

Vegetation adjacent to the translocation site consists of species associated with RE 12.8.3 and 12.8.8 and patches of ***L. camara***. Three ***M. integrifolia*** trees, including one large mature specimen, are situated at the northern end of the translocation site. ***M. tetraphylla*** and ***C. newmanii*** are also growing near the southern section of the site with C***. newmanii*** observed emerging from the ***L. camara*** in several locations. The translocation site is located directly opposite the impact site and several patches of ***M. integrifolia*** outside the impact site are present within 40 m of the northern section and within 130 m of the southern section.

Matching geology and vegetation between the translocation site and immediate areas suggest that there is a high probability that further ***M. integrifolia*** and ***C. newmanii*** individuals will be located at the translocation site as ***L. camara*** is removed and bush regeneration activities begin. This supports the assertion that the translocation site is highly suitable habitat for both of the species proposed for translocation.

5.3 Rainfall Data

The Lower Beechmont plateau has no weather station; therefore, rainfall data for three nearby weather stations (Tables 3, 4 & 5) indicate that the highest monthly rainfall occurs during the summer months with an average annual rainfall between 1300 – 1800 mm.

Table 3: Average monthly rainfall data for Beechmont Alert station (BOM 2010a)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lowest	3.0	36.0	24.0	7.0	8.0	3.0	0.0	1.0	9.0	5.0	0.0	34.0	589.0
Highest	337.0	533.0	200.0	165.0	222.0	277.0	66.0	94.0	55.0	182.0	278.0	283.0	1382.0
Site name: BEECHMONT ALERT **Latitude:** 28.14° S, **Longitude:** 153.19° E, **Elevation:** 520 m													

Table 4: Average monthly rainfall data for Hinze Dam Alert station (BOM 2010b)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lowest	3.0	15.0	9.0	8.0	9.0	2.0	0.0	1.0	11.0	18.0	0.0	37.0	526.0
Highest	248.0	438.0	149.0	77.0	128.0	277.0	80.0	100.0	90.0	135.0	389.0	234.0	1827.0
Site name: HINZE DAM ALERT **Latitude:** 28.05° S, **Longitude:** 153.28° E, **Elevation:** 82 m													

Table 5: Average monthly rainfall data for Laheys Lookout Alert station (BOM 2010c)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lowest	4.0	8.0	4.0	18.0	14.0	0.0	0.0	1.0	8.0	14.0	28.0	19.0	651.0
Highest	239.0	340.0	209.0	217.0	257.0	157.0	56.0	77.0	91.0	154.0	350.0	151.0	1342.0
Site name: LAHEYS LOOKOUT ALERT **Latitude:** 28.00° S, **Longitude:** 153.18° E, **Elevation:** 549 m													

5.4 Land Tenure and Security

The proposed translocation site is situated on land owned by the Commonwealth Department of Defence and forms part of the CFTA. This parcel of land is located on freehold properties (Lot Plan: 97WD841; Lot Plan: 1RP124843). The translocation site is not used for any purpose other than a buffer for military training activities. Therefore, no clearing activities are planned or are likely to occur in the future and the land can be considered secure. The Commonwealth Department of Defence will provide a statement to verify the security of this parcel of land and support for use as an environmental offset site. The land is also secure in that any development activities in the area would be subject to detailed environment impact assessment.

6 SITE PREPARATION

6.1 Surveying and Pegging of Site

Prior to undertaking the translocation and rehabilitation works, the site shall be surveyed with GPS coordinates and pegged at each coordinate. The pegs shall have flagging tape attached to allow for high visibility when preparing the site.

6.2 Vegetation Protection Plan

Vegetation protection measures shall be implemented in accordance with the Main Roads Technical Standard, General Requirements Landscape and Rehabilitation Works (MRTS16). The contractor undertaking site preparation works shall be required to submit a Vegetation Protection Plan (VPP) in accordance with MRTS16A. The VPP shall include measures to ensure that existing native vegetation within and surrounding the translocation site is not harmed. The VPP shall include measures to locate flag and protect all existing native vegetation within the Translocation area.

6.3 Weed Removal and Treatment

The translocation site is heavily infested with ***L. camara***. Therefore, in order to prepare suitable areas for rehabilitation, ***L. camara*** and all other exotic flora species shall require removal. Machinery such as skid steer loaders and excavators with a mulching head attachment may be used in accessible patches to remove ***L. camara*** and other exotic flora species. Inaccessible patches shall be treated by hand mechanical treatment. Mechanical treatment shall be followed by chemical treatments targeting emerging exotic seedlings and vegetative growth. The persons carrying out the ground works must be suitably qualified and experienced and able to identifying emerging and established native species. Naturally regenerating seedlings shall be identified during site preparation and avoided.

7 PREPARATION OF PLANTS FOR TRANSLOCATION

Translocation is defined as 'the deliberate transfer of plants or regenerative plant material from an ***ex situ*** collection or natural population to a location in the wild, including existing or new sites or those where the taxon is now locally extinct' (Vallee ***et. al.,*** 2004). Translocation methods can include vegetative propagation (cuttings, layering and tissue culture), propagation via seedling germination, transplanting entire plants, the collection and spreading of soil, leaf litter and vegetation containing seeds (brush matting) (Vallee ***et. al.,*** 2004).

7.1 Propagation of *Macadamia integrifolia*

Wild ***M. integrifolia*** generally produce few mature nuts that could be collected for propagation (Ian McConachie Pers. Comm. July 2010). The direct transplantation of ***M. integrifolia*** is achievable and ***M. tetraphylla*** were successfully transplanted for the Tugun Bypass and Ballina Bypass projects (SMEC 2010; Ecos Environmental 2009). However, the impact site for this project is situated on a steep basalt scree slope; therefore, access for machinery to undertake the transplantation is highly compromised. Moreover, the success rate of transplanted ***M. integrifolia*** is often quite low (Ian McConachie Pers. Comm. July 2010). Therefore, the primary focus of this plan is to retain the germplasm of all ***M. integrifolia*** trees to be removed, which will involve two methods – propagation of each tree to be impacted by means of cuttings and collection and propagation of seeds where available. ***Macadamia integrifolia*** cuttings have been successfully propagated for the Hinze Dam Stage 3 project and are being planted with early indications suggesting the project will be successful (Scott Abbey. Pers. Comm. December 2010). An inspection of the Hinze Dam cuttings prior to planting was undertaken to ascertain the success of this translocation method and the plants appeared healthy and ready for planting showing active growth (Figure 7).

