Bronte Gully Ecological Restoration Action Plan

2015 – 2045

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INTRODUCTION

Encompassing a significant portion of Bronte Park, Bronte Gully occurs directly inland from Bronte Beach and is one of the largest areas of urban bushland in Sydney's Eastern Suburbs.

Bronte Gully ('the Gully') supports approximately 3.5ha of mixed native and exotic vegetation on the north and south-facing slopes surrounding Bronte Creek. The vegetation is bounded by residential Bronte to the north, west and south (including the historic Bronte House), and to the east by Bronte Park and Beach.

The original native vegetation that once occurred over Bronte Gully would have been a mixture of Coastal Heath and Scrubland vegetation on the upper slopes and more open areas to the east, with Wet Sclerophyll Forest / Gallery Rainforest vegetation present within the riparian zone of Bronte Creek (UBM 1993).

Bronte Creek remains a viable watercourse with a natural base flow and also serves to channel urban stormwater through an open concrete watercourse from the base of the waterfall to the western extent of the main grassed section of Bronte Park. From here it is directed to its discharge point at the northern end of Bronte Beach via underground pipes.

Land management practices over the past 100 years have resulted in the great majority of the remnant native bushland being lost from the Gully, with vegetation currently existing as native and exotic plantings (historic and recent), exotic weeds and restored / reconstructed native bushland communities.

Vegetation clearing and the introduction of large exotic trees to create a European-style park resulted in the loss of the majority of the native open forest vegetation on the gully slopes and the gallery-rainforest type riparian vegetation surrounding the creek.

Vegetation on the southern slopes, once part of Bronte House's "wild garden", supports a number of native species, some of which may have established from remnant soil-stored seed, and a range of exotic species, both invasive weeds and ornamental plantings.

Native species occur on the banks surrounding the waterfall at the head of the Gully, though the vegetation on the "yet to be restored" northern side dominated by invasive smothering ground cover and mid-storey species.

Further north of the waterfall between the gully floor and Murray Street a steep slope previously used as an unofficial tip site, supports a diverse suite of dense exotic vegetation growing on the unconsolidated fill and rubble. This diverse and heavily weed infested slope supports species such as Giant Reed (*Arundo donax*), Tree of Heaven (*Alianthus altissima*), Morning Glory (*Ipomoea indica*), Coral Trees (*Erythrina x sykesii*), Black Locust (*Robinia pseudoacacia*), Climbing Asparagus (*Asparagus plumosus*) and Trad (*Tradescantia fluminensis*).

The northern gully slope is dissected by an informal walking track running east-west from the end of Hewlett Street to the recently undertaken terracing and revegetation works. Above the track a number of native tree plantings have grown to maturity, however the shrub and ground cover layers are dominated by dense exotic species infestations. Below the walking track the vegetation is dominated by large mature Coral Trees (*Erythrina x sykesii*) over an exotic groundcover of shade tolerant herbs.

Along the eastern most section of the northern gully slopes approximately 0.5ha of restored native vegetation exists as a result of ongoing bush regeneration works undertaken by the local Bronte Bushcare group over the last 15 years. This restoration work, augmented by Waverley Council funded revegetation and weed control projects, has resulted in vast improvements in ecological heath and serves as an example and benchmark for what can be achieved within Bronte Gully.

Bronte Gully provides a large habitat resource for a wide range of native fauna species as both a temporary refuge for transient bird species and a permanent home for native frogs, reptiles and small to medium sized birds and mammals.

Ecological restoration of Bronte Gully will increase the quality of the habitat availability for native fauna and attract more species into the area. It will restore and increase the occurrence of a locally uncommon natural resource; healthy native vegetation in the Eastern Suburbs. It will provide higher quality passive recreation and educational opportunities for the local community and those visiting the area, greatly increase the visual amenity of the area and reduce a major source of exotic weed seed spreading into surrounding remnant native bushland patches, under threat of being permanently lost.

Bronte Park 1943. Sand dunes present in the east and north of the Gully, with Bronte House's "Wild Garden" observable through the centre of the Park.

Bronte Park 2014. Heavily vegetated gully illustrating Bushcare areas where sand dunes previously existed. Also evident is recent terracing and revegetation project undertaken by Council

Restored native vegetation on the northern gully slopes. Previous and ongoing restoration works undertaken by Bronte Bushcare Group and Professional Bush Regeneration Contractors.

GOALS & OBJECTIVES

1) Staged restoration of Bronte Gully bushland to a stable and self-sustaining ecosystem characteristic of the original native vegetation communities once present on the site.

2) Improve habitats for, and increase diversity and abundance of, native flora and fauna species.

3) Restoration of the northern bank surrounding the waterfall to more natural conditions complementing works undertaken on the southern bank.

4) Construct a formal walking track from the northern waterfall bank at mid-slope level through to the western end of Bayview Street.

5) Staged removal of Coral Trees (totalling 120-150) on the gully slopes and floor to increase public safety (trees are notorious for dropping limbs), enhance channel stability in Bronte Creek and increase native biodiversity values.

6) Stabilisation and consolidation of fill slopes through removal of surface rubble and fill, installation of slope stability measures and establishment of a dense native vegetation.

7) Increase public awareness and support of the long-term restoration goals at Bronte Gully, with an aim of increasing volunteer Bushcare participation. Erection of interpretative signage across the gully from the outset of restoration works will increase public awareness of the project and the gully's biodiversity values.

8) Create opportunities for community and corporate revegetation projects within the eastern end of the Gully bordering Bronte Park.

9) Allocation of recurrent, long-term funding and resources to undertake ongoing bush regeneration and ecological restoration works as outlined within this Ecological Restoration Action Plan from 2014 to 2037

   a) Sourcing of funding from Waverley Council annual budgets, State and Federal Government, and NGO grant programmes to implement restoration works and other assisted activities, engage professional contractors and train Council Staff.

   b) It should be ensured that those persons undertaking ongoing maintenance works be appropriately trained and experience in bush regeneration / native vegetation management techniques (ie. Council Staff, Bushcare Volunteers or Professional Contractors).

Leucopogon ericoides

Banksia serrata

Calochlaena dubia

NATIVE PLANT COMMUNITIES

The major goal of this Ecological Restoration Action Plan (ERAP) is to re-establish native species within the bushland currently dominated by invasive exotic weeds. This Plan outlines a staged and methodical programme of weed removal, bush regeneration, substrate stabilisation, rock armouring and revegetation utilising both manual and mechanical means in order to achieve this.

The target of the programme of works is to restore the Gully's bushland to a more natural condition characterised by species once present in the area. As outlined above it is accepted that Coastal Heath and Scrubland, and Wet Sclerophyll Forest / Littoral Rainforest were the overarching remnant vegetation types within the Gully.

Recent studies by the NSW Office of Environment and Heritage – OEH (formerly Dept. of Environment, Climate Change and Water – DECCW) have mapped and described vegetation communities across the Sydney Metropolitan Area and can be used as a basis to describe the vegetation originally present within Bronte Gully and the surrounding area.

Remnant vegetation across Sydney's Eastern Suburbs is generally uncommon and occurs mainly in small isolated patches, with Waverley supporting only 6ha (approx.) over the entire Council Area. Using the remnant vegetation maps published by OEH in the Native Vegetation of the Sydney Metropolitan Area project (OEH 2013) the following communities were found to occur in areas with similar geographical, topographical and microclimatic conditions to Bronte Gully;

- *Coastal Sandstone Foreshore Forest* – found in Parsley Bay Reserve, Cooper Park, Thomas Hogan Reserve and Tamarama Park.
- *Coastal Sand Apple-Bloodwood Forest* – found in Pioneers Park and La Perouse Headland (Botany Bay NP).
- *Coastal Sandplain Heath* (a component of Eastern Suburbs Banksia Scrub) – found at Randwick Environmental Park, Pioneers Park and Malabar Headland.
- *Coastal Dune Littoral Rainforest* – found on the shores of Botany Bay and on the coastline in the Royal National Park.

Restoration and revegetation works will focus on creating an ecotone of the above listed communities and where necessary include characteristic species of similar communities to incorporate aspects specific to the site's ecological conditions.

Coastal Sandstone Foreshore Forest and Coastal Sand Apple Bloodwood Forest are dry sclerophyll communities found on sand dunes and sheltered sandstone slopes along the Sydney Coastline, like those currently and historically found within Bronte Gully.

Both communities are open forests in structure with a mix of dry and moist shrub and groundcover species such as Old Man Banksia (*Banksia serrata)*, Blueberry Ash (*Elaeocarpus reticulatis*), Sweet Pittosporum (*Pittosporum undulatum*) Black She-oak (*Allocasuarina littoralis*), Paroo Lily (*Dianella caerulea*), Bracken Fern (*Pteridium esculentum*), Matt-rush (*Lomandra longifolia*), Blady Grass (*Imperata cylindrica*) and Kangaroo Grass (*Themeda australis*). Canopy species common to both communities include Smoothed-Bark Apple (*Angophora costata*), Bangalay (*Eucalyptus botryoides*) and Sydney Peppermint (*Eucalyptus piperita*) (OEH 2013).

These communities would have naturally occurred on the upper and mid-slopes of Bronte Gully and hence will be the target communities for restoration works undertaken on the western and northern gully slopes. Species recommended for revegetation works in these areas are outlined on the Upper-Mid Slope Species list in Appendix A of this Plan.

Coastal Sandplain Heath is an open to dense shrubby community found on large, deep Quaternary sand dunes along the New South Wales Coast. Such sand dunes would have been extensive between Botany and Woollahra, however are now highly modified and urbanised with the remaining vegetation highly disturbed (as is the case at Bronte Gully). Remnant Coastal Sandplain Heath in the Botany and Woollahra area is considered a component of Eastern Suburbs Banksia Scrub, a State and Federally listed threatened ecological community (OEH 2013).

Characteristic species include Old Man Banksia (*Banksia serrata*), Scrub she-oak (*Allocasuraina distyla*), Coastal Tea-tree (*Leptospermum laevigatum*), Pink Beard-heath (*Leucopogon ericoides*), Slender Rice Flower (*Pimelea linifolia*), Finger Hakea (*Hakea dactyloides*), Pale Mat-rush (*Lomandra gluaca*) and Wiry Panic (*Entolasia stricta*) (OEH 2013).

Heath vegetation would have originally occurred on the more exposed upper slopes surrounding the gully and further east towards Bronte Beach and the Nelson Bay Headlands, hence revegetation works will aim to create a community similar in structure and species composition on the upper and eastern gully slopes. Species recommended for revegetation works in these areas are outlined on the Upper Slope Species list in Appendix A of this Plan.

It should be noted that restoration works outlined within this Plan will not result in the recreation of Eastern Suburbs Banksia Scrub at Bronte Gully. Revegetated plant communities cannot be considered to conform to State and Federally listed Endangered Ecological Communities (EECs) like ESBS.

Coastal Dune Littoral Rainforest is a closed canopy dominated by tuckeroo (*Cupaniopsis anacardioides*) and a sandy substrate helps differentiate this littoral rainforest from others found in the Sydney area. This community forms a low closed canopy of rainforest trees with an occasional emergent eucalypt, casuarina, banksia or paperbark. It is situated on recent sand deposits, typically in swales or depressions on low-lying sheltered hind dunes less than 10 metres in elevation. Many tree species are shared with other littoral rainforest communities, including lilly pilly (*Acmena smithii*) and cheese tree (*Glochidion ferdinandi*).

Bronte Gully's geographical and microclimatic conditions may have prevented the original remnant vegetation on the lower slopes and gully floor from comprising of a littoral rainforest, however current conditions of increased shading and nutrient load tend towards a rainforest community as being the most suitable vegetation assemblage to be reconstructed.

Original vegetation may have existed as communities more closely aligned with wet sclerophyll forests common in coastal sandstone gullies across the Sydney area (ie. *Coastal Enriched Sandstone Moist Forest* and *Coastal Sand Littoral Forest*). As a result elements of these communities will be incorporated into the revegetation of Bronte Gully's lower and southern slopes. Species recommended for revegetation works in these areas are outlined on the Lower-Mid Slope Species list in Appendix A of this Plan.

Community Profiles form the OEH vegetation mapping project (OEH 2013) contain more exhaustive lists of species characteristic to the above communities and have been included within the Appendices of this Plan. These lists have formed the basis for species recommended to be planted within the various zones as outlined below.

Information on the vegetation communities, native flora species and characteristics of the restored bushland are to be displayed on signage within Bronte Gully and on Council's website.

ECOLOGICAL RESTORATION – WORKS STAGING

Staging and prioritisation of the vegetation management works outlined within this ERAP has been based on best practice principles of ecological restoration. The following factors were considered for all management zones when determining the sequence of the restoration works contained in this Plan:

- The presence of remnant native vegetation;
- The natural resilience of each area;
- The level of exotic species infestation; and
- Previous management activities and the level of prior resource input.

Initial priorities were based on protecting areas of native vegetation where either exotic species abundance was relatively low, or some level of natural resilience was assessed as present, so as to prevent further ecological degradation.

Higher priority was also given to those areas where previous vegetation management activities had been undertaken in order to consolidate and build on previous improvements in ecological condition.

Ongoing staging then generally followed the accepted pattern of working from areas of higher ecological condition towards degraded and disturbed areas where exotic species dominate the vegetation.

The timeline has been based on a staged plan (ie. Stage 1, 2, 3, etc.) to ensure that ongoing availability of resources does not have the effect of making the Plan outdated, should sufficient funds not be available to commence works on the next stage earmarked for restoration. Minimum commencement dates have been provided for each new work stage based on the level of maintenance required to ensure successful completion of previous works.

Exotic species density and resilience assessments were made for all management zones during the development stage of his Plan. Maps illustrating the 2014 findings of these assessments are presented in Appendix C of this ERAP.

WHS and Site Safety: It is to be ensured that for work on steep gully slopes, where the ground is often unstable, bush regeneration contractors, staff, and bushcare volunteers are to prepare a risk assessment for works and liaise with Council's Safety Officer to ensure that safe work practices are implemented in all situations.

Coastal Sandstone Foreshore Forest (OEH 2013)

Coastal Sand Apple Bloodwood Forest (OEH 2013)

Coastal Sandplain Heath (OEH 2013)

Coastal Dune Littoral Rainforest (OEH 2013)

BRONTE GULLY ECOLOGICAL RESTORATION ACTION PLAN - MANAGEMENT ZONES

Restoration Actions: Stages 01 and 02

Stage 01 – From commencement of Action Plan

- **Zone 1a: Restoration of creek bank Above Waterfall to complement works completed on adjacent bank**
  - Works undertaken in two sub-zones; Above Waterfall and Below Waterfall, due to the higher abundance of desirable native vegetation in the upper area. Delineate Zone 1a / Zone 1b boundary by installation of post and wire sediment fencing.
  - Consider creation of alternative habitat for fauna pre-clearance.
  - Undertake methodical bush regeneration approach to weed removal works on banks Above Waterfall.
  - Undertake secondary weed control, revegetate (4 plants/m^2) and maintain for 12 months.
  - Species to be selected from Lower-Mid Slope Species List (Appendix A)

**JK Geotechnics produced a Report on the stormwater and geotechnical issues impacting the slopes of Bronte Gully. A major finding of their Report (relating to this ERAP) was that it appears that the stepped walkway leading down from Murray Street provides a concentrated flow path for surface water run-off which subsequently discharges over the downslope (eastern) side of the path onto the hill slope above the crib wall. Such concentrated flows, if not suitably controlled by surface drainage features, have the potential to cause extensive erosion of soil from the near surface of the slope and wash-out retaining wall backfill materials (JK Geotechnics 2014).*
JK Geotechnics' recommendations for site remediation include; 1) Control of surface water run-off; 2) Underpinning eastern side of Landing No.2, including eastern end of retaining wall lining northern side of Landing No. 2; 3) Strengthen and reconstruct retaining walls lining northern side of Landing No. 2; 4) Continued bush regeneration across gully slopes; 5) Maintenance of creek walls and backfill materials; 6) Ongoing periodic monitoring of site.
Works proposed above for Zone 1a (and future Zone 2 & 3 works) will fulfil part of the above remediation actions. Council is obliged to implement the remaining remediation actions and will require the engagement of Stormwater / Geotechnical Engineer / Designer to ensure issues are appropriately and comprehensively addressed. The principles of Water Sustainable Urban Designs (WSUD) should be considered to augment and protect the vegetation management actions, and reduce urban run-off in bushland areas.

- **Zone 4: Dense revegetation, following treatment of re-emerging / newly established exotic vegetation**
  - Regular secondary weed control visits from the outset of this ERAP.
  - Installation of "Forestry-Tube" or "Hiko" sized tubestock at 4-6 plants/m^2 across entire terraced area.
  - Species to be selected from Upper-Mid Slope Species List (Appendix A)
  - Planting's survivorship at no less than 80% at 12 months from installation, and ongoing to completion of vegetation management works.
  - Weed species FPC at no more than 5% at 12 months from installation, and ongoing to completion of vegetation management works.
  - Bush regeneration maintenance works as required.

Stage 01 & Ongoing – From commencement of Action Plan

- **Coral Tree removal: Approximately 10 to be removed each year.**
  - Remove trees within Zones 9a and 10 (approx. 6-8)
  - Removal of 10-12 trees closest to public areas and those damaging Bronte Creek waterway
  - Replace Coral Trees removed from within Bronte Park with 400L advanced trees from species such as; Smooth-barked Apple (*Angophora costata*), Red Bloodwood (*Corymbia gummifera*), Blueberry Ash (*Elaeocarpus reticulatus*), Scribbly Gum (*Eucalyptus haemastoma*), Sydney Peppermint (*Eucalyptus piperita*) or Turpentine (*Syncarpia glomulifera*).

