6.2 f Cassowary Specific Revegetation -A Cyclone Tolerant Orchard Ella Bay

ELLA BAY
Far North Queensland

Cassowary Specific Revegetation -

A Cyclone Tolerant Orchard

At Ella Bay

October 2010 Revision 1



Executive Summary

Cyclone events are one of the major impacts on the survival of the endangered Southern Cassowary. In the aftermath of Cyclone Larry the immediate loss of food from fruit drop and the structural damage to Cassowary habitat had a significant impact on cassowary mortality. Many birds starved to death, while others were aided by widespread feeding stations while handfeeding resulted in some birds becoming nuisances to the local residents particularly around Mission Beach. Cassowaries entering into built-up areas increased their risk of mortality from interaction with vehicles and dogs.

The proponent engineered and trialled a revegetation strategy to establish a specialised protected fruit orchard that would allow early post cyclone access for cassowaries to fruit with the goal of enabling cassowary survival.

Specific species selection was involved and the Maximum Diversity Method was utilised. Species were recorded as being tolerant to cyclonic conditions and also to be identified as cassowary food source trees. These were planted in rows to act as a windbreak and under planted with cassowary food source smaller trees and shrubs.

There is limited data available on revegetation for the coastal plains, and with the costly management of weed control with Maximum Diversity planting being a significant problem; a further strategy aim was to establish a better managed low cost base revegetation project.

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1. Introduction

This report describes the establishment of a cyclone tolerant cassowary fruit orchard located on the perimeter of the western boundary of Ella Bay property adjacent to the Ella Bay National Park. The aims of the project were to

- Increase existing lowland rainforest habitat for the local cassowary population;
- Provide an all year round supply of cassowary food through a variety of native fruiting plants known to fruit throughout the year;
- Design the plantings to be as cyclone tolerant as possible using known "cyclone hardy", wind resistant species to provide shelter for lesser wind resistant species;
- Design a more cost effective revegetation strategy without sacrificing biodiversity and species abundance; and
- Develop a natural looking planting method that is not in rows etc whilst still allowing access between trees for weed maintenance.

1.1 Increase existing lowland rainforest habitat

Much of the Southern cassowary's former lowland rainforest habitat has in relatively recent history been cleared for mainly agricultural purposes through much of the wet tropics. In the past century this has also occurred at Ella bay where clearing took place to grow a variety of crops and to graze cattle near the turn of the century.

The loss of lowland rainforest has significantly reduced the abundance and diversity of fruit species previously available to cassowaries.

Cassowaries typically forage through a range of different topographical habitats and utilise a wide range of native fruit producing plants which grow in different areas. However many of the plants which provide the largest and most abundant fruit grow on the low plains where the soils are often richer and more fertile than the adjacent slopes.

This project aims to grow a diverse range of native lowland fruit producing tree species to help increase the available food resources for the cassowaries living in the forests surrounding the proposed development site to ensure the ongoing survival of the birds in the area.

1.2 Provide an all year round supply of cassowary food

Plant selection was based on species native to the remnant lowland rainforests on and surrounding the site as well as their utilization by cassowaries. As great emphasis for this project lies in providing a fruit supply for the cassowaries throughout the year. Trees were selected based on their fruiting seasons and this ensures that fruit will be available to the birds year round.

1.3 Design the plantings to be as cyclone tolerant

Cyclone events are one of the major impacts on the survival of the endangered Southern Cassowary. In the aftermath of Cyclone Larry the immediate loss of food from fruit drop and the structural damage to Cassowary habitat had a significant impact on cassowary mortality. Many birds starved to death, while others were aided by widespread feeding stations while handfeeding resulted in some birds becoming nuisances to the local residents especially around Mission Beach. Cassowaries entering into built-up areas increased in search of hand-outs increased their risk of mortality from interaction with vehicles and dogs.

Queensland Parks and Wildlife Service (QPWS) confirmed that 23 cassowaries had been killed since Cyclone Larry, most of them hit by cars. A number of the problem birds were anaesthetised and relocated to the western less-cyclone ravaged areas. The relocation was a last resort action as the territorial nature and home range instinct of the cassowary would have meant a difficult if not impossible existence.

A number of feeding stations were established around the Flying Fish Point area and along Ella Bay Road. It is suspected that the combination of the feeding station and hand feeding of the cassowaries has habitualised the cassowaries to the road and surrounding reserve areas creating a further ongoing unintended mortality risk with vehicles and dogs.

The aim is to establish a specialised protected fruit orchard that would allow early post cyclone access for cassowaries to fruit with the goal of enabling cassowary survival. It is not expected that this orchard will be able to withstand a category 5 cyclone such as cyclone Larry or Yasi however using the knowledge from these events should enable better survival after all cyclone events.

The strategy relies on reports of certain species of tall fruiting trees surviving Cyclone Larry relatively unscathed (Curran et al., 2008) (Tucker et al., 2006) (Turton et al., 2008) (Jackes., 2008). The cyclone tolerant cassowary food source trees would be planted in rows to act as a windbreak and then under planted with smaller cassowary food source trees and shrubs. The surface profile of the rows of taller trees would be sealed on the windward side by dense rows of shrubs to reduce edge effect and to improve the apparent wind profile to reduce wind eddying under the tree canopy that often results in tree damage and fall during high wind events.

The trees and shrubs planted between the rows of protecting trees would be selected as species that are able to sustain a cassowary's diet in the post-cyclone season (February to July).

1.4 Design a more cost effective revegetation strategy

A further aim was to establish a better managed low cost base revegetation. Revegetation in the Wet Tropics region has been characterised by high cost and poor success rate (Cantrell). The trials have mostly been at high elevation and there is limited data available for the coastal plains. Additionally, revegetation has evolved into a system of minimal species selection, primarily pioneer 'framework' species to achieve canopy cover as early as possible and minimise costs. This has been referred to as the Framework Species Method versus the Maximum Diversity Method (Goosem, S., Tucker, N., 1995) used in this trial.

The limited species selection and minimal cassowary fruiting trees suitable for Framework Species Method would result in insufficient availability of cassowary fruit post a cyclone event. The trial will require trees that have a variety fruiting periods and resilience to survive the uncertainties of cyclone intensity and timing.

The Maximum Diversity Method of planting will provide the best chance of availability of fruiting post a cyclone event but the downside will be that the trees will be slower to canopy closure; there will be holes in the canopy for many years and weed control will be an ongoing problem. It will not provide an even look for many years but once established will maximise the trial and evaluation of species suitability. The management of weed control with Maximum Diversity planting will become the dominant problem on an ongoing basis.

1.5 Develop a natural looking planting method.

A further goal for development and resort requirement is for the planting to be aesthetically pleasing in that the planting will not look like a plantation; that there are no straight lines and preferably a viewer is not able to look through the "rows" and see row lines to the ends.

The development of the methodology required evaluation of;

- Location;
- Research into tall protective cyclone tolerant species;
- Selection of suitable, indigenous and commercially available species;
- Defining a planting strategy, pattern and densities;
- Planting method;
- Protection and weed control; and
- Monitoring for fruit development and cassowary usage.

2. Location

Two locations were evaluated as being suitable; both provided some topographic protection from proximity to the base of the Graham range to the trees and would be away from major population centres within the resort and development area.