Figure 7: Macadamia integrifolia cutting established for HinzeDam Stage 3 project (October 2010)

7.1.1 Taking and Establishing Cuttings

A nursery with experience in propagation of species belonging to the family Proteaceae with confidence in ***M. integrifolia*** cuttings shall be engaged to collect and propagate no less than 300 cuttings taken from the impact site in order to obtain a strike rate of 102 cuttings (V - NC Act ratio 1:3.5 = 29 x 3.5 = 101.5).

1. Collect cutting material ***M. integrifolia*** from 29 trees.
2. Propagate no less than 102 ***M. integrifolia*** by means of cuttings and seedlings taken from the site. Cuttings must be taken from each ***M. integrifolia*** tree and labeled according to a predefined code (Table 6). All successful cuttings shall be supplied to the Department of Transport and Main Roads when ready for planting.
3. Propagate cuttings
    a. Take and record coordinates from each donor tree and label cuttings to coincide with each tree (e.g. 153.2389300, -28.0614539= MTPC 1)
    b. Cuttings from each tree shall be kept separate in the nursery and trays labeled accordingly (e.g. MTPC1, MTPC2 etc)
    c. Grow sun hardened cuttings in 90 mm tubes until ready for planting in the ground (approximately 12 -18 months or less)
    d. Prepare a spreadsheet with coordinates to coincide with the codes (MTPC 1 etc). The spreadsheet shall contain details of the exact numbers of each successful cutting taken from each tree (Table 6). Provide to Transport and Main Roads.
    e. When cuttings are ready for planting each shall be labeled with the matching codes (e.g. MTPC1, MTPC2 etc)

Table 6: Example table (spreadsheet)

M. integrifolia **Coordinates (donor site)**	**Tree Code**	**Number of successful cuttings established**
153.2389300, -28.0614539	MTPC 1	17
153.2394100, -28.0609720	MTPC 2	5
153.2410630, -28.0588550	MTPC 3	12

7.1.2 Seedling Germination

A nursery with experience in collecting and propagating wild ***M. integrifolia*** seeds shall be engaged to collect and propagate as many seeds as possible from the impact site, and where necessary, from additional trees located in the targeted search for ***M. integrifolia*** (Reynolds 2010). However it is understood that seeds may not be available.

- All seedlings shall be grown in 50x50x120 mm native tubes or larger until established. Plants shall be inspected by a TMR environmental officer or representative prior to transporting to the translocation site for planting.

- Average heights shall be recorded and included in the initial monitoring report.
- Where it is determined a longer establishment period is required prior to planting, this will be granted.
- If seeds have developed, they should be found from December – March (Cribb 1990: 102).

7.2 Propagation of *Cupaniopsis newmanii*

Cupaniopsis newmanii produce ripe seeds between October – November (Floyd 2008: 388). Trees at the impact site were observed to have ripe fruit in October 2009 (Figure 8) and many trees were observed to have flowers in June 2010. ***C. newmanii*** is a small spindly tree with few branches and few leaves at the tip of each stem. Therefore, the focus for translocation for this species shall be collection and propagation of seeds for use in rehabilitation at the translocation site. Cuttings shall also be collected from each tree in order to propagate and retain the germplasm from the impact site. No less than 177 ***C. newmanii*** shall be propagated via seedling germination and cutting establishment which shall be planted at the translocation site (NT - NC Act) ratio 1:3 = 59 x 3 = 177).

Figure 8: *C. newmanii* ripe fruit at impact site October 2009

7.2.1 Taking and Establishing Cuttings

A nursery experienced in propagation of Australian native plants from cuttings shall be engaged to collect as much cutting material as is available from the impact site and grow to establishment as many ***C. newmanii*** as possible. The aim is to retain the germplasm of all ***C. newmanii*** at the impact site.

1. Collect cutting material from the ***C. newmanii*** from 37 trees.

2. Propagate no less than 74 ***C. newmanii*** by means of cuttings and seedlings taken from the site. Cuttings must be taken from each ***C. newmanii*** tree and labeled accordingly. The taking of approximately 150 cuttings shall be required in order to obtain a strike rate of 74 cuttings. All successful cuttings shall be supplied to the Department of Transport and Main Roads when ready for planting.

3. Propagate cuttings

    a. Take and record coordinates from each donor tree and label cuttings to coincide with each tree (e.g. 153.2389300, -28.0614539= CNPC1)
    b. Cuttings from each tree shall be kept separate in the nursery and trays labeled according to a predefined code (e.g. CNPC 1, CNPC 2 etc; Table 6).
    c. Grow sun hardened cuttings in 50x50x120 mm tubes until ready for planting in the ground (approximately 12 -18 months or less)
    d. Prepare a spreadsheet with coordinates to coincide with the codes (CNPC1 etc). The spreadsheet shall contain details of the exact numbers of each successful cutting taken from each tree (Table 7). Provide to Transport and Main Roads.
    e. When cuttings are ready for planting each shall be labeled with the matching codes (e.g. CNPC 1, CNPC 2 etc)

Table 7: Example table (spreadsheet)

C. newmanii **Coordinates (donor site)**	**Tree Code**	**Number of successful cuttings established**
153.2389300, -28.0614539	CNPC 1	1
153.2394100, -28.0609720	CNPC 2	2
153.2410630, -28.0588550	CNPC 3	2

7.2.2 Germination and Establishment of Seedlings

A nursery with experience in collecting and propagating wild ***C. newmanii*** seeds shall be engaged to collect and propagate as many seeds as possible from the impact site

and where necessary from additional trees located in the targeted search for ***C. newmanii*** (Reynolds 2010).

- All seedlings shall be grown in 50x50x120 mm native tubes or larger until established. Plants shall be inspected by a TMR environmental officer or representative prior to transporting to the translocation site for planting.
- Average heights shall be recorded and included in the initial monitoring report
- Where it is determined a longer establishment period is required prior to planting, this will be granted.
- If seeds have developed, they should be found from October – November (Floyd, 2008: 388).