- **Additional ongoing bush regeneration / ecological restoration works**
  - Commence sourcing and growth of revegetation and reforestation tubestock for upcoming works, species to be selected from appropriate species lists (Appendix A)
  - Continue bushcare maintenance works within Zones 10
  - Yearly targeted treatments of Pampas Lily-of-the-Valley (*Salpichroa origanifolia*) within Zones 6abc, 7abc, 8ab & 9bc to prevent establishment of the species due to encroachment form heavily infested upper slopes
  - Yearly targeted treatment of Madeira Vine (*Anredera cordifolia*) within Zones 1b, 2, 3, 5, 6abc, 7abc, 8ab & 9bc, and where it occurs with Coral Trees to be removed
  - Promote Zone 12a as Corporate / School opportunity for tree planting, set-aside resources to terrace and revegetate slope as opportunities arise
  - Undertake 12 month maintenance contracts with Professional Bush Regeneration Contractors, or appropriately Trained Council Staff where necessary to ensure the ongoing success of bush regeneration works across the Work Zones
  - Restoration works (except Coral Tree removal) within Zones 11a,b,c and 12a,b have not been detailed within this Plan as they are expected to be undertaken by Waverley Council Parks Staff as resources become available

Stage 02 – Following 12 Months of Maintenance Work in Zones 1 & 4

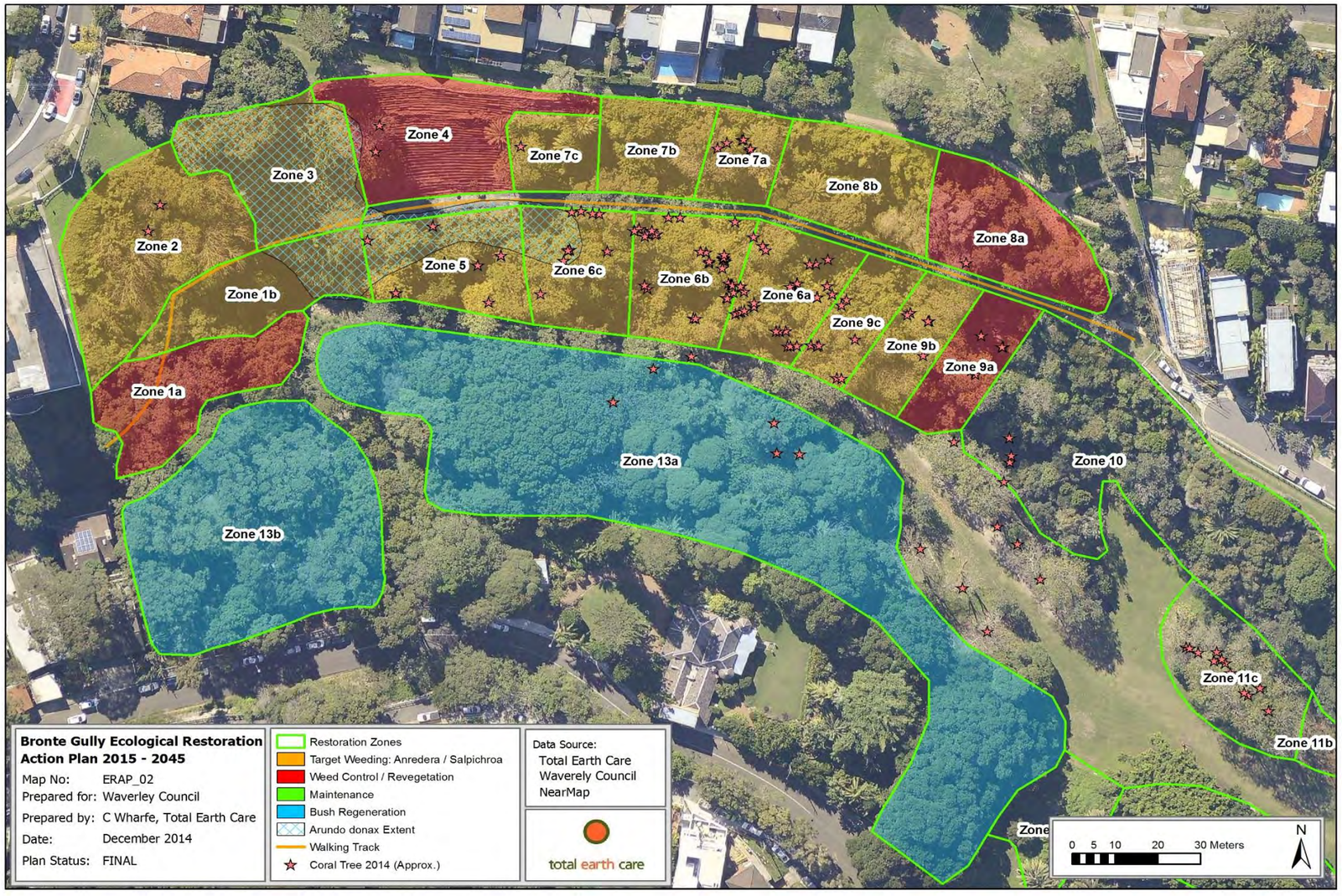
- **Zone 9a: Bush Regeneration and Revegetation Project**
  - Remove all Coral Trees within Zones 9a and10. Most appropriate method likely via crane from mid slope track.
  - Undertake primary weed control, slope stabilisation, secondary weed control, revegetation (4 plants/m^2), watering / planting maintenance
  - Revegetation species to be selected from Lower-Mid Slope Species Lists (to be installed lower downslope) and Upper-Mid Slope Species Lists (to be installed higher upslope) (Appendix A).
  - Professional Bush Regeneration Company engaged for; 6 month primary/secondary/revegetation period, 24-60 month maintenance period

- **Zone 8a: Bush Regeneration & Revegetation Project**
  - Remove poisoned Spotted Gums and other non-indigenous / exotic tress and those deemed unwanted/invasive ie. Phoenix Palms etc.
  - Undertake primary weed control, slope stabilisation, mulch installation, secondary weed control, revegetation (4 plants/m^2), watering / planting maintenance
  - Revegetation species to be selected from Upper Slope Species Lists (Appendix A)
  - Professional Bush Regeneration Company engaged for; 6 month primary/secondary/revegetation period, 24-60 month maintenance period

- **Zone 13a&b: 12 month Bush Regeneration contract for maintenance works**
  - 12 month contract with professional Bush Regeneration Company for bush regeneration works / targeted weed removal in 13b and bush regeneration maintenance works within 13a.
  - Large nature Camphor Laurel trees are to be retained in 13a area due to their value as a habitat resource, their historic value and intrinsic value to park users.
  - Juvenile Camphor Laurel specimens are to be removed due to their invasive nature. Care should be taken not to poison suckers, potentially damaging adjacent mature trees.

- **Zone 1a: 12-24 month Bush Regeneration contract for maintenance works**
  - 12-24 month contract with professional Bush Regeneration Company for continuation of bush regeneration works in Zone 1a.

- **Coral Tree removal**
  - Removal of 10-12 trees closest to public areas and those damaging Bronte Creek waterway




Bronte waterfall c. 2011


Bronte waterfall during reshab works


Creek bank rock-work

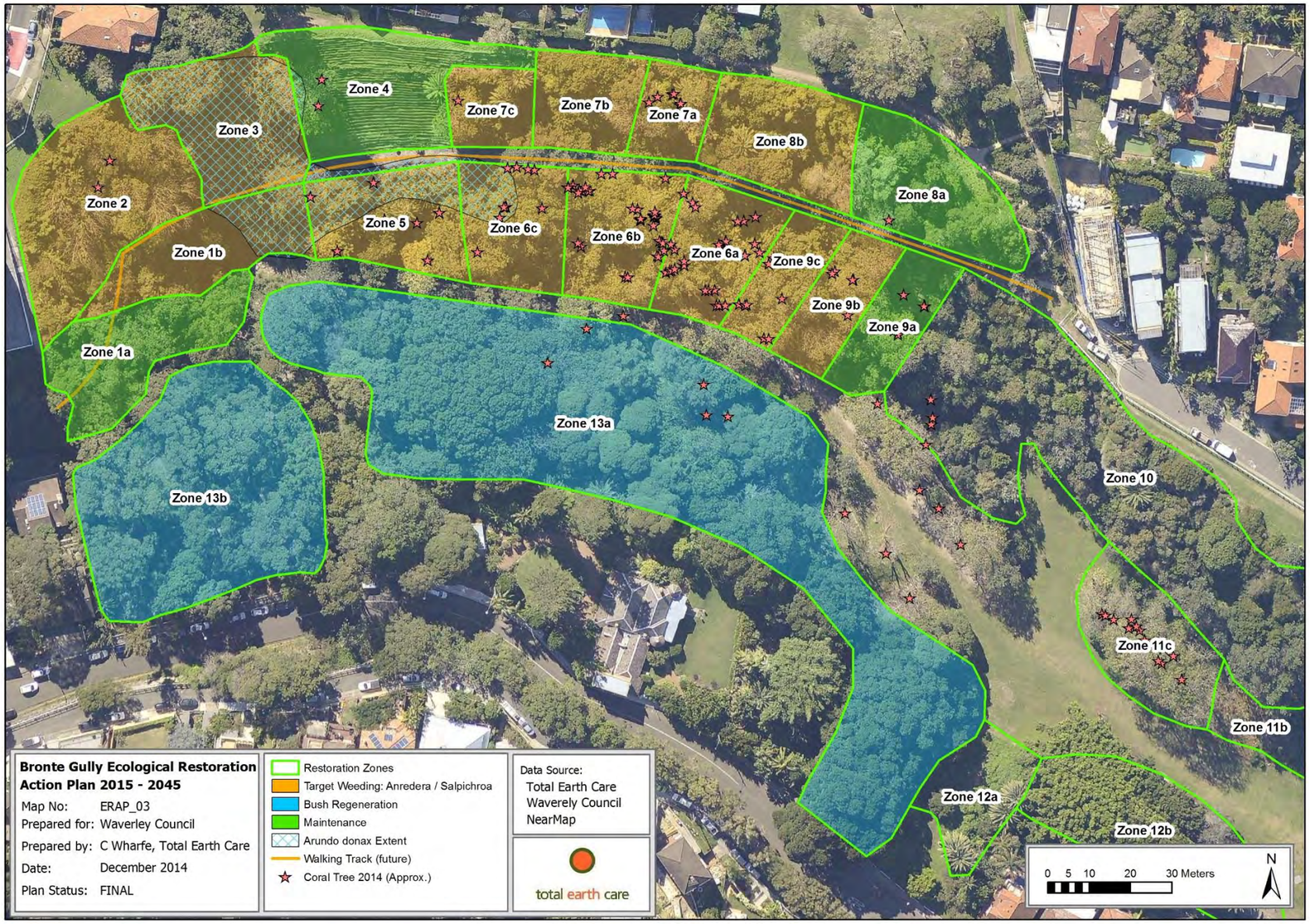

Degraded creek bank


Restored creek bank w/ coir logs


Creek bank rock-work


Bronte waterfall August 2014

Restoration Actions: Stages 03 and 04



Stage 03 – Following at least 12 Months of Maintenance Work in Zones 8a & 9a

- **Zones 8a & 9a: 12 month Bush Regeneration contract for maintenance works**
  - 12 month contract with professional Bush Regeneration Company for continuation of bush regeneration works in Zones 8a & 9a.
- **Zone 13a&b: 12 month Bush Regeneration contract for maintenance works**
  - 12 month contract with professional Bush Regeneration Company for bush regeneration works within 13a&b.
  - Undertake supplementary revegetation works if areas are left bare following weed removal. Species should be shade tolerant and selected from the Lower-Mid Slope Species Lists (Appendix A)
- **Coral Tree removal**
  - Removal of ~5 trees closet to public areas (Zone 11c) and replacement where necessary as outlined for Years 1 & 2 above, AND
  - Removal of ~5 tress within Zones 3/4 and 13a
- **Zone 06: Commence restoration works**
  - Commence ongoing yearly targeted treatment of exotic species within Zone 6, with the exception of Trad (*Tradescantia fluminensis*). An understorey monoculture of Trad is desired to facilitate reforestation works across Zone 6 as a less complex / diverse weed infestation is more manageable during future scheduled works.

Stage 04 – Following Maintenance Work as Outlined for Stage 03

- **Zones 8a & 9a: 12 month Bush Regeneration contract for maintenance works**
  - 12 month contract with professional Bush Regeneration Company for continuation of bush regeneration works in Zones 8a & 9a.
- **Coral Tree removal**
  - Removal of ~5 trees within Zone 5 (as outlined above), AND
  - Removal of ~5 tress across Zones 7a, 9bc, 11c
  - Options for removal include crane from informal walking track or excavator lift over Bronte Creek in sections and into chipper.

Case Study: Fred Hollows Reserve, Coogee

Fred Hollows Reserve is an approximately 2ha Reserve running north-south along the length of Glebe Gully from Allison Road in Coogee to Bligh Place, Clovelly.

The Gully supports facets of remnant rainforest vegetation which overtime was severely degraded by exotic species infestations, uncontained stormwater, and urban dumping and run-off as a result of surrounding development.

Similarities can be drawn between Fred Hollows Reserve (Glebe Gully) and Bronte Gully which faces similar pressure which have led to degradation of the native vegetation. The head of Glebe Gully was heavily infested with exotic species including Coral Trees, Lantana, Moring Glory and Wandering Trad on the steep slopes above a stormwater entry point feeding the creek at the gully floor.

Randwick City Council have invested significant resources into the restoration of this valuable patch of urban bushland since the early 2000's and the results have been very positive.

Heavily weed infested head of Glebe Gully c. 2002 looking north towards Bligh Place.

Dense stands of Coral Trees, thickets of Lantana and infestations of smothering Morning Glory vine have resulted in a very degraded ecosystem, supporting very little habitat for native flora and fauna

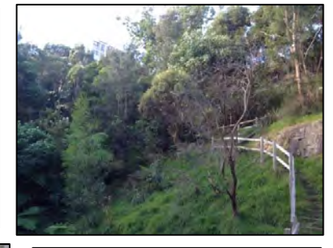
Heavily weed infested Gully wall, all available habitat occupied by Lantana, Giant Reed (*Arundo donax*), Coral Trees and Morning Glory. Large scale exotic vegetation removal works were undertaken using a combination of heavy machinery and manual labour, followed by reshaping and substrate stabilisation.

Following removal and successful treatment of exotic vegetation the upper gully slopes were stabilised via installation of jute mesh and coir logs in early 2003.

Native tubestock were then densely installed to help prevent surface erosion, and re-establish the desired native vegetation cover.

Fred Hollows Reserve 2014: Ten years of maintenance and supplementary planting works have successfully restored the native vegetation over the head of the gully.

Native species now dominate every vegetation strata and require incrementally less maintenance.



Fred Hollows Reserve 2014.

Ecological wins such as those seen as Fred Hollows Reserve are what this Ecological Restoration Action Plan is aiming to achieve at Bronte Gully.

Pics. 1 & 2 above courtesy of RCC

Restoration Actions: Stage 05

Stage 05 – Following Maintenance Work as Outlined for Stage 04

- **Zone 5: Coral Tree & Weed Removal and Revegetation**
  - Remove remaining Coral Trees within Zone 5; Options for removal include crane from walking track below Zone 4 or excavator lift over Bronte Creek in sections and into chipper. Ensure all vegetative debris collected and removed.
  - Remove *Arundo donax* using tritter, remove full extent of plants including those in adjacent Zone 6. Consider the need for fauna pre-clearance prior to any tritter work.
  - Ensure mechanical weed removal does not negatively impact on lower portion of Zone (adjacent to Bronte Creek) where pervious weed removal / management works have been successfully undertaken
  - Remove exotic understory vegetation utilising manual best practice bush regeneration methods, install erosion control / slope stabilisation measures, and revegetate with full suite of Rainforest / Wet Sclerophyll species as outlined on the Lower-Mid Slope Species List (Appendix A) at 4 plants/m^2.
  - Delineate Zone 1 / Zone 5 boundary by installation of post and wire sediment fencing.
  - Planting's survivorship at no less than 80% at 12 months from installation, and ongoing to completion of vegetation management works
  - Planting and weed control maintenance for 24-60 months from final installation of tubestock by professional Bush Regeneration Contractor

- **Zone 9b: Bush Regeneration and Revegetation Project**
  - Remove any remaining Coral Trees within Zone
  - Undertake primary weed control, slope stabilisation, secondary weed control, revegetation (4 plants/m^2), watering / planting maintenance
  - Revegetation species to be selected from Lower-Mid Slope Species Lists (to be installed lower downslope) and Upper-Mid Slope Species Lists (to be installed higher upslope) (Appendix A).
  - Professional Bush Regeneration Company engaged for; 6 month primary/secondary/revegetation period, 24-60 month maintenance period

- **Zone 7c: Bush Regeneration and Revegetation Project**
  - Remove non-indigenous and exotic trees and undertake primary weed control.
  - Stabilise slope using coir-logs and install jute mesh where required to prevent surface erosion. Install mulch for weed suppression. Undertake secondary weed control as required for up to 6 months to exhaust exotic soil stored seed
  - Dense revegetation following successful secondary weed control
  - Install plants at no less than 4 plants/m^2, species to be selected from the Upper-Mid Slope Species List (Appendix A)
  - Maintain plantings by watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance for 24-60 months from final installation of tubestock by professional Bush Regeneration Contractor
  - Planting's survivorship at no less than 80% at 12 months from installation

- **Coral Tree removal**
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones


Tritter mounted on independent wheel based excavator


Tritter head on 12t tracked excavator


Tritter attachment on posi-track

Tritters are an effective and dynamic piece of machinery whereby large areas of weed biomass can be successfully treated and removed efficiently whilst minimising damage to more sensitive plants and areas by utilising the correct machine base for the works. Desirable plants can be avoided/retained by using the mobility and reach of an excavator arm and substrates can be protected by using the independently mounted wheel-based machines.


Bronte Gully slope prior to works


Bronte Gully slope prior to works

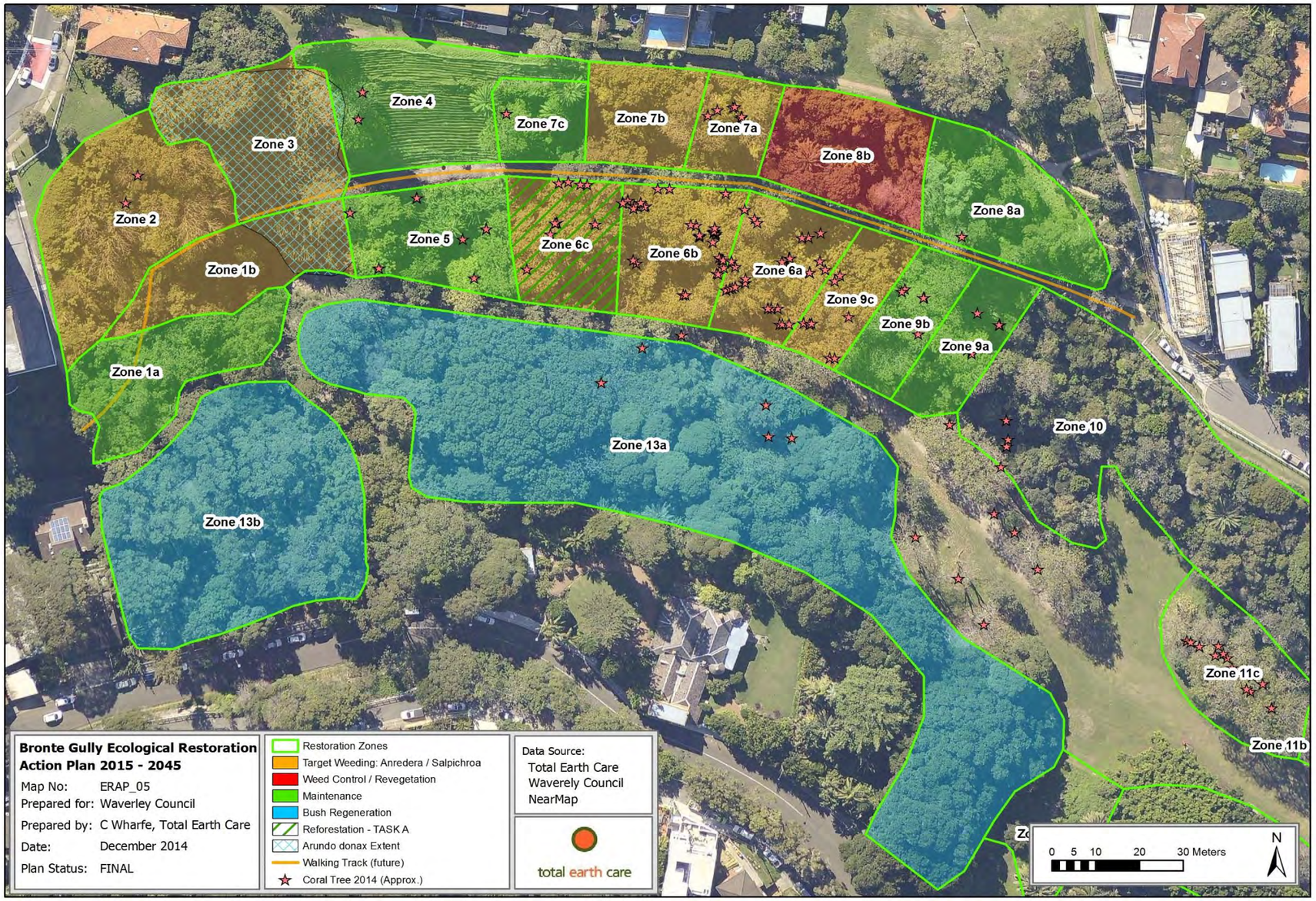

Tritter removing exotic vegetation


Slope stabilisation works


Mulching and reveg at top of slope


Zone 4 August 2014 following additional revegetation works

Restoration Actions: Stages 06 and 07



Stage 06 – Following at least 24 Months of Maintenance Work in Zones 5, 7c & 9b

- **Zone 6c: Commencement of Reforestation works – TASK A**
  - Concentrated weed control works within Zone 6c to achieve understorey monoculture of Trad, all shrub and vine weeds also successfully treated.
  - Install very dense shade tolerant Acacia, Casuarina and other fast growing shrubs/small tree species (as per Reforestation Species Lists – Appendix A) during early-mid autumn, when Coral trees start to defoliate.
  - Timing of planting is essential to allow tubestock maximum sunlight exposure during Coral Tree dormancy period.
  - Plantings installed at 6-8 plants/m^2, clearance of Trad required surrounding each plant. Consider using individual weed mats.
  - Maintain plantings via watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance through to TASK B works from final installation of tubestock by professional Bush Regeneration Contractor
  - Planting's survivorship at no less than 80% at 12 months from installation