- Southern boundary – this is a 100m wide buffer zone between the National Park and the southern boundary of the South West Residential Precinct.
- North West- this location provided two areas one referred to as the Hidden Paddock which was located within the East West conservation corridor and between two creeks and the North West boundary with the National Park. The North West cleared area also transgressed into the Ella Bay National Park by some 30m which was included in the revegetation area

Figure 2:1 The two revegetation sites near the north-west corner of the Ella Bay site

The North West boundary (4.12 hectares) was chosen as the trial revegetation site due to wildlife monitoring cameras showing this as a frequently visited area by a number of birds male (and chicks), female and sub-adults. The creek crossing into the Hidden Paddock provided the most frequent monitoring camera images of birds on Ella Bay property.

The combination of the revegetation site and a hotspot of cassowary activity also would make this location an ideal site for a research blind to study cassowary movement and usage of the revegetation site. This location has been identified in the Masterplan for a future research station.

The North West boundary comprised two cleared areas of roughly 2 hectares each. The sites were relatively flat with the hidden paddock comprising small undulations in the far west boundary (0.1 ha). The hidden paddock was heavily infested with weeds predominately Sicklepod (*Senna obtusifolia*) over the majority of the internal flat area (1.5 ha) with Giant Bramble (*Rubus alceifolius*) on the perimeter to a width of 10 to 20m from the riparian vegetation. While the North-West block was grassed with exotic Creeping Signal Grass (*Brachiaria humidicola*).

The riparian vegetation in this area is narrow approximately 20 to 40m width, extremely susceptible to wind damage due to the open paddocks on either side. This area suffered extreme wind damage with leaf breakage resulting in defoliation from susceptible trees above the high bank and tree snap or uprooting of some species during Cyclone Yasi (Category 5). Widening this section of thin riparian vegetation will also provide protection to the existing vegetation and significantly improve existing edge effects.

3. Cyclone Tolerant Species Selection

The selection of what has been termed here as cyclone tolerant species is a very subjective assessment. Some species survive by having a low tolerance to wind; loosing all leaves during low category cyclones whereas other species survive with minor leaf loss relying on trunk and root system integrity. For these species in an extreme wind event the prior ground conditions whether water logged or dry determine whether the tree survives without trunk snap or uprooting.

The aim of the strategy is to create an area of vegetation that in high wind events should fair better than its surrounds; *not* to attempt to design an area that is impervious to the effects of a Category 5 cyclone.

Through this protection it is anticipated that vegetation will manage to retain some level of fruit-on-branch, particularly on the smaller, protected shrubs i.e. lower fruit drop; and also endure lesser damage affording a quicker recovery time (and potentially re-fruit).

The data generated post Cyclone Larry (Turton 2008, Metcalfe et al, 2008,) on cyclone tolerance was also varied with reports of some species surviving relatively unscathed in some areas whereas due to possible different wind shear events were broken off or uprooted in others. Metcalfe reports that the physical environment of the trees also determined the damage from cyclones and is impacted by:

- Local wind velocity – intensity of the cyclone and proximity to the eye;
- Local wind shear in the immediate area – local exposure and wind shielding topography;
- Soil type – Colluvial, basalt, sand etc
- Soil moisture and degree of saturation – pre-cyclone rainfall;
- Edge effects and width of vegetation - the apparent vegetation density.

Another physical difference to consider is the difference in root system development with the coastal constant heavy rain which will induce the development of a shallow and very spread root system.

The resistance to cyclone damage was found to be related to wood density in terms mechanical strength in a study of six species by Curran (Curran, 2008), where as resilience of recovery and increase in biomass post cyclone recovery was found to be negatively related to wood density. That is the trees with lower wood density re-sprouted or coppiced faster and increased biomass quicker than the trees that were potentially more resistant with higher wood density but were damaged.

More general guidelines of cyclone tolerant trees are provided by (Calvert G., 2011; Jackes, B., 2008):

- Species with thin leaves that allowed the wind to pass through;
- Flexible stems as found in palms;
- Well-developed root system with a good taproot or secondary aerial roots like some figs;
- Ease of defoliation, i.e. the ability to lose leaves quickly and so offer little resistance to the wind;
- Open branch systems allow the wind to pass through;
- Lack of a dense top heavy canopy or crown; and
- Healthy trees, vigorous growth. Slow growing trees are often the best.

The problem with the above analysis is that most cyclone tolerant trees and shrubs will make poor wind breaks due to the early leaf shedding, thin leaves or open branch structure. The most suitable, are trees with well developed root systems or are flexible stemmed. Additionally the focus has not been on which species fruited earliest after the cyclone or are sufficiently unaffected that the species continues with its normal fruiting cycle.

The conclusion was that the above observations of cyclone tolerance could provide a guide in predicting which trees would perform best in terms survival but little in terms of the suitability for

a windbreak or fastest recovery to fruiting following a cyclone. The decision was made to plant those trees which in general performed suitably and monitor.

The selection of a number of cyclone tolerant tree species was also made on local observation, plant availability and evaluation to the general guidelines.

The ultimate goal in this revegetation trial is to ascertain whether revegetation can be selectively chosen to enhance cassowary food source post a cyclone, therefore other aspects of fruiting period and recovery to early fruiting are also important. These observations have not been reported in the post Cyclone Larry analysis.

3.1 Species Selection

The species selection was divided in to two parts; species that were tall trees that were "cyclone tolerant" and preferably cassowary fruit sources to provide the shelter and other species that were cassowary "fruit sources" that fruited in the late wet season or early dry season.

Along the edges of the replanting area, a strip of denser species will be planted to ameliorate the 'edge effect'. It has been suggested that the disadvantages of narrow corridors with large edge to area ratios can sometimes be reduced if species with dense canopies that persist to ground level are used to 'seal' the boundary (Tucker and Murphy 1997, Pullar & Lamb 2008). Species suitable for this edge include sun tolerant small trees, shrubs and herbaceous plants and the cyclone tolerant palms. The spacing density for these edge plantings will be similar to natural rainforest in order to rapidly seal edges to reduce weed invasion and wind as well as light penetration.

The cassowary fruit source species were divided into height range:

>30m Lowland rainforest species, cyclone tolerant, preferably "cassowary fruit sources" that grow over 30m tall;

15 - 30m Lowland rainforest species, preferably cyclone tolerant, "cassowary fruit source" fruiting (March to November), that grow between 15 and 30 m tall; and

<15m Lowland rainforest species; preferably cyclone tolerant, "cassowary fruit source", shrub species that grow less than 15m, dense foliage trees and palms that seal the edge.

In all the species selection process was required to cross reference:

- Site specific vegetation surveys for endemic species (3D 2007, 2008);
- Cassowary food source (Bradford et al, 2008; Cooper, 1953-; Beasley, 2008; Nicholson & Nicholson 2007);
- Fruiting period (Cooper, 1953-; Beasley, 2008; Nicholson & Nicholson 2007);
- Cyclone tolerance (Calvert, et al.2011; Curran et al.,2008; Tucker et al., 2006; Turton et al., 2008; Jackes., 2008)
- Seed stock that had been provided from Ella Bay (Appendix C);
- The tube stock available at the local Council nursery in Innisfail and Tully (to ensure local provenance); and
- Tree height

Approximately 50 species of cassowary fruit source trees were chosen in the planting mix to maximise the variety of species fruiting times and provide diversity and promote resilience to environmental threats.

