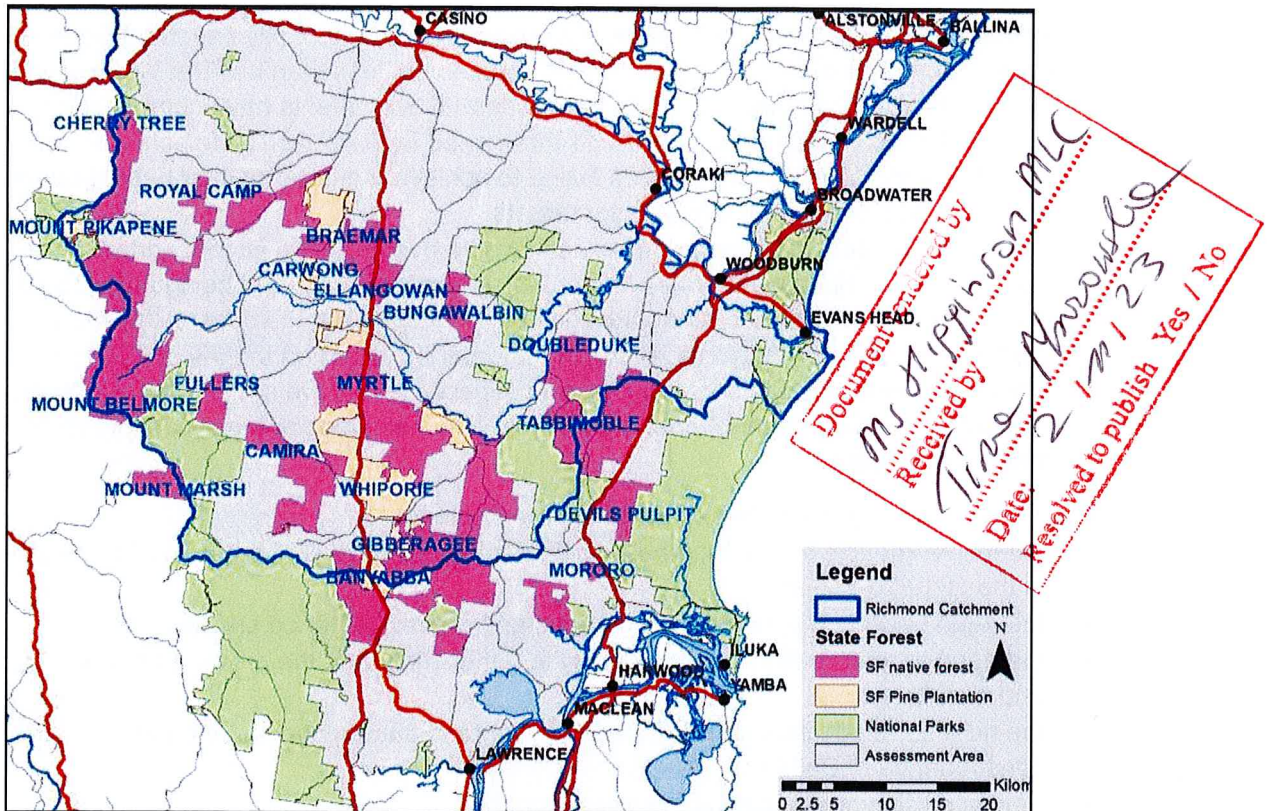


Protecting the Southern Richmond

Dailan Pugh, North East Forest Alliance, October 2023.

This assessment of the Southern Richmond identifies the conservation values of 56,200 hectares of native vegetation on State forests in the southern Richmond River catchment and on the southern Richmond Range in north-east NSW, Australia.



This assessment is focussed on the State Forests in the southern Richmond River catchment and on the southern Richmond Range. The assessment area is bordered to the north by the Richmond River from Ballina to Casino, to the south by the Clarence River from Iluka to Lawrence, and to the west by the Richmond Range. The named State forests are recommended as additions to the reserve system.

It is recommended that the southern Richmond State forests be transitioned to the reserve system due to:

- being part of the Banyabba Area of Regional Koala Significance, the largest area of high quality Koala habitat with potential for long-term viability in the Richmond catchment
- encompassing 28,000ha of Nationally Important Koala Areas, identified as a Commonwealth priority for reservation
- supporting a high diversity of plants and animals including; many reaching or approaching their northern, southern or eastern distributional limits, a significant woodland outlier, a suite of plants endemic to the Clarence-Moreton Basin or with disjunct populations in the Sydney basin, migratory and nomadic nectivores, and a refuge for species declining elsewhere
- providing potential habitat for four Critically Endangered, 39 Endangered and 89 Vulnerable species, along with an Endangered Population
- providing tree-hollows essential as dens and nests for a multitude of species, of which 22 species are threatened with extinction, including the Endangered Southern Greater Glider and Vulnerable Spotted-tailed Quoll, Yellow-bellied Glider, South-eastern Glossy Black-

- Cockatoo, Masked Owl, Barking Owl, Sooty Owl, and Powerful Owl who need the large hollows provided by trees over 220 years old
- providing critical winter nectar resources for a multitude of migratory, nomadic and resident nectivores, including the Critically Endangered Swift Parrot and Regent Honeyeater
- encompassing parts of the largest area of intact wetlands, woodlands and forests left on the extensively cleared Richmond floodplain, mostly now listed as Endangered Ecosystems
- encompassing 35,000ha of forest ecosystems that still fail to meet the 1997 targets for inclusion of 15% of their original extent in the national reserve system
- being within the NSW section of the nationally and internationally important South-East Queensland Bioregion which has only 14% reserved, less than half the target of 30% reservation by 2030 that both State and Federal Governments have committed to
- contributing to viable populations of 41 threatened fauna which fail to achieve reserve targets set in 1998, with 14 species failing to achieve a quarter of their habitat targets, and another 18 less than half their habitat targets
- providing an altitudinal gradient from sea level to over 600m to accommodate shifts in species distributions in response to increasing temperatures, and being part of a nationally significant climate corridor along the Richmond Range from the coast to the Border Ranges
- ability to immediately begin regaining in the order of 28 million tonnes of CO₂ released into the atmosphere through past logging, and capacity to remove some 359,000 tonnes of atmospheric CO₂ per annum and again store it in their wood and soils as forests recover and trees grow bigger.

The need for action to protect these forests is urgent due to:

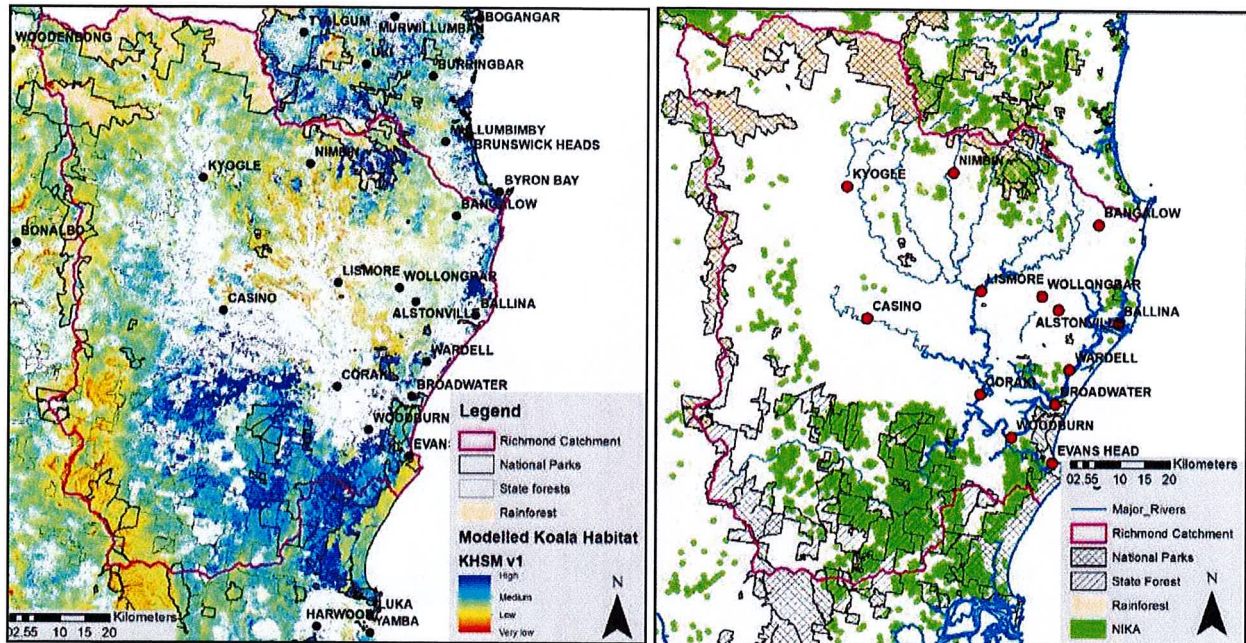
- extensive impacts from past logging being amplified by 86% of the State Forests being burnt in the 2019/20 wildfires
- the rapid decline in populations of Koalas and other threatened species
- the need to restore the forest's integrity to better withstand the growing threats of droughts and bushfires
- the need to rehabilitate stands invaded by lantana due to logging, and those in collapse as a consequence of Bell Miner Associated Dieback
- the imperative of reducing atmospheric carbon.

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1. SOUTHERN RICHMOND SUMMARY

The principal motivation for this assessment is concern for the Banyabba Area of Regional Koala Significance (ARKS). Since NEFA identified and stopped logging of multiple Koala High Use Areas in Royal Camp State Forest in 2012 we have focussed on better defining and protecting this poorly known population. It was identified as an ARKS and as a Nationally Important Koala Area (NIKA) due to its *high-quality and relatively intact Koala habitat and potential for long-term viability*. These forests provide exceptional habitat because of their extent, high numbers of preferred Koala feed trees, ability to access shallow groundwater in droughts, and limited threats from urban interactions.



Models of Koala habitat across the Richmond catchment show the extent and importance of Koala habitat in the southern Richmond, particularly on public lands LEFT: OEH Koala Habitat Suitability Model ranking of Koala habitat (dark blue is highest). RIGHT: Nationally Important Koala Areas (NIKAs) (green) mapped by the NESP Threatened Species Recovery Hub (Runge *et. al.* 2021).

The southern Richmond's NIKA are identified by the Commonwealth as priority habitat for inclusion into state protected areas because they support viable populations with the greatest potential for population-level recovery.

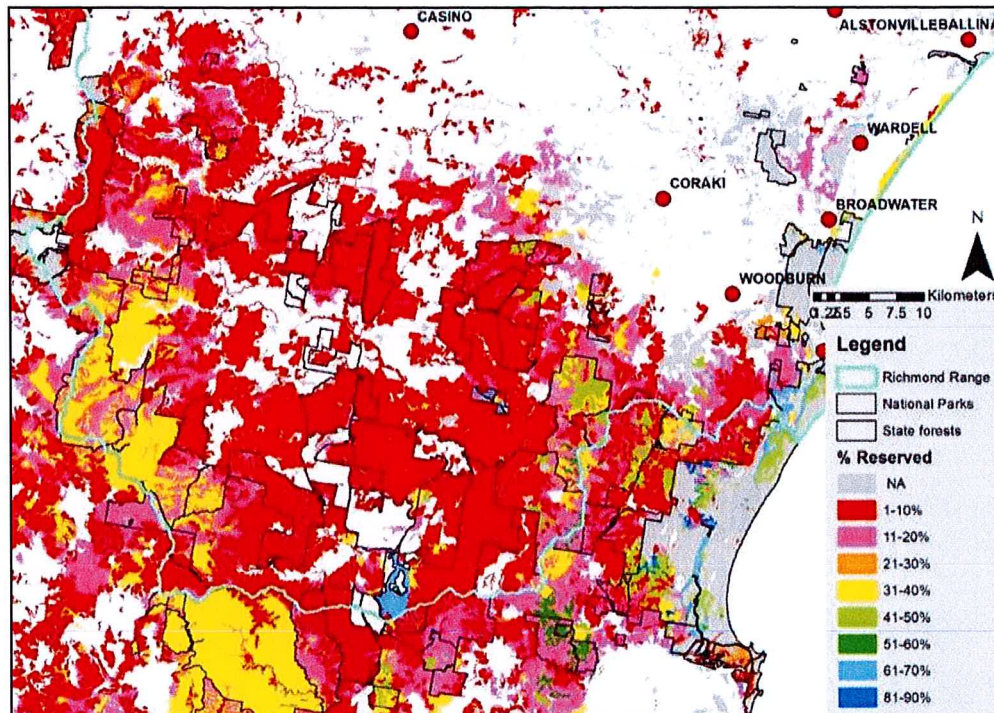
On the north coast Koala populations are estimated to have halved in the last few decades. In the southern Richmond the primary threats to Koala are clearing, logging, wildfires and climate heating. Past logging has focussed on removing mature and oldgrowth trees, in the process reducing the biomass of mature trees (>30cm DBH) by around two thirds in extensive areas. The loss of mature trees preferred by Koalas, and reduced volume of browse, has significantly reduced the numbers of Koalas these forests can support.

The 2019/20 wildfires burnt through most of these forests, resulting in significant losses of both Koalas and mature feed trees. Some 86% of the State Forests were burnt and over half their Koalas killed. Recovery will be a slow process, taking decades, though it is underway. The Koala's future is increasingly precarious as temperatures rise, and droughts, heatwaves and wildfires are becoming more frequent and intense.

Continued logging will compound problems by removing most surviving mature feed trees, drying the forest and increasing fire risk. The Banyabba Koalas urgently need a reprieve to give their population a chance to recover and increase, by allowing their preferred feed trees to grow.

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From 1995-1998 the NSW Government undertook a Comprehensive Regional Assessment aimed at protecting a minimum of 15% of the pre-European extent of each forest ecosystem in accordance with national forest reserve criteria. The outcome was that most lowland forest ecosystems and their biota in the southern Richmond have 10% or less of their original extent reserved due to a political deal made by the then ALP member for Clarence, Harry Woods, to minimise reservation of Spotted Gum forests to appease the loggers. By any metric, the forests of the southern Richmond are very inadequately protected. It is past time to give these forests the protection they clearly deserve.