7.3 Propagation of Co-occurring Species

A nursery experienced in propagation of Australian native plants shall be engaged to collect as much propagation material as is available from the impact site and surrounding vegetation and must be of local provenance material collected from the Beechmont area. The species propagated shall be based on species associated with RE 12.8.3 and selected species that were identified in the flora survey for the impact site (Reynolds 2010) (Table 8). Species may be substituted with additional plants of the species that are available provided the ratio of pioneer, secondary and mature phase and the ratio of trees, small trees, shrubs, grasses and clumping species are retained.

Table 8: Native flora species associated with RE 12.8.3 with selected species identified from the impact site.

Family	Genus & Species	Common Name	List	Habit	Succession	Number
BYTTNERIACEAE	***Commersonia bartramia***	brown kurrajong	IS	T	P	250
CUNONIACEAE	***Pseudoweinmannia lachnocarpa***	marara	RE/IS	T	M	10
CYPERACEAE	***Gahnia sieberiana***	red-fruit saw-sedge	IS	G	US	200
ELAEOCARPACEAE	***Elaeocarpus obovatus***	hard quandong	IS	T	M	10
EUPHORBIACEAE	***Macaranga tanarius***	macaranga	IS	T	P	200
EUPHORBIACEAE	***Mallotus philippensis***	red kamala	IS	ST	S	50
HEMEROCALLIDACEAE	***Dianella caerulea***	flax lily	IS	G	US	200
LAURACEAE	***Beilschmiedia obtusifolia***	blush walnut	RE	T	M	10
LAURACEAE	***Cryptocarya obovata***	pepperberry	RE	T	M	10
LAURACEAE	***Endiandra pubens***	hairy walnut	RE/IS	T	M	10
LAXMANNIACEAE	***Cordyline congesta***	palm lily	IS	S	US	200
MELIACEAE	***Toona ciliata***	red cedar	IS	T	M	10
MIMOSACEAE	***Acacia aulacocarpa***	short hickory wattle	IS	ST	P	50
MIMOSACEAE	***Acacia melanoxylon***	blackwood	IS	T	P	150
MIMOSACEAE	***Archidendron grandiflorum***	pink lace flower	IS	T	M	10
MORACEAE	***Ficus coronata***	sandpaper fig	IS	ST	S	10
MORACEAE	***Streblus brunonianus***	whalebone tree	IS	T	S	10
MYRTACEAE	***Gossia hillii***	scaly myrtle	IS	ST	M	10
MYRTACEAE	***Syzygium francisii***	giant water gum	RE	T	M	10
OLEACEAE	***Olea paniculatum***	native olive	RE/IS	T	M	10
PHYLLANTHACEAE	***Breynia oblongifolia***	breynia	IS	S	US	100
PITTOSPORACEAE	***Hymenosporum flavum***	native frangipani	IS	ST	S	100
PROTEACEAE	***Stenocarpus sinuatus***	firewheel tree	IS	T	M	10
QUINTINIACEAE	***Quintinia verdonii***	smooth possumwood	IS	T	S	10
ROSACEAE	***Rubus moluccanus*** var. ***trilobus***	molucca bramble	IS	S	US	100
SAPINDACEAE	***Diploglottis***	native tamarind	RE/IS	T	S	10

	australis					
SAPINDACEAE	***Guioa semiglauca***	guioa	IS	T	S	10
SAPINDACEAE	***Harpullia hillii***	blunt-leaved tulip	IS	T	S	10
SAPINDACEAE	***Jagera pseudorhus*** var. ***pseudorhus***	foambark	IS	T	S	10
STERCULIACEAE	***Argyrodendron trifoliolatum***	white booyong	RE	T	M	10
URTICACEAE	***Pipturus argenteus***	native mulberry	IS	T	P	200
VITACEAE	***Cissus antarctica***	kangaroo vine	IS	V	US	80
ZINGIBERACEAE	***Alpinia caerulea***	native ginger	IS	S	US	222

LEGEND:

Succession Phase (Big Scrub Rainforest Landcare Group 2005: 104-110)
M: Mature phase species (14%)
S: Secondary phase species (10%)
P: Pioneer phase species (36%)
US: Understory species (40%)

Growth Habit
T: Tree (height > 20 m at maturity)
ST: Small tree (height > 5 m and no > 20 m at maturity)
S: Shrub (< 5 m at maturity)
CG: Clumping/Grass/Ground
V: Vine

List
RE: Regional Ecosystem 12.8.3 association
IS: Impact site species list

7.3.1 Germination and Establishment of Seedlings and Cuttings

- All seedlings and cuttings shall be grown in 50x50x120 mm native tubes or larger until established.
- Plants shall be inspected by a TMR environmental officer or representative prior to transporting to the translocation site for planting

8 PLANTING

Cuttings and seedlings can be planted out at the translocation site when they have reached a level of maturity that is deemed to be mature for their containers. Plant quality shall be in accordance with the MRTS16C (Clause 10.2.2) specifications (Table 9).

Table 9: Plant quality requirements (MRTS16C 2009: 10)

Plants Material Compliance Requirements
Plants shall be acclimatized to the conditions of the project site – acclimatization shall include sun hardening and reduction in water

Plants shall be of a size commensurate with the container size
Plants and container soil shall be in a healthy condition free from weeds, pests and diseases
Plants shall be showing signs of active growth relative to season and true to form of the species
Plant roots shall be healthy, not pot-bound, and able to support healthy plant growth
Trees shall have a single leading stem unless otherwise specified
Each group of plant species shall be clearly and correctly labeled according to botanical nomenclature
Labels shall be water resistant and tied securely to one species per tray

8.1 Planting Cuttings and Seedlings

Plant all species as listed in Table 10 at the specified spacing. The planting model is adopted from the Big Scrub Rainforest Landcare Group (2005:38, 39). This is a variation of the intermediate model that aims to plant a mix of pioneer, secondary and mature phase and understorey species. The dominant species shall be pioneer as the rehabilitation site is located close to several large patches of vegetation mapped as remnant RE 12.8.3/12.8.8 60/40%. Therefore, it is expected that pioneer species shall grow fast, creating rapid canopy closure and provide the basis for natural recruitment. The majority of pioneer species listed in this plan were dominating the impact site, which was in the early stages of succession.