- **Zone 13a&b: Bush Regeneration contract for weed control and revegetation**
  - 12 month contract with professional Bush Regeneration Company for bush regeneration works / targeted weed removal within 13a and maintenance weeding of 13b (if required).
  - Remove juvenile Camphor Laurel specimens. Care should be taken not to poison suckers, potentially damaging adjacent mature trees.
  - Undertake understorey revegetation in areas of 13a left bare following weed removal. Species should be shade tolerant and selected from the Lower-Mid Slope Species Lists (Appendix A)

Stage 06 – Cont'd

- **Coral Tree removal**
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones

Stage 07 – Following at least 24 Months of Maintenance Work in Zone 6c

- **Zone 8b: Bush Regeneration & Revegetation Project**
  - Remove non-indigenous / exotic tress
  - Undertake primary weed control, slope stabilisation, mulch installation, secondary weed control, revegetation (4 plants/m^2), watering / planting maintenance
  - Revegetation species to be selected from Upper Slope Species Lists (Appendix A)
  - Professional Bush Regeneration Company engaged for; 6 month primary/secondary/revegetation period, 24-60 month maintenance period

- **Coral Tree removal**
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones

Coral Tree Removal

Removal of Coral Trees across Bronte Gully is to be undertaken as a staged and methodical process using a range of techniques to ensure safe and effective removal of the large, fragile exotic trees.

Coral Trees are notorious for dropping branches (which can be very large) and this can often occur without warning and during times of calm weather. The tree's removal across Bronte Gully is as important for public safety as it is for ecological restoration.

Professional arboricultural contractors are to be engaged to remove the trees as per the programme outlined in this Plan. Exclusion zones should be set up surrounding trees to be removed where public safety is an issue. Heavy machinery (excavators and cranes) may be required to safely and efficiently move the felled / cut trees and limbs from where they stand into a chipper. All stumps are to be retained to provide stability to the soil and help prevent erosion on the gully slopes.

All Coral Tree stumps are to be treated with undiluted Glyphosate to ensure death of the roots and prevent the plants from re-shooting. Vegetative growth from all parts of Coral Trees is possible when left in contact with the soil. To prevent this ensure all sections of the trees are removed from site and disposed of. Re-use of chipped Coral Trees as mulch on site is not recommended due to this tendency for vegetative growth, unless effective solar sterilisation techniques (or similar) are diligently implemented prior to use.

Reforestation (Revegetation) to facilitate Weed Control

Zone 6 (and to a lesser extent Zones 5 & 9) supports the majority of the Coral Trees present at Bronte Gully. A staged and methodical approach is required to ensure successful removal of the invasive exotic trees and replacement with native vegetation.

Complete and simultaneous removal of the Coral Trees across this northern gully slope would result in near total removal of the forest canopy. Likely results would include increased weed issues below due to rapid increase in sun exposure, potential erosion issues, loss of habitat and loss of shade and greenery for the park users.

To minimise these and other potential issues, dense planting will be undertaken prior to Coral Tree removal. This will help ensure semi-mature trees and shrubs are established and providing shade, and stabilising the soil as the Coral Trees are taken out. A selection of fast growing, nitrogen fixing pioneer species (Acacias, Casuarinas etc.) will be planted during early autumn to allow for initial growth and establishment during the months when sunlight is more available to the forest floor due to Coral Tree dormancy and loss of foliage.

This approach is based on the theory that getting the upper strata species (trees and shrubs) established first will improve soil condition and lead to a better growth medium for native groundcovers, where they were previously disadvantaged by exotic species.

In order to facilitate establishment of native species and increase the likelihood of successful competition with exotic weeds, ongoing bush regeneration weed control is also required. During the establishment period of the canopy crop of plantings a reduction in weed diversity will be the main goal of weed control works. An understorey monoculture of Trad is an effective means of suppressing more invasive weeds that may compete with native plantings and reduce their likelihood of success. Trad is also relatively simple to eventually treat by rolling the thick mats and composting the debris in black plastic. Targeted control of all other weed species (excl. Trad) is to be undertaken to establish this monoculture. This process has been titled Reforestation TASK A within this ERAP.

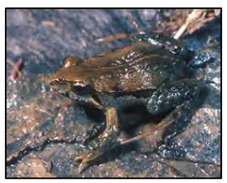
Following no less than 48 months of growth by the initial plantings, the Coral Trees within the Management Zones are to be removed. A crane or excavator may be required to remove the trees from the closest Zone boundary to help limit damage to reforestation plantings. Directional felling of trees away from reforestation plantings may be required to minimise damage to installed plantings.

Once Coral Trees have been removed full weed control and revegetation is to be undertaken beneath the newly established shrub/tree layer. If required, some of the dense canopy specimens may be selectively removed to provide space and light to encourage the growth of the new plantings. This secondary stage of plantings is to consist mainly of understory grass, herb, forb and climber species with occasional canopy species to grow out and over the initial Acacias and Casuarinas. Any plantings damaged by Coral Tree removal may require replacement. This process has been titled Reforestation TASK B within this ERAP.

This Reforestation process is to be undertaken in three (3) sections across Zone 6 (a, b & c) as outlined in the following sections of this Plan, and Coral trees are to be selectively removed in the same west to east direction.

Species to be installed during each stage of the reforestation process are outlined in Appendix A accompanying this Plan.

This process has been successfully implemented in a number of areas in Western Sydney (ie. surrounding Western Sydney Parklands) where large scale revegetation has resulted in eventual regeneration of native species from the soil seedbank. Natural regeneration is unlikely at Bronte Gully and hence the recommendation for re-planting of understorey species. The possibility remains however, and ongoing bush regeneration works may facilitate regeneration from soil stored seed or germination of future native seed rain and help to restore elements of the areas remnant vegetation



Restoration Actions: Stages 08 and 09

Stage 08 – Following at least 24 Months of Maintenance Work in Zone 8b

- **Coral Tree removal**
  - Removal all Coral Trees remaining within Zone 6c.
  - Crane or excavator to be used from closest Zone boundary (above or below). Care to be taken to limit damage to reforestation plantings.
  - Directional felling trees away from reforestation plantings may be required to minimise damage to installed plantings.
  - Coral Trees should be removed prior to installation of understorey plantings as outlined in Reforestation TASK B below.

- **Zone 6c : Reforestation – Task B**
  - Commence treatment of Trad monoculture beneath initial plantings at no less than 48 months from installation of plants, install mulch as required, and continue regular on-going weed control to exhaust exotic reproductive material in soil.
  - Undertake selective removal of cover crop shrubs/trees to increase light to new plantings and forest floor.
  - Planting of dense understorey and scattered canopy tubestock (as per Reforestation Species List) beneath initial plantings.
  - Maintain plantings via watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance for 18 months from final installation of tubestock by professional Bush Regeneration Contractor.
  - Planting's survivorship at no less than 80% at 12 months from installation
  - Make good any damage caused by removal of Coral Trees within the Zone ie. replant below any damaged plants.

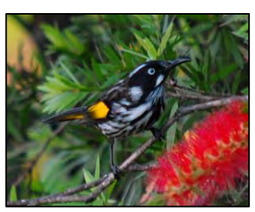
- **Zone 13a&b: Bush Regeneration contract for weed control and revegetation**
  - 12 month contract with professional Bush Regeneration Company for bush regeneration works / targeted weed removal within 13a and maintenance weeding of 13b (if required).
  - Remove juvenile Camphor Laurel specimens. Care should be taken not to poison suckers, potentially damaging adjacent mature trees.
  - Undertake understorey revegetation in areas of 13a left bare following weed removal. Species should be shade tolerant and selected from the Lower-Mid Slope Species Lists (Appendix A)

Stage 09 – Following at least 24 Months of Maintenance Work in Zones 6c, 13a & 13b

- **Zone 9c: Bush Regeneration and Revegetation Project**
  - Remove any remaining Coral Trees within Zone
  - Undertake primary weed control, slope stabilisation, secondary weed control, revegetation (4 plants/m^2), watering / planting maintenance
  - Revegetation species to be selected from Lower-Mid Slope Species Lists (to be installed lower downslope) and Upper-Mid Slope Species Lists (to be installed higher upslope) (Appendix A).
  - Professional Bush Regeneration Company engaged for; 6 month primary/secondary/revegetation period, 24-60 month maintenance period

- **Zones 6c: 12 month Bush Regeneration contract for maintenance works**
  - 12 month contract with professional Bush Regeneration Company for continuation of bush regeneration works in Zone 6c.

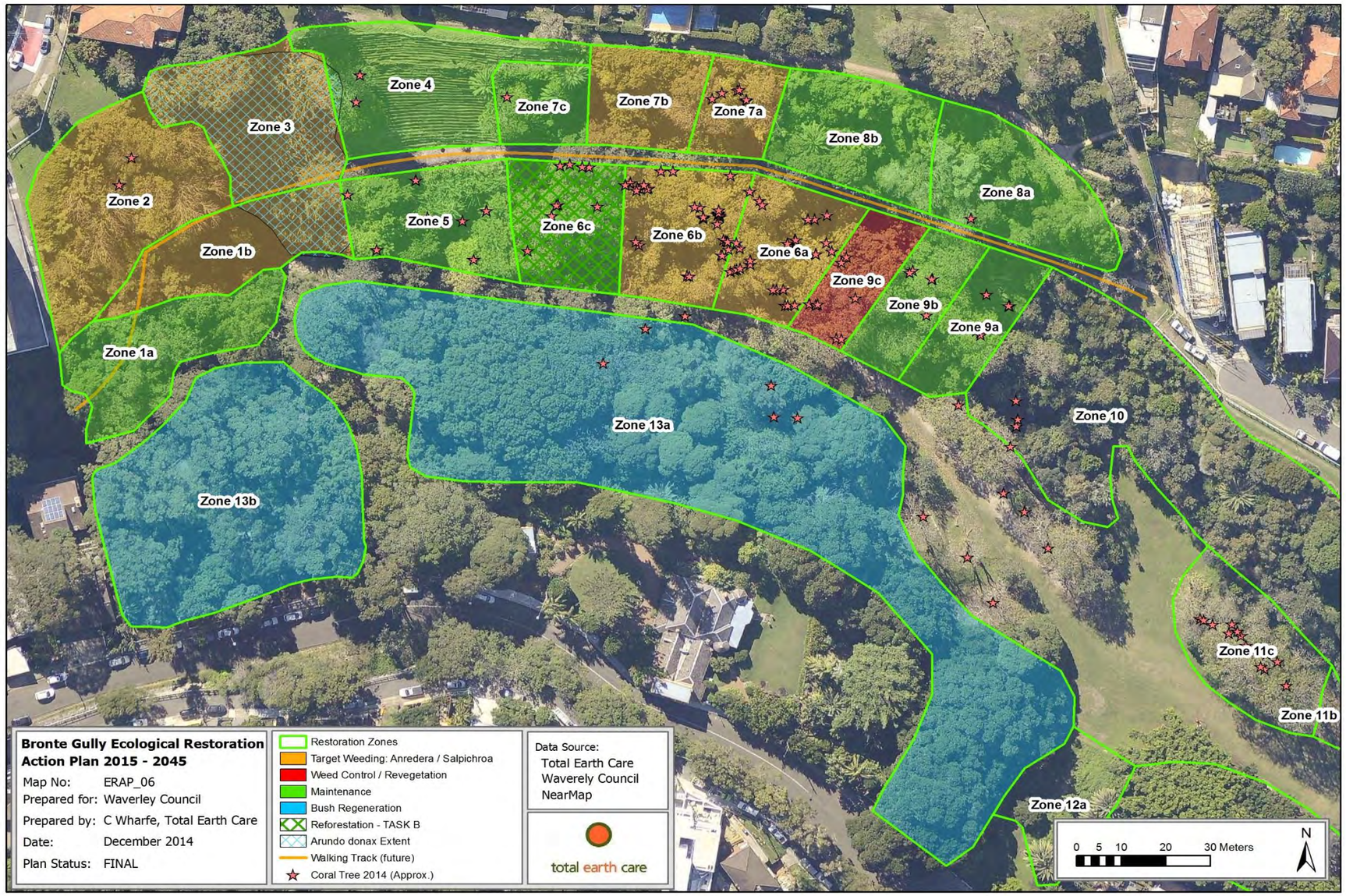
- **Coral Tree removal**
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones



Native *Microleana* groundcover at Fred Hollows Reserve

Restored Glebe Gully (Fred Hollows Reserve) dominated by native species in all strata

Successful recruitment of native shrubs at Fred Hollows Res.



Restoration Actions: Stages 10 and 11

Stage 10 – Following at least 12 Months of Maintenance Work in Zone 9c

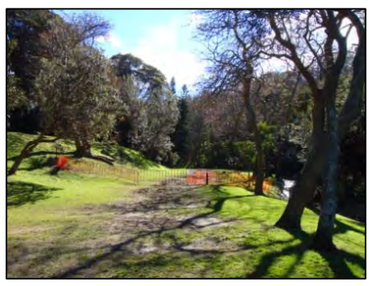
- **Zone 6b: Commencement of Reforestation works – TASK A**
  - Concentrated weed control works within Zone 6b to achieve understorey monoculture of Trad, all shrub and vine weeds also successfully treated.
  - Install very dense shade tolerant Acacia, Casuarina and other fast growing shrubs/small tree species (as per Reforestation Species Lists – Appendix A) during early-mid autumn, when Coral trees start to defoliate.
  - Timing of planting is essential to allow tubestock maximum sunlight exposure during Coral Tree dormancy period.
  - Plantings installed at 6-8 plants/m^2, clearance of Trad required surrounding each plant. Consider using individual weed mats.
  - Maintain plantings via watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance through to TASK B works from final installation of tubestock by professional Bush Regeneration Contractor
  - Planting's survivorship at no less than 80% at 12 months from installation

- **Coral Tree removal**
  - Selective removal of up to 5 trees from within Zone 6b, integrity of Reforestation works must be maintained. Use of crane/excavator from above the zone likely to be most appropriate method for removal; AND
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones

Stage 11 – Following at least 24 Months of Maintenance Work in Zone 6b

- **Zone 7a: Bush Regeneration and Revegetation Project**
  - Remove non-indigenous and exotic trees (incl. any remaining Coral Trees) and undertake primary weed control.
  - Stabilise slope using coir-logs and install jute mesh where required to prevent surface erosion. Install mulch for weed suppression. Undertake secondary weed control as required for up to 6 months to exhaust exotic soil stored seed
  - Dense revegetation following successful secondary weed control
  - Install plants at no less than 4 plants/m^2, species to be selected from the Upper-Mid Slope Species List (Appendix A)
  - Maintain plantings by watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance for 24-60 months from final installation of tubestock by professional Bush Regeneration Contractor
  - Planting's survivorship at no less than 80% at 12 months from installation

- **Coral Tree removal**
  - Selective removal of up to 5 trees from within Zone 6b, integrity of Reforestation works must be maintained. Use of crane/excavator from above the zone likely to be most appropriate method for removal; AND
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones



Bronte Park looking west to the waterfall

ERAP Restoration Zone 6abc August 2014

Bronte Park looking east to Bronte Beach

Restoration Actions: Stages 12 and 13

Stage 12 – Following at least 24 Months of Maintenance Work in Zone 7a

- **Coral Tree removal**
  - Removal all Coral Trees remaining within Zone 6b.
  - Crane or excavator to be used from closest Zone boundary (above or below). Care to be taken to limit damage to reforestation plantings.
  - Directional felling trees away from reforestation plantings may be required to minimise damage to installed plantings.
  - Coral Trees should be removed prior to installation of understorey plantings as outlined in Reforestation TASK B below.

- **Zone 6b : Reforestation – Task B**
  - Commence treatment of Trad monoculture beneath initial plantings at no less than 48 months from installation of plants, install mulch as required, and continue regular on-going weed control to exhaust exotic reproductive material in soil.
  - Undertake selective removal of cover crop shrubs/trees to increase light to new plantings and forest floor.
  - Planting of dense understorey and scattered canopy tubestock (as per Reforestation Species List) beneath initial plantings.
  - Maintain plantings via watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance for 18 months from final installation of tubestock by professional Bush Regeneration Contractor.
  - Planting's survivorship at no less than 80% at 12 months from installation
  - Make good any damage caused by removal of Coral Trees within the Zone ie. replant below any damaged plants.

Stage 13 – Following at least 24 Months of Maintenance Work in Zone 6b

- **Zone 7b: Bush Regeneration and Revegetation Project**
  - Remove non-indigenous and exotic trees (incl. any remaining Coral Trees) and undertake primary weed control.
  - Stabilise slope using coir-logs and install jute mesh where required to prevent surface erosion. Install mulch for weed suppression. Undertake secondary weed control as required for up to 6 months to exhaust exotic soil stored seed
  - Dense revegetation following successful secondary weed control
  - Install plants at no less than 4 plants/m^2, species to be selected from the Upper-Mid Slope Species List (Appendix A)
  - Maintain plantings by watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance for 24-60 months from final installation of tubestock by professional Bush Regeneration Contractor
  - Planting's survivorship at no less than 80% at 12 months from installation

- **Zone 2: Targeted Weed Removal**
  - Zone 2 – Targeted treatment of Madeira Vine (*Anredera conrdifolia*), Morning Glory (*Ipomoea indica*), Climbing Asparagus (*Asparagus plumosus*), Asparagus Fern (*Asparagus aethiopicus*) and Tree of Heaven (*Ailanthus altissima*) juv./suckers to facilitate future large scale works.

- **Zones 6b: 12 month Bush Regeneration contract for maintenance works**
  - 12 month contract with professional Bush Regeneration Company for continuation of bush regeneration works in Zone 6b.