Reserve status of forest ecosystems: as identified in the 2018 North East NSW Regional Forest Agreement "variation", based on pre-European extent of RFA identified forest ecosystems, showing the poor reservation of southern Richmond forests, particularly the lowland forests. Note that rainforest and non-forest ecosystems were not assessed (NA).

These forests are part of the South Eastern Queensland Bioregion, a nationally and internationally recognised biodiversity hotspot. The NSW section of this bioregion currently only has 14% of its extent protected in reserves.

In accordance with the [Kunming-Montreal Global Biodiversity Framework](#), the NSW and Commonwealth Governments have committed to reserving 30% of our land area by 2030. Native forests on State forests encompass 10.3% of the NSW section of the south-east Queensland bioregion, so protecting them will increase reservation to 24.3%. Achieving the 30x30 target (which should be a minimum for such a biodiverse region) will also necessitate protecting 94,000 ha of private land.

The woodlands and dry forests of the southern Richmond extend inland from coastal dunes and wetlands, across an extensive floodplain dotted with wetlands, onto gently rolling sandstone country and thence up onto the Richmond Range at around 400-600 metres. To the north the Richmond Range has higher rainfall and extensive rainforest.

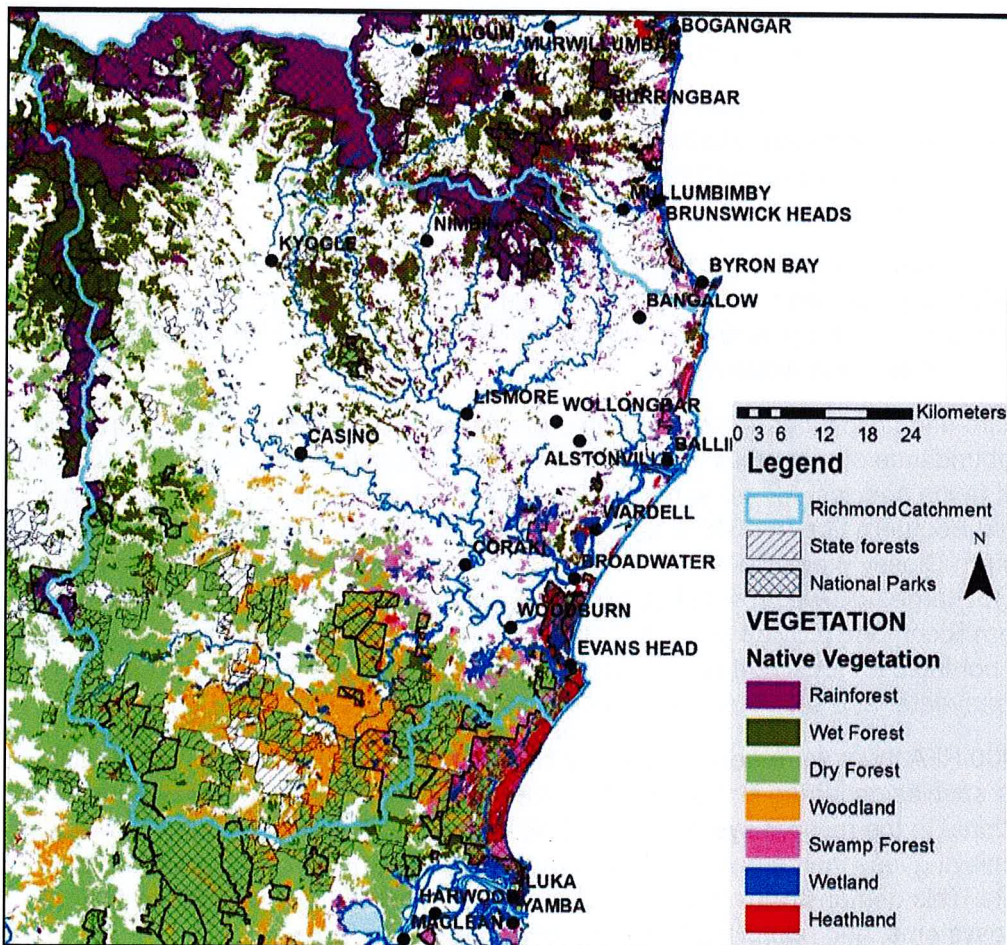
The Richmond Range forms the watershed between the Richmond River and Clarence River catchments. The Richmond Range extends from sea level in Bundjalung National Park (south of Evans Head), for some 230 km west and then north, to join the McPherson Range (NSW-Queensland border) at around 800m elevation near Mount Lindesay, north-east of Woodenbong.

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Within the southern Richmond the range is characterised by cliffs and peaks, mostly 400-500m, rising to 658m at the summit of Mount Belmore. The range is forested its entire length, except for clearing near Mallanganee, and is mostly within public lands, making it a nationally important wildlife corridor.

The underlying geology is sedimentary rocks, primarily sandstones deposited over 200 million years in the subsiding Clarence-Moreton Basin during the dinosaur (Mesozoic) era, now being eroded by the Richmond River creating an extensive floodplain. The floodplain is surrounded by the exposed underlying sandstone that generally produces gently rolling country with flat topography. This is ringed by the older sandstones forming the Richmond Range.

The coastal vegetation (mostly within Broadwater and Bundjalung National Parks) is dominated by heathlands on old dunes, interspersed with wetlands and swamp forest. This is not further considered herein.



Broad vegetation groups across the Richmond River valley. The extensive dry forests and woodlands south from Casino to Lawrence are the focus of this assessment.

Where it remains uncleared the extensive floodplain has scattered patches of wetlands and swamp forest, including small rainforest stands, amid extensive areas of Lowland Red Gum woodlands. Because of the extensive clearing of the floodplain to the north, most remnant floodplain vegetation is identified as Endangered Ecological Communities (EECs).

The southern Richmond is characterised by extensive dry forests on sandstones. On the lowlands around the floodplain the dry forests are dominated by Spotted Gum, often with Lowland Grey Box, in various associations with ironbarks, grey gum, red gums, Blackbutt and apples. Spotted Gum

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dominated forests extend onto the Richmond Range in Cherry Tree State Forest. The sandstone ranges are mostly dominated by Blackbutt, stringybarks, mahogany, bloodwoods and apples.

The eucalypt forests and woodlands on the Clarence-Moreton sandstones support a suite of endemic plant species, 11 of which are threatened with extinction and have most, or a significant part, of their distribution within the southern Richmond. A further 11 threatened plant species prefer these dry forests, some reaching their greatest abundance here. They provide an important refuge for a suite of threatened woodland birds and mammals that are rapidly declining inland, and provide an important over-wintering site for nectivorous migratory and nomadic birds.

Wetlands and patches of wet sclerophyll forests and rainforest are scattered amongst the dry forests along streams and in topographically protected refuges. Another 12 threatened species of plants occur in the eucalypt forests associated with wetlands and wet habitats, and 29 threatened plants associated with rainforest. Large stands of dry rainforests and wet-sclerophyll forests occur on the Richmond Range north from Mount Pikapene, these too are identified as Endangered Ecological Communities due to past clearing.

The plants and animals are very diverse, some reach or approach their southern limits, others their northern and some are endemic to the sub-tropics. In total there are 63 plant species found in the forests of the southern Richmond that are threatened with extinction, with two Critically Endangered, 27 Endangered and 34 Vulnerable to extinction.

Of the diverse fauna inhabiting the forests of the southern Richmond, 66 species are threatened with extinction, of these two are Critically Endangered, nine Endangered and 55 Vulnerable to extinction. Additionally, there is an endangered Emu population, and three Endangered fish known to inhabit the streams and wetlands.

Large mature and hollow-bearing trees have been severely depleted by past logging and along with them the abundance of resources that the survival of many species depend upon. Of the threatened fauna species, 22 utilize tree-hollows for denning, roosting or nesting, including the Endangered Southern Greater Glider and Vulnerable Spotted-tailed Quoll, Yellow-bellied Glider, South-eastern Glossy Black-Cockatoo, Masked Owl, Barking Owl, Sooty Owl, and Powerful Owl who need the large hollows provided by trees over 220 years old. The mature trees (>40cm DBH) in the southern Richmond provide abundant critical winter nectar resources for a multitude of migratory, nomadic and resident nectivores, including the Critically Endangered Swift Parrot and Regent Honeyeater and six Vulnerable species, including the Grey-headed Flying Fox.

For the 2000 RFA there were aerial targets for habitat to be included in reserves identified for 45 threatened species occurring in the lower Richmond. Based on average target achievement (across all populations) in the reserve system as at 2004; 41 species failed to achieve their reserve targets, with 14 achieving less than a quarter of their targets and an additional 18 achieving less than half their targets. This demonstrates the inadequacies of the existing reserve system for forest fauna as well as ecosystems, and reinforces the need for a significant expansion.

The southern Richmond is particularly significant because most of the area remains forested, with some 250,000ha mapped as forest. Half this is on private lands, with 26% in National Parks and 23% in State Forests. Most of the remnant forest has been degraded by past logging and grazing, leaving little of the more productive accessible forests as oldgrowth. The largest intact areas are on National Parks in the Banyabba and Bundjalung Wilderness Areas. Of the 56,500 ha of forests and woodlands on State Forests around half, some 27,900 ha, are currently available for relogging.

As the biggest trees have been progressively removed for sawlogs this has resulted in the loss of most old trees, with an overall loss of around 59% of live above ground biomass, which means the depletion food resources and essential tree hollows for fauna, along with a reduction in sawlogs. It

is a mining operation where removals are not balanced by regrowth. Past logging of the southern Richmond State forests has likely resulted in a net release of CO₂ to the atmosphere in the order of some 28 million tonnes. If the State forests are now protected they have the capacity to remove this carbon from the atmosphere and again store it in their wood and soil, drawing down some 359,000 tonnes of CO₂ per annum. They can make a significant contribution to addressing climate heating.

The region was significantly affected by the 2019/20 wildfires burning two thirds of the forests, increasing to 86% of State Forests. It is expected that in these State forests 14% of trees >30 cm DBH and 43% of trees <30cm DBH were killed, and across the forests populations of an array of threatened species substantially reduced. The most immediate need identified was the protection of unburned or partially burned areas as refugia and source areas for population recovery, which would need protection for at least 20 years. The Forestry Corporation responded by denying any significant loss of resources, extending Wood Supply Agreements for 5 years (unaltered), while placing the temporary exclusions required for the least affected forests over those most intensively burnt. Logging, lantana, and climate heating are increasing the risk of worse fires in the future, emphasizing the need to allow these forests time to recover and regain their natural resilience.

The exceptionally biodiverse forests of the southern Richmond have been poorly treated and denied the protection they need and deserve for far too long, it is time to protect those occurring on State forests.

1.1. Property Description

The Richmond River catchment covers 685,800 ha in north-east NSW, Australia. The Richmond River floodplain is the largest coastal floodplain on the NSW coast, covering 100,000 ha. The tidal limit extends 110 kilometres upstream to Casino on the Richmond River and Boat Harbour at Lismore on the Wilson River.

This assessment is focussed on 56,200 ha of native vegetation on State Forests in the southern Richmond River catchment and on the southern Richmond Range. These are considered in the context of a broader assessment area covering 376,000 ha (Map, p.1), bordered to the north by the Richmond River from Ballina to Casino, to the south by the Clarence River from Iluka to Lawrence, and to the west by the Richmond Range. Within the assessment area forest values and impacts are considered more broadly. Beaches, sand dunes, heathlands and coastal wetlands are generally not considered.

The southern Richmond River catchment included in the assessment area is 267,669 ha. The National Parks considered total 77,937 ha. The State forests encompass 56,200 ha of native vegetation, with an additional 16,400 ha of State forests claimed as pine plantations.

The native forests recommended for reservation occur on the State forests of: Banyabba, Braemar, Bungawalbin, Camira, Carwong, Cherry Tree, Devil's Pulpit, Doubleduke, Ellangowan, Fullers, Gibberagee, Mororo, Mount Belmore, Mount Marsh, Mount Pikapene, Myrtle, Royal Camp, Tabbimoble, and Whiporie. These forests are recommended for protection in their entirety, excluding pine plantations - except where required for connecting corridors.

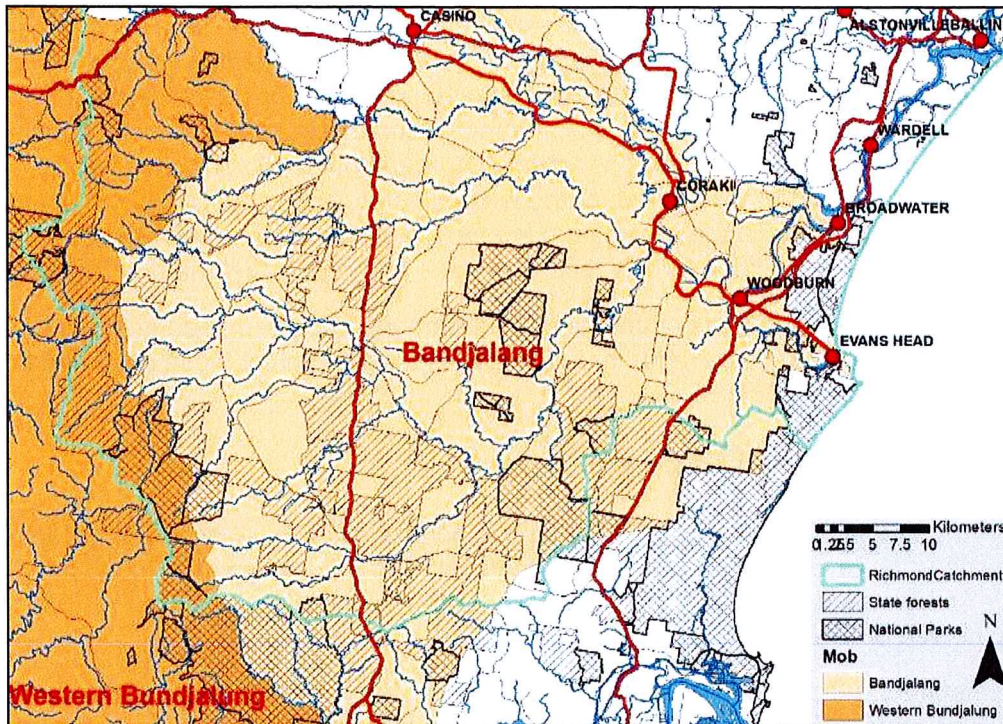
The area is part of a landscape of cultural importance to the people of the Bundjalung Nation, particularly the Bandjalang and Western Bundjalung peoples. It contains a network of cultural sites, including mythological sites, open campsites, stone arrangements, stone artefacts and rock shelters containing paintings and engravings.