3.1.1 Wind Break Tree Species >30m

Selection of windbreak trees relied on reports post Cyclone Larry (Curran et al., 2008) (Tucker et al., 2006) (Turton et al., 2008) (Jackes., 2008) and site observation. The selection process was further restricted or substituted due to the lack of availability of sufficient quantities of certain species. The emphasis in species selection was a preference to cassowary fruiting

species. The 20 species selected below will provide a variation in growth rates and resilience versus resistance.

Species Name	Common Name	Ella Bay	Form	Height (m)	Fruit	Cass Fruit Source	Cyclone Tolerance
Archontophoenix alexandrae	Alexander Palm	Y	Palm	30	June-Sept	Y	flexible
Bischofia javanica	Java Cedar		Tree	30	feb-jun		Unknown low density
Carallia brachiata	Corky Bark	Y	Tree	30	Sept- Nov	Y	Tolerant of strong winds.
Cerbera florbunda	Cassowary plum	Y	Tree	30	Jan- Oct	Y	early post cylone fruit
Endiandra montana	Brown Walnut	Y	Tree	30	April- Dec	Y	Unknown
Ficus variegata	Variegated fig	Y	Tree	30	Any month	Y	loss of limbs
Gmelina dalrympleana	White Beech	Y	Tree	30	Jan-Jul	Y	resistant little damage
Syzygium angophoroides	Yarrabah Satinash		Tree	30	sep-feb	Y	loss of limbs
Syzygium luehmannii	Cherry Satinash	Y	Tree	30	Nov-March	Y	loss of few limbs, leaves
Acmena graveolens	Cassowary Satinash		Tree	35	apr-nov	Y	tolerance
Acmena hemilampra subsp. hemilampra	Broad leaf Lilly Pilly	Y	Tree	35	Jan-Sep	Y	loss of limbs
Beilschmiedia obtusifolia	Blush Walnut	Y	Tree	35	July- Nov		Site obs. loss of limbs
Cinnamomum laubatii	Pepperwood		Tree	35	jul-nov	Y	few leaves
Elaeocarpus grandis	Blue Quandong	Y	Tree	35	Any month	Y	loss of leaves
Ficus racemosa	Cluster Fig		Tree	35	May- Feb		good loss of limbs
Flindersia bourjottiana	Queensland Silver Ash	Y	Tree	35	Aug- Jan	Y	very resistant
Syzygium kuranda	Kuranda Satinash	Y	Tree	35	jun-mar	Y	loss of limbs
Brachychiton acerifolius	Flame Tree	Y	Tree	45	Any month		small leaf loss
Melia azaderach	White Cedar	Y	Tree	45	mar-jun		Fast resprout - moderate damage
Nauclea orientalis	Leichardt Pine	Y	Tree	45	Dec- July	Y	loss of limbs, leaves

3.1.2 Cassowary Fruiting Species >15m <30m

Less information on tree performance was available for this species selection and some of the selections were made on a generic basis as well as post Cyclone Larry (Curran et al., 2008) (Tucker et al., 2006) (Turton et al., 2008) (Jackes., 2008) and site observation.

The selection process was further restricted or substituted due to the lack of availability of sufficient quantities of certain species. The emphasis in species selection was a preference to cassowary fruiting species however some pioneer trees were chosen for speed to canopy closure.

Species Name	Common Name	Ella Bay	Form	Height (m)	Fruit	Cass Fruit Source	Cyclone Tolerance
Syzygium wilsonii	Powderpuff Lilly Pilly		Shrub	6	oct-jan	Y	little damage
Phaleria clerodendron	Scented Daphne	Y	Shrub	10	Dec- July	Y	
Terminalia arenicola	Brown Almond, Brown Damson	Y	Tree	10	Feb-Oct	Y	loss of few limbs, leaves
Aglaia sapindina	Boodyarra	Y	Tree	12	Nov- May	Y	
Diploglottis smithii	Smith's Tamarind	Y	Tree	15	Nov- Dec	Y	
Mischocarpus exangulatus	Red Tokoonja	Y	Tree	15	May- Oct	Y	
Polyscias australiana	Ivory Basswood	Y	Shrub	15	July- April	Y	
Ptychosperma elegans	Solitaire palm		palm	15	Apr-nov, jan	Y	flexible
Syzygium fibrosum	Fibrous Satinash		Shrub	15	July- Feb	Y	loss of limbs
Terminalia catappa	Beach Almond	Y	Tree	15	Feb-April	Y	loss of leaves
Atractocarpus fitzalanii	Native Gardenia	Y	shrub	20	jan-aug	Y	Ok when protected
Chionanthus ramiflorus	Native Olive	Y	Tree	20	July- Feb	Y	
Cryptocarya triplinervis	Brown Laurel	Y	Shrub	20	Dec- April		
Endiandra compressa	Queensland Greenheart	Y	tree	20	Mar- Nov	Y	
Ficus benjamina	Weeping Fig		tree	20	Feb- Dec		loss of limbs
Helicia nortoniana	Norton's Oak	Y	Tree	20	Any	Y	
Licuala ramsayi	Licuala	Y	Palm	20	Nov-Dec	Y	flexible
Omalanthus novo-guinensis	Bleeding Heart	Y	tree	20	nov-feb		poor pioneer low density
Pandanus solmslaubachii	swamp Pandan	Y	Shrub	20	July-Nov		No Loss
Toechima erythrocarpum	Pink tamarind	Y	tree	20	oct-feb		
Syzygium australe	Creek Cherry		Shrub	24	Any month	Y	loss of limbs
Barringtonia racemosa	Cassowary Pine	Y	Tree	25	Mar- April	Y	
Cryptocarya mackinnoniana	Rusty Laurel, Mackinnons laurel	Y	Tree	25	Apr-Nov	Y	hardy
Myristica insipida	Native Nutmeg	Y	Tree	25	jan-feb	Y	
Schefflera actinophylla	Umbrella tree	Y	Tree	25	Oct-Mar		loss of limbs
Syzygium cormiflorum	Bumpy Satinash	Y	Tree	25	Sept-June	Y	loss of limbs
Syzygium forte subsp. forte	White Apple	Y	Tree	25	Nov- April	Y	loss of few limbs, leaves
Syzygium johnsonii	Johnson's Satinash		tree	25	june-mar	Y	tolerance
Syzygium tierneyanum	River Cherry		Tree	25	Jan- May	Y	little damage
Barringtonia calyptrata	Mango Pine		tree	30	Dec- Jan	Y	No Loss
Scolopia braunii	Flintwood, Brown Birch		tree	30	dec-apr	Y	No Loss
Syzygium alliiligneum	Onion Wood	Y	Tree	30	May- Oct	Y	loss of limbs

Terminalia sericocarpa	Damson Plum	Y	Tree	30	Nov-May	Y	loss of few limbs, leaves
Aleurites moluccana	Candlenut		tree	30	Sep- Feb		Unknown sulphur crested cockatoos
Flindersia brayleyana	QLD Maple		Tree	30	July- Jan		very resistant
Melicope elleryana	Corkwood	Y	Tree	30	April- Sept		Unknown Ulysis butterfy food

3.1.3 Edge Closure trees and shrubs <15m

Less information on tree performance was available for this species selection and some of the selections were made on a generic basis as well as post Cyclone Larry (Curran et al., 2008) (Tucker et al., 2006) (Turton et al., 2008) (Jackes., 2008) and site observation.