- **Zone 6a: Commencement of Reforestation works – TASK A**
  - Concentrated weed control works within Zone 6a to achieve understorey monoculture of Trad, all shrub and vine weeds also successfully treated.
  - Install very dense shade tolerant Acacia, Casuarina and other fast growing shrubs/small tree species (as per Reforestation Species Lists – Appendix A) during early-mid autumn, when Coral trees start to defoliate.
  - Timing of planting is essential to allow tubestock maximum sunlight exposure during Coral Tree dormancy period.
  - Plantings installed at 6-8 plants/m^2, clearance of Trad required surrounding each plant. Consider using individual weed mats.
  - Maintain plantings via watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance through to TASK B works from final installation of tubestock by professional Bush Regeneration Contractor
  - Planting's survivorship at no less than 80% at 12 months from installation

- **Coral Tree removal**
  - Selective removal of up to 5 trees from within Zone 6a, integrity of Reforestation works must be maintained. Use of crane/excavator from above the zone likely to be most appropriate method for removal; AND
  - Removal of 2 trees within Zone 2; AND
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones

Retention and restoration of fauna habitat resources supported by Bronte Gully's bushland is an important part of this Ecological Restoration Plan.

Habitat retention will be maximised by undertaking works using the staged approach outlined in this Plan. Patches of weed infested vegetation provide shelter for native species and will be retained while adjacent areas undergo clearing and revegetation works. Removal of weeds and revegetation in discreet work zones will ensure that habitat is always available across the gully for native birds, mammals, reptiles and frogs. Retained weedy areas will then be worked once plantings installed in adjacent works zones have established a dense cover to replace that habitat temporarily removed.

Habitat restoration includes increasing fauna specific habitat resources within the bushland being resorted. All restoration / revegetation works undertaken as part of this Plan should include aspects of the following habitat restoration methods;

- Placement of logs (preferably hollowed out) of variable diameters throughout the works areas to provide habitat for skinks and frogs. Logs will provide shelter and as they decay they provide warmth and attract prey insects. Creation of rock piles from locally sourced material will also increase shelter available for small retiles (rock piles should generally be placed in sunnier areas, to increase warmth and attractiveness to reptiles).
- Plantings of dense groundcover species provides shelter for small frogs and reptiles, dense shrubs provide shelter for small birds, flowering plants in the *Myrtaceae* and *Proteaceae* families provide nectar for birds, and larger trees will over time provide hollows for larger birds and arboreal mammals.
- Placement of nest boxes across the gully will increase habitat available for larger hollow-dwelling birds ie. kookaburras, parrots and owls, as well as possums and micro-bats, which may be lost when larger exotic trees across the gully are removed. Nest boxes should be of variable sizes and installed over a range of heights and aspects specific to habitat requirements of the target native species. Construction of nest boxes out of sections of tree trunks removed during restoration works should be considered to reduced costs (Coral Trees are not suitable due to their propensity for vegetative growth)


Typical nest boxes


Dense understorey vegetation


Eastern Blue-tongue


Tree trunk nest box


Common Ring-tail Possum


Tree trunk nest boxes mounted on poles

Restoration Actions: Stages 14 and 15


Imperata cylindrica Bladv Grass


Banksia ericifolia Heath-leaved Banksia

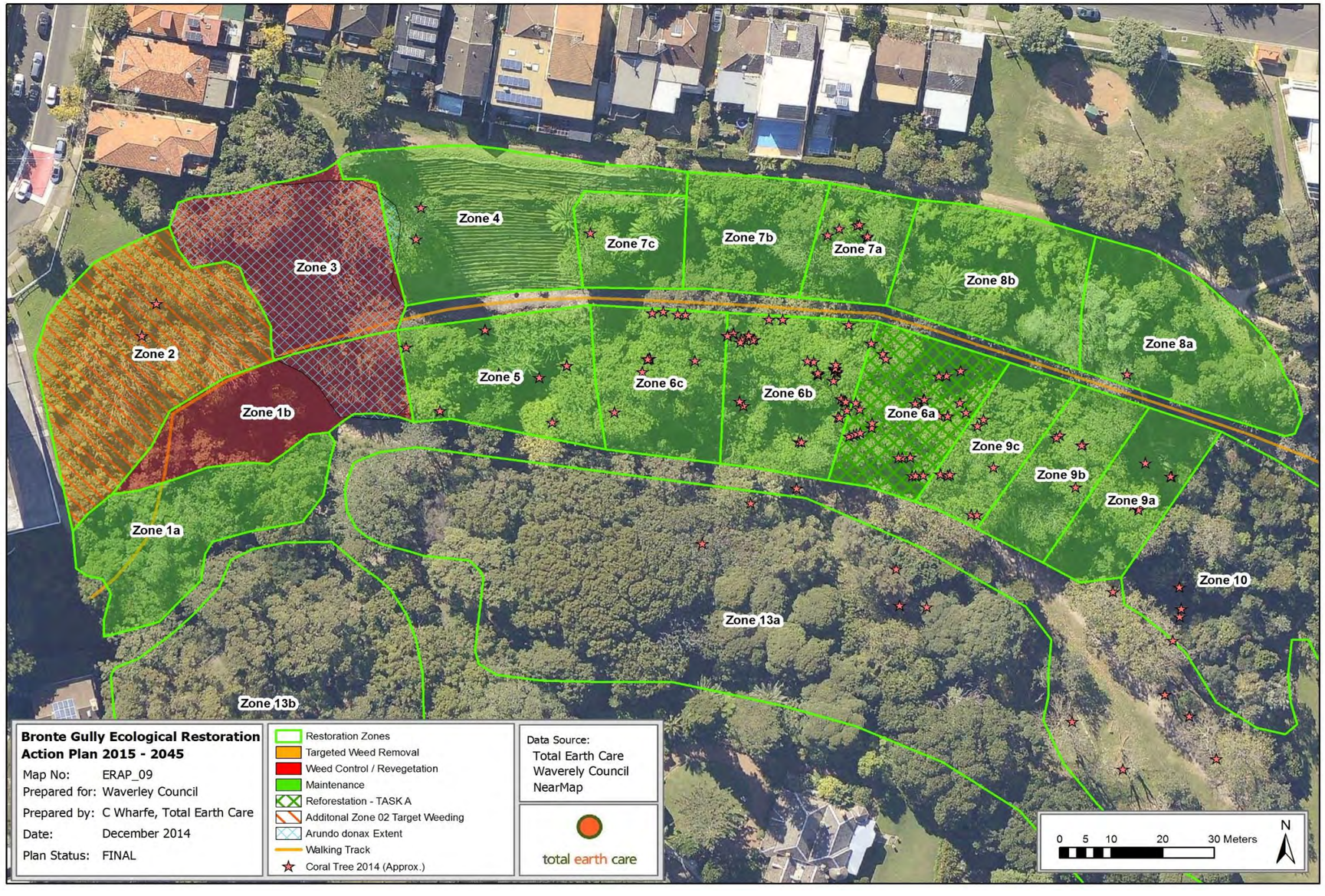

Acacia ulicifolia Prickley Moses


Grevillea linearifolia Linear-leaf Grevillea


Hakea dactyloides Finger Hakea


Eustephus latifolius Wombat Berry


Themeda asutralis Kangaroo Grass





Sandstone retainng walls as recommended for Zone 2






Weed control, bank stabilisation and resotoration of degardred and eroding creek in Penrith

Stage 14 – Following at least 24 Months of Maintenance Work in Zone 6a & 7b

- **Zone 3: Weed removal, slope stabilisation and revegetation**
  - Undertake pre-clearance surveys to minimise potential impacts to fauna utilising Giant Reed as shelter habitat.
  - Remove *Arundo donax* and other exotic vegetation using mechanical methods (tritter) where possible, and manual removal where / if appropriate. Consider the need for fauna pre-clearance prior to any tritter work.
  - Stabilise slope using coir logs and install jute mesh where required to prevent surface erosion. Install mulch for weed suppression, establishment of a cover crop of sterile grass should be considered to increase erosion protection during follow-up weed control works.
  - Undertake secondary weed control as required for up to 6 months to exhaust exotic soil stored seed.
  - Dense revegetation following successful secondary weed control.
  - Install plants at no less than 4 plants/m^2, species to be selected from the Upper-Mid Slope Species List (Appendix A)
  - Plant survivorship at no less than 80% at 12 months from installation, and ongoing to completion of vegetation management works
  - Planting and weed control maintenance for 24-60 months from final installation of tubestock by professional Bush Regeneration Contractor

- **Zone 2: Targeted Weed Removal**
  - Zone 2 – Targeted treatment of Madeira Vine (*Anredera conrdifolia*), Morning Glory (*Ipomoea indica*), Climbing Asparagus (*Asparagus plumosus*), Asparagus Fern (*Asparagus aethiopicus*) and Tree of Heaven (*Ailanthus altissima*) juv./suckers to facilitate future large scale works.

- **Coral Tree removal**
  - Selective removal of up to 5 trees from within Zone 6a, integrity of Reforestation works must be maintained. Use of crane/excavator from above the zone likely to be most appropriate method for removal; AND
  - Removal of up to 5 trees where they remain within Zones 7abc, 9bc, 11c, 13a and outside the work zones

Stage 15 – Following at least 24-36 Months of Maintenance Work in Zone 3

- **Zone 1b: Restoration of creek bank Below Waterfall**
  - Works undertaken in two sub-zones; Above Waterfall and Below Waterfall, due to the higher abundance of desirable native vegetation in the upper area.
  - Establish machine access through *Arundo donax* from beneath terracing in Zone 4. Consider the need for fauna pre-clearance prior to any tritter work.
  - Undertake exotic vegetation removal within zone. Heavy and hand-held machinery required Below Waterfall (whilst ensuring any desirable natives present are retained).
  - Delineate Zone 1 / Zone 2, boundary by installation of post and wire sediment fencing.
  - Stabilisation, re-shaping works and removal of debris/rubble as required on upper creek bank. Installation of sandstone rock to armour lower creek bank and where practicable on upper bank for stabilisation and landscaping / visual amenity.
  - Install jute mesh and coir logs as required, undertake secondary weed control, revegetate (4 plants/m^2) and maintain for 24-60 months.
  - Species to be selected from Lower-Mid Slope Species List (Appendix A)

- **Walking Track Construction**
  - Construct crushed sandstone walking track from stepped walkway to Murray St (Landing 2) on the northern side of stormwater channel, through Zones 1 and 3, along the current (2014) informal mid-slope track below Zones 4,7,8, continue track to Bayview St.
  - Erect signage at access points to inform public of restoration works being undertaken, and to prohibit dogs from within bushland areas.
  - Ongoing edge maintenance (weed control) will be required.

- **Coral Tree removal**
  - Removal all Coral Trees remaining within Zone 6a.
  - Crane or excavator to be used from closest Zone boundary (above or below). Care to be taken to limit damage to reforestation plantings.
  - Directional felling trees away from reforestation plantings may be required to minimise damage to installed plantings.
  - Coral Trees should be removed prior to installation of understorey plantings as outlined in Reforestation TASK B below.

- **Zone 6a : Reforestation – Task B**
  - Commence treatment of Trad monoculture beneath initial plantings at no less than 48 months from installation of plants, install mulch as required, and continue regular on-going weed control to exhaust exotic reproductive material in soil.
  - Undertake selective removal of cover crop shrubs/trees to increase light to new plantings and forest floor.
  - Planting of dense understorey and scattered canopy tubestock (as per Reforestation Species List) beneath initial plantings.
  - Maintain plantings via watering and removal of smothering weeds to facilitate establishment
  - Planting and weed control maintenance for 18 months from final installation of tubestock by professional Bush Regeneration Contractor.
  - Planting's survivorship at no less than 80% at 12 months from installation
  - Make good any damage caused by removal of Coral Trees within the Zone ie. replant below any damaged plants.

- **Zone 2: Targeted Weed Removal**
  - Zone 2 – Targeted treatment of Madeira Vine (*Anredera conrdifolia*), Morning Glory (*Ipomoea indica*), Climbing Asparagus (*Asparagus plumosus*), Asparagus Fern (*Asparagus aethiopicus*) and Tree of Heaven (*Ailanthus altissima*) juv./suckers to facilitate future large scale works.

Restoration Actions: Stage 16

Stage 16 – Following at least 24-36 Months of Maintenance Work in Zone 1b & 6a

- **Zone 2: Weed removal, Slope Stabilisation and Revegetation**
  - Remove remaining exotic vegetation using mechanical methods (excavator) where possible, and manual / chemical removal where necessary
    - Tree of Heaven not to be poisoned while dormant (winter). Cut stump and paint with *Access* ® herbicide mixed 1:60 with diesel OR *Vigilant* ® herbicide undiluted (See Chemical Labels and APVMA Off-label Permits for more detail)
    - Large exotic biomass to be removed from Zone via a chipper and winch, pulling vegetation upslope from grasses reserve
  - Remove 2x Coral Trees. Options for removal include crane from reserve adj. Murray Street or excavator lift over Bronte Creek in sections and into chipper at waterfall pool. Ensure all vegetative debris collected and removed.
  - Machinery required to undertake stabilisation, re-shaping and removal of debris / rubble on slope. Where practicable rubble to be buried and sandstone capped at toe of slope to flatten gradient directly above sandstone retaining wall.
  - Construct sandstone rock wall to retain lower slopes, delineate slope from crushed sandstone walking track and improve aesthetics of the area.
  - Install jute mesh and coir logs across slope above sandstone wall, sow and establish crop of sterile grass seed to quickly establish vegetation cover to prevent surface erosion.
  - Undertake secondary weed control for a 3-6 month period, ensuring regular visits to monitor surface erosion and maintain jute mesh and coir logs.
  - Install plants at no less than 4 plants/m^2, species to be selected from the Upper-Mid Slope Species List (Appendix A)
  - Maintain plantings by watering and removal of smothering weeds to facilitate plant establishment
  - Planting and weed control maintenance for 24-84 months from final installation of tubestock by professional Bush Regeneration Contractor
  - Plant survivorship at no less than 80% at 12 months from installation
  - Sandstone capping of the top edge of Zone 2 may be a viable option and will reduce maintenance and provide suitable substrate for growth of plantings. Capping may also be required if Asbestos is located amongst the fill / rubble.
- **Zones 6a: 24 month Bush Regeneration contract for maintenance works**
  - 24 month contract with professional Bush Regeneration Company for continuation of bush regeneration works in Zone 6a.
- **Coral Tree removal**
  - Removal of up to 5 trees per year where they remain across Bronte Gully

Sandstone capping top of slope in Lane Cove National Park

Sandstone capping of land contaminated by Asbestos

Sandstone Capping is the installation of clean crushed sandstone over degraded / weed infested / contaminated soils and is recommended to be considered for the top of Zone 2 along the boundary of the vegetation and the small Reserve, and approximately 5-8m down slope. The major benefits from sandstone capping include providing a clean planting medium for tubestock to become established within, and greatly suppressing the weed regrowth from soil stored seed. Greater success of tubestock establishment and a reduction in maintenance costs are therefore very likely and desirable outcomes.

This process requires the following steps:

- Removal of the weed biomass and grading/smoothing of the surface to be capped.
- Eradication, usually through herbicide application, of the next generation of weed propagules.
- Selection of weed free, crushed sandstone with varying particle sizes.
  - Sufficient percentage composition of fines is required to provide adequate plant growing media. The material must also have adequate sand/silt/clay composition to provide free drainage Water Holding Capacity (WHC), and nutrient availability
  - The sand /silt clay composition must also provide adequate soil binding characteristics to allow it to gain an adequate angle of repose on the batters to which it is applied.
- The depth of the capping required depends on the following parameters.
  - The contour and surface shape of the ground to be covered. Rough uneven surfaces require deeper capping.
  - Steeper slopes require deep capping at their toe and reduced depths at the top of the slope.
  - The working tolerances of the machinery / labour used to install the capping (200mm is the minimum suggested capping depth if it is spread by hand and the weed species being suppressed are not intractable stoloniferous or root spreading species.)
  - In general 400mm depth of sandstone capping allows for adequate weed suppression contour/reshaping and is also spreadable by excavator without the teeth of the excavator digging and mixing weedy soil into the clean capping material.
- Installation of crushed sandstone
  - A track mounted excavator should only be used to spread the sandstone. The excavator's tracks exert less force on the ground per square meter than a tyred vehicle. Their slewing ability and boom reach enable them to spread material without compacting it which is very important for the air filled porosity of the soil and plant growth.
- Mulch, which decomposes to sugars, is required to initiate the establishment of Mycorrhizal fungi.
  - Light mulching (25mm) of native tree wood fibre is suggested in conditions where there is a source of adjacent weeds. Clean crushed sandstone is not conducive to weed growth but decomposing mulch is. Light mulching provides some sugars but not a phosphorous rich and high pH medium that occurs in deeply mulched areas. Light mulching is also suitable to direct seeding applications especially of native tree species.
  - Heavy mulching is suggested where there is not a source of adjacent weed seeds and native canopy species recruitment is not required.