The co-occurring species shall be planted where the ***L. camara*** has been removed from 12232m² of land within the translocation site and spaced accordingly. The ***M. integrifolia*** and ***C. newmanii*** shall be planted throughout the entire 30240m² translocation site and spaced accordingly.

It is important that the labeling system adopted during the propagation phase of the translocation procedure be continued throughout. Plant tags identifying the origin of the cutting material (e.g. MTPC1, MTPC2 etc; Tables 6 & 7) are to be attached to each planted individuals to ensure accurate record keeping and to aid in future research and monitoring activities. It is recommended that details be etched onto the surface of metal tags (e.g. aluminium or copper). Metal tags are relatively permanent and resistant to weathering and are therefore suitable for an ongoing project such as this which extends over a number of years.

Table 10: Planting palette for translocation site

Family	Genus & Species	Common Name	List	Habit	Succession	Number
BYTTNERIACEAE	***Commersonia bartramia***	brown kurrajong	IS	ST	P	250

CUNONIACEAE	***Pseudoweinmannia lachnocarpa***	marara	RE/IS	T	M	10
CYPERACEAE	***Gahnia sieberiana***	red-fruit saw-sedge	IS	G	US	200
ELAEOCARPACEAE	***Elaeocarpus obovatus***	hard quandong	IS	T	M	10
EUPHORBIACEAE	***Macaranga tanarius***	macaranga	IS	ST	P	200
EUPHORBIACEAE	***Mallotus philippensis***	red kamala	IS	ST	S	50
HEMEROCALLIDACEAE	***Dianella caerulea***	flax lily	IS	CG	US	200
LAURACEAE	***Beilschmiedia obtusifolia***	blush walnut	RE	T	M	10
LAURACEAE	***Cryptocarya obovata***	pepperberry	RE	T	M	10
LAURACEAE	***Endiandra pubens***	hairy walnut	RE/IS	T	M	10
LAXMANNIACEAE	***Cordyline congesta***	palm lily	IS	S	US	200
MELIACEAE	***Toona ciliata***	red cedar	IS	T	M	10
MIMOSACEAE	***Acacia aulacocarpa***	short hickory wattle	IS	ST	P	50
MIMOSACEAE	***Acacia melanoxylon***	blackwood	S	T	P	150
MIMOSACEAE	***Archidendron grandiflorum***	pink lace flower	IS	ST	M	10
MORACEAE	***Ficus coronata***	sandpaper fig	IS	ST	S	10
MORACEAE	***Streblus brunonianus***	whalebone tree	IS	T	S	10
MYRTACEAE	***Gossia hillii***	scaly myrtle	IS	ST	M	10
MYRTACEAE	***Syzygium francisii***	giant water gum	RE	T	M	10
OLEACEAE	***Olea paniculatum***	native olive	RE/IS	T	M	10
PHYLLANTHACEAE	***Breynia oblongifolia***	breynia	IS	S	US	100
PITTOSPORACEAE	***Hymenosporum flavum***	native frangipani	IS	ST	S	100
PROTEACEAE	***Macadamia integrifolia***	QLD nut	IS	ST	S	102
PROTEACEAE	***Stenocarpus sinuatus***	firewheel tree	IS	T	M	10
QUINTINIACEAE	***Quintinia verdonii***	smooth possumwood	IS	T	S	10
ROSACEAE	***Rubus moluccanus*** var. ***trilobus***	molucca bramble	IS	S	US	100
SAPINDACEAE	***Cupaniopsis newmanii***	long leaved tuckeroo	IS	T	US	177
SAPINDACEAE	***Diploglottis australis***	native tamarind	RE/IS	T	S	10
SAPINDACEAE	***Guioa semiglauca***	guioa	IS	T	S	10
SAPINDACEAE	***Harpullia hillii***	blunt-leaved tulip	IS	T	S	10

SAPINDACEAE	***Jagera pseudorhus*** var. ***pseudorhus***	foambark	IS	T	S	10
STERCULIACEAE	***Argyrodendron trifoliolatum***	white booyong	RE	T	M	10
URTICACEAE	***Pipturus argenteus***	native mulberry	IS	ST	P	200
VITACEAE	***Cissus antarctica***	kangaroo vine	IS	V	US	80
ZINGIBERACEAE	***Alpinia caerulea***	native ginger	IS	S	US	222

LEGEND:

Succession Phase (Big Scrub Rainforest Landcare Group 2005: 104-110)
M: Mature phase species (12%)
S: Secondary phase species (16%)
P: Pioneer phase species (31%)
US: Understory species (41%)

Growth Habit
T: Tree (height > 20 m at maturity)
ST: Small tree (height > 5 m and no > 20 m at maturity)
S: Shrub (< 5 m at maturity)
CG: Clumping/Grass/Ground
V: Vine

List

RE: Regional Ecosystem 12.8.3 association
IS: Impact site species list

Total number of all plants: 2573

Spacing c-occurring species: 1/ 5m²

Spacing *C. newmanii*: 1/17 m²

Spacing *M. integrifolia*: 1/29 m²

Planting shall be undertaken as outlined:

- After consistent rain and soil moisture content is adequate for planting.
- Test soil moisture content prior to planting to ensure that soil moisture content is high.
- If necessary planting may be undertaken in batches to ensure that soil moisture content is high prior to planting each batch.
- Soak seedlings prior to planting with a diluted Seasol/Maxicrop solution.
- Prepare appropriate planting holes as specified (Figure 3).
- Apply fertilizer to planting holes as specified (Figure 3) using fertilizer suitable for use with native species.
- Water each plant immediately after planting.