The selection process was further restricted or substituted due to the lack of availability of sufficient quantities of certain species. The emphasis in species selection was a preference to cassowary fruiting species and edge closure.

Species Name	Common Name	Ella Bay	Form	Height (m)	Fruit	Cass Fruit Source	Cyclone Tolerance
Leea indica	Bandicoot Berry		Shrub	4	Mar- Dec	Y	flexible
Cordyline manners-suttoniae	Giant Palm Liliy	Y	Lily	5	dec-may	Y	flexible
Breynia cernua	Fart Bush	Y	shrub	5	Any month	Y	
Davidsonia pruriens	Davidson's Plum	Y	shrub	6	Any	Y	
Ficus congesta	Fig, Red Leaved Fig	Y	Shrub	6	Any month	Y	loss of limbs
Fagraea cambagei	Porcelain fruit	Y	Shrub	8	Apr_Nov	Y	
Glochidion harveyanum	Buttonwood	Y	Shrub	12	june-feb		lost small branches leaves
Leea indica	Bandicoot Berry		Shrub	4	Mar- Dec	Y	flexible
Cordyline manners-suttoniae	Giant Palm Liliy	Y	Lily	5	dec-may	Y	flexible
Breynia cernua	Fart Bush	Y	shrub	5	Any month	Y	
Davidsonia pruriens	Davidson's Plum	Y	shrub	6	Any	Y	
Ficus congesta	Fig, Red Leaved Fig	Y	Shrub	6	Any month	Y	loss of limbs
Fagraea cambagei	Porcelain fruit	Y	Shrub	8	Apr_Nov	Y	
Glochidion harveyanum	Buttonwood	Y	Shrub	12	june-feb		lost small branches leaves

4. Planting Strategy, Pattern and Densities

4.1.1 Planting Strategy

The conventional wisdom would be rows of tall trees to form a wind break, however the wind velocity, variable wind direction and tree destruction in the cyclones may be greater than can be protected by a wind break of trees and the closer proximity of interspersed tall trees may be an alternative to provide greater protection. Research on wind break affects has been predominately focussed on the benefits from crop yields and there is little comment on the protection afforded to plants from cyclones. In general the benefits of a windbreak are realised up to 10 times the tree height downstream of the windbreak.

The two areas were defined by the local descriptions of:

- North-West Block (2.36 ha). Planted with rows of tall trees as windbreak; and
- Hidden Paddock (1.71 ha). Planted with rows of trees with tall trees interspersed.

The species planting process for the North-West block was to plant in zones of the tree heights with the low height edge sealing trees on the eastern prevailing wind direction side. Whereas the Hidden Paddock site was planted in rows with the taller trees planted in random, but with clusters of taller trees.

4.2 Planting Pattern

Weed control will be the dominant ongoing issue of the revegetation until canopy closure is sufficient to minimise weed reoccurrence. Weed control methods are usually labour intensive; on foot with backpack, or by quad as practised in plantation style rows. The decision was made to use a quad bike with a towed 300l tank and a shielded boom spray. The use of a quad also provided a limitation to row spacing and density. This is contra to the advice on Maximum Diversity planting in Repairing the Rainforest which recommends that "*trees should be planted at random 2 -2.2 m spacings, avoiding straight lines*" but this would force all weed control to be manual on foot with a backpack.

The requirement for economic weed control necessitates that the trees are planted in rows so that the quad is able to travel along a row. The typical tree density in revegetation varies from 400 to 800 in most plantations to 3,000 to 6,000 in a mature rain forest depending on canopy cover, basal area and height range (Catterall, 2006). Tree/shrub spacing of 5,000 equates to a tree every 2m² or a tree to tree average distance of 1.4m.

	Row spacing closest packed					
Tree row spacing	1.41m	1.8m	2.0m	2.2m	2.5m	3.0m
Number of trees/Ha	5,016	3,086	2,500	2,066	1,600	1,111

Table 4:1 Revegetation density - number of trees per hectare

The dense shrub vegetation (<15m tall) and palms found in the edge closure rows will be required to be planted more densely to enhance edge closure and minimise light into the revegetation block. The rows of edge closure trees will also be required to have a high wind resistance (low porosity) to the cyclonic winds, and be frangible. Due to the relatively small size of the shrubby vegetation, the planting density was selected at 3,000 plants per ha with a spacing of 1.8m.

The cassowary "fruit source" trees (15m to 30m) were planted at a density of 2,500 plants per ha with a spacing of 2.0m. These are larger trees and will require a larger footprint once established however the variable growth rates will lead to holes in the canopy prolonging weed control until canopy closure.

The taller trees >30m were planted at a spacing of 2,000 plants per ha with a spacing of 2.2m. Weed control will be a longer term problem in this area, but the additional row spacing should lead to more efficient motorised spraying.

The requirement to be aesthetically pleasing is a development and resort requirement in that the tree rows should not look like a plantation; there should be no straight lines and a veiwer should not able to look through the “rows” and see row lines.

This will be achieved by two methods, varying the planting density and planting in the trees in undulating wave rows. This landscape appearance will be enhanced by planting zones of the different height trees and an edge zone which will close off the view from the edge.

4.2.1 Planting Pattern North-West Block

The North-West Block was planted with edge closure rows on the prevailing weather eastern side. The block was divided into undulating wave rows in general running north south.

The order of the tree zones from east to west were:

- 5 x rows; <15m edge closure shrubs and palms;
- 2 x rows; 15 – 30m cassowary fruiting trees;
- 11 x rows; >30m wind break trees;
- 16 x rows; 15 – 30m cassowary fruiting trees;
- 12 x rows >30m wind break trees; and
- 7 x rows; 15 – 30m cassowary fruiting trees.

The purpose of the first two zones is to provide a gradual canopy profile increase to form a ramp shape to the wind to reduce wind eddying under the tree canopy that often results in tree damage and fall during high wind events.

4.2.2 Planting Pattern Hidden Paddock

The variation with tree planting in the hidden paddock was that the trees were planted in bands of tree height but additional cyclone resistant tall trees (>30m) were mixed in with the cassowary fruiting trees e.g. Blue Quangdong (*Elaeocarpus angustifolius*) and White Apple (*Syzygium forte*). This additional planting is designed to enable the larger trees to offer greater protection to the smaller trees/shrubs during high wind events. The shape of the hidden paddock was elongated in an east west direction and to maintain the comparison to the North West block the rows were arranged in many short rows. This has proven to be very poor design and increased effort in weed control. and has meant that a greater amount of time has been spent in on foot spraying.

The order of the tree zones from east to west were:

- 10 x rows; 15 – 30m cassowary fruiting trees;
- 10 x rows; >30m wind break trees; and
- 15 x rows; 15 – 30m cassowary fruiting trees;
- 10 x rows >30m wind break trees; and
- 25 x rows; 15 – 30m cassowary fruiting trees.
- 10 x rows >30m wind break trees; and
- 25 x rows; 15 – 30m cassowary fruiting trees
- 10 x rows >30m wind break trees; and
- 10 x rows; 15 – 30m cassowary fruiting trees
- 5 x rows >30m wind break trees; and
- 5 to 10 x rows; 15 – 30m cassowary fruiting trees

The planting pattern of the revegetation in North-West area (2.36 ha) and Hidden Paddock (1.71 ha) is shown in Figure 4.1. The plan is diagrammatic and each row line represents 5 planted rows.