Bronte Gully Ecological Restoration Action Plan - Appendix A

Revegetation Species

Genus species	Common Name	Upper Slope Species	Upper-Mid Slope Species	Lower-Mid Slope Species	Reforestation - Part A	Reforestation - Part B
Acacia floribunda	White Sally Wattle			X	X	
Acacia implexa	Hickory Wattle		X		X	
Acacia irrorata ssp irrorata	Green Wattle			X	X	
Acacia linifolia	White Wattle		X		X	
Acacia longifolia ssp longifolia	Sydney Golden Wattle	X	X	X	X	
Acacia longissima	Long-leaf Wattle			X	X	
Acacia parramattensis	Sydney Green Wattle			X	X	
Acacia suaveolens	Sweet Wattle	X	X			
Acacia terminalis	Sunshine Wattle		X			
Acacia ulicifolia	Prickly Moses	X	X			
Acmena smithii	Lilly Pilly			X	X	
Allocasuarina distyla		X				
Allocasuarina littoralis	Black She-oak		X		X	
Allocasuarina torulosa	Forest Oak			X	X	
Angophora costata	Sydney Red Gum		X	X		X
Austromyrtus tenuifolia				X		X
Austrostipa pubescens		X				
Backhousia myrtifolia	Grey Myrtle			X		X
Baeckea linifolia	Weeping Baeckea			X		
Banksia aemula	Wallum Banksia		X			
Banksia ericifolia ssp ericifolia	Heath-leaved Banksia	X	X		X	
Banksia integrifolia ssp integrifolia	Coast Banksia		X	X		
Banksia marginata	Silver Banksia	X			X	
Banksia serrata	Old-man Banksia	X	X			
Billardiera scandens	Hairy Apple Berry		X	X		X
Brachyloma daphnoides	Daphne Heath	X				
Breynia oblongifolia	Coffee Bush		X	X		X
Callicoma serratifolia	Black Wattle		X	X		X
Callistemon linearifolius				X		X
Calochlaena dubia	Soft Bracken		X	X		

Genus species	Common Name	Upper Slope Species	Upper-Mid Slope Species	Lower-Mid Slope Species	Reforestation - Part A	Reforestation - Part B
Casuarina glauca	Swamp Oak			X	X	
Ceratopetalum apetalum	Coachwood			X		X
Ceratopetalum gummiferum	Christmas Bush		X	X		
Commelina cyanea	Scurvy Weed		X	X		
Corymbia gummifera	Red Bloodwood		X			
Cupaniopsis anacardioides	Tuckeroo			X		
Dianella caerulea	Blue Flax-lily		X	X		X
Dianella revoluta	Paroo Lily		X			X
Dichelachne micrantha	Shorthair Plumegrass		X			
Dillwynia retorta			X			
Dodonaea triquetra	Large-leaf Hop-bush		X	X		X
Elaeocarpus reticulatus	Blueberry Ash		X	X	X	
Entolasia marginata	Bordered Panic		X	X		X
Entolasia stricta	Wiry Panic	X	X			X
Eragrostis brownii	Brown's Lovegrass		X			
Eucalyptus botryoides	Bangalay		X	X		X
Eucalyptus haemastoma	Scribbly Gum		X			
Eucalyptus pilularis	Blackbutt			X		X
Eucalyptus piperita	Sydney Peppermint		X	X		X
Eustrephus latifolius	Wombat Berry		X	X		
Ficus coronata	Sandpaper Fig		X	X		X
Geitonoplesium cymosum	Scrambling Lily		X			
Glochidion ferdinandi var ferdinandi	Cheese Tree		X	X		X
Glycine clandestina			X			
Grevillea linearifolia	Linear-leaf Grevillea	X	X			
Grevillea mucronulata			X			
Grevillea sphacelata	Grey Spider Flower	X				
Hakea dactyloides	Finger Hakea	X	X			
Hardenbergia violacea	Purple Coral Pea	X				
Hebertia dentata			X	X		X

Genus species	Common Name	Upper Slope Species	Upper-Mid Slope Species	Lower-Mid Slope Species	Reforestation - Part A	Reforestation - Part B
Hibbertia scandens	Climbing Guinea Flower		X			
Imperata cylindrica	Blady Grass		X			
Isopogon anemonifolius	Broad-leaf Drumsticks	X				
Juncus usitatus	Common Rush			X		
Kunzea ambigua	Tick Bush		X			
Leptospermum laevigatum	Coast Teatree	X				
Leptospermum polygalifolium	Yellow Tea-tree			X	X	
Leucopogon ericoides	Pink Beard-heath	X	X			
Leucopogon juniperinus	Prickly Beard-heath		X			
Lomandra glauca	Pale Mat-rush	X				
Lomandra longifolia	Spiny-headed Mat-rush		X	X		X
Lomatia myricoides	River Lomatia			X		
Lomatia silaifolia	Crinkle Bush		X			
Melaleuca armillaris	Bracelet Honey-myrtle	X			X	
Melaleuca linariifolia	Flax-leaved Paperbark			X		X
Melaleuca nodosa		X				
Microlaena stipoides var stipoides	Weeping Grass		X	X		X
Melia azederach var *australasica*	White Cedar		X	X		X
Monotoca elliptica	Tree Broom-heath		X			
Monotoca scoparia		X				
Morinda jasminoides	Sweet Morinda			X		X
Myrsine variabilis			X			
Notelaea longifolia	Large Mock-olive		X	X		X
Oplismenus aemulus	Oplismenus		X	X		X
Oplismenus imbecillis	Oplismenus		X	X		X
Ozothamnus diosmifolius	Rice Flower		X			
Pandorea pandorana	Wonga Wonga Vine		X	X		X
Paspalidium distans			X			
Persoonia levis	Broad-leaved Geebung		X			

Genus species	Common Name	Upper Slope Species	Upper-Mid Slope Species	Lower-Mid Slope Species	Reforestation - Part A	Reforestation - Part B
Persoonia linearis	Narrow-leaved Geebung		X			
Pittosporum revolutum	Wild Yellow Jasmine		X	X		X
Pittosporum undulatum	Sweet Pittosporum		X	X	X	
Poa affinis	Poa		X	X		X
Polyscias sambucifolia	Elderberry Panax		X	X		X
Pratia purpurascens	Whiteroot		X			
Pteridium esculentum	Common Bracken		X			X
Ricinocarpos pinifolius	Wedding Bush	X				
Smilax glyciphylla	Sweet Sarsaparilla		X			
Syncarpia glomulifera ssp glomulifera	Turpentine			X		X
Themeda australis	Kangaroo Grass		X			
Toona ciliata	Red Cedar			X		X
Tristaniopsis laurina	Water Gum			X		X
Viola hederacea	Native Violet			X		
Zieria smithii	Sandfly Zieria		X			

Bronte Gully Ecological Restoration Action Plan - Appendix B

Target Vegetation Community Profiles (OEH 2013) for Restoration Works

COASTAL SANDSTONE FORESHORES FOREST S_DSF06

Statewide Class Sydney Coastal Dry Sclerophyll Forests

NSW Plant Community Type: 1778
Biometric Number(s): ME65

Description

Coastal Sandstone Foreshores Forest is found on sheltered sandstone slopes along the foreshores of Sydney's major waterways and coastal escarpments. It is an open forest with a moist shrub layer and a ground cover of ferns, rushes and grasses. The flora of this community has a maritime influence given its exposure to prevailing sea breezes. The canopy can be dominated by pure stands of smooth-barked apple (*Angophora costata)*, though more regularly this is found in combination with other tree species. Localised patches of bangalay (*Eucalyptus botryoides*) and coast banksia (*Banksia integrifolia*) occur closest to the coast, whereas Sydney peppermint (*Eucalyptus piperita*) and blackbutt (*Eucalyptus pilularis*) prefer more protected locations and in the case of the latter some minor shale enrichment in the soil. A prominent layer of hardy mesic small trees and shrubs is present. These include sweet pittosporum (*Pittosporum undulatum*), cheese tree (*Glochidion ferdinandi*) and blueberry ash (*Elaeocarpus reticulatus*). In the suburban environment the proliferation of these species in the understorey at long unburnt sites has generated considerable debate, particularly as there appears to be strong correlation between time since fire and their density (Rose and Fairweather 1997). It is also appears that these species are more common in these littoral zones than in other sheltered sandstone forests situated further away from the coast.

This forest is restricted to sandstone soils derived from either Hawkesbury or Narrabeen geology. The distribution is coastal and requires a combination of low elevation (between two and 45 metres above sea level) and mean annual rainfall that exceeds 1100 millimetres per annum. It is noticeable that most sites are exposed to salt-laden winds. Samples are situated up to 10 kilometres from the coastline, but still in close proximity to major waterways.

Floristic Summary*

	Average Height & Height Range (m)	Average Cover & Cover Range (%)	Typical Species
Trees	18 m ±7 6-28	30% ±14 8-55	*Angophora costata, Banksia integrifolia, Eucalyptus piperita, Eucalyptus botryoides, Eucalyptus pilularis*
Small Trees	6 m ±4 1-15	24% ±17 1-55	*Glochidion ferdinandi, Pittosporum undulatum, Allocasuarina littoralis, Breynia oblongifolia, Notelaea longifolia, Dodonaea triquetra, Elaeocarpus reticulatus, Polyscias sambucifolia, Acacia longifolia, Myrsine variabilis*
Ground Covers	1.1 m ±0.5 0.2-2.0	27% ±21 5-80	*Dianella caerulea, Pteridium esculentum, Lomandra longifolia, Entolasia stricta, Imperata cylindrica* var. *major, Microlaena stipoides* var. *stipoides, Poa affinis, Themeda australis, Xanthorrhoea arborea, Lepidosperma laterale, Pratia purpurascens*
Vines & Climbers	N/A	N/A	*Smilax glyciphylla, Billardiera scandens, Pandorea pandorana, Glycine clandestina*

*Compiled from 17 sites with structural data recorded.

Threats

Clearing for urban development has occurred across the range of the community. Weed infestation is widespread in stands close to urban margins. Fire is likely to have been excluded for long periods of time and many stands are isolated within dense urban landuses. The absence of fire may be preferentially encouraging some mesic woody species over pyrophytic species. Many stands, given there proximity to water views, experience very high recreational pressures. Dieback arising from *Phytophora* is severely affecting stands in the Sydney Harbour area.

Conservation Status

This vegetation community is represented in Sydney Harbour NP, Royal NP and Lane Cove NP.

	Within Study Area	Within Sydney Basin
Estimate of pre-clearing area	Not available	Not available
Estimated percentage cleared	Not available	Not available
Total NPWS reserves	164 +0.9 hectares 25% of extant area	Not available
Total reserved	403 +7.7 hectares 62% of extant area	Not available
Total non-reserved	245 +54.4 hectares	Not available
Total extant	648 hectares	Not available

Example Locations

- Ridgetops of Jamieson Park, Warringah LGA
- South-facing slopes North Head, Sydney Harbour NP
- Hacking River foreshores, Lilli Pilli, Sutherland LGA

Species Richness

Number of sites	69
Total native species	303
Average no. native species per site	35.4 ±9.2

Variations and Dynamics

Forest height varies depending on exposure to coastal winds and disturbance history. On some coastal foreshores the combination of exposure and disturbance produces a low scrub with scattered eucalypts. Sites with greater shelter are taller and marked by a mesic shrub layer.

Relationship to Other Communities

Floristically the community is closely related to the taller wet sclerophyll forests (S_WSF02) found in nearby enriched sandstone gullies of the coast and hinterland. It also shares species with littoral rainforest (S_RF07) into which it grades in much protected harbourside escarpment gullies. Typically, as distance from the coast increases the forest grades into less mesic, enriched sandstone forest (S_DSF04).

Accuracy

Sampling density is high. Map unit boundaries were based on the interpretation of sheltered forests on sandstone comprising a semi-mesic understorey. Mapped area may include some stands better describing S_DSF04.

A 0.04 hectare site located in this map unit is expected to contain at least 14 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 28 or greater.

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Acacia implexa	1	10%	1	4%	Uninformative
Acacia linifolia	1	20%	2	20%	Uninformative
Acacia longifolia	1	38%	2	21%	Positive diagnostic
Acacia suaveolens	1	33%	1	28%	Uninformative
Acacia terminalis	1	25%	2	20%	Uninformative
Acacia ulicifolia	1	28%	1	25%	Uninformative
Allocasuarina littoralis	1	45%	2	26%	Positive diagnostic
Angophora costata	3	77%	2	36%	Positive diagnostic
Banksia integrifolia	1	42%	2	8%	Positive diagnostic
Billardiera scandens	1	51%	1	36%	Constant
Breynia oblongifolia	1	59%	1	15%	Positive diagnostic
Callicoma serratifolia	1	10%	2	5%	Uninformative
Calochlaena dubia	2	33%	2	16%	Positive diagnostic
Cassytha pubescens	1	35%	2	27%	Uninformative
Ceratopetalum gummiferum	2	13%	2	18%	Uninformative
Cissus hypoglauca	1	16%	2	8%	Uninformative
Commelina cyanea	1	39%	2	8%	Positive diagnostic
Dianella caerulea	2	94%	2	43%	Positive diagnostic
Dianella revoluta	1	35%	2	16%	Positive diagnostic
Digitaria didactyla	2	12%	2	0%	Positive diagnostic
Digitaria parviflora	1	13%	2	5%	Uninformative
Dillwynia retorta	1	10%	2	26%	Uninformative
Dodonaea triquetra	1	68%	2	21%	Positive diagnostic
Elaeocarpus reticulatus	2	74%	1	19%	Positive diagnostic
Entolasia marginata	1	46%	2	22%	Positive diagnostic
Entolasia stricta	2	87%	2	58%	Positive diagnostic
Epacris longiflora	2	16%	2	8%	Uninformative
Eragrostis brownii	1	10%	2	7%	Uninformative
Eucalyptus botryoides	4	10%	3	5%	Uninformative
Eucalyptus pilularis	4	22%	3	13%	Uninformative
Eucalyptus piperita	3	16%	3	20%	Uninformative
Eucalyptus resinifera subsp. *resinifera*	3	16%	1	5%	Positive diagnostic
Eustrephus latifolius	1	45%	2	14%	Positive diagnostic
Ficus rubiginosa	1	41%	1	3%	Positive diagnostic
Gahnia clarkei	2	10%	2	3%	Uninformative
Geitonoplesium cymosum	1	19%	2	9%	Uninformative
Glochidion ferdinandi	2	87%	1	11%	Positive diagnostic
Glycine clandestina	1	14%	2	18%	Uninformative
Gonocarpus teucrioides	1	16%	2	24%	Uninformative
Grevillea linearifolia	1	32%	2	6%	Positive diagnostic
Hakea dactyloides	1	14%	2	24%	Uninformative
Hardenbergia violacea	1	13%	1	16%	Uninformative
Hibbertia dentata	1	32%	2	7%	Positive diagnostic
Hypolepis muelleri	2	12%	2	5%	Uninformative
Imperata cylindrica var. *major*	2	33%	2	20%	Uninformative
Kennedia rubicunda	1	22%	1	9%	Positive diagnostic
Kunzea ambigua	2	36%	2	14%	Positive diagnostic
Leucopogon juniperinus	1	19%	2	10%	Uninformative
Livistona australis	1	13%	2	10%	Uninformative
Lomandra filiformis	1	14%	2	23%	Uninformative
Lomandra gracilis	1	13%	2	10%	Uninformative
Lomandra longifolia	2	94%	2	45%	Positive diagnostic
Lomandra obliqua	1	14%	2	33%	Uninformative
Lomatia silaifolia	1	20%	1	28%	Uninformative
Microlaena stipoides var. *stipoides*	2	67%	2	35%	Positive diagnostic
Monotoca elliptica	2	28%	1	6%	Positive diagnostic
Myrsine variabilis	1	16%	1	8%	Uninformative
Notelaea longifolia	2	64%	1	20%	Positive diagnostic
Omalanthus nutans	1	51%	1	8%	Positive diagnostic
Opercularia aspera	1	12%	1	8%	Uninformative
Oplismenus aemulus	1	45%	2	9%	Positive diagnostic
Oplismenus imbecillis	1	23%	2	12%	Uninformative
Ozothamnus diosmifolius	1	12%	1	12%	Uninformative
Pandorea pandorana	2	70%	2	15%	Positive diagnostic
Paspalidium distans	1	19%	2	7%	Positive diagnostic
Persoonia linearis	1	17%	1	20%	Uninformative
Phyllanthus hirtellus	1	14%	2	28%	Uninformative
Pittosporum revolutum	1	39%	1	8%	Positive diagnostic
Pittosporum undulatum	2	87%	2	23%	Positive diagnostic
Platylobium formosum	1	22%	2	8%	Positive diagnostic

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Platysace lanceolata	1	28%	2	8%	Positive diagnostic
Poa affinis	2	43%	2	10%	Positive diagnostic
Polyscias sambucifolia	1	61%	1	13%	Positive diagnostic
Pratia purpurascens	2	20%	2	18%	Uninformative
Pseuderanthemum variabile	2	12%	2	13%	Uninformative
Pteridium esculentum	2	77%	2	39%	Positive diagnostic
Smilax glyciphylla	2	81%	2	31%	Positive diagnostic
Syncarpia glomulifera	3	12%	3	13%	Uninformative
Themeda australis	1	29%	2	23%	Uninformative
Xanthorrhoea arborea	1	19%	2	11%	Uninformative
Xanthosia pilosa	1	16%	2	21%	Uninformative
Xanthosia tridentata	1	10%	2	22%	Uninformative
Zieria pilosa	1	13%	2	6%	Uninformative
Zieria smithii	1	23%	1	5%	Positive diagnostic

COASTAL SAND APPLE-BLOODWOOD FOREST S_DSF03

Statewide Class Coastal Dune Dry Sclerophyll Forests

NSW Plant Community Type: 1647: Red Bloodwood-Smooth-barked Apple Heathy Woodland on Coastal Sands of the Central and Lower North Coast

Biometric Number(s): HU861; ME009

Description

Coastal Sand Apple-Bloodwood Forest is one of several vegetation communities found on the large sand dunes associated with the prominent headlands of the Sydney coastline. The forest is of low to moderate height and is characterised by an open cover of dry shrub and heath plants. Typically the canopy comprises smooth-barked apple (*Angophora costata*), old-man banksia (*Banksia serrata*) and red bloodwood (*Corymbia gummifera*), though may also include broad-leaved scribbly gum (*Eucalyptus haemastoma*) and less frequently bangalay (*Eucalyptus botryoides*). The surface soil is generally deeply podsolised, inferring that the dune systems upon which this forest grows have been stable for a long time. These impoverished soils, in combination with the exposed wind-blown situations, support a heath understorey of tea-trees, banksias, broom heath and grass trees above a ferny ground cover.

These forests are found on the larger headland systems at Jibbon Head near Bundeena, Kurnell and La Perouse. The massive dune systems that once covered the Botany-Randwick area would have once supported a network of these low-growing forests amongst the treeless sandplain heaths. Some examples are on thin sand mantles above sandstone rock plates. Beyond the Sydney metropolis, the community is found on low elevation dunes of the Central Coast (NPWS 2000c, Bell 2002).

Floristic Summary*

	Average Height & Height Range (m)	Average Cover & Cover Range (%)	Typical Species
Trees	12 m ±2 10-15	39% ± 3 35-40	*Angophora costata, Corymbia gummifera, Banksia serrata, Eucalyptus botryoides, Eucalyptus piperita, Eucalyptus haemastoma, Banksia aemula*
Small Trees	6 m ±2 3-8	20% ±15 5-40	*Acacia suaveolens, Acacia longifolia, Banksia serrata, Xylomelum pyriforme, Elaeocarpus reticulatus, Banksia integrifolia*
Shrubs	2.3 m ±0.4 2.0-2.5	25% ±7 20-30	*Acacia ulicifolia, Bossiaea heterophylla, Leucopogon ericoides, Aotus ericoides, Breynia oblongifolia, Monotoca elliptica, Banksia ericifolia* subsp. *ericifolia*
Ground Covers	1.0 m ±0.6 0.5-2.0	35% ±24 10-60	*Dianella caerulea, Pteridium esculentum, Entolasia stricta, Imperata cylindrica* var. *major, Lomandra longifolia, Themeda australis, Gonocarpus teucrioides, Lepidosperma laterale, Pomax umbellata*
Vines & Climbers	N/A	N/A	*Hibbertia scandens, Smilax glyciphylla, Billardiera scandens, Hardenbergia violacea*

*Compiled from 4 sites with structural data recorded.

Threats

Coastal development has removed extensive areas of this community in the eastern suburbs of Sydney. However, the threats arising from the invasive bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*), amongst other exotic species, persists across the range of this community. Clearing for urban development continues to threaten areas outside of Sydney on the Central Coast.

Conservation Status

The majority of the remaining area of this community in the study area is located within Royal and Kamay Botany Bay national parks.

	Within Study Area	Within Sydney Basin*
Estimate of pre-clearing area	Not available	32,000-38,000 hectares
Estimated percentage cleared	Not available	35-50%
Total NPWS reserves	100 +0.1 hectares 68% of extant area	6500-6550 hectares 30-35% of extant area 15-20% of pre-clearing area
Total reserved	128 +0.1 hectares 86% of extant area	Not available
Total non-reserved	20.0 +4.3 hectares	Not available
Total extant	148 hectares	Est. 20,000 hectares

*As this forest is only a component of the equivalent regional community, these figures overestimate the regional extent.

Example Locations

- Between Jibbon Beach and east of Eric Street, Bundeena, Royal NP
- Kurnell Peninsula, Kamay Botany Bay NP

Species Richness

Number of sites	15
Total native species	142
Average no. native species per site	34.9 ±6.1

Variations and Dynamics

Variation in canopy height can vary depending on exposure and depth of the sand mass.

Relationship to Other Communities

Floristically the community is closely related to other map units found on the older dune systems of the Sydney Basin Bioregion including forests (S_DSF21) and heaths (S_HL04, S_HL03). Where headland dune soils become shallower there is often a gentle transition into sandstone forests and woodlands such as S_DSF04 and S_DSF06.