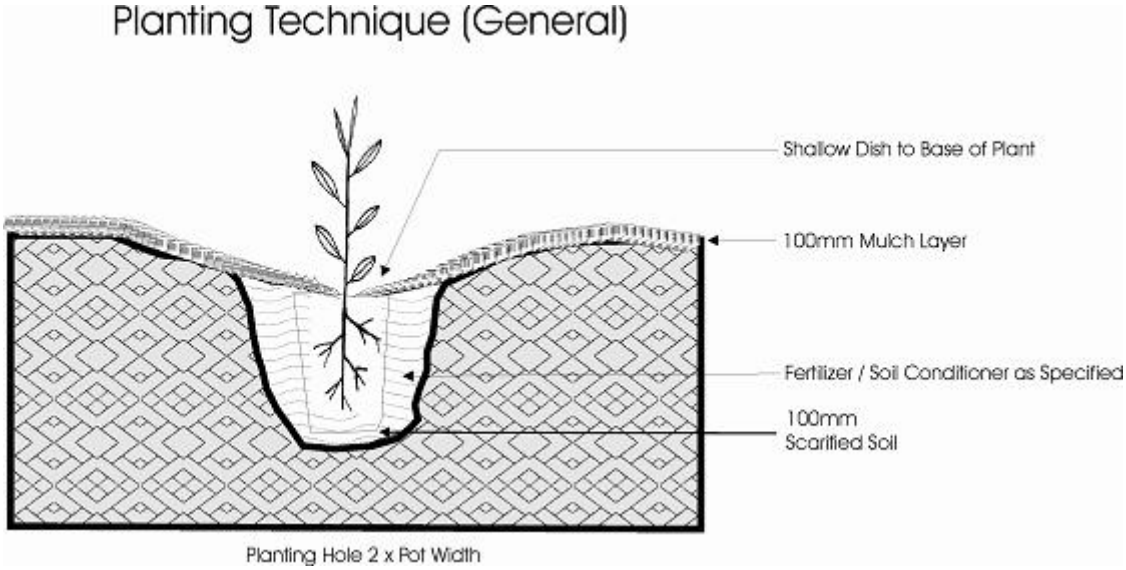


Figure 9: Generalised planting scheme depicting depth of hole and scarification as required for planting containerised stock.

8.1.1 Fertilizer Treatments

Fertilizer treatments shall be as follows:

- Recommended coated slow-release granular fertilizer with NPK (N18-25, P1-4, and K6-20) at rates in accordance with the manufacturer's specifications.
- Water storage crystals shall be incorporated with the fertilizer at the manufacturer's specified rates.
- Liquid seaweed solution (Seasol/Maxicrop) shall be applied to plants prior to planting and at the initial watering.

8.1.2 Planter Bag Installation

Installation of planter bags around each translocated individual of ***M. integrifolia*** and ***C. newmanii*** shall be undertaken. Benefits of planter bags in this situation are as follows:

- To aid in the location of the plants during the monitoring period.
- To discourage herbivory by browsing animals.
- To limit the potential for damage to the target plants caused by herbicide overspray during site maintenance.

The following procedure for installing planter bags shall be followed:

Install 3 (1500x25x25mm) hardwood stakes for each tree and 1 (TMX-11285TALL Tall Sleeve 600mm x 400mm x 120um) plastic sleeve or similar product. Refer to Figure C7-7 Road Landscape Manual (1997) for installation methods.

Planter bags are to be removed when this is deemed appropriate through the ongoing monitoring program.

8.2 Timing of Planting

Planting is best performed when conditions are most conducive to plant survival (Vallee ***et. al.*** 2004: 45). The most suitable time of year for planting the co-occurring species and ***M. integrifolia*** and ***C. newmanii*** trees (Tables 6 & 7) is when soil moisture content is high and day-time temperatures are reducing. Given that the highest rainfall generally occurs during the summer months for the translocation site (Table 3, 4 & 5), an autumn plant-out and transplant should be considered the optimal time for undertaking the transplant component of this project as soil moisture content should be high and daytime temperatures reducing. This approach was used for the Tugun Bypass translocation project as outlined by Ecos Environmental (2006: 72).

8.3 Completion of Planting

Upon completion planting all ***M. integrifolia***, ***C. newmanii*** and co-occurring species the site shall be inspected by the Department of Transport and Main Roads.
Where it is determined all plants have been planted correctly, spaced as specified, are alive, appear healthy and each plant is weed free, the contractor shall be issued with a ***Certificate of commencement of the Landscape and Revegetation Establishment Period***.

9 INITIAL ESTABLISHMENT AND MONITORING PERIOD

The initial establishment and monitoring period shall be for 12 weeks and include, watering, weeding, plant replacement and monitoring. The 12 week establishment period shall commence upon issuing of the ***Certificate of Commencement of the Landscape and Revegetation Establishment Period***.

9.1 Watering

Due to the large area, difficult terrain and access to the translocation site, planting shall only be undertaken when soil moisture content is tested and determined to be high. Therefore all planting shall be undertaken during the wettest months of January – March and when rain is forecast as minimal watering shall be necessary. After the initial watering the co-occurring species are not required to be watered again due to the inaccessible terrain of the site.

All plants shall be watered immediately after planting which may require:

- Planting batches at a time to allow for adequate watering
- Carrying water bottles into the site for each planting batch

9.2 Watering Schedule

The ***M. integrifolia*** and ***C. newmannii*** shall be watered by hand for a period of no less than 12 weeks after planting. The contractor shall allow for the watering schedule in accordance with the MRTS16E specifications for these species (Table 11); however, the contractor may submit an alternative watering schedule provided that no ***M. integrifolia*** or ***C. newmannii*** shall succumb to desiccation due to lack of water.

- Precipitation exceeding 20 mm in any given day may be deemed as one water cycle (evidence of precipitation may be requested and shall be recorded in the monitoring reports).

Table 11: Watering schedule for all translocation and rehabilitation works (MRTS16E)

A 12 week watering period is to be implemented immediately following installation of all planting and rehabilitation works to ensure successful establishment during the Landscape Establishment Period, as follows:		
Week	**Frequency**	**Liquid Seaweed Solution Treatment**
Week 1 & 2	Once every day	1 per week
Week 3 & 4	Once every second day	Week 4 only
Week 5 – 8	Twice every week	Weeks 6 and 8 only
Week 9 – 12	Once a week	Weeks 10 and 12 only

9.3 Weed Control

Weed control during the initial 12 week establishment period should be minimal with preference given to hand-weeding methods. Herbicide treatments using a Glyphosate based bioactive herbicide treatment only shall also be allowed where it is determined hand weeding is inadequate.