The Bandjalang clan first lodged a native title application in the 1996, with a larger second application lodged in 1998. The claim took 17 years to have their relationship with the land formally and legally recognised by the Federal Court. On 2 December 2013 Native Title was recognised over

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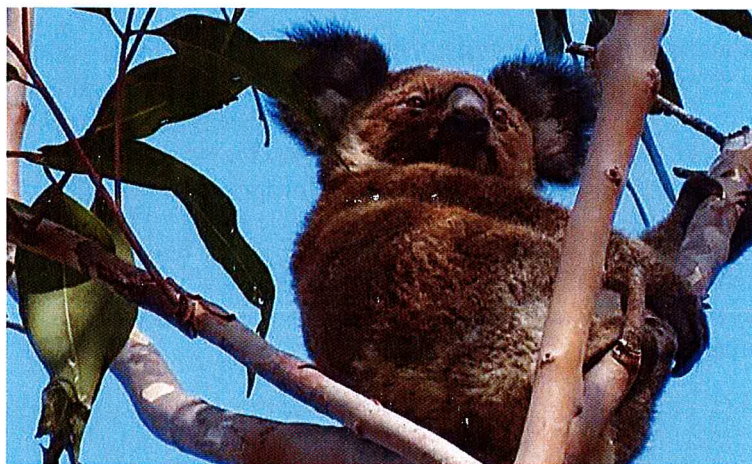
2,750 km² from Evans Head, north-west to Casino, inland to Busby Flat and south to Junction Hill near Grafton, with native title recognised over extensive areas of crown land and vested in the Bandjalang Aboriginal Corporation Prescribed Body Corporate.

On 29 August 2017 the Western Bundjalung clan had their 'non-exclusive' Native Title rights and interests recognised by the Federal Court over 5,773 km² from near Casino west to near Tenterfield, and from near Grafton north to near Tooloom.



Map 1. The Bandjalang clan are acknowledged as the Native Title holders for the majority of the southern Richmond catchment. The Western Bundjalung clan are acknowledged as the Native Title holders for the Richmond Range to the west, including Cherry Tree, Mount Pikapene and Mount Belmore State Forests.

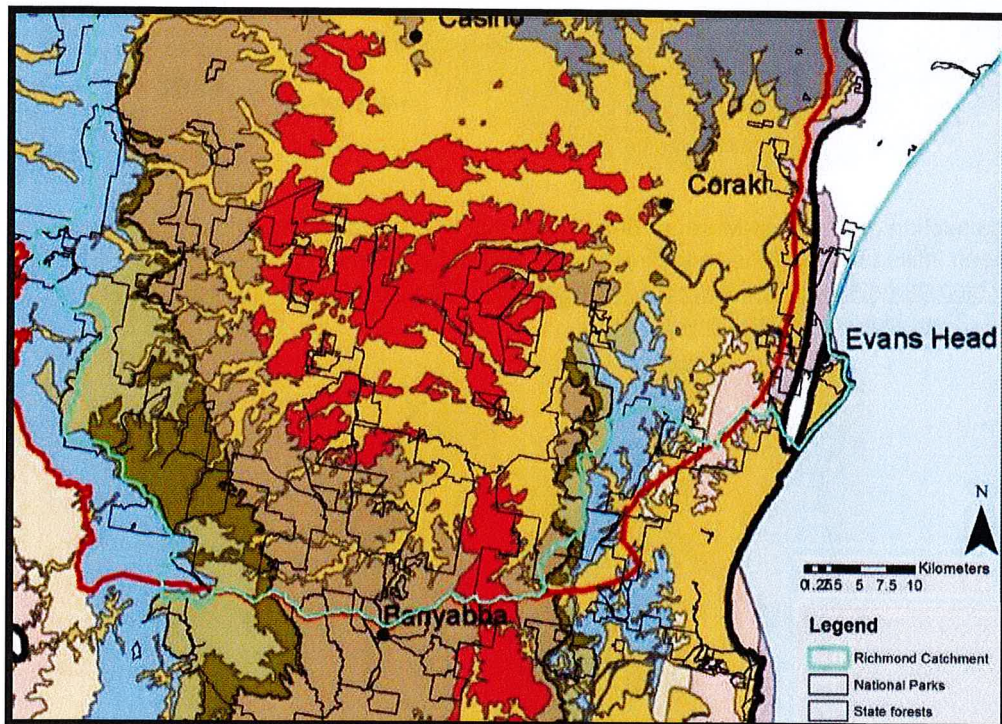
The forests primarily occur within the Richmond Valley Local Government Area (LGA), though extend to the west and south into the Clarence Valley LGA, and marginally to the north-west into the Kyogle LGA and to the north-east into the Ballina LGA. They are in the NSW electorate of Clarence, with marginal extensions into the Lismore electorate to the north west and Ballina electorate to the north east. They fall within the Federal electorate of Page.



2.GEOLOGY

The Richmond River catchment is underlain by the 2.5-4km thick, 250-65 million year old, sediments of the Clarence-Moreton Basin, deposited in sequences of swamps, rivers and lakes as the basin subsided and filled during the dinosaur era. To the north the catchment boundary is defined by the ranges and plateaus formed by the remnants of the Focal Peak and Tweed Volcanoes that intruded through the basin's sediments 20-25 million years ago.

The southern Richmond is formed from the eroded sedimentary rocks of the Clarence-Moreton basin, bounded by the Richmond Range. The boundary between the 180 million year old Walloon Coal Measures (medium- to fine-grained, soft, grey lithic sandstone, siltstone and shale with bituminous coal seams) and the overlying 135–180 million year old Kangaroo Creek Sandstone, characterised by unusual caves and rocky outcrops, form the bulk of the Richmond Range.



Simplified surface geology

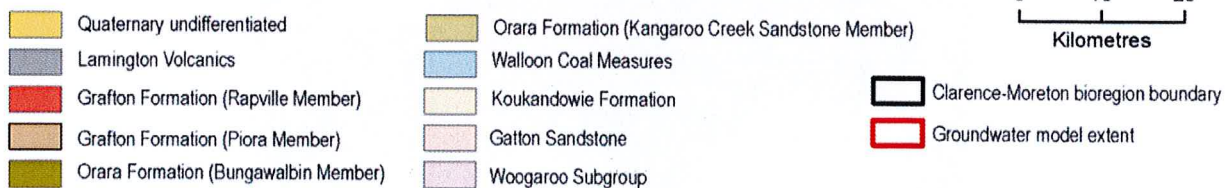


Figure 10 New geological map derived from different pre-existing maps and showing the revised stratigraphy in New South Wales

Map 2. Adapted extract of Figure 10 from Raiber *et. al.* (2016).

Younger sedimentary rocks of the Orara and Grafton Formations are progressively exposed at lower elevations. The floodplain is overlain with alluvium (Quaternary undifferentiated) washed down from the exposed bedrock, to a depth mostly less than 30m in the centre of the alluvium around the lower Richmond River, with local thicknesses of up to approximately 45m. The headwater alluvial deposits are usually less than 15-20m deep.

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Soils mainly consist of infertile shallow loams on the Richmond Range, and poor draining, low-nutrient yellow and red textured soils on most of the lower lying areas. The sandstone-derived soils tend to be infertile, poorly structured and highly susceptible to erosion.

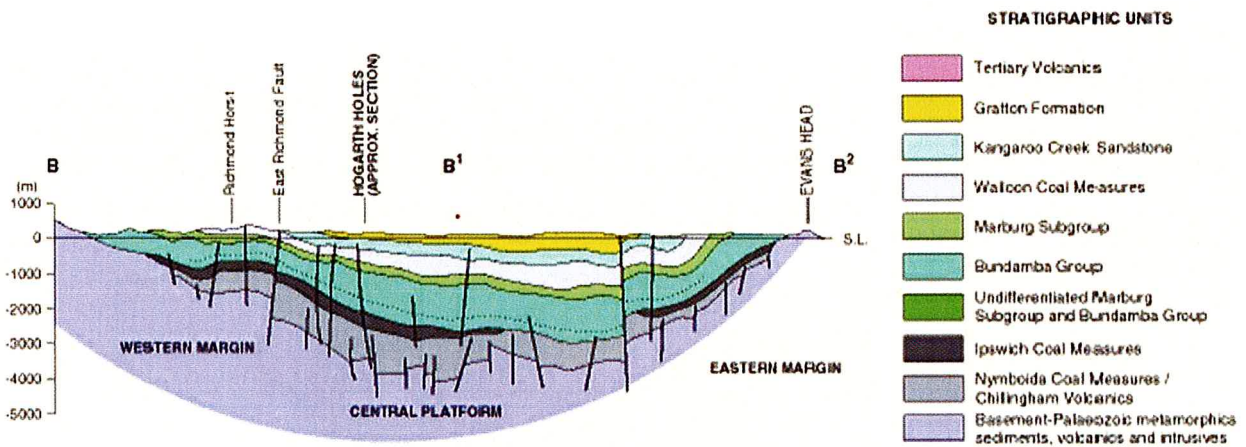
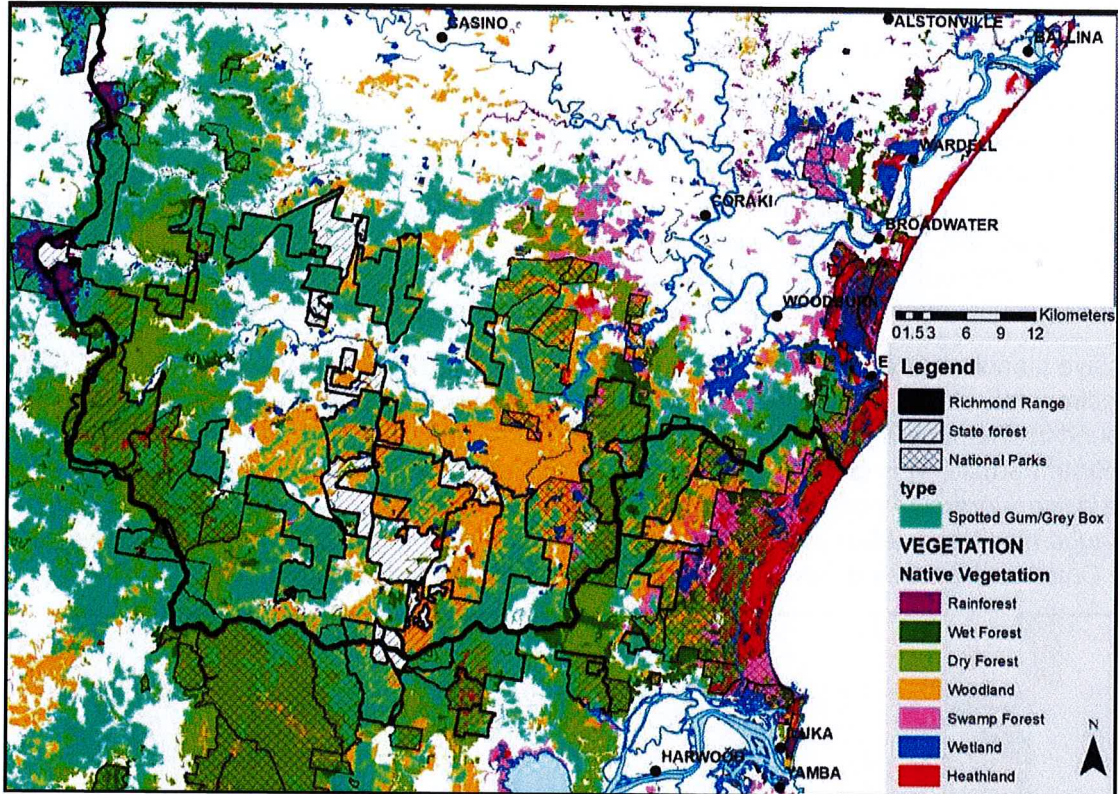


Fig. 1. Cross section of Clarence-Moreton Basin, note that the layers of different sediments show how the basin has been infilled by progressive sedimentation as it subsided over 185 million years. From: <https://www.bioregionalassessments.gov.au/assessments/23-conceptual-modelling-clarence-moreton-bioregion/2322-geology-and-hydrogeology>



3. ECOSYSTEMS

The forests of the southern Richmond extend inland from coastal dunes and wetlands, across an extensive floodplain dotted with wetlands, onto gently rolling sandstone country and thence up onto the Richmond Range at around 400-600m. To the north the Richmond Range becomes wetter.



Map 3. Vegetation groups based on the NE Regional Forest Agreement ecosystems across all tenures was prepared by OEH for the Northern Rivers Catchment Management Authority. Used as the basis for this assessment due to its compatibility with CRA data, rather than the more contemporary Plant Community Types. The Dry Forest has an overlay of types with Spotted Gum and/or Grey Box as dominants or co-dominants to show the prevalence of these types. Note that Woodlands are the community Lowland Red Gum.

The coastal vegetation (mostly within Broadwater and Bundjalung National Parks) is dominated by heathlands on old dunes, interspersed with wetlands and swamp forest. The values of these coastal systems are generally not assessed herein.

