New Oakleigh Coal

Native Ecosystem Rehabilitation Plan

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1.0 Introduction

New Oakleigh Coal Pty Ltd (NOC) conducts coal mining activities at New Oakleigh Mine approximately 65km west of Brisbane and 1-2km north of the township of Rosewood. NOC plans to cease operations at the mine in 2010, when economic reserves will be exhausted.

Mining operations are currently conducted under Environmental Authority (EA) number M5637 which designates that areas significantly disturbed by mining activities must be rehabilitated to one of the four following post-mining land uses:

- Residual void;
- Grazing;
- Native ecosystem; and
- Sediment and water supply dams.

This document outlines the strategies and actions NOC intends to follow with regards to the rehabilitation of disturbed lands to the Native Ecosystem post-mining land-use. Rehabilitation of the remaining three land-uses is addressed in the New Oakleigh Coal Mine Closure Plan.

Strategies and actions outlined in this plan have been developed to ensure that a systematic approach to rehabilitation is undertaken which results in the successful establishment of the Native Ecosystem land-use to a standard which enhances the environmental values of the area and ultimately enables the surrender of the relevant mining lease.

This plan is a dynamic document and will be updated on a regular basis to take into account changes in the requirements of the rehabilitation program including updated knowledge and understanding of rehabilitation techniques. Specific details within the Plan may be amended as a result of any such changes. The Native Ecosystem Rehabilitation Plan should be considered in conjunction with the current Plan of Operations and the New Oakleigh Mine Closure Plan.

1.1 Requirements of Environmental Authority

Schedule F1-1 of the EA designates that 30ha of recontoured spoil is to be rehabilitated as Native Ecosystem.

Schedule F3-1 states that areas to be progressively rehabilitated to Native Ecosystem must comply with the following outcomes:

a) A self-sustaining native ecosystem has been established and species composition and distribution is comparable with that of analogue sites identified in a separate study proposing rehabilitation acceptance criteria;
b) All areas disturbed by mining activities must be rehabilitated to the landform design criteria listed in Table 1-1;
c) Landforms are stable with erosion comparable to analogue sites;
d) Landforms have been reshaped as close as practicable to the aspect orientation appropriate to the climax community; and
e) Species composition does not include new genetic material from native species outside the local area.

Table 1-1 Landform design criteria

Slope range (%)	Projective Surface Area (ha)	Max distance between erosion control devices (m)
40	5	13
30	7	23
20	10	50
15	20	133
10	22	220
5	26	520
3	28	900

2.0 Rehabilitation Area

The original Environmental Management Overview Strategy (EMOS) identified a number of discontinuous areas to be rehabilitated as Native Ecosystem (NE), many of which were less than 1ha in size. Following a review of the environmental value and the suitability of the original rehabilitation design a decision was made to consolidate the areas of NE rehabilitation into a single larger area. Such a change will result in a number of enhancements including:

- Reduced pressure from invasive species, as edge effects are reduced with increased patch size;
- Greater protection of an adjacent patch of remnant vegetation;
- Increased environmental value due to the provision of better quality and larger habitat area; and
- Increased potential for natural recruitment from adjacent patches of remnant vegetation.

The northern edge of the out-of-pit dump on mining lease ML 4698 was selected as the most suitable site to establish the NE rehabilitation. The primary advantage of this area is that the rehabilitation will serve to protect and enhance an existing remnant vegetation patch immediately to the north. This patch has been mapped as Regional Ecosystem (RE) type 12.9-10.6 "Brigalow (*Acacia harpophylla*) open forest with Belah (*Casuarina cristata*) and vine thicket species". Early RE mapping identified a second remnant patch immediately to the west, however this patch is not classified as RE in the latest EPA mapping (EPA 2003 Regional Ecosystem Map searched on 27 October 2006).

Existing plantings have already been undertaken in this area which was designated for rehabilitation as NE in the original EMOS. The proposed changes will effectively result in an expansion of the rehabilitation in this particular area rather than a major change in the final land-use plan.

Figure 2-1 shows the location and nominal extent of the proposed NE rehabilitation area and the area of remnant vegetation. Two topsoil stockpiles are present on the top of the dump, one of which lies within the NE area. This topsoil is being retained for use in rehabilitating the final in-pit dump area and as such will remain in place until the end of active mining. Rather than shifting the stockpile which reduces the viability of the topsoil and results in excess costs due to double handling, the rehabilitation area has been extended to the west to meet the 30ha requirement. It is anticipated that the 1.7ha left open due to the stockpile space will become vegetated through natural regrowth with seed stock from the adjoining planted areas. This 1.7ha will therefore be additional NE in excess of the area required under the EA.