9.4 Plant Replacement

- 80% success for all propagated ***M. integrifolia*** and ***C. newmanii*** shall be required; therefore, any death of more than 20% of either species during the initial 12 week establishment period shall be replanted by the contractor. All replacement plants shall be of the same quality and propagated from the same material as collected from the impact site. All plants shall be labeled correctly and installed as per the specifications.

- Due the difficulty in watering the site only 50% success for all propagated co-occurring species shall be required; therefore, where it is determined that more

than 50% loss has occurred during the initial 12 week establishment period the contractor shall replant. All replacement plants shall be of the same quality and propagated from the same material as collected from the impact site or local provenance species associated with RE 12.8.3.

9.5 Monitoring Schedule and Reporting

Monitoring during the initial 12 week establishment period shall be undertaken weekly by the contractor. A monitoring report shall be prepared and submitted to Transport and Main Roads at the end of the initial 12 week establishment period detailing as a minimum the following and with the following headings:

- Introduction.
- Planting schedule.
  - Method of planting.
  - Timing of planting.
  - Fertilizer treatment.
- Rainfall data and watering schedule for the site.
- Weed control data and herbicide application records.
- Results.
  - Success rate of the propagated and planted ***M. integrifolia*** and ***C. newmanii*** stock and replacement schedule applied.
  - Success rate of the propagated and planted co-occurring species and replacement schedule.
  - Success rate of the direct transplanted ***M. integrifolia*** and ***C. newmanii*** trees.
- Photographic imagery shall be included in the initial monitoring report.
- Discussion.
- Recommendations and adaptations.
- References.

9.6 Completion of 12 Week Establishment and Monitoring Period

Upon completion of the initial 12 week establishment and monitoring period the site shall be inspected by the Department of Transport and Main Roads. Where it is determined all no less than 50% survival of the co-occuring species and no less than 80% survival of the ***M. integrifolia***, ***C. newmanii*** and each plant is weed free. The

contractor shall be issued with a ***Certificate of Commencement of the Landscape and Revegetation Monitoring Period***.

10 LONG-TERM MAINTENANCE AND MONITORING

Long-term maintenance and monitoring for a period of no less than five years is required to ensure the successful establishment of the site with priority given to 80% success of the propagated and planted ***M. integrifolia*** and ***C. newmanii*** to the specified numbers. It is estimated that ***M. integrifolia*** grown from cuttings will flower and set seeds within five years (Hinze Dam Alliance 2010). Additional maintenance and monitoring shall occur once every 2 years until evidence of recruitment from the propagated ***M. integrifolia*** and ***C. newmanii*** is documented.

10.1 Watering Schedule Additional

Additional watering shall be undertaken where it is determined that excessive dry conditions may result in a high mortality rate for the project. The contractor shall allow for the inclusion of additional watering throughout the five year maintenance and monitoring period where required. Additional watering shall only be required for the ***M. integrifolia*** and ***C. newmanii*** individuals***.***

10.2 Weed Control Objectives

The primary objective of the five year maintenance and monitoring period shall be the continual eradication of emergent weeds throughout the translocation site to ensure long-term viability of the site. There are several reasons why it is important to allocate resources to long-term maintenance of this site including:

- Long-term viability of newly planted site can be compromised if maintenance is not undertaken.
- During the initial 2-3 years after planting, weeds have the potential to smother and out-compete leading to high mortality and subsequent failure of the site.
- Excessive and prolonged dry conditions after planting may lead to failure of the site, particularly during the first year after planting.
- Natural phenomenon such as storms can devastate or damage the site and promote weed spread and growth; therefore, maintenance is necessary after such events.
- The expected natural mortality rate is between 5-10%; therefore, continued weed control shall help to ensure natural regeneration and fill the gaps thus promoting canopy development.

- Pests and diseases may lead to high mortality and subsequent failure of the project if left unchecked.
- Exotic climbers have the potential to smother even the tallest of trees; therefore, ongoing maintenance is required where these weeds are prevalent.
- Failure to maintain this project is neglecting to protect the initial investment of resources and, therefore, poor allocation of resources.

10.3 Maintenance Schedule

Typically a maintenance regime for a rehabilitation site will consist of a high level of maintenance for the first year after planting. These visits will focus primarily on weed control, and include some replanting, watering and fertilizing where necessary. After the second year of planting it will be expected that the trees have reached a height in excess of 1 metre if planted from tube stock, and can be as much as 2.5 metres. The second year of maintenance is not expected to be as intensive as the first year; however, the regime will aim to reduce the occurrence of weeds and encourage rapid growth in height and width in order to develop a closed canopy, which will shade out competing weeds. This can be achieved by the application of liquid and solid fertilizer, additional planting and weed control. The third year of maintenance will be vastly reduced as it is expected by this stage that a canopy closure has begun to occur and trees have reached a height where annual weeds no longer pose a threat to their continued survival. The maintenance regime of the third year will involve weed control and possibly some pruning of the lower branches to encourage canopy development and reduce the potential for vine weeds to grip and smother the vegetation. It is expected that by the fourth year of growth the rehabilitation site will be largely a self sustaining entity. After the fourth year each site will require only minimal maintenance and include some removal of vine weeds, rubbish and pruning where necessary. Natural recruitment should now be prevalent; therefore, no further planting should be necessary. The required maintenance schedule for this project commencing on completion of initial 12 week maintenance and monitoring period is detailed in Table 12.

Table 12: Required Maintenance Schedule

Year	Season	Number of Maintenance Cycles
1	Spring	2 cycles
	Summer	3 cycles
	Autumn	2 cycles
	Winter	1 cycle

2	Spring	2 cycles
	Summer	3 cycles
	Autumn	1 cycles
	Winter	1 cycle
3	Spring	2 cycles
	Summer	2 cycles
	Autumn	1 cycle
	Winter	1 cycle
4	Spring	1 cycles
	Summer	2 cycles
	Autumn	1 cycle
	Winter	1 cycle
5	Spring	1 cycle
	Summer	1 cycles
	Autumn	1 cycle
	Winter	1 cycle

10.3.1 Ongoing Maintenance and Monitoring

Additional long term maintenance and monitoring of the site shall be required once every two years until evidence of seed set and seedling establishment has been recorded for both ***M. integrifolia*** and ***C. newmanii.*** This is necessary in order to ensure the project has met the success indicators as set out in Table 13.