Where it remains uncleared, the extensive floodplain has scattered patches of wetlands and swamp forest, including small rainforest stands, amid extensive areas of lowland Red Gum (*Eucalyptus tereticornis*) woodlands and patches of dry forests. Because of the extensive clearing most of the floodplain forests are classified as the Endangered Ecological Communities (EECs) Subtropical Coastal Floodplain Forest and Swamp Sclerophyll Forest.

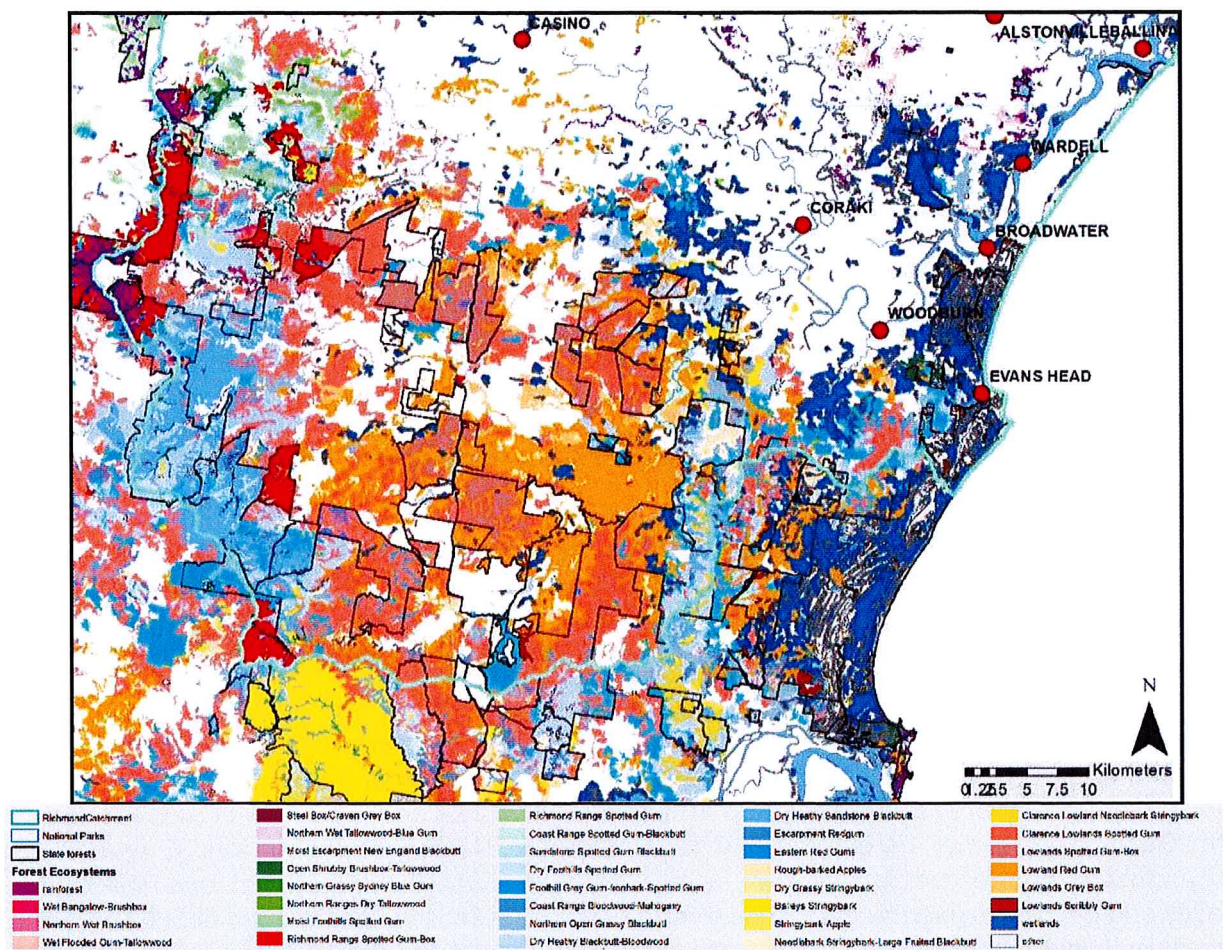
The southern Richmond is characterised by extensive dry forests on sandstones. On the lowlands surrounding the floodplains, the dry forests are dominated by Large-leaved Spotted Gum (*Corymbia henryi*) and Coastal Grey Box (*Eucalyptus moluccana*), in various associations with Small-fruited Grey Gum (*E. propinqua*), Forest Red Gum (*E. tereticornis*), Narrow-leaved Ironbark (*E. crebra*), Grey Ironbark (*E. siderophloia*), Narrow Leafed White Mahogany (*E. acmenoides*), and Pink Bloodwood (*Corymbia intermedia*). These forests encompass most of the northern population of the nationally Vulnerable Slaty Red Gum (*E. glaucina*), which can be the dominant red gum on ridges.

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Spotted Gum dominated forests, characterised by Large-leaved Spotted Gum (*Corymbia variegata*), extend onto the Richmond Range in Cherry Tree State Forest. Elsewhere the southern ranges are mostly dominated by Coastal Blackbutt (*Eucalyptus pilularis*), Bailey's Stringybark (*E. baileyana*), Needlebark Stringybark (*E. planchoniana*), Forest Red Gum (*E. tereticornis*), White Mahogany (*E. acmenoides*), Grey Ironbark (*E. siderophloia*), Small-fruited Grey Gum (*E. propinqua*), Brown Bloodwood (*C. trachyphloia*), Pink bloodwood (*C. intermedia*), Large-leaved Spotted Gum (*C. henryi*) and Rough-barked Apple (*Angophora woodsiana*).

Wet sclerophyll forests are generally restricted to sheltered locations on the south-facing slopes and creek lines. Dominant canopy species include Brush Box (*Lophostemon confertus*), Turpentine (*Syncarpia glomulifera*), Tallowwood (*E. microcorys*), Steel Box (*E. rummeryi*), Blue Gum (*E. saligna*) and Flooded Gum (*E. grandis*). The Endangered Ecological Community Grey Box-Grey Gum Wet Sclerophyll Forest, often with the rare Steel Box as a co-dominant, is common on the Richmond Range north from Mount Pikapene, in Cherry Tree State Forest. Rainforest understories are characteristic, and can become dominant in small scattered stands across the valley.

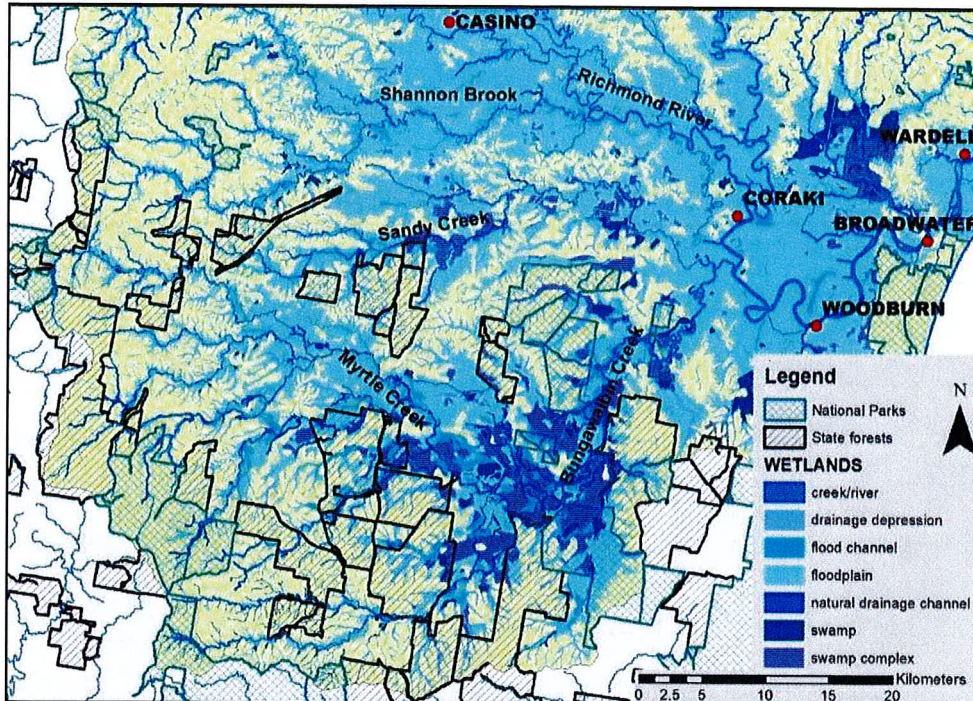
Extensive stands of Dry Rainforest occur around Mount Pikapene on clay-loam soils derived from the sedimentary Walloon Coal Measures, with pockets extending northwards up the range. These are found in Pikapene and Mallanganee National Parks, and parts of Mount Belmore and Cherry Tree State Forests. This dry rainforest is of a Yellow Tulipwood – Hoop Pine alliance (*Drypetes australasica* – *Araucaria cunninghamii*) and a Teak – Hoop Pine sub-alliance (*Flindersia* spp. – *A. cunninghamii*) (Floyd 1990). All of these rainforests form part of Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community.



Map 4. The distribution of OEH vegetation communities across the southern Richmond valley.

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The distribution of Swamp and Woodland forest types, and major Wetlands, primarily mirror the Richmond River floodplain. Groundwater resources have a similar distribution, thereby providing a source of water for deep rooted vegetation during dry times. This makes these forests particularly important during droughts for animals reliant upon foliar moisture (ie Koala and Greater Glider) or nectar during dry periods.



Map 5. Most of the mapped floodplain and swamps occur within the Richmond River floodplain. Where vegetation remains, the floodplain is chiefly comprised Swamp and Woodland forest types, and major Wetlands. Due to extensive clearing, much of the remnant forest is classified as the Threatened Ecological Communities Subtropical Coastal Floodplain Forest and Swamp Sclerophyll Forest. Most of the floodplain is on private lands, though there are significant occurrences on public lands,

The Australian Wetlands Database (<http://www.environment.gov.au/cgi-bin/wetlands/report.pl>) identifies the *Lower Bungawalbin Catchment Wetland Complex* as being a Nationally Important Wetland, describing it as including “*Bungawalbin National Park and Nature Reserve and Bungawalbin and Double Duke State Forests and Private Property*”, noting:

This wetland complex has extremely high nature conservation values with one of the highest biodiversity levels in Australia (surpassed only by Far North Queensland), and there is little disturbance to the wetland habitats (although threats and disturbance have escalated in recent years). There are a number of threatened flora species (including at least 10 nationally endangered species) as well as significant vegetation communities that provide important habitat for fifty threatened fauna species (including nine nationally endangered). The Bungawalbin Wetlands have a high diversity of native fish species including rare and threatened species.

The Tuckean Swamp is also included as a Nationally Important Wetland, though identified as degraded, noting:

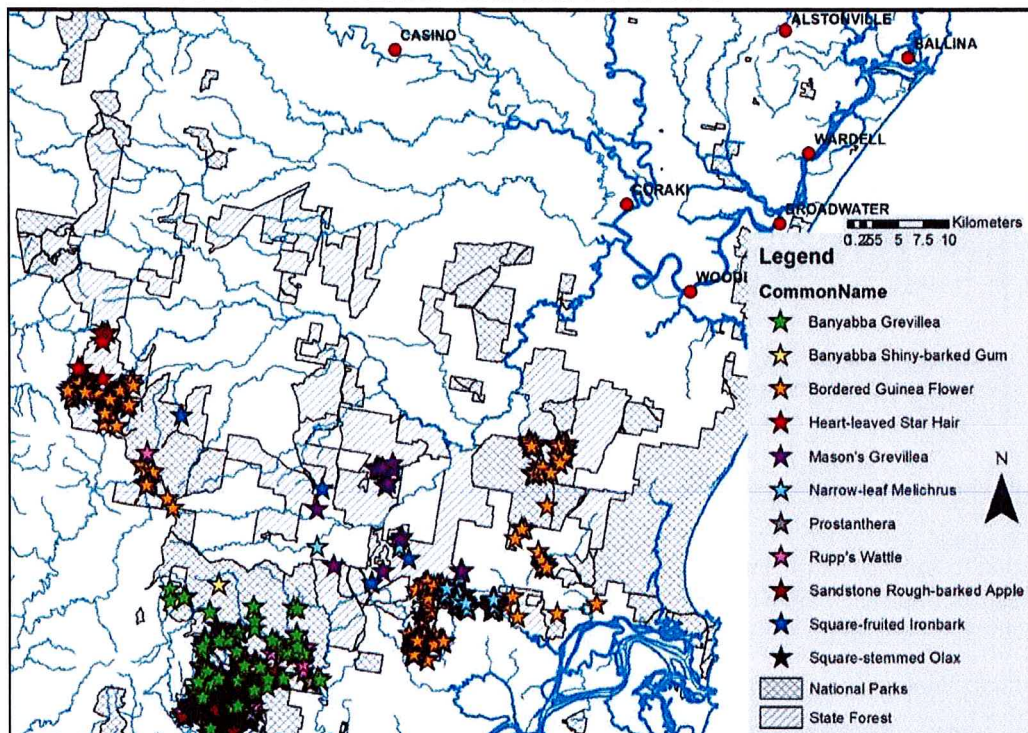
*The swamp provides habitat for a large variety of avifauna, even though it has suffered from drainage and acidification. The reserve, mainly covered by *Melaleuca* swamp forest in varying states of succession, also supports bats and other typical fauna.*

3.1. Threatened Plants

The southern Richmond forests support a high diversity of plants, with many reaching of approaching their north, south and eastern distributional limits, a suite of species endemic to the Clarence-Moreton Basin (see 2. Geology), some with disjunct populations in the Sydney basin or Tableland woodlands, and many associated with rainforest.

There are 63 species of plants found in the forests of the southern Richmond that are threatened with extinction, with 29 listed as Endangered and 34 as Vulnerable under the NSW *Biodiversity Conservation Act 2016*.