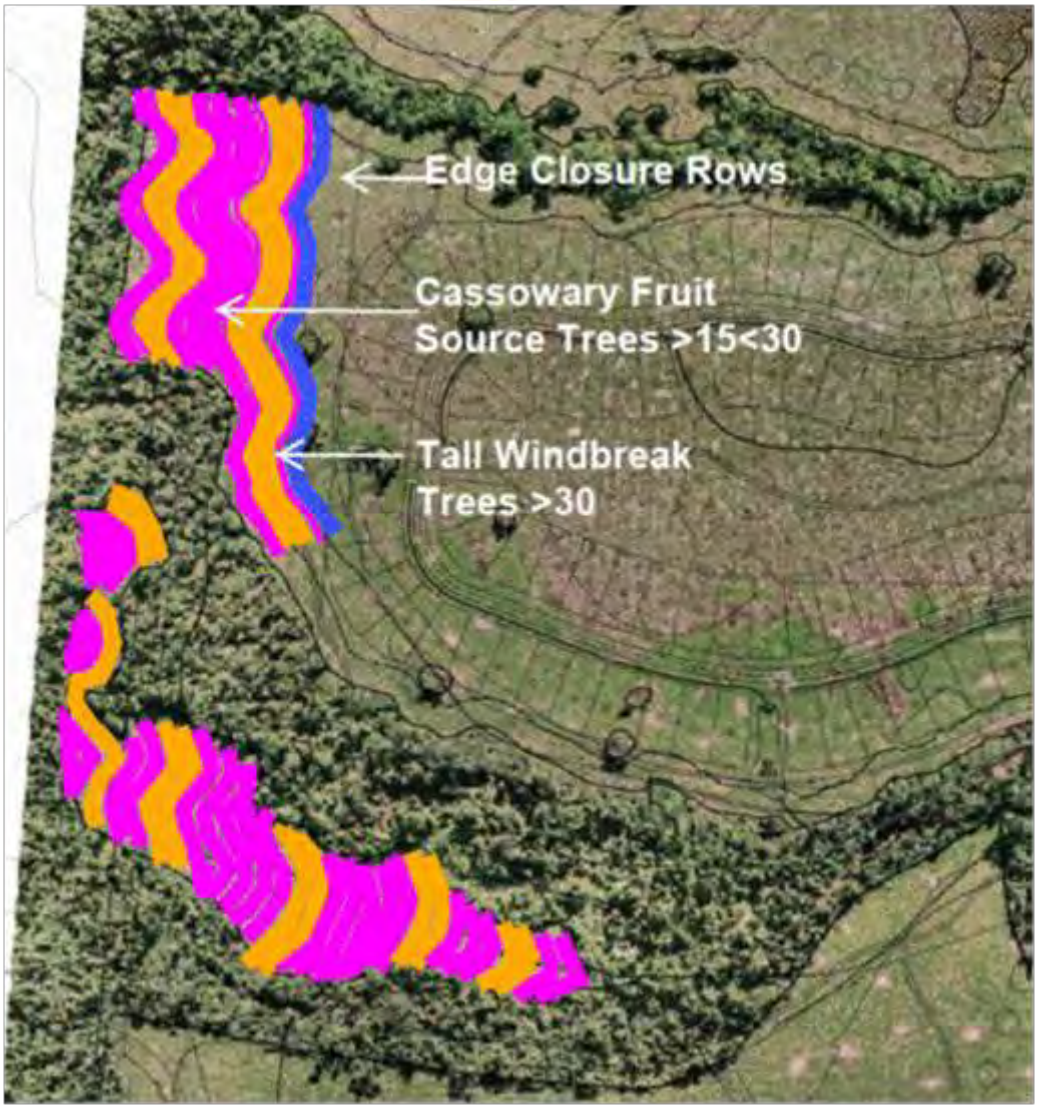

Figure 4:1 Planting pattern of revegetation - each individual line represents 5 rows

4.3 Planting Process

Ground Preparation

Ground preparation included 3 broad boom spray applications with Glyphosate 540. One week after each spray this was followed by a slashing program. New emergent weed species were further controlled by 'spot' spray application at intervals between boom sprays, slashing and revegetation implementation.

Figure 4:2 North West corner after two boom sprays and second slash

The plant species were set aside in the local nurseries. The purchase of 12,000 trees involved purchases from Innisfail and Tully council nurseries and from C4 cassowary conservation group. While the combined production from the nurseries tallies to over 80,000 plants per year the specific species that were required were limited. Ella Bay staff had been providing the nurseries with seed stock for some 12 months prior.

Figure 4:3 Plants set aside for hardening in the sun

Plant Sorting

Once plants were collected from the nursery they were allocated colours based on the species category in this case

- Yellow >30m
- Pink >15m < 30m
- Blue <15m edge effect

Each small tree/shrub planting box contained a random assortment of species. Large tree planting boxes contained 20% blue quandong (*E. angustifolius*) and 20% white apple (*S. forte*). The remaining plants in the large tree planting boxes consist of a random assortment of other species.

The plants were set aside in a fenced enclosure with overhead sprinkling to sun harden and acclimatise the plants. The plants remained in the enclosure for 4 to 12 weeks as the species tally was

Figure 4:4 Plant Laydown area at Ella Bay.

Marking the planting locations

Preparing the revegetation site for planting to ensure correct placement of species involved the following:

- To help with marking out individual planting positions on the ground for each tree, long lengths of rope were utilized with knots tied along the length of the rope.
- 90 meter sections of rope knotted at either 2.0 m or 2.2 m intervals. These sections were laid out using the design guide in waving rows parallel to each other and existing vegetation edge;
- Each knot was then spray marked to represent a planting location. This is individually marked with the associated paint whose colour to match the desired zone for that area (i.e. either orange paint for large trees or pink paint for small trees/shrubs);
- Individual large trees are to be no closer than 2.2m from their nearest neighbour, including small trees/shrubs;
- The rope was laid out in a wave pattern with the amplitude of the wave greater than the row spacing.

Planting

The Contract Planters were supported by Ella Bay staff to ensure the correct methodology was followed. A pre-works meeting was held daily with all contractors and staff. In the acclimatisation area Ella Bay staff carried out quality control by organising the allocation and mix of species specific to the colour category.

Figure 4:5 Contract tree planter preparing to insert a plant into the ground

Regular quality control through-out the day was also conducted with particular focus at the end-of-day where Ella Bay staff would do a walk through of the days work.

Additional actions required for this process were:

- The establishment of an on-site 'central plant acclimatisation and lay-down area' which was fenced to manage wallaby predation of plants; it didn't however protect against the native rodents which ate out a lot of the palms before planting could commenced.
- Once planted certain species that were identified as a 'wallaby favourite' eg. Alexander Palm, Solitaire Palm were afforded individual plant protection from predation in the form of a biodegradable bag with 3 cane stakes;

Figure 4:6 Wallaby preferred species were protected with biodegradable bags.

On going maintenance

Once planted, the revegetation area was taken over by on-going maintenance:

- maintaining exclusion the fence from the wallabies;
- weed control; and

- replacement of any casualties with endemic species.

Figure 4:7 North West corner spot spraying prior to fabrication of custom spray boom.