Accuracy

Sampling density is moderate. Map boundaries of the community were based on the interpretation of the presence of a eucalypt canopy, relative tree height and exposed aspects found on the dune systems of the coastal headlands and coastal sandplains.

A 0.04 hectare site located in this map unit is expected to contain at least 13 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 27 or greater.

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Acacia longifolia	2	87%	2	21%	Positive diagnostic
Acacia suaveolens	1	73%	1	28%	Positive diagnostic
Acacia terminalis	1	60%	1	19%	Positive diagnostic
Acacia ulicifolia	1	47%	1	25%	Constant
Allocasuarina distyla	1	13%	2	11%	Uninformative
Angophora costata	3	100%	3	36%	Positive diagnostic
Aotus ericoides	2	53%	2	8%	Positive diagnostic
Austrostipa pubescens	1	13%	2	20%	Uninformative
Banksia ericifolia subsp. *ericifolia*	1	13%	2	26%	Uninformative
Banksia integrifolia	2	53%	2	9%	Positive diagnostic
Banksia serrata	2	93%	2	33%	Positive diagnostic
Billardiera scandens	1	60%	1	37%	Constant
Bossiaea heterophylla	2	73%	2	17%	Positive diagnostic
Bossiaea scolopendria	1	27%	2	7%	Uninformative
Breynia oblongifolia	1	60%	1	16%	Positive diagnostic
Cassytha pubescens	2	33%	2	27%	Uninformative
Clematis aristata	1	20%	1	7%	Uninformative
Corymbia gummifera	3	73%	2	41%	Constant
Cupaniopsis anacardioides	1	27%	2	2%	Positive diagnostic
Daviesia mimosoides	2	20%	1	0%	Positive diagnostic
Dianella caerulea	2	80%	2	45%	Constant
Dianella revoluta	1	20%	2	17%	Uninformative
Dichelachne micrantha	1	13%	2	9%	Uninformative
Dillwynia retorta	2	27%	2	26%	Uninformative
Dodonaea triquetra	2	27%	2	23%	Uninformative
Elaeocarpus reticulatus	1	47%	1	20%	Constant
Entolasia stricta	2	53%	2	59%	Constant
Eragrostis brownii	1	13%	2	7%	Uninformative
Eucalyptus botryoides	1	20%	3	5%	Uninformative
Eucalyptus haemastoma	3	20%	2	12%	Uninformative
Eucalyptus piperita	2	33%	3	20%	Uninformative
Eustrephus latifolius	1	13%	2	15%	Uninformative
Geitonoplesium cymosum	2	27%	2	9%	Uninformative
Glochidion ferdinandi	1	20%	2	13%	Uninformative
Gonocarpus teucrioides	2	67%	2	23%	Positive diagnostic
Grevillea mucronulata	2	13%	2	7%	Uninformative
Hardenbergia violacea	1	53%	1	16%	Positive diagnostic
Hibbertia aciculars	1	20%	1	0%	Positive diagnostic
Hibbertia obtusifolia	1	27%	1	1%	Positive diagnostic
Hibbertia scandens	1	60%	2	6%	Positive diagnostic
Hybanthus monopetalus	2	13%	1	3%	Uninformative
Hypolaena fastigiata	2	13%	2	3%	Uninformative
Imperata cylindrica var. *major*	1	67%	2	20%	Positive diagnostic
Isopogon anemonifolius	1	33%	2	18%	Uninformative
Lepidosperma concavum	3	67%	2	4%	Positive diagnostic
Lepidosperma filiforme	2	20%	2	8%	Uninformative
Leptospermum laevigatum	2	40%	2	5%	Positive diagnostic
Leucopogon ericoides	1	40%	1	8%	Positive diagnostic
Leucopogon parviflorus	2	13%	1	1%	Uninformative
Lomandra cylindrica	1	13%	2	11%	Uninformative
Lomandra glauca	3	13%	2	16%	Uninformative
Lomandra gracilis	2	13%	2	10%	Uninformative
Lomandra longifolia	2	87%	2	46%	Positive diagnostic
Lomandra multiflora subsp. *multiflora*	1	20%	2	24%	Uninformative
Macrozamia communis	3	53%	1	4%	Positive diagnostic
Monotoca elliptica	2	87%	1	6%	Positive diagnostic
Notelaea longifolia	2	67%	1	21%	Positive diagnostic
Omalanthus nutans	1	27%	1	9%	Uninformative
Persoonia lanceolata	1	20%	1	11%	Uninformative
Persoonia levis	1	27%	1	33%	Uninformative
Persoonia linearis	1	13%	1	20%	Uninformative
Petrophile pulchella	2	13%	2	16%	Uninformative
Philotheca salsolifolia	2	13%	2	2%	Uninformative
Phyllota phylicoides	1	13%	2	13%	Uninformative
Pimelea linifolia	2	20%	2	27%	Uninformative
Pittosporum revolutum	3	13%	1	9%	Uninformative
Pittosporum undulatum	1	13%	2	25%	Uninformative
Poa affinis	1	33%	2	11%	Uninformative
Pomax umbellata	2	13%	2	15%	Uninformative
Pteridium esculentum	3	100%	2	40%	Positive diagnostic

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Ricinocarpos pinifolius	2	60%	1	7%	Positive diagnostic
Schizaea dichotoma	1	20%	1	1%	Positive diagnostic
Smilax glyciphylla	2	93%	2	32%	Positive diagnostic
Themeda australis	2	60%	2	23%	Positive diagnostic
Woollsia pungens	1	20%	2	12%	Uninformative
Xanthorrhoea arborea	2	20%	2	11%	Uninformative
Xanthorrhoea resinosa	2	33%	2	10%	Uninformative
Xylomelum pyriforme	2	60%	1	6%	Positive diagnostic

COASTAL SANDPLAIN HEATH S_HL04

Statewide Class Wallum Sand Heaths

NSW Plant Community Type: 1061: Old-man Banksia-She-oak-Red Bloodwood Heathland on Coastal Sands, Southern Sydney Basin

Biometric Number(s): ME011; SR589

Description

Coastal Sandplain Heath (Tozer et al. 2010) is an open to dense shrubland community found on large, deep Pleistocene sand dunes along the New South Wales coast. In the Sydney area it occurs south of Sydney Harbour on deep Pleistocene sand dunes such as at Kurnell (where depth reaches 40 metres (Roy and Crawford 1981)) and at Jibbon near Bundeena in Royal NP. It also occurs on smaller though prominent dunes at La Perouse. Deep dunes would have been far more extensive between Botany and Woollahra, however these are now highly modified and urbanised with remaining vegetation very highly disturbed. It resembles Coastal Sand Mantle Heath (S_HL03) because it shares a similar habitat and structure and has also adapted to the low nutrient podsolised soils that are associated with older hind dunes and headland sand masses found along the coastal zone. Coastal Sandplain Heath in the Botany and Woollahra area is included as a component of Eastern Suburbs Banksia Scrub (Benson and Howell 1990) and has been listed as an Endangered Ecological Community under the NSW TSC Act in recognition of its conservation status.

In the Sydney area the heath layer supports an open cover of stunted old-man banksia (*Banksia serrata*) and scrub she-oak (*Allocasuarina distyla*). Sites north of Botany Bay may include wallum banksia (*Banksia aemula*). At times clumps of low eucalypts may be present. The remainder of the dense shrub layer comprises a wide variety of woody species such as tea-trees, grevilleas, peas and wattles. The ground layer comprises on open cover of sedges and forbs.

Floristic Summary*

	Average Height & Height Range (m)	Average Cover & Cover Range (%)	Typical Species
Small Trees	2.1 m ±0.4 1.5-2.5	48% ±20 25-80	*Banksia serrata, Allocasuarina distyla, Leptospermum laevigatum*
Shrubs	0.9 m ±0.2 0.7-1.0	40% ±0 40-40	*Isopogon anemonifolius, Monotoca scoparia, Pimelea linifolia, Aotus ericoides, Acacia suaveolens, Allocasuarina distyla, Ricinocarpos pinifolius, Hakea dactyloides, Bossiaea scolopendria, Brachyloma daphnoides, Leucopogon ericoides, Grevillea sphacelata, Platysace linearifolia, Bossiaea ensata, Hibbertia fasciculata*
Ground Covers	0.7 m ±0.2 0.3-1.0	51% ±19 25-80	*Hypolaena fastigiata, Lomandra glauca, Gonocarpus teucrioides, Lepidosperma concavum, Schoenus ericetorum, Dampiera stricta, Entolasia stricta, Pteridium esculentum, Xanthorrhoea media, Austrostipa pubescens, Haemodorum planifolium, Patersonia glabrata*
Vines & Climbers	N/A	N/A	*Cassytha pubescens*

*Compiled from 7 sites with structural data recorded.

Threats

Coastal and urban development and sandmining have depleted extensive stands of this heath community across its range in New South Wales. Within Sydney large areas are likely to have been lost in the eastern suburbs. The recovery plan for Eastern Suburbs Banksia Scrub (DEC 2004) indicates that further clearing and habitat fragmentation are continuing threats. Remnants are further impacted by a range of urban-related disturbances including weed invasion, heavy recreational pressures, rubbish dumping, inappropriate fire regimes and altered hydrological regimes (DEC 2004). In Royal NP local dune erosion may occur from recreational pressures and trampling by feral deer. Weed invasion, particularly from bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*), and frequent fire may also impact upon the community.

Conservation Status

Coastal Sandplain Heath is a component of Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion, an Endangered Ecological Community listed under the NSW TSC Act. Eastern Suburbs Banksia Scrub of the Sydney Region is also listed as an Endangered Ecological Community under the Commonwealth EPBC Act.

This vegetation community is represented in Royal and Kamay Botany Bay national parks.

	Within Study Area	Within Sydney Basin
Estimate of pre-clearing area	Not available	<1110 hectares
Estimated percentage cleared	Not available	<70%
Total NPWS reserves	273 +1.7 hectares 79% of extant area	530 hectares 53% of extant area 20-40% of pre-clearing area
Total reserved	308 +1.9 hectares 90% of extant area	Not available
Total non-reserved	36.0 +3.9 hectares	Not available
Total extant	344 hectares	1000 hectares

Example Locations

- Dunes at Jibbon, Bundeena, Royal NP

Species Richness

Number of sites	23
Total native species	166
Average no. native species per site	34.2 ±7.7

Variations and Dynamics

No floristic or structural variations are currently recognised in this community.

Relationship to Other Communities

This community is most closely related to Coastal Sand Apple-Bloodwood Forest (S_DSF03). It grades into coastal sand mantle heath (S_HL03) as the sand dune thins to expose sandstone bedrock. It grades into forests (S_DSF03, S_DSF21) in more protected situations. Small swales and drainage depressions may also be situated nearby which support an open sedgeland or heath swamp (S_FrW13).

Accuracy

Sampling density is high. Map boundaries were drawn using the interpretation of current and historic digital imagery to identify patterns in sandstone and sand substrates. Map boundaries were supplemented with extensive field traverse and the review of existing map data.

A 0.04 hectare site located in this map unit is expected to contain at least 12 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 27 or greater.

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Acacia longifolia	2	52%	2	21%	Positive diagnostic
Acacia suaveolens	1	74%	1	28%	Positive diagnostic
Acacia ulicifolia	2	17%	1	26%	Uninformative
Actinotus helianthi	2	26%	1	8%	Uninformative
Allocasuarina distyla	3	70%	2	10%	Positive diagnostic
Amperea xiphoclada	1	22%	1	6%	Uninformative
Anisopogon avenaceus	2	17%	2	14%	Uninformative
Aotus ericoides	2	83%	2	7%	Positive diagnostic
Astroloma pinifolium	1	35%	1	2%	Positive diagnostic
Austrostipa mollis	2	17%	1	0%	Uninformative
Austrostipa pubescens	2	35%	2	20%	Uninformative
Banksia ericifolia subsp. *ericifolia*	2	13%	2	26%	Uninformative
Banksia integrifolia	2	22%	2	9%	Uninformative
Banksia marginata	2	17%	2	9%	Uninformative
Banksia serrata	3	96%	2	32%	Positive diagnostic
Billardiera scandens	1	35%	1	37%	Uninformative
Boronia ledifolia	2	17%	2	13%	Uninformative
Bossiaea ensata	2	43%	1	6%	Positive diagnostic
Bossiaea heterophylla	2	35%	2	17%	Uninformative
Bossiaea scolopendria	2	43%	1	6%	Positive diagnostic
Brachyloma daphnoides	2	43%	1	5%	Positive diagnostic
Cassytha glabella	1	26%	2	14%	Uninformative
Cassytha pubescens	2	57%	2	27%	Positive diagnostic
Caustis pentandra	2	17%	2	5%	Uninformative
Ceratopetalum gummiferum	2	13%	2	17%	Uninformative
Conospermum taxifolium	1	22%	2	2%	Positive diagnostic
Correa reflexa	1	13%	2	5%	Uninformative
Dampiera stricta	2	48%	2	23%	Constant
Dianella revoluta	2	35%	1	17%	Uninformative
Dillwynia glaberrima	2	17%	2	1%	Uninformative
Dillwynia retorta	2	22%	2	26%	Uninformative
Entolasia stricta	2	48%	2	59%	Constant
Gompholobium glabratum	1	26%	2	4%	Positive diagnostic
Gonocarpus teucrioides	2	78%	2	23%	Positive diagnostic
Grevillea sphacelata	2	30%	2	6%	Positive diagnostic
Haemodorum planifolium	2	35%	1	2%	Positive diagnostic
Hakea dactyloides	2	57%	2	23%	Positive diagnostic
Hardenbergia violacea	1	22%	1	16%	Uninformative
Hibbertia fasciculata	2	39%	2	1%	Positive diagnostic
Hibbertia obtusifolia	1	13%	1	1%	Uninformative
Hibbertia serpyllifolia	2	17%	2	3%	Uninformative
Hypolaena fastigiata	3	70%	2	2%	Positive diagnostic
Imperata cylindrica var. *major*	2	17%	2	20%	Uninformative
Isopogon anemonifolius	2	70%	2	18%	Positive diagnostic
Lambertia formosa	2	22%	2	26%	Uninformative
Lepidosperma concavum	2	65%	2	3%	Positive diagnostic
Lepidosperma viscidum	3	13%	2	2%	Uninformative
Leptospermum laevigatum	2	70%	2	5%	Positive diagnostic
Leucopogon ericoides	2	57%	1	8%	Positive diagnostic
Leucopogon parviflorus	2	17%	1	1%	Uninformative
Leucopogon virgatus	2	17%	1	1%	Uninformative
Lomandra glauca	2	57%	2	16%	Positive diagnostic
Lomandra longifolia	2	52%	2	47%	Constant
Lomandra obliqua	2	13%	2	32%	Uninformative
Melaleuca armillaris subsp. *armillaris*	2	13%	2	1%	Uninformative
Melaleuca nodosa	3	26%	2	5%	Positive diagnostic
Monotoca elliptica	2	43%	1	6%	Positive diagnostic
Monotoca scoparia	2	65%	1	16%	Positive diagnostic
Patersonia glabrata	2	30%	2	16%	Uninformative
Persoonia lanceolata	1	39%	1	11%	Positive diagnostic
Persoonia levis	1	17%	1	33%	Uninformative
Petrophile pulchella	2	13%	2	16%	Uninformative
Petrophile sessilis	2	13%	2	7%	Uninformative
Philotheca salsolifolia	2	39%	1	1%	Positive diagnostic
Phyllota phylicoides	2	26%	2	13%	Uninformative
Pimelea linifolia	2	87%	2	26%	Positive diagnostic
Platysace lanceolata	3	13%	2	8%	Uninformative
Platysace linearifolia	2	35%	2	29%	Uninformative
Pomax umbellata	2	17%	2	15%	Uninformative
Pteridium esculentum	2	61%	2	40%	Constant

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Ricinocarpos pinifolius	2	61%	1	7%	Positive diagnostic
Schizaea bifida	1	13%	1	4%	Uninformative
Schoenus ericetorum	2	39%	2	6%	Positive diagnostic
Styphelia viridis subsp. *viridis*	1	17%	1	0%	Uninformative
Themeda australis	2	26%	2	23%	Uninformative
Woollsia pungens	2	17%	2	12%	Uninformative
Xanthorrhoea media	2	35%	2	19%	Uninformative
Xanthorrhoea resinosa	1	35%	2	10%	Positive diagnostic
Xanthosia pilosa	2	43%	2	20%	Constant
Xylomelum pyriforme	1	22%	1	6%	Uninformative
Zieria pilosa	1	13%	2	6%	Uninformative

COASTAL DUNE LITTORAL RAINFOREST S_RF06

Statewide Class Littoral Rainforests

NSW Plant Community Type: 1536: Tuckeroo-Lilly Pilly-Coast Banksia Littoral Rainforest
Biometric Number(s): HU750; ME84

Description

A closed canopy dominated by tuckeroo (*Cupaniopsis anacardioides*) and a sandy substrate helps differentiate this littoral rainforest from others found in the Sydney area. This community forms a low closed canopy of rainforest trees with an occasional emergent eucalypt, casuarina, banksia or paperbark. It is situated on recent sand deposits, typically in swales or depressions on low-lying sheltered hind dunes less than 10 metres in elevation. Many tree species are shared with other littoral rainforest communities, including lilly pilly (*Acmena smithii*) and cheese tree (*Glochidion ferdinandi*). In the Sydney region the threatened species magenta lilly pilly (*Syzygium paniculatum*) has been recorded amongst the small tree layer.

Only small, isolated stands of this rainforest occur in the Sydney area on the Kurnell Peninsula and Bundeena. At Towra Point the understorey is threatened by encroaching lantana which defines parts of the reserve previously subject to clearing. The lantana can smother the understorey, inhibiting the development of the ferns and vines that are otherwise present in less-disturbed sites. Outside of the Sydney area the community extends north along the Central Coast where it occurs in Wyrrabalong and Wamberal nature reserves (NPWS 2000c). While similar habitats are found south of Sydney, tuckeroo is not present (NPWS 2002c) and the sand littoral rainforests there are considered to form part of the Temperate Littoral Rainforest community of Tozer et al. (2010).

Floristic Summary*

	Average Height & Height Range (m)	Average Cover & Cover Range (%)	Typical Species
Trees	15 m	70%	*Cupaniopsis anacardioides, Syzygium paniculatum, Streblus brunonianus*
Small Trees	4 m	10%	*Acmena smithii, Breynia oblongifolia, Pittosporum undulatum, Glochidion ferdinandi, Notelaea longifolia, Syzygium paniculatum*
Ground Covers	0.4 m	50%	*Pellaea falcata, Pteridium esculentum, Viola hederacea, Adiantum aethiopicum*
Vines & Climbers	N/A	N/A	*Cayratia clematidea, Cissus antarctica, Geitonoplesium cymosum, Hibbertia scandens, Maclura cochinchinensis, Marsdenia rostrata*

*Compiled from one site with structural data recorded.

Threats

Invasive weeds such as lantana (*Lantana camara*) and bitou bush (*Chrysanthemoides monilifera* subsp. *monilifera*) are prolific in disturbed landscapes that adjoin the remaining stands in the Sydney area.

Conservation Status

Coastal Dune Littoral Rainforest is a component of Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions, an Endangered Ecological Community under the TSC Act. It is also a component of Littoral Rainforest and Coastal Vine Thickets of Eastern Australia, a Critically Endangered Ecological Community under the EPBC Act.

It is represented in Towra Point NR and Royal NP.