CLARENCE-MORETON THREATENED ENDEMIC PLANTS



Map 6. Threatened Clarence-Moreton sandstone endemic plants

The inland forests and woodlands on the sandstones of the Clarence-Moreton Basin support a suite of endemic species, 11 of which are threatened with extinction and have most or a significant part of their distribution within the southern Richmond valley:

Endangered

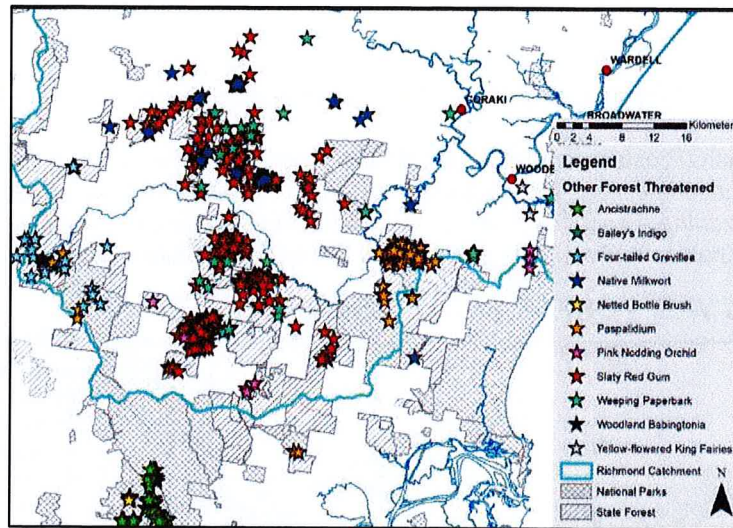
Narrow-leaf Melichrus (*Melichrus gibberagee*), Heart-leaved Star Hair (*Astrotricha cordata*), Rupp's Wattle (*Acacia ruppilii*), Banyabba Shiny-barked Gum (*Eucalyptus pachycalyx* subsp. *banyabba*), and Mason's Grevillea (*Grevillea masonii*).

Vulnerable

Bordered Guinea Flower (*Hibbertia marginata*), *Prostanthera sejuncta*, Sandstone Rough-barked Apple (*Angophora robur*), Square-fruited Ironbark (*Eucalyptus tetrapleura*), Square-stemmed Olax (*Olax angulata*), and Banyabba Grevillea (*Grevillea banyabba*).

Narrow-leaf Melichrus is extremely restricted with most of the population within Gibberagee State Forest. Heart-leaved Star Hair has most of its population in Mount Belmore State Forest. Whiporie State Forest has the largest population of Mason's Grevillea on public lands. Fortis Creek National Park and Banyabba Nature Reserve are particularly important for Rupp's Wattle, Banyabba Shiny-barked Gum, *Prostanthera sejuncta*, and Banyabba Grevillea.

OTHER OPEN FOREST THREATENED PLANTS



Map 7. Threatened plant species associated with dry forests and woodlands. Note that only records within the assessment area are shown.

Eleven other threatened plants are associated with dry forests and woodlands, some with disjunct populations on the Hawkesbury Sandstones in the Sydney Basin, or to the west on the tablelands:

Endangered:

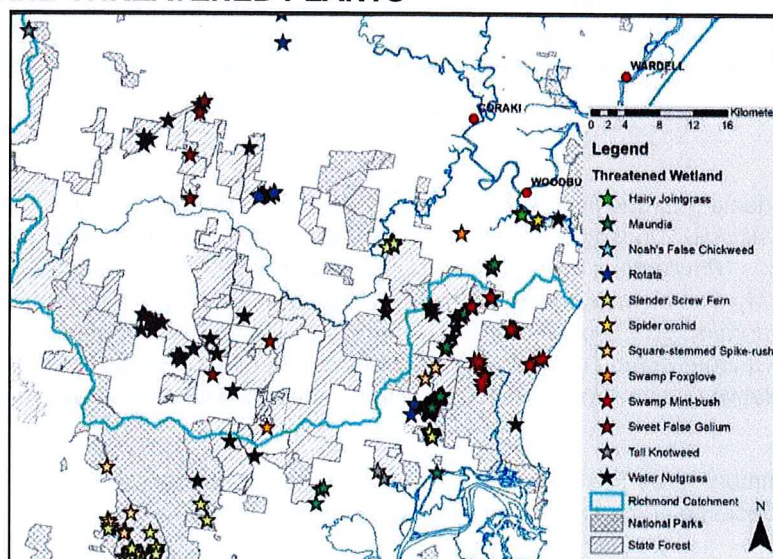
Bailey's Indigo (*Indigofera baileyi*), Woodland Babingtonia (*Kardomia silvestris*), Weeping Paperbark (*Melaleuca irbyana*), Native Milkwort (*Polygala linariifolia*), Pink Nodding Orchid (*Geodorum densiflorum*), and Yellow-flowered King of the Fairies (*Oberonia complanata*).

Vulnerable:

Netted Bottle Brush (*Callistemon linearifolius*), Slaty Red Gum (*Eucalyptus glaucina*), *Ancistrachne maidenii*, *Paspalidium grandispiculatum*, and Four-tailed Grevillea (*Grevillea quadricauda*).

The populations of Woodland Babingtonia and Four-tailed Grevillea in Mount Belmore State Forest are particularly significant due to these species' relatively low numbers and restricted distribution. Fortis Creek National Park and Banyabba Nature Reserve are particularly important for *Ancistrachne maidenii*.

FOREST WETLAND THREATENED PLANTS



Map 8. Threatened plant species associated with wet forest habitats. Note that only records within the assessment area are shown.

Protecting the Southern Richmond

There are 12 threatened species of plants associated with wetlands and wet habitats that occur in forests:

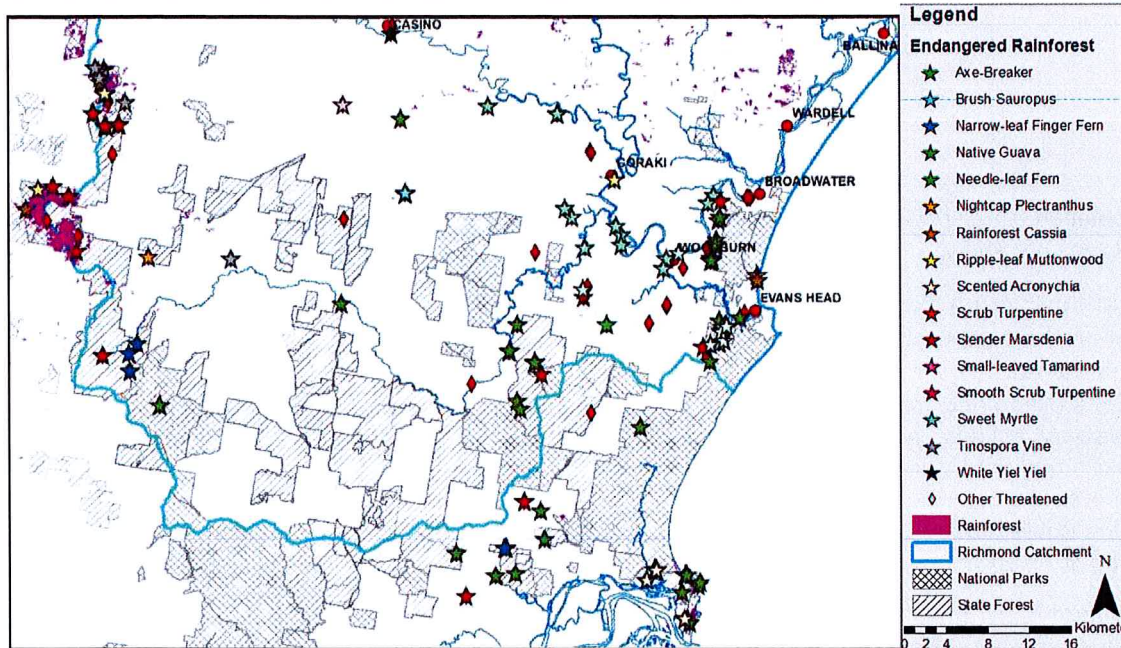
Endangered

Water Nutgrass (*Cyperus aquatilis*), and Square-stemmed Spike-rush (*Eleocharis tetraquetra*),

Vulnerable

Swamp Mint-bush (*Prostanthera palustris*), Noah's False Chickweed (*Lindernia alsinoides*), Slender Screw Fern (*Lindsaea incisa*), *Rotala tripartite*, Spider orchid (*Dendrobium melaleucaphilum*), Swamp Foxglove (*Centranthera cochinchinensis*), *Maundia triglochinosides*, Hairy Jointgrass (*Arthraxon hispidus*), Tall Knotweed (*Persicaria elatior*), and Sweet False Galium (*Oldenlandia galioides*).

RAINFOREST AND WET FOREST THREATENED PLANTS



Map 9. Threatened rainforest associated plants, only Endangered species are shown. Note that only records within the assessment area are shown.

There are 29 threatened species of plants associated with rainforest, which are important because some reach their southern limits, and some provide genetic links with rainforests to the south of the Clarence River and to the west in Washpool. It is revealing that most records of individual threatened plants occur outside mapped rainforest, mostly in wet sclerophyll forest or in riparian vegetation along streams (Arrow-head Vine is the only species with the majority of its records in mapped rainforest):

Endangered

Slender Marsdenia (*Marsdenia longiloba*), Rainforest Cassia (*Senna acclinis*), Nightcap Plectranthus (*Plectranthus nitidus*), Tinospora Vine (*Tinospora smilacina*), Sweet Myrtle (*Gossia fragrantissima*), Brush Sauropus (*Phyllanthus microcladus*), Needle-leaf Fern (*Belvisia mucronate*), Ripple-leaf Muttonwood (*Myrsine richmondensis*), White Yiel Yiel (*Grevillea hilliana*), Scented Acronychia (*Acronychia littoralis*), Axe Breaker (*Coatesia paniculate*), Narrow-leaf Finger Fern (*Grammitis stenophylla*), Smooth Scrub Turpentine (*Rhodamnia maideniana*), Scrub Turpentine (*Rhodamnia rubescens*), Native Guava (*Rhodomyrtus psidioides*), and Small-leaved Tamarind (*Diploglottis campbellii*).

The once common Scrub Turpentine and Native Guava are now identified as nationally Critically Endangered because of the introduced fungus Myrtle Rust.

Vulnerable

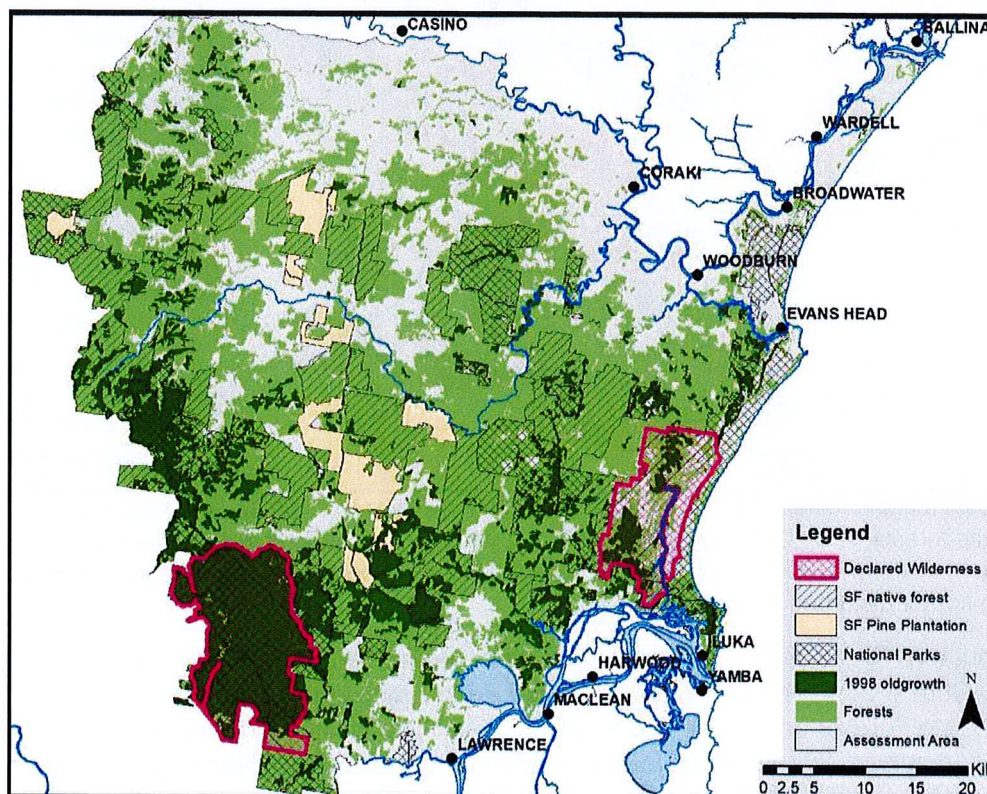
Milky Silkpod (*Parsonsia dorrigoensis*), Thorny Pea (*Desmodium acanthocladum*), Brush Sophora (*Sophora fraseri*), White Lace Flower (*Archidendron hendersonii*), Giant Spear Lily (*Doryanthes*

palmeri), Stinking Cryptocarya (*Cryptocarya foetida*), Onion Cedar (*Owenia cepiodora*), Red Lilly Pilly (*Syzygium hodgkinsoniae*), Red-flowered King of the Fairies (*Oberonia titania*), Brown Fairy-chain Orchid (*Peristeranthus hillii*), Macadamia Nut (*Macadamia integrifolia*), Rough-shelled Bush Nut (*Macadamia tetraphylla*), and Arrow-head Vine (*Tinospora tinospoides*).

3.2. Condition

The southern Richmond is particularly significant because most of the area remains forested. Though most of the remnant forest has been degraded by past logging, thinning and grazing, leaving patches of relatively intact oldgrowth generally on steeper and less accessible areas or sites of lower productivity. Mapping of oldgrowth forest was last undertaken in 1997, identifying 23% of the remnant forests as oldgrowth at that time, though this has not been updated since, despite obligations to do so. There has been ongoing attrition of oldgrowth since then by logging and fire.