The northern edge of the NE area is defined by the top of a gully which runs down to the railway easement. The steepness of the gully precludes planting in this area due to safety issues however it is anticipated that natural regrowth will result in the extension of the NE area towards the edge of the existing remnant vegetation patch. The north-western edge of the NE area is defined by the area disturbed by mining and limited by a buffer zone established prior to mining to protect existing vegetation further to the west and south of the railway line.

Figure 2-1 Native Ecosystem rehabilitation area at New Oakleigh Coal Mine

2.1 Soil Analysis and Nutrient Availability

To create the out-of-pit dump upon where the NE rehabilitation will be established, waste rock was loose dumped and covered by a minimum of 1-2m of inert clay. A 0.5m layer of subsoil was then spread over the inert clay layer and this was in turn covered with a minimum of 0.15m of topsoil recovered from pre-clearing activities.

Soil analysis results from 5 sites in the rehabilitation area, along with a nearby undisturbed site located adjacent to the Tallegalla coffee shop, are shown in Table 2-1

Table 2-1 Soil analysis results

Parameter	Disturbed	Non-disturbed	Comment
Salinity (µS/cm)	200-750	130	
pH	7.8-8.1	7.3	6.5-7.0 optimum
N (meq/100g)	0.1-8.6	12.6	
P (meq/100g)	2-11	27	
K (meq/100g)	0.3-0.6	1.5	
Ca:Mg	1:1	6:1	4-6:1 optimum
ESP (%)	7-18	1.2	15% extreme or sodic

From the analysis the disturbed areas are more alkaline and considerably lower in macronutrients than the undisturbed area of remnant vegetation. It should also be noted that considerable nutrient contained in the biomass of the remnant area was not quantified. The absence of the biomass component of the nutrient cycle in the disturbed area has long-term implications with regard to nutrient deficiency.

In the short term, the nutrient deficiency may be overcome through the application of slow release fertilisers. However, for optimum growth on-going applications of fertilisers would be required until a suitable biomass component is established. The use of nitrogen-fixing species (e.g. *Acacia* spp.) will assist the nutrient content of the disturbed areas. Cost and logistical issues are associated with the on-going use of fertilisers.

The combination of high exchangeable sodium percentage and poor calcium-magnesium ratio in the disturbed area will adversely affect soil pedology and aggregate stability, and indicates that these areas are prone to soil crusting, poor water infiltration, dispersion and erosion. The recommended approach to addressing these issues is the application of gypsum at the time of planting. Contouring and drainage issues will be addressed to reduce the erosion potential in the rehabilitation area.

The use of composted soil conditioners to improve the chemical and physical state of the soil in the rehabilitation area has been considered however the logistics, cost and sensitivity of the site (i.e. in terms of public perception) currently preclude the use of this form of soil amelioration. Developments/improvements in this technology will be monitored to identify potential future applications.

3.0 Rehabilitation Methodology

3.1 Species Selection and Sourcing

NOC has its own nursery area where tubestock are grown from locally sourced seeds. Trees to be planted in the NE rehabilitation area will also be sourced from local growers when required and will not include new genetic material from native species outside the local area. NOC has a number of preferred suppliers who have previously provided healthy plants from local seed stock which have had good survival rates. Wherever possible, seeds and tubestock will be sourced from within the Lockyer Valley district. Should there be a reduction in the availability of suitable local stock such that the success of the rehabilitation may be affected NOC will discuss the possibility of extending the range of acceptable seed sources with the EPA.

Species selection will be based on the species composition of the analogue site discussed in Section 6.0. Appendix 1 lists the species that may be used for planting in the NE rehabilitation area. This list has been developed from a survey of the adjacent RE area undertaken by an independent local expert in May 2004.

3.2 Ground Preparation

Tree planting will be restricted to areas with grades suitable for the safe operation of machinery as deemed by New Oakleigh Mine's Production Superintendent.

Appropriate ground preparation is considered one of the keys to successful Native Ecosystem rehabilitation. The two primary elements to be addressed in ground preparation are the removal of grass and weeds and the physical preparation of the soil prior to planting.

Weed and grass removal from areas to be planted will be undertaken through slashing or poisoning or a combination of both. This is to be undertaken well prior to planting activities and is essential to minimise competition for growth resources and to maximise soil moisture conditions for the newly establishing tree species (see also Section 3.5).