	Within Study Area	Within Sydney Basin*
Estimate of pre-clearing area	Not available	Not available
Estimated percentage cleared	Not available	Not available
Total NPWS reserves	17.9 +0.2 hectares 74% of extant area	144 hectares 75-80% of extant area
Total reserved	19.1 +0.2 hectares 79% of extant area	Not available
Total non-reserved	5.0 +<.1 hectares	Not available
Total extant	24.1 hectares	185 hectares

*As this forest is only a component of the equivalent regional community, these figures overestimate its regional extent.

Example Locations

- Charlotte Breen Memorial Park, Kurnell
- Towra Point NR

Species Richness

Number of sites	4
Total native species	68
Average no. native species per site	28.5 ±10.3

Variations and Dynamics

No floristic or structural variations are currently recognised in this community.

Relationship to Other Communities

Closely related to other mesic forests (S_WSF03) found on sand dunes into which it grades in more exposed situations.

Accuracy

Sampling density is moderate. Map unit boundaries are based on the interpretation of digital imagery, sample sites, topographic position and field traverse. Small areas of the community may be overlooked in very disturbed situations where regeneration of pioneer species may obscure image patterns.

The minimum number of positive diagnostic species expected in a site located in this community was not calculated as the number of sites used to define this map unit in the study area is too small.

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Acmena smithii	3	75%	2	6%	Positive diagnostic
Adiantum aethiopicum	2	25%	2	7%	Uninformative
Banksia integrifolia	2	75%	2	9%	Positive diagnostic
Baumea juncea	2	25%	2	4%	Uninformative
Breynia oblongifolia	1	100%	1	17%	Positive diagnostic
Carex appressa	2	25%	2	1%	Positive diagnostic
Cassytha pubescens	1	25%	2	27%	Uninformative
Casuarina glauca	1	75%	2	7%	Positive diagnostic
Cayratia clematidea	2	100%	2	4%	Positive diagnostic
Cissus antarctica	2	75%	2	2%	Positive diagnostic
Cissus hypoglauca	1	25%	2	8%	Uninformative
Clematis glycinoides	2	25%	2	6%	Uninformative
Clerodendrum tomentosum	2	50%	1	5%	Positive diagnostic
Commelina cyanea	1	75%	2	9%	Positive diagnostic
Cupaniopsis anacardioides	3	75%	2	2%	Positive diagnostic
Cyperus imbecillis	2	25%	1	0%	Positive diagnostic
Diospyros australis	3	25%	2	1%	Positive diagnostic
Echinopogon ovatus	2	25%	2	6%	Uninformative
Einadia nutans	1	25%	1	1%	Positive diagnostic
Elaeodendron australe	3	25%	1	1%	Positive diagnostic
Entolasia marginata	2	25%	2	22%	Uninformative
Euchiton gymnocephalus	1	25%	2	0%	Positive diagnostic
Eustrephus latifolius	2	50%	2	15%	Constant
Ficus coronata	2	25%	2	1%	Uninformative
Ficus rubiginosa	4	50%	1	4%	Positive diagnostic
Geitonoplesium cymosum	2	100%	2	9%	Positive diagnostic
Geranium solanderi	1	25%	2	1%	Positive diagnostic
Glochidion ferdinandi	4	50%	1	13%	Constant
Glycine clandestina	1	25%	2	18%	Uninformative
Hibbertia scandens	2	75%	2	7%	Positive diagnostic
Hydrocotyle acutiloba	2	25%	2	1%	Positive diagnostic
Hypolepis muelleri	2	25%	2	5%	Uninformative
Imperata cylindrica var. *major*	1	25%	2	20%	Uninformative
Juncus usitatus	1	25%	1	3%	Uninformative
Kennedia rubicunda	1	25%	1	9%	Uninformative
Lepidosperma concavum	1	25%	2	4%	Uninformative
Leptospermum laevigatum	3	25%	2	5%	Uninformative
Livistona australis	1	50%	2	10%	Constant
Lomandra longifolia	3	50%	2	47%	Constant
Maclura cochinchinensis	2	50%	2	1%	Positive diagnostic
Marsdenia rostrata	2	50%	1	1%	Positive diagnostic
Myrsine variabilis	1	25%	1	8%	Uninformative
Notelaea longifolia	1	75%	1	21%	Constant
Omalanthus nutans	1	25%	1	9%	Uninformative
Oplismenus aemulus	2	25%	2	10%	Uninformative
Oplismenus imbecillis	2	25%	2	13%	Uninformative
Parsonsia straminea	2	25%	1	5%	Uninformative
Pellaea falcata	2	75%	2	2%	Positive diagnostic
Phyllanthus gunnii	1	25%	2	1%	Uninformative
Pittosporum revolutum	2	75%	1	9%	Positive diagnostic
Pittosporum undulatum	2	50%	2	25%	Constant
Plectranthus parviflorus	1	25%	2	3%	Uninformative
Poa affinis	1	25%	2	11%	Uninformative
Pyrrosia rupestris	1	25%	2	2%	Uninformative
Rhagodia candolleana subsp. *candolleana*	3	25%	2	0%	Positive diagnostic
Sarcopetalum harveyanum	2	50%	1	4%	Positive diagnostic
Senecio bipinnatisectus	3	25%	2	0%	Positive diagnostic
Senecio minimus	1	25%	1	0%	Positive diagnostic
Solanum americanum	1	25%	1	1%	Positive diagnostic
Solanum stelligerum	1	25%	1	0%	Positive diagnostic
Stephania japonica	2	75%	1	6%	Positive diagnostic
Streblus brunonianus	3	25%	0	0%	Positive diagnostic
Syzygium oleosum	1	25%	1	0%	Positive diagnostic
Syzygium paniculatum	3	50%	1	0%	Positive diagnostic
Viola hederacea	2	75%	2	6%	Positive diagnostic
Wahlenbergia gracilis	2	25%	1	8%	Uninformative

COASTAL ENRICHED SANDSTONE MOIST FOREST S_WSF02

Statewide Class North Coast Wet Sclerophyll Forests

NSW Plant Community Type: 1841
Biometric Number(s): ME59

Description

Coastal Enriched Sandstone Moist Forest is a tall open eucalypt forest with a distinctive mesic shrub and small tree layer. The canopy may be dominated by various combinations of eucalypts although smooth-barked apple (*Angophora costata*) is invariably present. On the north shore and inner harbours turpentine (*Syncarpia glomulifera*), blackbutt (*Eucalyptus pilularis*) and Sydney blue gum (*Eucalyptus saligna*) are dominant trees while on the Warringah and Pittwater escarpments bangalay (*Eucalyptus botryoides*) and mahoganies (*Eucalyptus umbra/scias*) are more prevalent. Elsewhere, Sydney peppermint (*Eucalyptus piperita*) may dominate. A tall stand of forest oak (*Allocasuarina torulosa*) is often present below the eucalypt canopy. Tall small trees tend to be rainforest plants such as coachwood (*Ceratopetalum apetalum)*, blueberry ash (*Elaeocarpus reticulatus)* and occasionally cabbage tree palms (*Livistona australis*). The forest floor is covered by a sparse to dense cover of ferns and twiners.

The distribution of this forest is widespread though patchy across the Sydney area. Typically it is situated in sandstone gullies and sheltered slopes enriched by clay material. This material is sourced from shale bands in the sandstone bedrock associated with Narrabeen sandstone on the Pittwater escarpment or Hawkesbury sandstone in the Lane Cove River valley. At other places the material is sourced from shale caps situated on ridgelines above the creek. Outcropping rocks and benches are common. It occurs at elevations between 10 and 120 metres above sea level and mean annual rainfall of 850-1250 millimetres per annum. A small disjunct location occurs in a shale-enriched gully near Campbelltown.

Floristic Summary*

	Average Height & Height Range (m)	Average Cover & Cover Range (%)	Typical Species
Trees	25 m ±6 15-35	34% ±15 10-65	*Angophora costata, Syncarpia glomulifera, Eucalyptus piperita, Eucalyptus pilularis, Eucalyptus saligna, Eucalyptus botryoides*
Small Trees	10 m ±5 4-20	30% ±21 2-80	*Elaeocarpus reticulatus, Pittosporum undulatum, Ceratopetalum apetalum, Allocasuarina torulosa, Glochidion ferdinandi*
Shrubs	4.1 m ±2.9 1.0-10.0	25% ±18 3-80	*Notelaea longifolia, Pittosporum undulatum, Dodonaea triquetra, Leucopogon lanceolatus* var. *lanceolatus, Polyscias sambucifolia, Pittosporum revolutum, Breynia oblongifolia, Myrsine variabilis*
Ground Covers	1.3 m ±0.7 0.3-3.0	28% ±20 5-75	*Dianella caerulea, Lomandra longifolia, Calochlaena dubia, Entolasia stricta, Pteridium esculentum, Poa affinis, Pseuderanthemum variabile, Lepidosperma laterale, Microlaena stipoides* var. *stipoides, Entolasia marginata, Gonocarpus teucrioides,*
Vines & Climbers	N/A	N/A	*Smilax glyciphylla, Pandorea pandorana, Eustrephus latifolius, Hibbertia dentata, Billardiera scandens, Cissus hypoglauca*

*Compiled from 25 sites with structural data recorded.

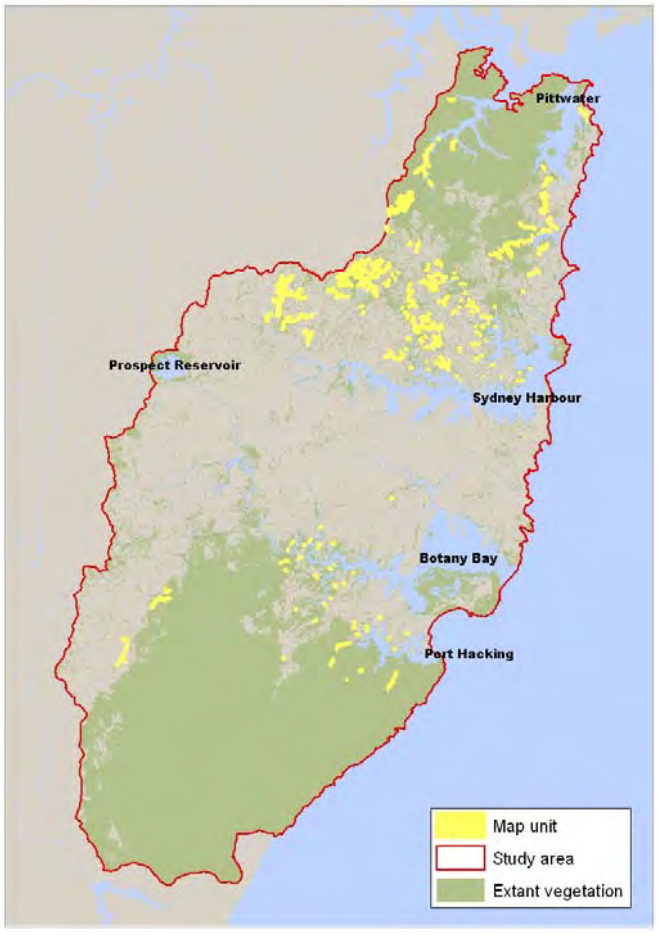
Threats

It is unlikely that extensive areas of this community have been lost to clearing as it persists in environments unsuitable for urban or agricultural development. However, the threats from weed infestation, particularly from lantana (*Lantana camara*) are high given prevailing moisture and soil enrichment. Frequent fire may present localised threats.

Conservation Status

The study area encompasses the majority of the distribution of the community in the region. The community is present in Lane Cove, Ku-ring-gai Chase, Royal and Sydney Harbour national parks.

	Within Study Area	Within Sydney Basin
Estimate of pre-clearing area	Not available	Not available
Estimated percentage cleared	Not available	Not available
Total NPWS reserves	337 +1.8 hectares 31% of extant area	Not available
Total reserved	741 +4.7 hectares 68% of extant area	Not available
Total non-reserved	343 +47.5 hectares	Not available
Total extant	1084 hectares	Not available



Example Locations

- Pennant Hills Park, Beecroft, Hornsby LGA
- Excelsior Park, North Rocks, Baulkham Hills LGA
- Warriewood escarpment, Pittwater LGA
- Myrtle Creek, Minto, Campbelltown LGA

Species Richness

Number of sites	81
Total native species	436
Average no. native species per site	41.5 ±9

Variations and Dynamics

Structural and floristic variations occur across the Sydney area. Variations in dominant eucalypt species are to be expected depending on location. Variations in the composition of some mesic species also occur as a result of variation in annual rainfall. For example *Livistona australis* is more common in low elevation coastal habitats while *Backhousia myrtifolia* occurs in lower rainfall zones. In protected sites the forest tends to be taller, while at sites exposed to ocean breezes the canopy is lower.

Relationship to Other Communities

This forest shares many species with other wet sclerophyll forests found on Narrabeen and Hawkesbury sandstones including S_DSF06, S_WSF05 and S_WSF04. The forest grades into rainforests in more protected situations (S_RF07, S_RF02). Importantly it may also grade into shale wet forests such as S_WSF09 or S_WSF01, which are both listed under the NSW TSC Act.

Accuracy

Sampling density is high. Map unit boundaries were determined on the interpretation of eucalypt forests with a moist understorey found on sandstone. The mapping may misclassify some areas that include a stronger shale influence in the composition of the understorey. These may be representative of the Sydney Turpentine Ironbark Forest Endangered Ecological Community.

A 0.04 hectare site located in this map unit is expected to contain at least 17 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 33 or greater.

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Acacia linifolia	2	12%	2	20%	Uninformative
Acacia terminalis	1	12%	1	20%	Uninformative
Acacia ulicifolia	2	21%	1	26%	Uninformative
Acmena smithii	1	19%	2	5%	Positive diagnostic
Acrotriche divaricata	2	15%	1	2%	Positive diagnostic
Adiantum aethiopicum	2	25%	2	6%	Positive diagnostic
Allocasuarina littoralis	2	16%	2	27%	Uninformative
Allocasuarina torulosa	3	58%	2	8%	Positive diagnostic
Angophora costata	3	73%	3	36%	Positive diagnostic
Asplenium flabellifolium	2	15%	1	3%	Positive diagnostic
Asterolasia correifolia	2	7%	2	0%	Positive diagnostic
Astrotricha floccosa	2	16%	2	2%	Positive diagnostic
Astrotricha latifolia	2	9%	1	1%	Positive diagnostic
Backhousia myrtifolia	4	9%	2	2%	Positive diagnostic
Banksia integrifolia	1	12%	2	9%	Uninformative
Banksia serrata	1	16%	2	34%	Uninformative
Banksia spinulosa	1	12%	2	27%	Uninformative
Billardiera scandens	1	48%	1	36%	Constant
Blechnum ambiguum	1	7%	1	0%	Positive diagnostic
Blechnum cartilagineum	2	44%	2	5%	Positive diagnostic
Breynia oblongifolia	1	42%	1	16%	Positive diagnostic
Callicoma serratifolia	2	25%	2	4%	Positive diagnostic
Calochlaena dubia	3	77%	2	14%	Positive diagnostic
Cassytha pubescens	2	26%	2	27%	Uninformative
Ceratopetalum apetalum	2	31%	3	4%	Positive diagnostic
Ceratopetalum gummiferum	2	44%	2	16%	Positive diagnostic
Cissus hypoglauca	2	42%	2	7%	Positive diagnostic
Clematis aristata	1	16%	1	7%	Uninformative
Clematis glycinoides	1	19%	2	6%	Positive diagnostic
Clerodendrum tomentosum	1	22%	1	5%	Positive diagnostic
Coronidium elatum	2	10%	1	1%	Positive diagnostic
Correa reflexa	2	20%	1	4%	Positive diagnostic
Dianella caerulea	2	93%	2	43%	Positive diagnostic
Dichondra repens	2	12%	2	14%	Uninformative
Dodonaea triquetra	2	40%	2	22%	Positive diagnostic
Elaeocarpus reticulatus	2	67%	1	19%	Positive diagnostic
Endiandra sieberi	1	14%	1	1%	Positive diagnostic
Entolasia marginata	2	23%	2	22%	Uninformative
Entolasia stricta	2	77%	2	58%	Positive diagnostic
Eucalyptus botryoides	2	14%	3	5%	Positive diagnostic
Eucalyptus pilularis	3	41%	3	13%	Positive diagnostic
Eucalyptus piperita	3	35%	3	19%	Positive diagnostic
Eucalyptus punctata	3	12%	2	11%	Uninformative
Eustrephus latifolius	2	59%	2	14%	Positive diagnostic
Galium binifolium	2	9%	1	2%	Positive diagnostic
Geitonoplesium cymosum	2	15%	2	9%	Uninformative
Glochidion ferdinandi	1	26%	2	13%	Positive diagnostic
Glycine clandestina	2	22%	2	18%	Uninformative
Gonocarpus teucrioides	2	35%	2	23%	Uninformative
Grevillea linearifolia	2	16%	2	7%	Uninformative
Hardenbergia violacea	2	15%	1	16%	Uninformative
Hibbertia dentata	2	48%	2	7%	Positive diagnostic
Hibbertia scandens	1	12%	2	7%	Uninformative
Imperata cylindrica var. *major*	2	32%	2	20%	Uninformative
Kennedia rubicunda	1	27%	1	8%	Positive diagnostic
Lasiopetalum ferrugineum	2	11%	2	11%	Uninformative
Lepidosperma elatius	1	6%	2	1%	Positive diagnostic
Lepidosperma laterale	2	51%	2	42%	Constant
Leptospermum polygalifolium	1	21%	2	14%	Uninformative
Leucopogon juniperinus	1	12%	2	10%	Uninformative
Leucopogon lanceolatus	1	52%	1	7%	Positive diagnostic
Livistona australis	2	35%	2	9%	Positive diagnostic
Lomandra filiformis	1	20%	2	23%	Uninformative
Lomandra longifolia	2	91%	2	45%	Positive diagnostic
Lomatia silaifolia	1	21%	1	28%	Uninformative
Marsdenia suaveolens	1	15%	1	3%	Positive diagnostic
Maytenus silvestris	1	14%	1	2%	Positive diagnostic