As at 1997, of the 55,980ha of forests (excluding rainforest) on State Forests, 7,961ha (14%) was mapped as oldgrowth forest. For the Regional Forest Agreement most of this was classed as High Conservation Value oldgrowth, using an arbitrary threshold, and protected. The Governments basically ignored the [Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative \(CAR\) Reserve System for Forests in Australia](#) (JANIS 1997) requirement that at a minimum '60% of the old-growth forest identified at the time of assessment' be protected. By 2019, 276 ha of unprotected oldgrowth had been logged, including sizeable patches in Camira and Doubleduke State Forests. It is revealing that 227 ha (82%) of the logged oldgrowth was comprised of 'Old Growth Forest Ecosystems' still not identified as reaching their minimum 60% reserve target in the 2018 North East RFA variation. The bulk of this was 162ha of oldgrowth Clarence Lowlands Spotted Gum, which still only has 42% of its 2000 mapped oldgrowth extent protected (with 16% of this "protected" on State Forests).



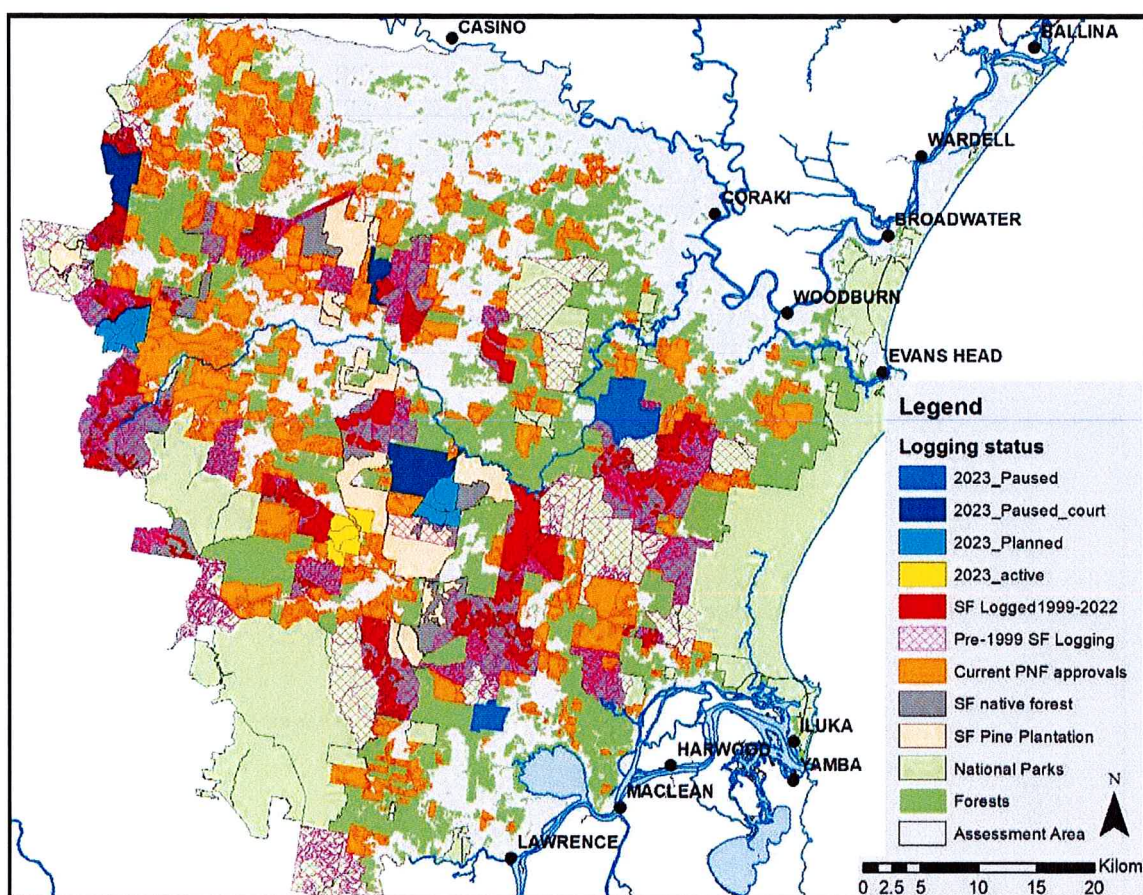
Map 10. Remaining forest cover, oldgrowth forest (CRAFTI) as mapped in 1997 and declared wilderness areas. This shows that while most forest cover remains, little of it remains in a natural state.

Protecting the Southern Richmond

Many oldgrowth trees were lost in the 2019/20 wildfires, and with over 1,500ha of oldgrowth on State forests in the category “canopy fully affected” (GEEBAM v2), large areas can be expected to no longer qualify as oldgrowth. Logging continued after the fires, in 2023 a stand of mapped oldgrowth forest in an unburnt fire refugia was [logged in Doubleduke State Forest](#).

It is important to recognise that the current protection for most oldgrowth and rainforest on State Forests is susceptible to the whim of the Government and claimed needs to log it in order to satisfy timber commitments. In response to a falsified shortage of sawlogs, the NRC (2018) proposed changing the mapping and reserve criteria to make most oldgrowth forest and rainforest available for logging. The 20019/20 fires stopped that attempt.

The Banyabba Wilderness and the Bundjalung Wilderness were declared in 2002 over existing national parks. These are large, natural areas of land which, together with their native plant and animal communities, remain essentially unchanged by modern human activity.



Map 11. Recent logging history for State forests and National Parks, current and proposed logging (October 2023) for State forests, and 2021 Private Native Forestry (PNF) Approvals (adapted from Durrant-Whyte 2021). These indicate the extent of logging disturbances at a landscape scale and the need to protect State Forests from further disturbance to act as refugia.

Over the southern Richmond assessment area there are some 251,000 ha of remnant forests and woodlands. Of this, 66,474ha (26%) is in National Parks, with significant parts logged prior to their protection. State Forests encompass 56,475ha (23%). Historically most accessible forests have been logged to varying intensities as utilisation standards changed, in recent years there have been requirements to exclude logging from various areas (ie rainforest, HCV oldgrowth, Endangered Ecological Communities), leaving 31,000ha of State Forests available for logging with current exclusions. In 2018 the logging rules were again changed to remove most required surveys and

exclusions for threatened fauna, instead requiring 10% of the loggable area (ie 3,100ha) to be protected at the Forestry Corporation’s discretion. While most State Forests have historically been logged, current requirements leave around half, some 27,900 ha, of native forests available for relogging. Over the period June 2000 until October 2019 Forestry Corporation logging history identifies 15,526ha as being logged, at an average rate of 803ha per annum.

Half the remnant forests are on private lands, totalling some 128,000ha. Of this some 50,000ha currently have Private Native Forestry Approvals (adapted from Durrant-Whyte 2021). Of the approved logging areas, over 17,000ha is Nationally Important Koala Areas (NIKAs).

For NEFA’s [Sandy Creek Koala Park](#) proposal (Pugh 2020) we measured representative vegetation plots to assess the structure of the logged Spotted Gum-Grey Box forests, and to identify structural changes related to logging we measured plots in CRAFTI mapped oldgrowth forest in Banyabba State Forest. These results are only indicative for this larger area, though they indicate the magnitude of the changes wrought by logging, and one of the opportunities from stopping logging.

Comparison between the unlogged and logged forests identify a reduction in basal area from 40.7 m² per hectare down to 20.2 m², primarily attributable to past logging. This was used to estimate corresponding reductions in above-ground biomass from 363.4 tonnes/ha down to 149.6 tonnes/ha. These data show there has been an overall loss of 59% of live above ground biomass from past logging, with the massive losses of larger trees targeted for logging not offset by the limited growth of small trees. Sawlog volumes have significantly declined due to logging.

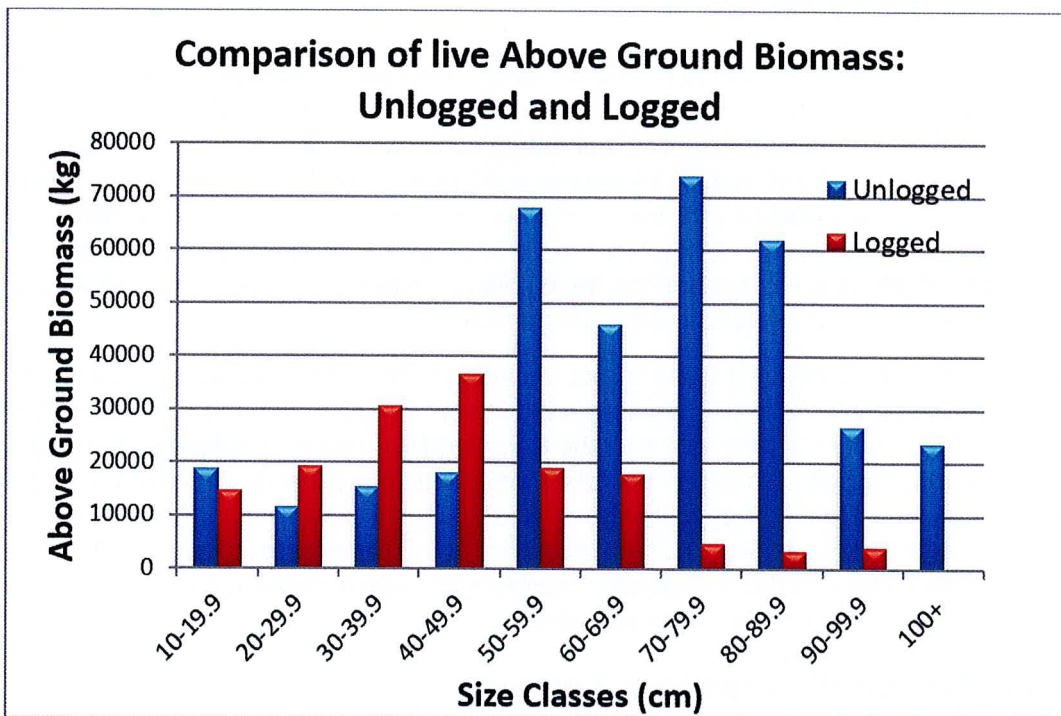


Fig.2. Comparison of Above Ground Biomass of logged and unlogged plots showing the dramatic reduction in the biomass of larger trees (from Pugh 2020). Above ground biomass is the volume of the trees excluding roots, size classes relate to Diameter at Breast Height (DBH).

The loss of 217 tonnes per hectare of above ground biomass of trees above 30 cm Diameter at Breast Height (DBH), a 65% reduction, is part of the cost of a hundred years of logging, and can be costed as both the value of timber lost and the volume of carbon released to the atmosphere. While public forestry operates at a financial loss, this depletion of biomass of large trees is part of the uncosted public losses due to forestry. These losses also illustrate the massive contribution these

forests can make to climate heating if they are allowed to recover and recapture the lost carbon from the air and store it in their growing trunks and soils.

The 65% reduction of biomass for trees above 30 cm DBH also reflects a loss of the volumes of leaves available for Koalas and Southern Greater Gliders to eat given their preferences for larger trees. It is likely that this reduction in potential food would have caused a corresponding decline in Koalas before they were decimated by the 2019 fire. Given that losses of biomass increases with tree size it is evident that the increased losses of larger feed trees preferred by Koalas and Southern Greater Gliders will have had a disproportionate impact on their food and population. These resource losses extend to species using nectar from trees and the availability of tree hollows.

The data indicate a reduction in both above and below ground carbon from 227 tC/ha down to 94 tC/ha, a reduction in carbon storage of 134 tC/ha (Pugh 2020). This is equivalent to the net release of 492 tonnes of Carbon Dioxide per hectare. To estimate CO₂ sequestration potential if these forests are left to grow, the annual growth rates of native species from long-term growth plot data in south-east Queensland (Ngugi *et. al.* 2015) was applied (Pugh 2020) to identify a CO₂ sequestration rate of 6.35 tCO₂/ha per annum.

Across the 56,475ha of forests and woodlands on southern Richmond State forests this indicates a net release in the order of 28 million tonnes of CO₂ to the atmosphere from past logging, and the capacity of recovering forests to draw down 359,000 tonnes of CO₂ per annum if logging is stopped.

3.3. Reservation

The 2000 North East NSW Regional Forest Agreement (RFA) was predicated upon achieving the national reserve targets for 15% of the pre-European extent of forest ecosystems, including a minimum of 60% of the remaining extent of Vulnerable ecosystems and 100% of rare and endangered ecosystems. There was an intentional political decision to constrain target achievement with timber commitments, especially for the Spotted Gum forests of the southern Richmond. This has left most of these forests very poorly reserved, and despite commitments to increase reservation from private properties there has been minimal improvement over the past 23 years. It is time to give these forests the protection they clearly deserve.

The NSW section of the south-east Queensland bioregion, which encompasses the southern Richmond, is part of an internationally significant biodiversity hotspot, and yet only has 14% of its extent currently reserved. In accordance with the [Kunming-Montreal Global Biodiversity Framework](#), the NSW and Commonwealth Governments have committed to reserving 30% of our land area by 2030. Native forests on State forests encompass 10.3% of the NSW section of the south-east Queensland bioregion, so protecting them is necessary to increase reservation to 24.3%. Though achieving the 30x30 target (which should be a minimum for such a biodiverse region), will also necessitate protection of 94,000 ha of private land.

3.3.1. Forest Ecosystem Targets

The [Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative \(CAR\) Reserve System for Forests in Australia](#) (JANIS 1997) established the minimum ecosystem targets for the establishment of a national system of conservation reserves;

As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the CAR reserve system with flexibility considerations applied according to regional circumstances, and recognising that as far as possible and practicable, the proportion of Dedicated Reserves should be maximised.