Physical ground preparation will involve mechanical ripping to improve water infiltration and minimise mechanical impedance to root growth. Generally this will consist of tandem deep ripping to a depth of 600-900mm with a spacing of 500-1000mm. Other forms of ripping may also be applied and the success or otherwise of any variations in technique will be monitored.

Rip lines will be contoured at a ratio of no more than 1:40 or 1.5 degrees to minimise the potential for erosion. Slashing will be conducted immediately prior to ripping and a herbicide (e.g. Gyphosate 360) will be applied along rip lines to a minimum width of 1.5m immediately after ripping. Mulch will be applied to the rip lines to help stabilize the soil, reduce water loss and impede weed growth.

3.3 Planting

NOC has extensive experience in tree propagation and planting. From this experience it is considered that the single most important factor in determining the success or otherwise of

a particular planting episode is the level of soil moisture at the time of planting. While late Spring-early Summer and late Summer-early Autumn are the targeted planting periods the specific decision to plant within each of these periods will be determined by the soil moisture level within the subject area. An additional consideration to be taken into account in the decision as to whether to plant will be the potential for follow-up rain in the period immediately after planting.

Planting will only be conducted when optimum soil moisture is available.

Planting will generally be carried out using specialized planting implements such as Hamilton tree planters. An initial application of a general fertiliser (e.g. Nutracote) will be made at the time of planting. Additionally, a wetting agent may also be applied to improve seedling survival and establishment rates.

Following Queensland Department of Primary Industries and Fisheries guidelines trees will be planted in rows separated by approximately 4m with 2.5m between trees to give an initial planting density of 1000 trees/hectare. This separation between rows will also enable easy access for maintenance equipment.

3.4 Water Requirements

It is intended that by ensuring appropriate preparation and only planting when suitable soil moisture levels are present there will be little need for ongoing watering of the rehabilitation. Should conditions deteriorate and supplementary watering becomes necessary to ensure the success of any particular planting episode then manual watering options will be investigated.

Conductivity of irrigation water should not exceed 500µS/cm. The use of water with higher conductivity levels will affect growth and mortality rates with the level of affect varying between plant species. While there are a number of water storages on-site, conductivity in the majority of them is above the desired level. An alternative water source would therefore be required should additional watering be necessary.

3.5 Follow-up Maintenance

Follow-up maintenance (i.e. weed and grass suppression) is critical to rehabilitation success.

The following weed suppression techniques will be employed:

- Periodic slashing and herbicide application will be undertaken post planting until such time as trees are considered sufficiently established to allow grazing access which will then be used as the weed and grass control measure.
- Grazing may be used to reduce competition from weed and grass species after the trees have reached a certain height where they themselves, will not be at risk from the grazing. As it is anticipated that the areas between each planting row will eventually be self-seeded grazing will be excluded entirely when the trees reach reproductive maturity.
- A weed eradication program will be developed and implemented on site to target potential sources of weed contamination (e.g.*Tipuana tipu*, Boxthorn, etc.).

It is expected that a monthly maintenance program involving slashing and spraying will be required in the first 12 months following planting. This schedule will likely be able to be reduced to a quarterly basis for the second and third years following planting and suspended altogether thereafter. The duration of the maintenance program will be influenced by the rate of tree and weed growth. Should poor weather conditions continue it is likely that tree growth will be reduced and that maintenance may be required for an extended period.

During this maintenance period it may also be necessary to carry out supplementary planting should survival rates of the initial plantings be reduced.

3.6 Fencing

Segregation of the rehabilitation area from existing and future grazing rehabilitation areas is of paramount importance to the success of re-establishing the Native Ecosystem land-use and is a commitment made by New Oakleigh Coal Pty Ltd at the Advisory Body Meetings for ML 50175. Newly planted seedlings are vulnerable to grazing pressure and grazing will therefore be excluded from areas of Native Ecosystem rehabilitation until such time as seedlings are sufficiently established to be able to withstand the presence of stock. Consideration will be given to the total exclusion of grazing from the rehabilitation area should it be deemed necessary.

The use of temporary fencing (either electric or otherwise) has proven to be ineffective in the past and is considered inadequate from a risk assessment perspective (i.e. based on the likelihood of failure of the temporary fencing and the potential consequences of unsuccessful rehabilitation). A more substantial fencing technique (such as 4 strand barbed wire) will be used in the future to ensure the NE rehabilitation areas are protected from grazing.