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Microlaena stipoides var. *stipoides*	2	42%	2	35%	Constant
Morinda jasminoides	2	28%	2	6%	Positive diagnostic
Myrsine variabilis	2	48%	1	7%	Positive diagnostic
Notelaea longifolia	2	65%	1	20%	Positive diagnostic
Omalanthus nutans	2	14%	1	9%	Uninformative
Opercularia aspera	2	20%	1	7%	Positive diagnostic
Oplismenus aemulus	2	20%	2	9%	Uninformative
Oplismenus imbecillis	2	30%	2	12%	Positive diagnostic
Ozothamnus diosmifolius	1	16%	1	11%	Uninformative
Pandorea pandorana	2	60%	2	15%	Positive diagnostic
Parsonsia straminea	1	11%	1	4%	Uninformative
Patersonia glabrata	1	11%	2	16%	Uninformative
Persoonia levis	1	12%	1	34%	Uninformative
Persoonia linearis	1	41%	1	19%	Positive diagnostic
Persoonia pinifolia	1	12%	1	21%	Uninformative
Phyllanthus hirtellus	1	16%	2	28%	Uninformative
Pittosporum revolutum	2	33%	1	8%	Positive diagnostic
Pittosporum undulatum	2	51%	2	24%	Positive diagnostic
Platylobium formosum	2	23%	2	8%	Positive diagnostic
Platysace lanceolata	2	23%	2	8%	Positive diagnostic
Poa affinis	2	43%	2	10%	Positive diagnostic
Podocarpus spinulosus	2	10%	2	2%	Positive diagnostic
Polyscias sambucifolia	1	27%	1	14%	Uninformative
Pomax umbellata	2	19%	2	15%	Uninformative
Poranthera microphylla	2	14%	2	7%	Uninformative
Pratia purpurascens	1	19%	2	18%	Uninformative
Pseuderanthemum variabile	2	43%	2	11%	Positive diagnostic
Pteridium esculentum	2	70%	2	39%	Positive diagnostic
Pultenaea daphnoides	1	19%	2	8%	Positive diagnostic
Pultenaea flexilis	2	25%	2	5%	Positive diagnostic
Pyrrosia rupestris	2	7%	2	1%	Positive diagnostic
Sarcopetalum harveyanum	1	15%	1	4%	Positive diagnostic
Schizomeria ovata	3	7%	1	1%	Positive diagnostic
Schoenus melanostachys	1	12%	2	6%	Uninformative
Smilax australis	2	11%	1	3%	Positive diagnostic
Smilax glyciphylla	2	81%	2	31%	Positive diagnostic
Stylidium laricifolium	2	7%	1	1%	Positive diagnostic
Stylidium productum	2	11%	2	5%	Uninformative
Syncarpia glomulifera	3	52%	2	12%	Positive diagnostic
Synoum glandulosum subsp. *glandulosum*	2	30%	2	5%	Positive diagnostic
Todea barbara	1	11%	2	1%	Positive diagnostic
Trema tomentosa var. *aspera*	1	10%	1	2%	Positive diagnostic
Tristaniopsis collina	2	10%	2	1%	Positive diagnostic
Trochocarpa laurina	1	7%	1	1%	Positive diagnostic
Tylophora barbata	1	17%	2	4%	Positive diagnostic
Xanthorrhoea arborea	2	31%	2	11%	Positive diagnostic
Xanthosia pilosa	1	23%	2	20%	Uninformative
Zieria pilosa	2	15%	2	5%	Positive diagnostic
Zieria smithii	1	23%	1	5%	Positive diagnostic

COASTAL SAND LITTORAL FOREST S_WSF03

Statewide Class North Coast Wet Sclerophyll Forests

NSW Plant Community Type: 1536: Bangalay-Smooth-barked Apple-Swamp Mahogany Low Open Forest of Southern Sydney, Sydney Basin Bioregion

Biometric Number(s): HU750; ME056

Description

Coastal Sand Littoral Forest comprises a forest and woodland community with a prominent component of littoral rainforest species amongst the shrub and small tree layer. An open cover of tuckeroo (*Cupaniopsis anacardioides*) and other waxy-leaved species occur below a canopy of banksia, casuarina and/or eucalypt trees. A high diversity of vines are found across multiple layers of the vegetation. The woody vine cockspur thorn (*Maclura cochinchinensis*), identifiable by its long spikes, is a useful diagnostic species for the community. Habitat and disturbance are both very influential in the structure and composition of the community at any given location. It is restricted to coastal sand deposits receiving greater than 1050 millimeters of mean annual rainfall. The most extensive areas remain on the older low-lying (c. 1.5-10 metres above sea level) transgressive barrier dunes along the northern side of the Kurnell Peninsula. On the drier siliceous sands the forest forms a eucalypt-dominated forest comprising bangalay (*Eucalyptus botryoides*) and/or swamp mahogany (*Eucalyptus robusta*) with a grassy and ferny ground cover. On the humic podsols associated with poorly drained areas eucalypts are less prominent and instead tall coast banksia (*Banksia integrifolia*) and swamp oak (*Casuarina glauca*) dominate above a ground cover of sedges thriving amongst the waterlogged soils. Above 10 metres above sea level this community is increasingly restricted to sheltered situations. Eucalypts may once have consistently dominated, however today lower-growing banksia scrubs are more common. Similar forests occur on the sand deposits on the New South Wales Central Coast.

Floristic Summary*

	Average Height & Height Range (m)	Average Cover & Cover Range (%)	Typical Species
Trees	15 m ±4 9-20	29% ±17 3-60	*Banksia integrifolia, Eucalyptus robusta, Eucalyptus botryoides, Casuarina glauca*
Small Trees	6 m ±3 3-10	24% ±18 5-60	*Cupaniopsis anacardioides, Banksia integrifolia, Pittosporum undulatum, Glochidion ferdinandi, Casuarina glauca, Leptospermum laevigatum*
Shrubs	3.1 m ±1.4 1.5-5.0	20% ±23 5-60	*Breynia oblongifolia, Monotoca elliptica, Notelaea longifolia, Imperata cylindrical* var. *major, Clerodendrum tomentosum*
Ground Covers	0.8 m ±0.6 0.2-2.0	43% ±18 15-80	*Lomandra longifolia, Pteridium esculentum, Commelina cyanea, Oplismenus imbecillis*
Vines & Climbers	N/A	N/A	*Geitonoplesium cymosum, Stephania japonica, Maclura cochinchinensis, Hibbertia scandens, Eustrephus latifolius*

*Compiled from 9 sites with structural data recorded.

Threats

Widespread and intensive disturbance arising from sand mining and industrial and urban development has resulted in extensive loss of this community. In many instances the original topography of the landscape has irreversibly changed with the loss and migration of sand dunes. Extant areas are often in dynamic stages of succession and heavily cloaked in invasive weeds such as lantana (*Lantana camara*) and bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*).

Conservation Status

Coastal Sand Littoral Forest is a component of Kurnell Dune Forest in the Sutherland Shire and the City of Rockdale, an Endangered Ecological Community under the NSW TSC Act. A significant proportion of the remaining area occurs within Towra Point NR.

	Within Study Area	Within Sydney Basin
Estimate of pre-clearing area	Not available	Not available
Estimated percentage cleared	Not available	Not available
Total NPWS reserves	44.4 +9.7 hectares 52% of extant area	Not available
Total reserved	47.4 +9.7 hectares 55% of extant area	Not available
Total non-reserved	38.5 +4.6 hectares	Not available
Total extant	85.9 hectares	Not available

Example Locations

- Central ridge of Towra Point NR, Kurnell (permission required for access)
- Charlotte Breen Memorial Park, Kurnell (highly disturbed example)

Species Richness

Number of sites	20
Total native species	103
Average no. native species per site	23.1 ±4.4

Variations and Dynamics

Variations are present across the distribution of this community. Eucalypt-dominated forests are prominent on low-lying sand flats while taller dunes tend to be mixed scrubs of banksia and tea-tree. Poorly drained sites on flats support a high proportion of swamp oak.

Relationship to Other Communities

This community shares many species with Coastal Dune Littoral Rainforest (S_RF06) and Coastal Sand Tea-tree-Banksia Scrub (S_HL02). The community grades toward swamp forests (S_FoW04, S_FoW03) on poorly drained low-lying areas. On higher dunes in more exposed situations the forest will grade into S_DSF21 or S_DSF02.

Accuracy

Sampling density is high. Map unit boundaries are drawn from the interpretation of digital imagery to identify mesic-influenced vegetation on coastal sand deposits. Disturbance patterns visible on aerial photography may mask the presence of this community in some instances.

Species S_WSF03

A 0.04 hectare site located in this map unit is expected to contain at least 11 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 17 or greater.

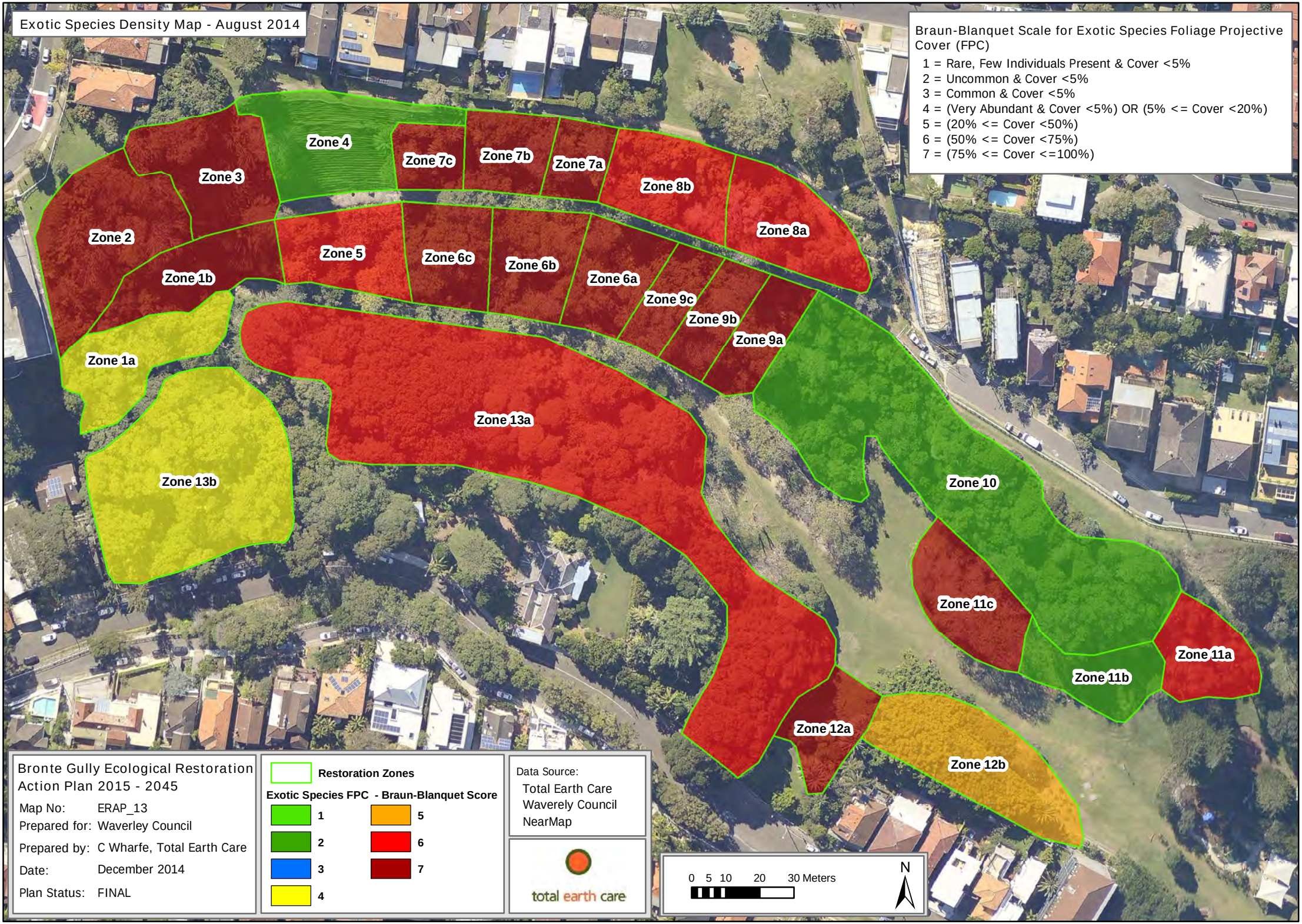
Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
Acacia longifolia	1	50%	2	21%	Positive diagnostic
Acacia maidenii	1	15%	1	1%	Uninformative
Acacia melanoxylon	2	10%	1	0%	Uninformative
Acmena smithii	2	20%	2	6%	Uninformative
Acronychia oblongifolia	2	10%	1	0%	Uninformative
Allocasuarina littoralis	1	15%	2	27%	Uninformative
Banksia integrifolia	2	100%	2	9%	Positive diagnostic
Banksia serrata	2	15%	2	33%	Uninformative
Baumea juncea	2	35%	2	4%	Positive diagnostic
Breynia oblongifolia	2	90%	1	16%	Positive diagnostic
Cassytha pubescens	1	10%	2	27%	Uninformative
Casuarina glauca	2	55%	2	6%	Positive diagnostic
Cayratia clematidea	2	40%	2	4%	Positive diagnostic
Cissus antarctica	2	10%	2	2%	Uninformative
Clematis aristata	1	15%	1	7%	Uninformative
Clematis glycinoides	2	35%	2	6%	Positive diagnostic
Clerodendrum tomentosum	1	30%	1	5%	Positive diagnostic
Commelina cyanea	2	55%	2	8%	Positive diagnostic
Cupaniopsis anacardioides	2	90%	1	1%	Positive diagnostic
Desmodium varians	2	15%	2	8%	Uninformative
Dianella revoluta	1	15%	2	17%	Uninformative
Dichondra repens	2	15%	2	14%	Uninformative
Elaeocarpus reticulatus	1	10%	1	21%	Uninformative
Entolasia marginata	1	20%	2	22%	Uninformative
Eucalyptus botryoides	2	25%	3	5%	Positive diagnostic
Eucalyptus robusta	4	30%	3	1%	Positive diagnostic
Eustrephus latifolius	2	45%	2	15%	Positive diagnostic
Ficus rubiginosa	1	10%	1	4%	Uninformative
Geitonoplesium cymosum	3	90%	2	8%	Positive diagnostic
Glochidion ferdinandi	2	70%	1	13%	Positive diagnostic
Glycine clandestina	2	10%	2	18%	Uninformative
Hibbertia scandens	2	45%	2	6%	Positive diagnostic
Imperata cylindrica var. *major*	2	55%	2	20%	Positive diagnostic
Ipomoea brasiliensis	2	15%	0	0%	Uninformative
Leptospermum laevigatum	3	30%	2	5%	Positive diagnostic
Leucopogon parviflorus	2	15%	1	1%	Uninformative
Lomandra longifolia	2	70%	2	46%	Constant
Maclura cochinchinensis	2	55%	2	0%	Positive diagnostic
Macrozamia spiralis	2	10%	1	1%	Uninformative
Marsdenia rostrata	1	15%	1	1%	Uninformative
Melaleuca nodosa	3	10%	2	5%	Uninformative
Monotoca elliptica	1	70%	2	6%	Positive diagnostic
Myoporum acuminatum	1	10%	2	0%	Uninformative
Myrsine variabilis	1	30%	1	8%	Positive diagnostic
Notelaea longifolia	2	70%	1	21%	Positive diagnostic
Omalanthus nutans	2	40%	1	9%	Positive diagnostic
Oplismenus aemulus	2	10%	2	10%	Uninformative
Oplismenus imbecillis	2	55%	2	12%	Positive diagnostic
Parsonsia straminea	2	35%	1	4%	Positive diagnostic
Pellaea falcata	2	10%	1	2%	Uninformative
Pimelea linifolia	1	10%	2	27%	Uninformative
Pittosporum revolutum	2	40%	1	9%	Positive diagnostic
Pittosporum undulatum	2	55%	2	25%	Positive diagnostic
Poa affinis	2	15%	2	11%	Uninformative
Pteridium esculentum	2	75%	2	40%	Positive diagnostic
Rhagodia candolleana subsp. *candolleana*	2	10%	2	0%	Uninformative
Sarcopetalum harveyanum	3	10%	1	4%	Uninformative
Schoenus melanostachys	2	10%	2	6%	Uninformative
Smilax glyciphylla	2	15%	2	33%	Uninformative
Spinifex sericeus	2	10%	2	1%	Uninformative
Stephania japonica	2	55%	1	5%	Positive diagnostic
Tetragonia tetragonioides	2	20%	2	2%	Positive diagnostic

Bronte Gully Ecological Restoration Action Plan - Appendix C

Planting Zones and Ecological Condition Mapping


Revegetation Types - Community References (OEH 2013)
Upper Slope Species - Coastal Sandplain Heath
Upper-Mid Slope Species - Coastal Sandstone Foreshore Forest & Coastal Sand Apple Bloodwood Forest
Lower-Mid Slope Species - Coastal Dune Littoral Rainforest with elements of Coastal Enriched Sandstone Mois Forest and Coastal Sand Littoral Forest
Zone 1a
Zone 1b
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6a
Zone 6b
Zone 6c
Zone 7a
Zone 7b
Zone 7c
Zone 8a
Zone 8b
Zone 9a
Zone 9b
Zone 9c
Zone 10
Zone 11a
Zone 11b
Zone 11c
Zone 12a
Zone 12b
Zone 13a
Zone 13b
Bronte Gully Ecological Restoration Action Plan 2015 - 2045
Map No: ERAP_11
Prepared for: Waverley Council
Prepared by: C Wharfe, Total Earth Care
Date: December 2014
Plan Status: FINAL
Restoration Zones
Revegetation Types
Upper Slope Species
Upper-Mid Slope Species
Lower-Mid Slope Species
Reforestation Species
Data Source:
Total Earth Care
Waverely Council
NearMap
total earth care
0 5 10 20 30 Meters
N


Bushland Resilience Map - August 2014
Native Vegetation Resilience Key
1 Soil profile intact for regeneration pathways (possible original soil profile and possible soil stored seed, seed rain or underground plant parts capable of reshooting)
2 Virtually weed free and all vegetation layers present (except if due to natural causes eg. fire, storm) VERY HIGH
2* Some minor weed growth or layers absent
3 Minor weed infestations but no layers absent HIGH
3* Weed infestations or disturbance leading to decline of at least one layer
4 Loss or strong decline of at least one layer but some active resilience at ground layer MEDIUM
4* Loss or strong decline of at least two layers with no or little active resilience at ground layer LOW
1* Soil profile NOT intact for regeneration pathways (No possibility of original soil profile nor any possibility for regeneration of soil stored seed, seed rain or underground plant parts capable of reshooting) NOT NATIVE VEGETATION
Zone 1a
Zone 1b
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6a
Zone 6b
Zone 6c
Zone 7a
Zone 7b
Zone 7c
Zone 8a
Zone 8b
Zone 9a
Zone 9b
Zone 9c
Zone 10
Zone 11a
Zone 11b
Zone 11c
Zone 12a
Zone 12b
Zone 13a
Zone 13b
Bronte Gully Ecological Restoration Action Plan 2015 - 2045
Map No: ERAP_12
Prepared for: Waverley Council
Prepared by: C Wharfe, Total Earth Care
Date: December 2014
Plan Status: FINAL
Restoration Zones
Resilience Scores
2 - Very High
3 - High
4 - Medium
4* - Low
Data Source:
Total Earth Care
Waverely Council
NearMap
total earth care
0 5 10 20 30 Meters
N


Exotic Species Density Map - August 2014
Braun-Blanquet Scale for Exotic Species Foliage Projective Cover (FPC)
1 = Rare, Few Individuals Present & Cover <5%
2 = Uncommon & Cover <5%
3 = Common & Cover <5%
4 = (Very Abundant & Cover <5%) OR (5% <= Cover <20%)
5 = (20% <= Cover <50%)
6 = (50% <= Cover <75%)
7 = (75% <= Cover <=100%)
Zone 1a
Zone 1b
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6a
Zone 6b
Zone 6c
Zone 7a
Zone 7b
Zone 7c
Zone 8a
Zone 8b
Zone 9a
Zone 9b
Zone 9c
Zone 10
Zone 11a
Zone 11b
Zone 11c
Zone 12a
Zone 12b
Zone 13a
Zone 13b
Bronte Gully Ecological Restoration Action Plan 2015 - 2045
Map No: ERAP_13
Prepared for: Waverley Council
Prepared by: C Wharfe, Total Earth Care
Date: December 2014
Plan Status: FINAL
Restoration Zones
Exotic Species FPC - Braun-Blanquet Score
1
2
3
4
5
6
7
Data Source:
Total Earth Care
Waverely Council
NearMap
total earth care
0 5 10 20 30 Meters
N