10.4 Supplementary Planting

Supplementary planting shall be required during the five-year maintenance and monitoring period where canopy closure is failing due to excessive loss of plants in clumps or where natural recruitment has not been recorded. Supplementary planting of ***M. integrifolia*** and ***C. newmanii*** shall also be required where 80% success of the required number of each species has not been observed. This will ensure that at the end of the five-year maintenance period, the required number of ***M. integrifolia*** and ***C. newmanii*** as specified shall be achieved. Watering for supplementary planting ***M. integrifolia*** and ***C. newmanii*** shall be undertaken in accordance with MRTS16E (Table 9).

10.5 Monitoring and Reporting Requirements

During the five-year maintenance and monitoring period, a total of five comprehensive monitoring reports shall be prepared and submitted to Transport and Main Roads on the last day of August for each consecutive year following commencement of the maintenance and monitoring period. The aim of the report shall be to document the success of the project as outlined by the success indicators (Table 13) and make any recommendations to improve the results of the project which may be used in planning future translocation projects. When all project success indicators have been met a final report shall be prepared and submitted to the DERM and DSEWPaC.

Table 13: Project success indicators and measures of success

Success Indicators	Measures of Success
M. integrifolia (propagated plants) establishment	• 80% success of propagated plants at end of 5 year maintenance • Average growth is measured and evidence of active growth is documented in each monitoring report • Reproduction through seedling recruitment is evident
C. Newmanii (propagated plants) establishment	• 80% success of propagated plants at end of 5 year maintenance • Average growth is measured and evidence of active growth is documented in each monitoring report • Reproduction through seedling recruitment is evident
Co-occurring species	• 50% success of propagated plants at end of 5 year maintenance • Average growth is measured and evidence of active growth is documented in each monitoring report • Natural recruitment of co-occurring species is evident throughout the site
Canopy closure	• Canopy closure is developing. • Weeds pose minimal threat to the ongoing survival of the translocated species

The reports shall be prepared utilizing the following headings and any additional headings as deemed necessary by the monitoring consultant:

- Introduction.
- Supplementary planting schedule.
  - Method of planting.
  - Timing of planting.
  - Fertilizer treatment.
- Rainfall data and additional watering schedule for the site.
- Weed control data and herbicide application records.
- Results.
  - Success and growth rate of the propagated and planted ***M. integrifolia*** and ***C. newmanii*** stock and replacement schedule applied.
  - Success and growth rate of the propagated and planted co-occurring species and replacement schedule.
  - Success rate of the direct transplanted ***M. integrifolia*** and ***C. newmanii*** trees.
- Photographic imagery shall be included for each monitoring report (photo points)
- Discussion.
- Recommendations and adaptations to maintenance (final report shall make a statement as to overall success of the project).
- References.

10.5.1 Adaptation

The monitoring reports shall make recommendations for additional works outside the scope of the contract where it is deemed necessary to improve the success rate of the project. This may include, but is not limited to recommendations:

- For future projects of a similar nature.
- Re-scheduling of maintenance and watering cycles.
- Additional planting.

11 PROJECT EVALUATION AND REVIEW

11.1 Development of Project Review Report

Transport and Main Roads shall prepare a final review report with reference to the monitoring reports. The final review report shall consist of a succinct document that aims to provide a summary of the entire project including the initial impact assessment and flora survey report to the final monitoring report.

11.1.1 Publishing for Future Reference

It is highly recommended that the final review report is published in a scientific or engineering journal or submitted to databases searchable by the public, such as the proposed National Plan for Environmental Information. Publishing shall provide valuable information for environmental and ecological planners and consultants who may be involved in projects of a similar nature.

12 PROJECT TIMING

The collection and propagation of ***M. integrifolia*** and ***C. newmanii*** from the impact site and the co-occurring Least Concern flora species from local provenance material is critical to the aims and success of this project. Therefore, in order to ensure collection of material at the optimum time of year, project commencement shall be required in the first instance (refer to Appendix 3 for project scheduling).