Areas not suitable for machinery access within the proposed corridor of native ecosystem rehabilitation (fenced area) will also be segregated from grazing to allow natural recruitment from adjoining areas.

4.0 Previous rehabilitation

NOC has been progressively rehabilitating areas as they have become available within the operational lands. Four different planting episodes have been undertaken since late 2001 with around 5000 trees planted over a total of approximately 5ha.

Different planting techniques have been trialled and the techniques outlined in Section 3.0 are based on the results of these early trials.

Figure 4-1 shows the location of the existing NE rehabilitation areas with the details of each area presented in Table 4-1.

Figure 4-1 Existing NE rehabilitation areas as at October 2006

Table 4-1 Details of existing rehabilitation areas

Plot	Initial planting	Approx Area (ha)	Number of trees
A	Dec 01	1	880
B	May & July 05	1.2	2300
C	Mid 02	1	1000
D	Oct &Nov 05	1.5	1000

Survival and growth rates in areas B, C and D have been affected by the drought conditions and it is likely that some supplementary planting will be required in these areas.

5.0 Future rehabilitation

Under the conditions of the current EA, NOC is required to rehabilitate 30ha of the Native Ecosystem land-use. Table 5-1 outlines the NOC's Native Ecosystem rehabilitation schedule. The duration of anticipated care and maintenance periods and potential maintenance and monitoring periods are also shown. A nominal period of 3 years care and maintenance and 5 years maintenance and monitoring has been used. However, it is noted that *the actual periods will depend upon the surrender requirements of the Environment Protection Agency (EPA) and can not be determined until rehabilitation criteria have been accepted.*

The schedule is based on two periods per year – February/March and September/October, when planting conditions are generally optimal. To manage the logistics of establishing the NE rehabilitation, the area has been separated into 5 plots as shown in Figure 5-1.

Table 5-1 Planting schedule and care/maintenance/monitoring periods

Area	Extent (ha)	Planting	Care and Maintenance	Maintenance and Monitoring
1	4.8	2001-2006	2007-2009	2010-2014
2	9.2	Feb/Mar 2007	2007-2009	2010-2014
3	4.0	Oct/Nov 2007	2008-2010	2011-2015
4	2.2	Oct/Nov 2007	2008-2010	2011-2015
5	9.8	Feb/Mar 2008	2008-2010	2011-2015

The goal of having the entire area planted by the end of 2008 has been developed on the basis that the mining lease can not be surrendered until the rehabilitation has reached a stage considered acceptable to the EPA and the understanding that there is likely to be a considerable interval between initial planting and acceptable rehabilitation. It is acknowledged that the achievement of this goal may be influenced by factors outside NOC's control, in particular with regard to climatic conditions. As outlined in Section 3.3, planting will not be carried out unless suitable conditions exist. For example, the 2006 planting program was reduced due to drought conditions and poor soil moisture and focussed on supplementing existing plots and minor additional plantings in an area of approximately 1ha.