The reserve criteria included increased protection for ecosystems that meet the criteria for vulnerable, rare or endangered ecosystems:

Protecting the Southern Richmond

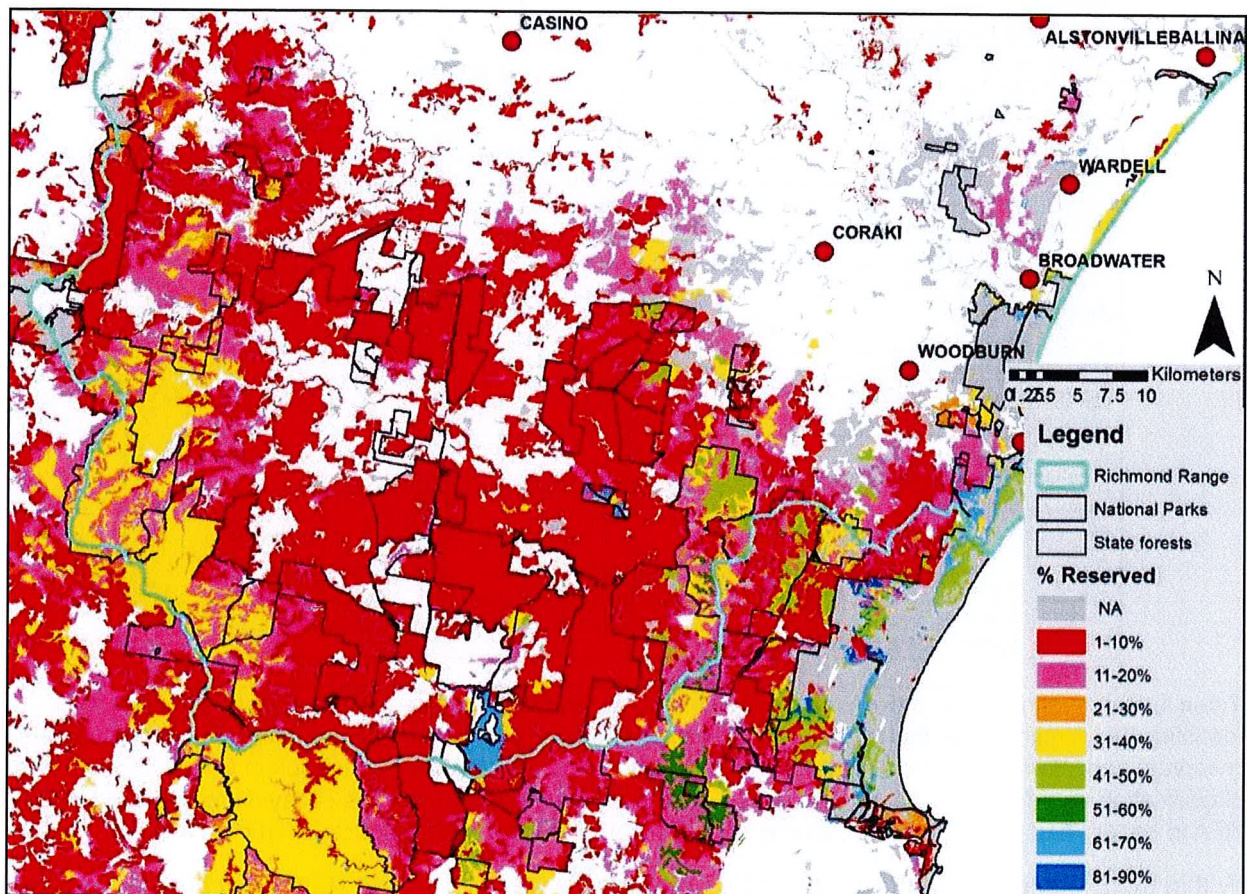
Where forest ecosystems are recognised as vulnerable, then at least 60% of their remaining extent should be reserved. ...

All remaining occurrences of rare and endangered forest ecosystems should be reserved or protected by other means as far as is practicable....

While the aim was to preferentially satisfy the targets from formally protected reserves (national parks, nature reserves etc.), there is allowance for targets to be achieved from ecosystems protected from logging in informal reserves (i.e. certain FMZ zones) or by prescriptions (i.e. rare non-commercial forest types) on State forests.

The 2000 North East NSW Regional Forest Agreement (RFA) was based upon the goal of establishing a CAR reserve system that satisfied the national forest reserve criteria. Though to satisfy the timber industry, the State ALP member for Clarence, Harry Woods, did a deal to limit the protection of the Spotted Gum forests in the lower Richmond valley. This was part of a general disregard for target achievement in preference for supplying politically guaranteed timber volumes to sawmillers.

For the most inadequately protected forest ecosystems the North East NSW RFA identifies forest ecosystems satisfying specified criteria as '*Private Land priorities for the Upper North East CAR Reserve System*', with the aim of increasing their reservation through voluntary protections on private lands.



Map 12. Reserve status of forest ecosystems: as identified in the 2018 North East NSW Regional Forest Agreement "variation", based on pre-European extent of RFA identified forest ecosystems. Note that rainforest and non-forest ecosystems were not assessed (NA).

Protecting the Southern Richmond

The 2018 [Deed of Variation to the Regional Forest Agreement for North East NSW](#) identifies the 'Percent of Forest Ecosystem (pre-1750) extent in the CAR Reserve System as at December 2017' for eucalypt forest ecosystems, which includes protection in the categories of Dedicated Reserve, Informal Reserve, and Prescription. Informal reserves and areas protected by prescription are generally logging exclusion areas within State Forests, which are generally neglected with no active management. These data clearly show the extremely poor reservation of forest ecosystems on the southern Richmond, with most lowland ecosystems having 15% or less of their original extent protected, which is particularly obvious for the Spotted Gum and/or Coastal Grey Box and lowland Forest Redgum vegetation types, which include the most significant Koala habitat.

Forest Type	% Reserved			Private Priority	RFA Status	Area (ha)
	Formal	Informal	Total			
Lowlands Grey Box	1	0	1	Y	V	521
Richmond Range Spotted Gum	5	0	5			270
Clarence Lowlands Spotted Gum	4	2	6	Y		12528
Richmond Range Spotted Gum-Box	5	2	7	Y		4247
Wet Flooded Gum-Tallowwood	6	1	7	Y		84
Grey Box-Red Gum-Grey Ironbark	7	1	8			88
Lowland Red Gum	6	2	8	Y		8284
Swamp Oak	9	0	9	Y	R	54
Lowlands Spotted Gum-Box	8	2	10			7206
Sandstone Spotted Gum-Blackbutt	9	4	13	Y		639
Coast Range Spotted Gum-Blackbutt	10	4	14	Y	R	73
Escarpment Redgum	10	4	14	Y		535
Coast Range Bloodwood-Mahogany	13	2	15			263
Dry Heathy Blackbutt-Bloodwood	15	5	20			6710
Foothill Grey Gum-Ironbark-Spotted Gum	14	6	20			4135
Northern Open Grassy Blackbutt	17	3	20			607
Wet Bangalow-Brushbox	21	1	22	Y	V	10
Coastal Flooded Gum	23	2	25			114
Northern Wet Brushbox	20	5	25			37
Open Shrubby Brushbox-Tallowwood	17	10	27			226
Steel Box/Craven Grey Box	24	3	27	Y	R	32
Lowlands Scribbly Gum	29	3	32	Y	V	420
Baileys Stringybark	35	0	35			108
Rough-barked Apples	25	10	35		V	207
Dry Foothills Spotted Gum	22	14	36			460
Dry Heathy Sandstone Blackbutt	30	6	36			4159
Moist Foothills Spotted Gum	24	16	40			114
Swamp Mahogany	40	2	42	Y	R	199
Northern Wet Tallowwood-Blue Gum	35	8	43			27
Heathy Scribbly Gum	39	5	44			889
Needlebark Stringybark-Large Fruited Blackbutt	36	12	48			955
Clarence Lowland Needlebark Stringybark	40	17	57			634
Eastern Red Gums	39	27	66		V	880
Moist Escarpment New England Blackbutt	76	6	82			3
TOTAL						55719

Table 1. Reservation status of RFA forest ecosystems on southern Richmond State forests. % Reserved identifies the percentage of their pre-European extent protected in formal reserves (national parks and nature reserves) and informal reserves on State forests (including by prescription). Status refers to their RFA classification as V for vulnerable or R for rare. Private property priority identifies ecosystems identified in the RFA to be targeted for reservation. (source North East NSW RFA). Areas were reported from a GIS.

Within the State forests of the southern Richmond there are 34 mapped RFA forest ecosystems. In the 2000 RFA five were identified as Vulnerable (therefore requiring a minimum of 60% of their 2000 extent to be reserved) and four as Rare (therefore requiring 100% of their 2000 extent to be reserved). Even with inclusion of areas in informal reserves and patches protected by prescription on State forests, most still remain inadequately reserved; 12 ecosystems fail to achieve the 15% target, together totalling 34,530ha (62%) of the State forests. The ecosystems of Lowland Red

Gum, Clarence Lowlands Spotted Gum, and Lowlands Spotted Gum-Box are the biggest failures. Though with 521 ha on these State forests, only 2% reserved and 69ha logged since the RFA, the Vulnerable Lowlands Grey Box represents the most outrageous policy failure.

It is disappointing that of the 13 forest ecosystems identified in the 2000 North East NSW RFA as 'Private Land priorities for the Upper North East CAR Reserve System', 18 years later only 3 (Wet Flooded Gum-Tallowwood, Swamp Oak, Swamp Mahogany) display marginally increased reservation in the 2018 RFA Variation, and still remain grossly inadequately reserved. Like most inadequately reserved ecosystems, they continue to be logged on State forests.

3.3.2. Bioregional Targets

The Governments have developed an agreed interim national bioregional framework (IBRA), which reflects the environmental determinants for broad patterns in landscape, ecosystem and species diversity. JANIS (1997) identifies that the bioregions and sub-regions should "*be used to help identify those regions to which the criteria should be applied when the CAR reserve system is being defined. The regions which underpin the definition of the CAR reserve system may be combinations of, or parts of, IBRA regions*".

For many years under the [Convention of Biological Diversity](#) Australia worked towards a target of 17 per cent of our continent to be protected as part of the National Reserve System. In December 2022, in response to the unprecedented rate of worldwide biodiversity loss, COP 15 adopted the goal of protecting 30% of the earth by 2030. This has since been reaffirmed by both the Australian and NSW Governments. The [Kunming-Montreal Global Biodiversity Framework](#) requires:

Ensure and enable that by 2030 at least 30 per cent of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures".

The 30x30 target aims to protect and conserve key biodiversity values, including species at risk, high-biodiversity areas, key migration sites, spawning areas, and ecologically intact areas which protect large-scale ecological processes. Adding in climate refugia and areas of high carbon density increases the area required to over 50%.

The national IBRA bioregions are the basis for assessing the adequacy of the national reserve system. The southern Richmond is within the South East Queensland Bioregion, which extends from Glenreagh north to near Gladstone in Queensland. The NSW section encompasses the whole of the Tweed and Richmond River catchments, and a substantial part of the Clarence River catchment, totalling 1,654,027 ha. The NSW section includes 6 subregions, three of which extend into Queensland. The subregions of Clarence Lowlands, Clarence Sandstones and Woodenbong are wholly within NSW.

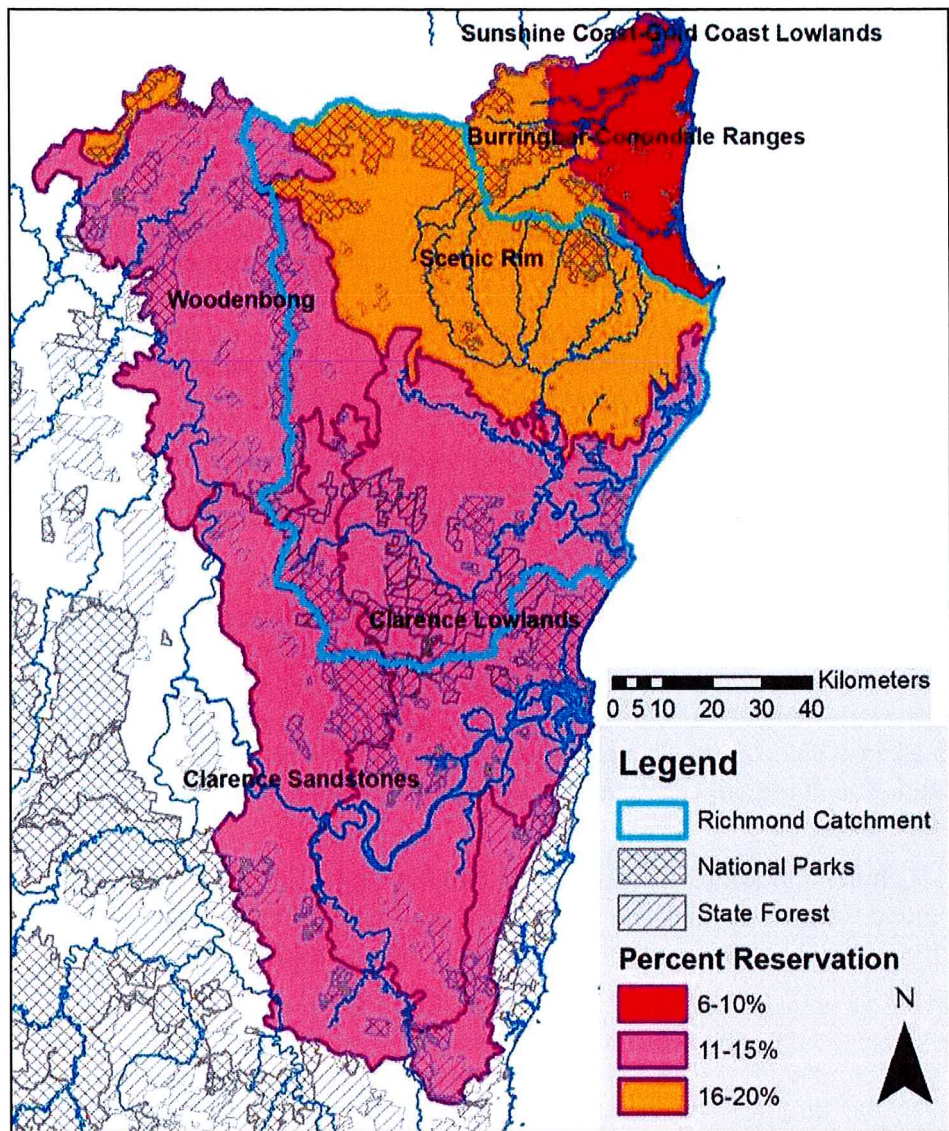
The southern Richmond lowlands are primarily within the Clarence Lowlands subregion, the south western Richmond Range is largely within the Clarence Sandstones subregion, and the Richmond Range north from Mount Pikapene within the Woodenbong subregion.