Weed control is a high resource and costly requirement of the maintenance program. Early intervention was important to ensure weeds were sprayed at low heights (avoiding over spray). The intent was to develop a custom boom spray and travel along the rows spraying the majority of the inter row with the boom and spraying in between the rows where required with the spot spray. The 300l towed tank was fitted with hose reel so that two people could use the quad bike, boom and hand boom and increase the area covered control emerging weeds. The reality was that the initial setout had problems with spacing of the rows and the tightness of the "wave" put in the rows. In the Hidden paddock many of the rows were too short meaning that there was difficulty in using the trailer with the tight turns

Figure 4:8 North West corner spot spraying with custom boom in background

Due to weather constraints the spraying of the revegetation areas is often broken up into short windows. A full spray is managed every two to three months on average but again this is highly variable depending on rainfall, temperature (time of year) and wind.

5. Revegetation Risks

The planting of large areas of Maximum Diversity species is not a recommended practice due to poor survival rates. This has been the driver to the more recent 'plantation style' layout in large area revegetation - with minimalistic 'pioneer species quota' of Framework Species Method.

The risks to plant survival were identified as:

- The high wallaby numbers which have denuded many riparian areas of germinating trees and have ravaged other earlier revegetation trials of trees, in particular all palms;
- Water stress – the range in species used have varying water requirements and it is best to either irrigate or plant in late dry season prior to the Wet;
- Weed control;
- Poor survival rates due to previous agricultural conditions; and
- Cyclone season.

To reduce the risk of wallaby damage the North West block was fenced with a trial of the cassowary exclusion fence – 1.8m high shadecloth fence (refer to Volume 6.1j) on the eastern side only. The Hidden Paddock was not fenced at all.

The planting did not occur until July and August in 2010 which is much later than was planned and in a dry year would have potentially caused a problem, however 2010/2011 saw the end to the El Niño and a wetter than normal dry season and wet season. This enabled the plants to get through the typical high stress period with few losses.

The tree mortality due to weed control has two forms;

- Damage to the seedlings from mechanical movement and from overspray; and
- Competition from overgrown weeds.

The damage from mechanical movement, quad bike wheels, inadvertent damage from spray hoses, and neighbouring vegetation branch drop have all been produced minor damage.

The varying growth rates of the species selected for maximum diversity will also mean that some of the faster pioneer species will shade the slower growing species resulting in holes in the canopy.

5.1 Tree Growth Performance

Plant mortality summary out of 12,000 seedlings

- 800 plants – High wind event (Category 5 Cyclone Yasi)
- 500 plants – Dry weather post planting
- 120 plants – Miscellaneous

Miscellaneous factors include:

- wallaby/pest attack
- overspray
- disease, lack of root development
- incorrect planting

5.1.1 High wind event

The species most affected by the cyclone were the faster growing species such as Blue Quandong, Bleeding Heart, Cassowary Plum, Fart Bush, Bandicoot Berry were all significantly affected by the strong winds. It is not thought to be a reflection of their species suitability but rather their initial rapid growth rate with a less established root system, as larger specimens of the same species over the property faired very well in comparison

5.1.2 Dry weather

The species which tended to perish shortly after planting due to dry weather were Fibrous Satinash, Porcelain Fruit, Licualas Palms and Davidson's Plums. This was attributed to several extended periods of dry weather and full sun combined with the plants smaller size at planting (approx 100mm) as compared to the other species when planted which were generally (300-600mm). It is thought that the smaller tube stock size and lack of adequate root development rather than the species ability to cope with dry periods is what may have contributed to their failure to establish and grow. The few larger specimens of these species that were planted out have survived and are growing well.

Davidson's Plum, Powder Puff Lilly Pilly and Porcelain Fruit appear to resent full sun as the majority of those planted seem to be struggling.

5.1.3 Wallabies

Some agile wallaby (*Macropus agilis*) invasion of the revegetation area did occur despite the efforts made with fencing to exclude them. The wallabies gained access by going around the fences and through the existing forest. Wallabies favourites included Alexander palm (*A.alexandrae*), solitaire palm (*P.elegans*), licuala palm (*L.ramsayi*), cordylines (*C. Manners-suttonae*) and blue quandongs (*E.grandis*).

5.1.4 Feral Pigs, Caterpillars, Insects and Other

Other pests such as feral pigs played a small part in the destruction of a few of the palms and Pandanus species which they chewed to extract the soft palatable cores.

Caterpillars also had a detrimental effect on some species including the larvae of the four-o'clock moth which fed heavily on the corkwood seedlings killing some of them by completely denuding them of leaves. The larvae of the Ulysses butterfly also fed heavily on the corky bark seedlings however most recovered quickly.

Their were occasions where during the spraying of weeds young trees were accidentally sprayed causing the plant to sicken or die. However this accounted for very little mortality.

At the end of the planting an excess of trees remained in the laydown area to be used for replacement planting - approximately 200 trees succumbed to the lethal effects of shading out etc whilst still in the boxes. The survivors were used to replace lost trees.

5.2 Replacement Plantings

Replacement trees were two separate mixed species groups one from the “orange” species mix and one from the “pink” species mix as well as around 100 trees to make up the balance consisting of Blue Quandongs and Alexander Palms, Licualas and Solitaire Palms.

5.2.1 Natural Recruitment

Native plants that have observed germinating include Milky Pine Blue quandong, Ylang-Ylang, Bleeding Heart Tree, Native Banana, Scott’s Ginger, Native Olive, Macaranga and Leichardt tree. Many of these germinate in wet weather and shrivel and die in the open sun light in dry periods. As the canopy develops the weed spraying can be reduced resulting in a higher survival rate for many of the recruitment seedlings.

5.3 Cyclone Yasi

The unidentified risk was category 5 Cyclone Yasi that devastated Far North Queensland during February 3rd 2011. The cyclone stripped protective adjacent vegetation, and snapped canopies and branches from trees. In many places the winds blew the branches on to the tree seedlings such that one side of the hidden paddock the majority of trees along the southern side were damage or broken over. Many seedlings had the top half stripped of leaves but were substantially undamaged where as many of the faster growing trees were broken over or broken off. In particular one of the most cyclone tolerant as a mature tree the Blue Quandong (*Elaeocarpus arnhemicus*) suffered greater than 80% mortality.

A few trees survived being blown over, and continued growing at a new angle (see below). Unfortunately this often resulted in them being in the track between rows, as such were sprayed with herbicide, and driven or trampled over.

Six months later

Fruiting of a number of species has occurred, despite two cyclonic events at the beginning of the year. Bandicoot Berry Fruiting in March 2011 (*below*)

6. Cost analysis

Revegetation in the wet tropics has been reported to cost from $20k to $60k per ha (Catterall and Kanowski, 2009) where as plantation cost in southern states are $4k to $6k. The difference in costs is due to a number of variables:

- Maximum diversity planning method;
- Planting density;
- Weed control ; and

The planting and acquisition costs in the wet tropics with bagging and site preparation are about $3 per tree, and with the planting density at 3 to 4 times the plantation density (typically 2000 to 3000 compared to 800 to 1000) the purchase costs alone are greater than the plantation costs.

With the Framework Species Method (FSM) the primary focus is to select trees to provide canopy cover, plant with a high density that helps to block out the weeds and then follow up with backpack spray of glyphosate twice a year for 3 to 4 years. With maximum diversity planting the trees grow at different rates creating holes in the canopy allowing weeds to grow, increasing the requirement for spraying to 4 to 6 times per year.