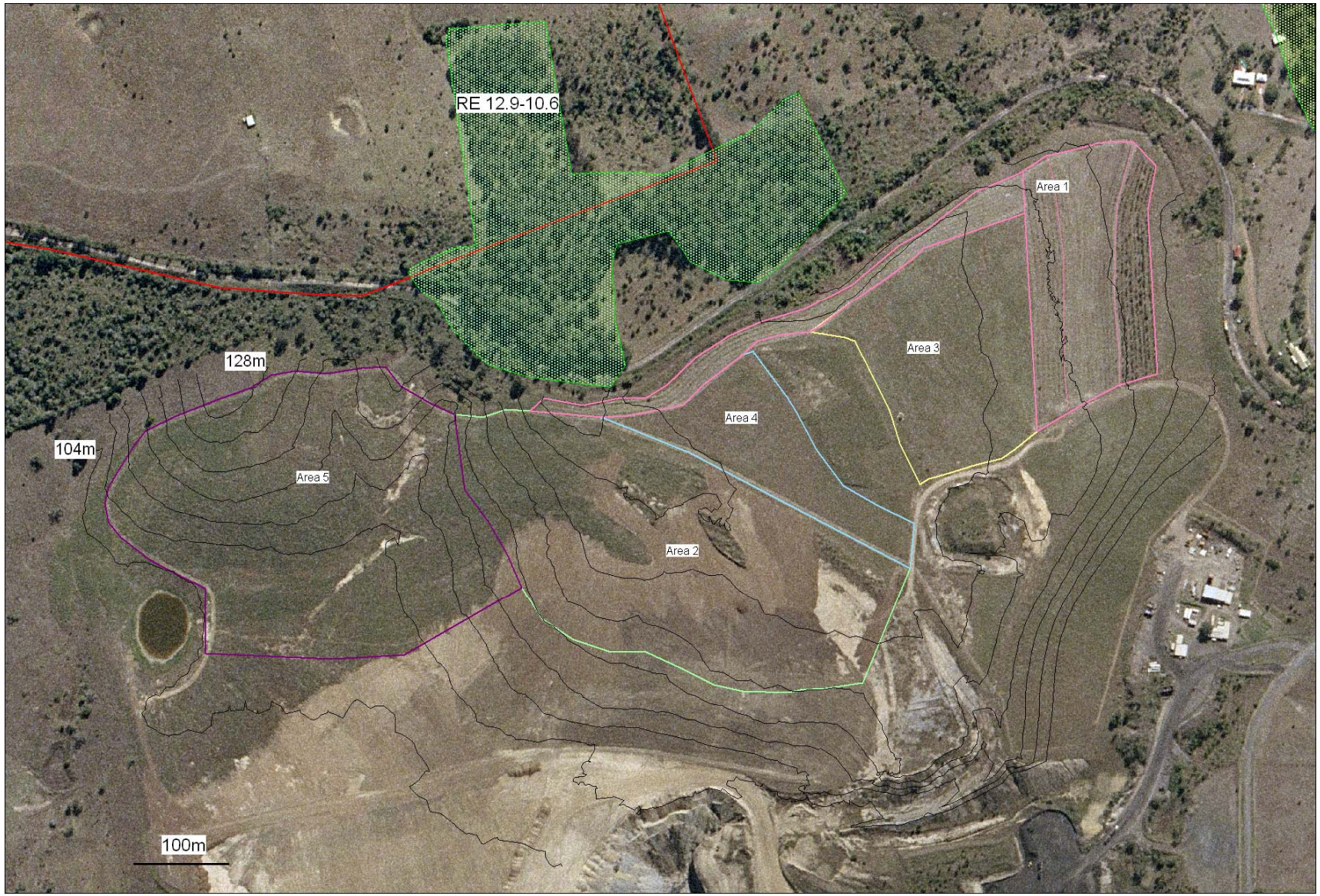

Figure 5-1 Proposed NE planting areas

6.0 Rehabilitation Acceptance Criteria

Schedule F3-2 of the current Environmental Authority requires NOC to conduct an investigation into the rehabilitation of disturbed areas and to submit a report to the administering authority proposing acceptance criteria to meet the Native Ecosystem post-mining landuse outcome.

In 2005 NOC submitted a report prepared by environmental consultancy, BTEQ, to the EPA proposing the following criteria against which the NE rehabilitation would be assessed:

- FPC (canopy cover) of rehabilitation sites averages within +/- 10% of the analogue site.
- FPC (midstorey cover) of rehabilitation sites averages within +/- 10% of the analogue site
- Species diversity on the rehabilitation sites to be on average within +/- 20% of the analogue site.
- Erosion rates of the rehabilitation areas, as determined by the Revised Universal Soil Loss Equation (RUSLE) (Renard *et. al*. 1994), to be within +/- 10% of the rates of the analogue site.

To date there has been no response from the EPA as to the suitability of the acceptance criteria. *Due to time constraints on the rehabilitation works, this rehabilitation plan has been developed on the assumption that the proposed criteria will be deemed acceptable.*

Monitoring of the rehabilitation areas against the criteria will be conducted once the rehabilitation has progressed to a suitable level. Monitoring will continue until such time as the criteria are met and the rehabilitation is judged to be complete.

The suggested analogue site is the adjoining remnant patch of Endangered Regional Ecosystem. As noted above, this Native Ecosystem Rehabilitation Plan has been developed on the assumption that the proposed analogue site will be acceptable to the EPA and details such as species selection have been developed and actions implemented based on this assumption.

7.0 Appendix 1 – Species list

This species list was developed from a flora survey of the Regional Ecosystem remnant patch adjoining the Native Ecosystem Rehabilitation Area, undertaken by Martin Bennett (consultant/local expert) on 12 May 2004. It has been supplemented with species known to occur in the immediate area and considered suitable for inclusion in the NE rehabilitation area. The list is not a complete species list for the patch as it only includes those species deemed suitable for planting (e.g. *Asparagus africans* is present in the RE but is an introduced species and is therefore not included in the list of species suitable for planting).