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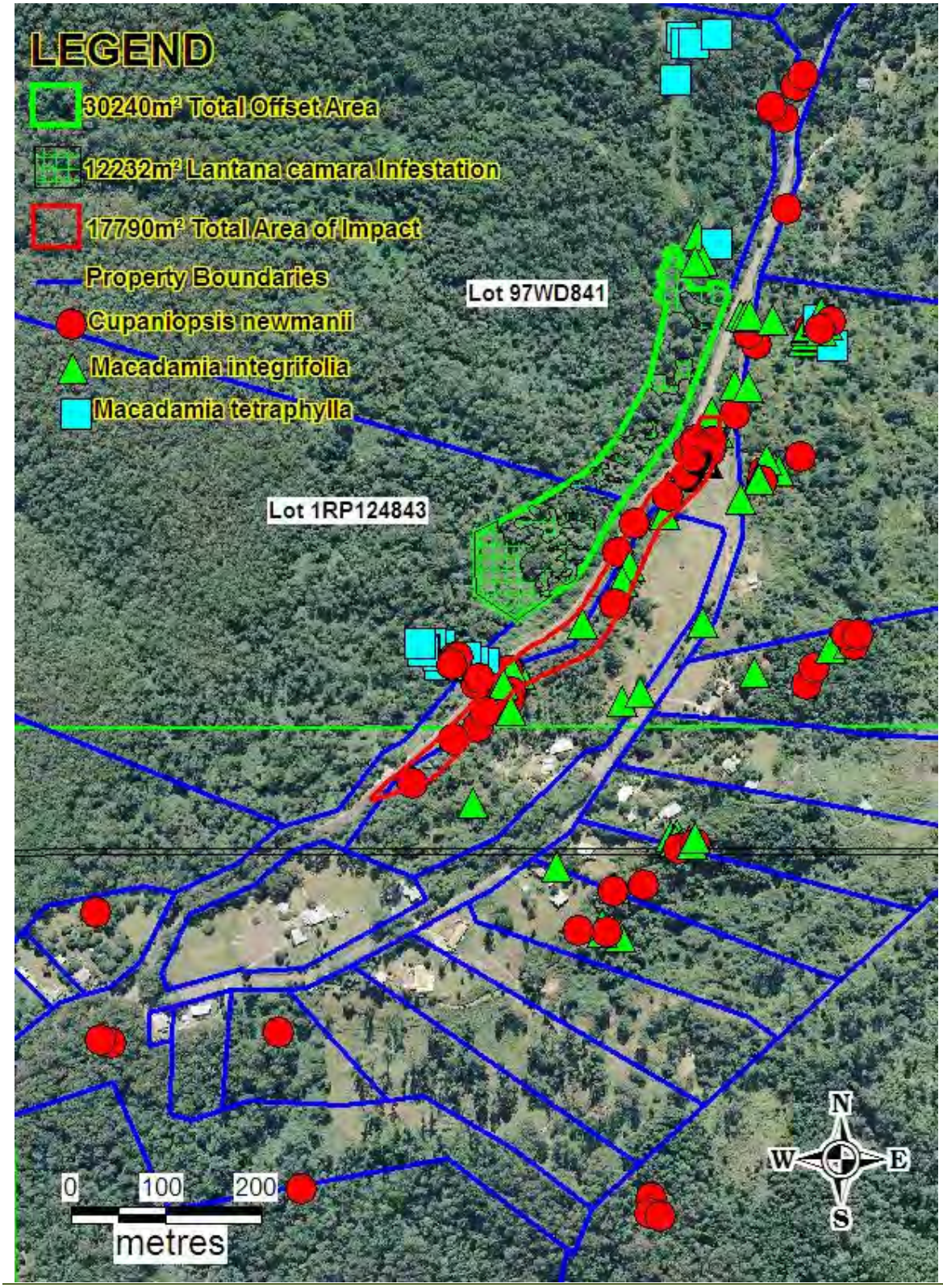
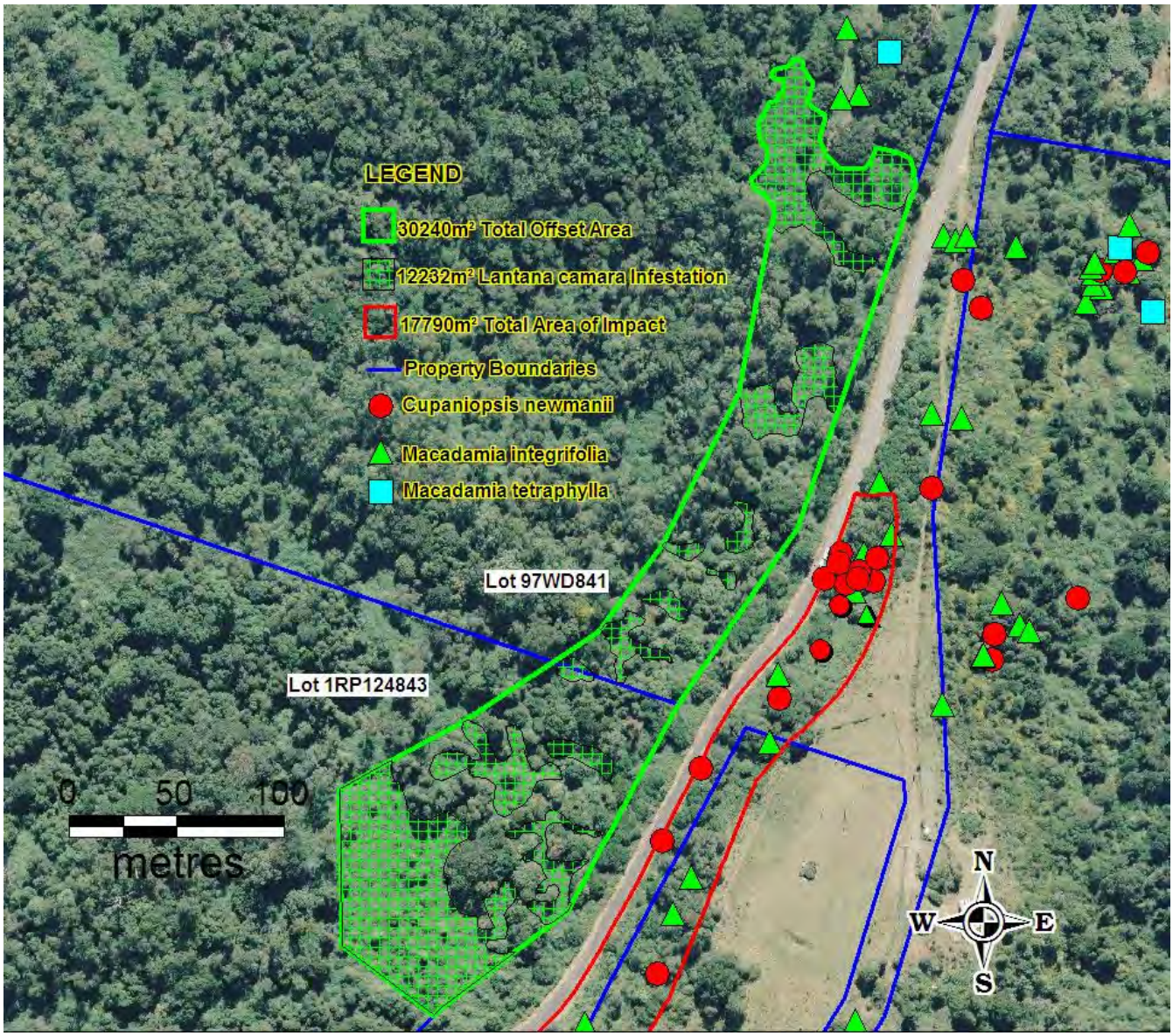
APPENDIX 1: TRANSLOCATION SITE VICINITY TO IMPACT



APPENDIX 2: TRANSLOCATION SITE



APPENDIX 3: PROJECT SCHEDULE GUIDE