The current data if extrapolated for an additional 3 years is trending towards $25,000 per ha. There are a number of learnings from this exercise, from a cost perspective:

- The row spacing and access for the spray vehicle is the most critical;
- That weed matting along around the tree would reduce competition and retain moisture in the first 12 months;
- The condition of the smaller seedlings are critical; and
- That some form of control of native rats and moth or caterpillar should be used in the laydown area.

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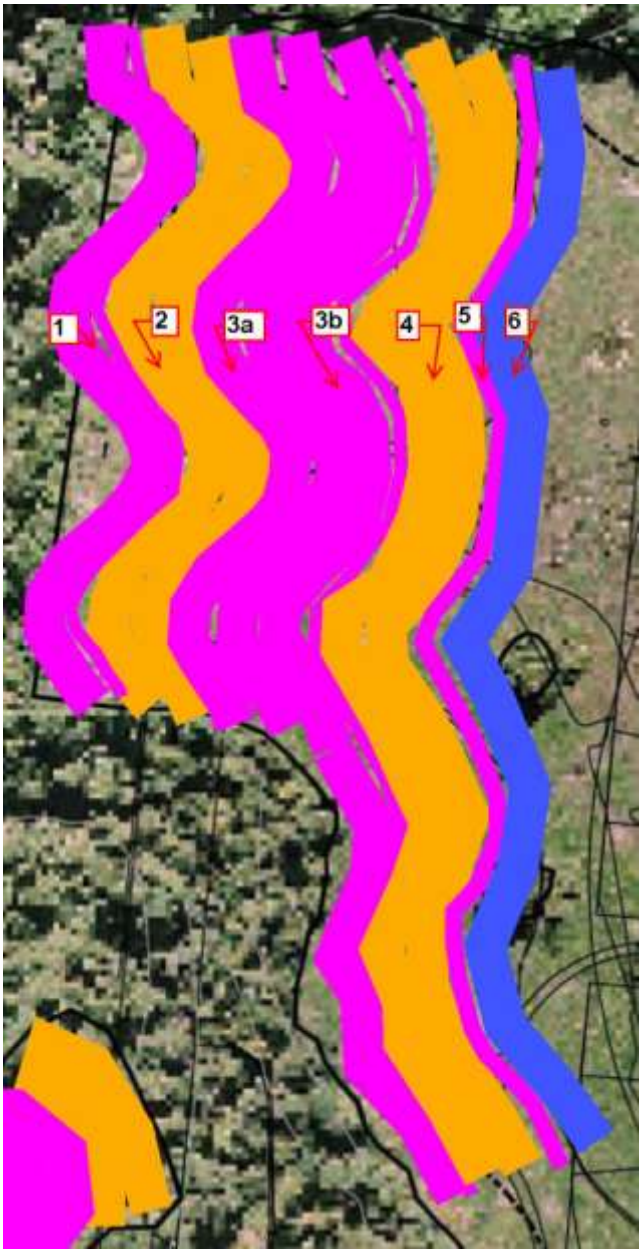
Appendix 1. List and Quantity of Initial Species Planted

Species Name	Common Name/s	No
Acmena graveolens	Cassowary Satinash	50
Acmena hemilampra subsp. hemilampra	Broad leaf Lilly Pilly	100
Aglaia sapindina	Boodyarra	150
Archontophoenix alexandrae	Alexander Palm	100
Atractocarpus fitzalanii	Native Gardenia	150
Barringtonia calyptrata	Mango Pine	240
Barringtonia racemosa	Cassowary Pine	63
Beilschmedia obtusifolia	Blush Walnut	250
Carallia brachiata	Corky Bark	300
Cerbera florbinda	cassowary plum	147
Chionanthus ramiflorus	Native Olive	150
Cinnamomum laubatii	Pepperwoood	150
Cordyline manners-suttoniae	GIANT Palm Liliy	90
Cryptocarya hypospodia	Northern Laurel	20
Davidsonia pruriens	Davidson's Plum	300
Diploglottis smithii	Smith's Tamarind	150
Elaeocarpus angustifolius	Blue quandong syn Grandis	500
Endiandra compressa	Queensland Greenheart	90
Endiandra montana	Brown Walnut	50
Fagraea cambagei	porcelain fruit	40
Ficus congesta	Fig, Red Leaved Fig	350
Ficus variegata	Variegated fig	50
Flindersia bourjottiana	Queensland Silver Ash	50
Flindersia brayleyana	QLD Maple	450
Gmelina dalrympleana	White Beech	50
Helicia nortoniana	Norton's Oak	150
Leea indica	Bandicoot Berry	150
Licuala ramsayi	Licuala	137
Mischocarpus exangulatus	Red Tokoonja	450
Myristica insipida	Native Nutmeg	80
Nauclea orientalis	Leichardt Pine	100
Phaleria clerodendron	Scented Daphne	150
Ptychosperma elegans	Solitaire palm	150
Scolopia braunii	Flintwood, Brown Birch	124
Syzygium alliiligneum	Onion Wood	400
Syzygium angophoroides	Yarrabah Satinash	50
Syzygium australe	Creek Cherry	239
Syzygium cormiflorum	Bumpy Satinash	150
Syzygium fibrosum	Fibrous Satinash	450
Syzygium forte subsp. forte	White Apple	203
Syzygium johnsonii	Johnson's Satinash	40
Syzygium kuranda	Kuranda Satinash	50
Syzygium luehmannii	Cherry Satinash	40
Syzygium tierneyanum	River Cherry	450
Syzygium wilsonii	Powderpuff Lilly Pilly	400
Terminalia arenicola	Brown Almond, Brown Damson	50
Terminalia catappa	Indian Almond, Beach Almond	171
Terminalia sericocarpa	Damson Plum	450
Toechima erythrocarpum	Pink tamarind	100

Appendix 2. North West Revegetation Strategy – Details for marking up paddock.

this picture is INDICATIVE only.



	Spacing between rows
PINK	2.0m
ORANGE	2.2m
BLUE	2.0m

	# of Rows	# of Trees (est.)
1	7 'short'	595
2	12 'short'	876
3a	9 'short'	765
3b	7 'long'	945
4	11'long'	1276
5	2 'long'	270
6	5 'long'	675

The numbers of trees for each 'section' are only estimates.

Work from the western vegetation line eastwards – and would suggest marking up the same way.