SCIENTIFIC NAME	**COMMON NAME**
Acacia fasciculifera	Rosewood wattle, Scaly bark
Acacia harpophylla	Brigalow
Acacia maidenii	Maiden's wattle
Acacia salicina	Sally wattle
Acalypha capillipes	Small leaved Acalypha
Acalypha eremorum	Acalypha
Alchornea ilicifolia	Native holly
Alectryon connatus	Grey's birds eye
Alectryon diversifolius	Scrub boonaree
Alstonia constricta	Bitter bark,Quinine tree
Alyxia ruscifolia	Chain fruit
Angophora floribunda	Rough barked apple
Aphananthe philippinensis	Rough leaved elm
Araucaria cunninghamii	Hoop pine
Atalaya salicifolia	Scrub whitewood
Auranticarpa rhombifolia	Hollywood, diamond holly
Austrosteenisia blackii	Blood vine
Baloghia inophylla	Scrub bloodwood
Brachychiton discolor	Lace bark
Brachychiton populneus	Kurrajong
Brachychiton rupestris	Bottle tree
Breynia oblongifolia	Coffee bush
Bridelia leichhardtii	Small leaved scrub ironbark
Bursaria incana	Prickly pine
Bursaria spinosa	Black thorn
Carissa ovata	Currant bush
Cassia brewsteri var. *tomentella*	Scrub cassia, velvet cassia
Casuarina glauca	Swamp oak
Celtis paniculata	Native elm
Cissus antarctica	Water vine
Citrus australis	Round lime
Claoxylon australe	Brittle wood
Cleistanthus cunninghamii	Omega
Corymbia tessellaris	Moreton bay ash
Croton acronychioides	Thick leaved croton
Croton stigmatosus	White croton
Cupaniopsis parvifolia	Small leaved tuckeroo

Elattostachys xylocarpa	Scrub beetroot
Erythrina sp.(Croftby P.I.Forster PIF6209	Pine Mt coral tree
Eucalyptus moluccana	Gum topped box
Eucalyptus tereticornis	Blue gum
Eustrephus latifolius	Wombat berry
Excoecaria dallachyana	Scrub poison tree
Ficus coronata	Creek sandpaper fig
Ficus fraseri	Sandpaper fig
Ficus macrophylla	Moreton bay fig
Ficus obliqua	Small leaved Moreton bay fig
Ficus opposita	Sandpaper fig
Ficus virens	Deciduous fig
Flindersia australis	Crow's ash
Flindersia collina	Leopard ash
Flindersia xanthoxyla	Yellow ash
Geitonoplesium cymosum	Scrambling lily
Grevillea robusta	Silky oak
Harpullia hillii	Blunt-leaved tulipwood
Harpullia pendula	Tulipwood
Hibiscus heterophyllus	Native rosella
Hymenosporum flavum	Native frangipani
Hypoestes floribunda	White karambal
Jagera pseudorhus	Foam bark, Fern top
Jasminum simplicifolium subsp.australiense	Stiff jasmine
Lophostemon suaveolens	Swamp box
Mallotus claoxyloides	Horny vine, burny vine
Mallotus philippensis	Green kamala
Maytenus bilocularis	Orange bark
Melaleuca bracteata	Black tea tree
Melia azedarach	White cedar
Myoporum montanum	Water bush, Boobialla
Olearia canescens	Daisy bush
Owenia venosa	Rose almond, red apple
Pavetta australiense	Butterfly bush
Pittosporum angustifolius	Mee-mee tree
Pittosporum revolutum	Hairy pittosporum
Pittosporum viscidum	Bird's nest bush
Plumbago zeylanica	Creeping Plumbago
Polyscias elegans	Celerywood
Rapanea variabilis	Muttonwood
Rhodosphaera rhodanthema	Deep yellow wood
Sarcomelicope simplicifolia	Bauerella
Senna acclinis	Scrub Senna
Senna coronilloides	Pepper leaf Senna
Senna gaudichaudii	Climbing Senna
Senna sulfurea	Scrub senna

Solanum aviculare	Kangaroo apple
Solanum stelligerum	Devil's needles
Sophora fraseri	Fraser's pea
Sterculia quadrifida	Peanut tree
Streblus brunonianus	Whalebone tree
Toona ciliata	Red cedar
Turraea pubescens	Witch hazel