Revegetation Area

North West – Cassowary refuge/ cyclone protection/ fruiting march till Nov

Zone	Description	Height Range	Planting Density (Trees/Ha)	Planting Spacing	number of rows	Approx number of Trees	Length of row Average
Pink	Low land rainforest species	>15-30m	2,500	2.0 m	171	8,529	85
Orange	Low land rainforest species	>30m	2,000	2.2 m	9	1,680	420
Yellow	Attractive low land rainforest shrub species that grow less than	<15	3,500	1.7 m	6	840	240
					185	11,049	

Length of strip 100 Approximate Total Area ha 4.1267 ha

Appendix 3. Seed collection table

Seed Collection for Revegetation Ella Bay 2010

Seed Collection Common Name:	Scientific Name:	January	February	March	April	May	June	July	August	September	October	November	December
Brown Salwood	Acacia mangium											5000	
Cassowary Satinash	Acmena graveolens					25			50				
Blush/Broad leaved Satinash	Acmena hemilampra					1000	5000 250 250						
Red-Bean Tree	Adenanthera pavonina				200				100				
Hairy Bird's Eye	Alectryon tomentosus				1500								
Candlenut	Aleurites moluccana			120 400									
Candlenut	Aleurites rockinghamensis								500				
Native Ginger	Alphinia caerulea			500									
Pleated Ginger	Alpinia arctiflora			1000	1000								
Black-stemmed Ginger	Alpinia modesta				1500								
Pink Ash	Alphitonia petriei											300	150
Dog Bane	Apocynum		10										
Alexandra Palm	Archontophoenix alexandrae			240 1000 2000 1500	2000 500	1500							
Australian Arenga Palm	Arenga australistica								100	50			
Bingil Bay Palm	Arenga australistica				200 200					100			
Native Dutchman's Pipe (Cairns Birdwing?) Vine	Aristolochia acuminata (tagala)				5,000								
Native Gardenia	Atractocarpus fitzalanii			5000									
Cassowary Pine	Barringtonia calyptrata												50 50
Yellow Walnut	Beilschmieda bancroftii										30 10		
Fart Bush	Breynia cernua						200					300	200
Fishtailed Lawyer Cane	Calamus caryotoides			50									
Beach callophyllum	Calophyllum inophyllum					2000	400						
Black Bean Tree	Castanospermum australae		50	65 200 150 200	150	200	300		200				
Cassowary Plum	Cerbra floribunda							80	12	30	2 200	20 20	20
Dog Bane	Cerbera manghas											20	30 1
Pimply Olive	Chionanthus axillans								400				
Native Olive	Chionanthus ramiflora								300	1000 1000			
Laurel / Pepperwood	Cinnimomum laubattii						150						
Silver Bush	Convolvulus cneorum			10									
Palm Lily	Cordyline cannifolia			100	800								
Clarkson's Laurel	Cryptocarya clarksonii										400 250		
Northern Laurel	Cryptocarya hypospodia										250		
Poison Walnut	Cryptocarya pleuropema												50
Qld Cycad	Cycas media				30								
Blue Flax Lilly	Dianella caerulea				1000	800 600 1000	800			300	30 300		
Dianella Spp.	Dianella Spp.				150	7000	180						
Red Beech	Dillenia alata				400	300 200	350 200 100	100	100 200		200 300 300	500	300
Cape York Cedar/Buff	Dysoxylum alliceum				40	80 100 100 1000	250 50						
Eumundi Quandong	Elaeocarpus eumund		1000	800									
Blue Quandong	Eleocarpus grandis						80 50 50		500				
Coral Tree	Erythrim variegata				800								
Porcelin Fruit	Fagraea cambagei						50	100					
Weeping Fig	Ficus benjamina									5000 10000	15000 5000		
Red-Leaf Fig	Ficus congesta					10000			10000			2000 10000 1000	
Rusty Fig	Ficus destruens									10000			
Drube Fig	Ficus drupacea						900						
Hairy Fig	Ficus hispida										1000 1000		
Small-leaved fig	Ficus obliqua			1E+05									
Septic Fig	Ficus septica				400								
Variegated Fig	Ficus variegata			1E+05			19000				2000		
White Fig	Ficus virens											4000	
Daintree Hickory/Scaly ash	Ganophyllum falcatum		20										
Buttonwood	Glochidion harveyanum				100 600								
Umbrella Cheese Tree	Glochidion sumatrum								200				
White Beech	Gmelina fasciculiflora											300 150	
Claudie Tuliipwood	Harpullia ramiflora			400									
Norton's Oak	Helicia nortoniana				500 500	500 400 800	150						
Sea Hearse	Hernandia nymphaefolia			200									
Cottonwood	Hibiscus tiliaceus		1000	200 1000								500	100
Bleeding Heart	Homalanthus novoguineum						3000	1000	1000 1000				
Creek Palm	Hydriastele wendlandiana										4 5		
Goat's Foot Morning Glory/creeper	Ipomea pescaprae						100						
Bandicoot Berry	Leea indica												
Qld Fan Palm	Licuala ramsayii										100 100 50		
Walking Stick Palm	Linospadix minor				200								

Seed Collection for Revegetation Ella Bay 2010

Seed Collection Common Name:	Scientific Name:	January				February				March				April					May				June			
Macaranga Tree	Macaranga tanarius																									
Native Lasiandra	Melastoma malabathricum																									
Turn-in-the-Wind	Mallotus paniculatus																			2000			1000			
Yellow Evodia	Melicope bonwickii																									
Corkwood	Meliocope elleryana										400															
Little Evodia	Meliocope rubra (meullerii)										2000															
Pongamia	Millettia pinnata										400															
Red Bell	Mischocarpus exangulatus																								105	
Cheese fruit	Morinda citrifolia									65	50000	240	120	240							500			500		
Native Banana	Musa banksii																		200							
Native Nutmeg	Myristica insipida																									
Leichhardt	Nauclea orientalis										50000															
Rainforest Pandan/Urchin-	Pandanus monticola															1000										
Swamp Pandan	Pandanus solmslaubachii																									
Rusty Pittosporum	Pittosporum ferrugineum																									
Solitaire Palm	Phytosperma elegans											100	500	100	50					100	50		500	50		
Coastal Premna	Premna serratifolia.										500					100										
Sea Lettuce/beach cabbage	Scaveola taccada									12	5000		600								2000			600		
Mission Beach Satinash/Onion Wood	Syzigium aliiligium																						200	50	300	
White Apple	Syzygium forte							250																		
Brown Damson	Terminalia arenicola																					500		1000		
Sea Almond	Terminalia catappa									50	200	500	350	500	300						10		200	50	50	
Mueller's Damson	Terminalia muelleri																									
Damson Plum	Terminalia sericocarpa										400															
Northern Cottonwood	Thespesia populnea									200										150	250					
Poison Peach	Trema orientalis																						600			
Golden Penda	Xanthostemon chrysanthus																									
Total Seeds	522,966							2330	0	962	318100	2990	4720	2990	7230	1700	0	8140	1580	4475	14810	12500	9230	26600	1235	0

Seed Collection Common Name:	July				August				September				October				November				December			
Macaranga Tree									250										500					
Native Lasiandra															5000									
Turn-in-the-Wind																								
Yellow Evodia									500															
Corkwood																								
Little Evodia																								
Pongamia																								
Red Bell			200																					
Cheese fruit																				200	200	80		
Native Banana																								
Native Nutmeg											50													
Leichhardt																								
Rainforest Pandan/Urchin-		500															50							
Swamp Pandan														50			40							
Rusty Pittosporum													400											
Solitaire Palm		50							1000															
Coastal Premna																						200		
Sea Lettuce/beach cabbage																			600	800	600	500		
Mission Beach Satinash/Onion Wood																								
White Apple																								
Brown Damson					200																			
Sea Almond			50		60																			
Mueller's Damson		30	250																					
Damson Plum					250																			
Northern Cottonwood		50			300									200					200					
Poison Peach																								
Golden Penda																								
Total Seeds	0	730	680	1000	3972	11500	0	0	6850	0	11080	11350	1766	15350	11200	3865	90	6000	12940	2470	1150	1381	0	0