It is evident that if all native State forests within the NSW section of the SE Queensland IBRA bioregion are protected then this would only increase reservation to 24.3%. The 30x30 reserve target would still not be achieved, though the Woodenbong and Clarence Sandstones sub-regions would just satisfy this target. The achievement of the minimum 30x30 target in this bioregion will require the protection of all native forest on public lands, and an additional 94,000 ha of private land.

Reserve status of South East Queensland (NSW section) IBRA subregions.

Sub-region	Area (ha)	National Reserve System		State Forest*	
	ha	ha	%	ha	%
Burringbar-Conondale Ranges	95696	6007	6.3	NA	
Clarence Lowlands	522378	58351	11.2	62736	12.0
Clarence Sandstones	328580	48640	14.8	53000	16.1
Scenic Rim	387418	73190	18.9	4084	1.1
Sunshine Coast-Gold Coast Lowlands	3051	193	6.3	NA	
Woodenbong	324148	46822	14.4	51892	16.0
TOTALS	1661270	233203	14.0	171712	10.3

Table 2. The area of land comprising the National Reserve System and State forests (*excluding claimed plantations) for IBRA subregions within the NSW section of South Eastern Queensland IBRA Region. The southern Richmond assessment area falls principally within the IBRA subregions of Clarence Lowlands and Clarence Sandstones, with Cherry Tree and Pikapene State Forests in the Woodenbong sub-region.



Map 13: Reserve status of IBRA subregions within the NSW section of the South East Queensland IBRA region.

4.FAUNA

The forests of the southern Richmond support an unusually diverse assemblage of forest species, part of the overlap between Australia's northern and southern species, an eastern outlier for a suite of Tableland woodland species, an important over-wintering site for migratory and nomadic nectivores, and a refuge for species declining elsewhere. There are 66 threatened fauna species known to inhabit these forests, with two of these Critically Endangered, nine Endangered and 55 Vulnerable to extinction. Additionally there is an endangered Emu population and three Endangered fish known to inhabit the streams and wetlands of the southern Richmond.

The capacity of trees to support populations of species utilizing them is related to their age, size and biomass. The larger their trunks and canopies the more resources and niches they provide for the invertebrates many species feed on, and the more forage they provide for Endangered Koalas and Southern Greater Gliders. Older trees provide vastly more flowers and flower more regularly, providing vital food for nectivores, including the Critically Endangered Regent Honeyeaters and Swift Parrots. It's the oldest trees that provide the hollows in broken branches and trunks that many species need for dens, nests and roosts. Of the threatened species, 23 utilize tree-hollows for denning, roosting or nesting, and eight species rely upon the abundant nectar provided by mature trees, both these resources have been severely depleted by past logging and thus logging is directly contributing to their extinction.

Pugh (2020) found that in the proposed [Sandy Creek Koala Park](#) there was an overall loss of 59% of tree biomass due to logging over the past century, with a loss of 65% of biomass for trees above 30cm DBH and 84% for trees above 50cm DBH. Trees with large hollows were reduced by 98% in the assessed areas. This is a major reduction in the resources available for many species in these forests and the populations they can support.

Logging has a multitude of other impacts on fauna, such as by: directly killing and maiming individuals; destroying understorey vegetation used for foraging, nesting and shelter; increasing vulnerability to predation; promoting lantana and other weeds; drying the forest and increasing fire risk, and; increasing turbidity and sedimentation of streams.

The National Forest Policy Statement (Anon 1992), included the goal of establishing adequate reserve systems, defined as *"the maintenance of ecological viability and integrity of populations, species and communities"*. In an effort to incorporate viable populations of priority fauna into the reserve system as part of the NSW Comprehensive Regional Assessment process, reserve targets were set to identify the area of habitat required to give each population of each priority species an equitable chance of survival (Environment Australia 1999). The achievement of these targets was updated by Flint *et. al.* (2004) to reflect what is effectively still the current reserve system. Flint *et. al.* (2004) found *"that the most poorly reserved habitats are dry coastal and dry tablelands sclerophyll forests, and habitat for species with large home ranges and species most vulnerable to threatening processes"*.

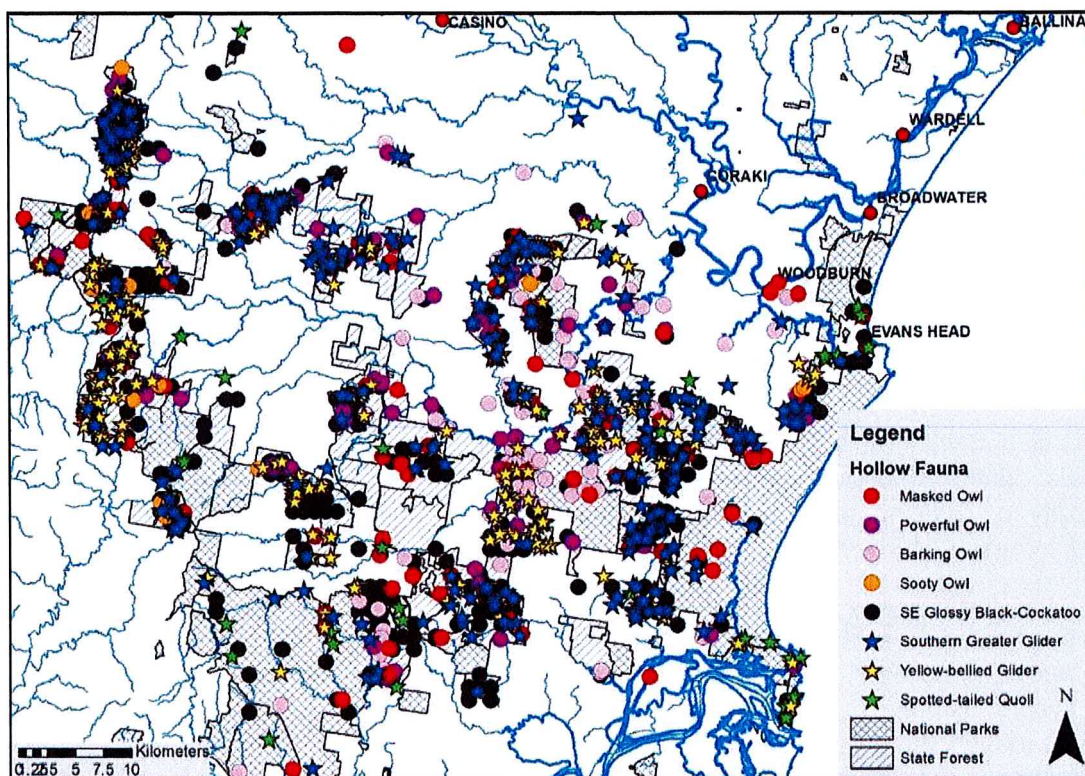
It is clear from the average target achievement that most threatened species within these forests are still not adequately protected. A comparison at the population level would make this starker, due to the very poor reserve outcomes for these populations.

For the 2000 RFA there were aerial targets for habitat to be included in reserves identified for 45 threatened species occurring in the southern Richmond. Based on average target achievement (across all populations) in the reserve system as at 2004; four species achieved their targeted area, 14 achieved less than a quarter of their targets and an additional 18 achieved less than half their targets. This demonstrates the inadequacies of the existing reserve system for forest fauna, and reinforces the need for a significant expansion of the reserve system.

4.1. Tree Hollow Dependence

Across the southern Richmond there has been a dramatic reduction in big old trees and thus the hollows they provide for a plethora of species dependent upon them for nesting, denning and roosting. The loss of old trees means that hollows are a limiting resource, eliminating many hollow-dependent species from degraded stands, and creating strong competition for those remaining.

Seventy species (28%) of vertebrates use hollows in north-east NSW (Gibbons & Lindenmayer 2002). Species vary in their hollow requirements based on entry size and internal dimensions, and while some use dead trees these do not provide insulation as effective as live trees. Most tree hollows that appear externally suitable do not have the appropriate internal structure to be habitable, with Gibbons and Lindenmayer (2002) finding 49-57% of hollow-bearing trees used.



Map 14: Records of select threatened species utilising large tree hollows. Note that only records within the assessment area are shown.

It is important to recognize that most species have requirements for multiple hollows as they move around their territories, to reduce predation and to avoid the accumulation of pests and parasites. For example: Gibbons & Lindenmayer (2002) note the Brush-tailed Phascogale has been found to use 27-38 different hollows; DCCEEW (2022) note that Southern Greater Gliders have preferences for certain tree species and utilise 4-20 different den trees; Craig (1985) found that a family group of 3 Yellow-bellied Gliders "*used at least eight den trees within their home area*"; and, Brigham *et. al.* (1998) found that Australian Owlet-nightjars move approximately 300m between roost sites every 9 days on average, with individuals using 2-6 different cavities over 1-4 months.

It is the large hollows, generally provided by trees over 220 years old, that larger species such as owls, cockatoos and gliders rely upon, that are of the utmost importance. Gibbons and Lindenmayer (2002) documented that relatively undisturbed temperate and sub-tropical eucalypt forests contain 13–27 hollow-bearing trees per hectare. NEFA undertook plots in Banyabba State Forest to assess

the structure of a relatively undisturbed forest, identifying an average of 18.3 trees per hectare with large hollows (>10cm entrance). Given the relatively poor productivity of the assessed stand, this can be considered to represent a minimum for these forests before logging. In NEFA's surveys for the proposed [Sandy Creek Koala Park](#), NEFA identified an average density of 0.3 trees per hectare with large hollows (>10cm entrance), showing their severe depletion. In NEFA's surveys of forests not logged for decades (when logging intensities were lower) in Cherry Tree State Forest, we identified an average of 8.1 trees per hectare with potential large hollows (>10cm entrance), though only 3.75 per hectare occurred in trees over 90 cm DBH, which are most likely to contain the hollows needed by larger species.

The NSW Scientific Committee (2007) has identified *Loss of Hollow-bearing Trees* as a Key Threatening Process. Logging has historically been the principal threat to hollow-bearing trees, with those too defective for milling often cut down for fence posts and sleepers, or ringbarked in Timber Stand Improvement operations. In recent decades there have been requirements to retain 5 to 8 hollow-bearing trees per hectare where they remain, though these are frequently damaged by machinery or falling trees, and left more vulnerable to post-logging burns or windthrow. As observed by Gibbons and Lindenmayer (2002); "*studies consistently show that the number of hollow-bearing trees that occurs on logged sites is negatively associated with the number of harvesting events*", and "*logging may result in a pulse of mortality among retained trees after each cutting event*".

Due to their damaged bases, and often hollow pipes, hollow-bearing trees are particularly vulnerable to fire. Large hollow-bearing trees were already at critically low levels in many forests before being further depleted by the 2019 fires. In this area Milledge and Soderquist (2022) found 22.6% of large trees and stags (≥60cm DBH) were lost or severely damaged in burnt forests, including 38.1% of trees >100 cm DBH.

The biggest threat to the persistence of hollow-dependent fauna in these forests is the Forestry Corporation's refusal to retain the largest and healthiest trees as recruitment trees to replace hollow-bearing trees as they succumb to threats. Until recently there were requirements to retain one of the next largest trees as a recruitment tree for each hollow-bearing tree, though this requirement was removed in 2018 so that these trees can be logged to increase sawlog supply. In their 'Final report Coastal IFOA operations post 2019/20 wildfires, June 2021' The [Natural Resources Commission \(NRC 2021\)](#) considered:

There is evidence that the mortality and collapse of trees retained in logged sites increases with logging intensity and the severity of post-logging fire. Species dependent on hollow-bearing trees (such as gliders) require the retention of existing hollow-bearing trees at rates that meet the requirements of the species, as well as the permanent retention of approximately two to three recruitment trees (for example, potential future hollow-bearing trees) for each hollow-bearing tree to perpetuate the hollow resource...

The NRC (2021) recognised the CIFOA "*was not designed to mitigate the risks of harvesting in severely fire-affected landscapes like those from the 2019/20 wildfires*", commenting:

The Coastal IFOA standard prescriptions do not provide effective retention of feed and habitat-trees, including recruitment trees in timber harvest areas of state forests, to support the persistence of species dependent on these resources in a severely fire-affected landscape

The NRC (2021) proposed changing the logging rules to restore this critical resource by retaining additional large trees as replacements where the 8 hollow-bearing trees per hectare are no longer available, and requiring the retention of 2 recruitment trees for each of these. No Government has responded to the NRC report, refusing to release it or respond to its recommendations.

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As the few remaining hollow-bearing trees succumb to their continuing abuses and increasing wildfires, the housing crisis for hollow-dependent species grows more acute, its time to protect all State forests to restore this vital resource if we want to give hollow-dependent species a future.

Within these forests 22 species threatened with extinction utilize tree hollows. Those depending on large hollows for dens and nests include the Endangered Southern Greater Glider, and Vulnerable Spotted-tailed Quoll, Yellow-bellied Glider, South-eastern Glossy Black-Cockatoo, Masked Owl, Barking Owl, Sooty Owl, and Powerful Owl.

Smaller hollows provided by trees >120-180 years old are important for the Vulnerable Squirrel Glider, Brush-tailed Phascogale, Yellow-bellied Sheath-tail-bat, Eastern Coastal Free-tailed Bat, Hoary Wattled Bat, Eastern False Pipistrelle, Southern Myotis, Eastern Long-eared Bat, Greater Broad-nosed Bat, Little Lorikeet, Turquoise Parrot, Brown Treecreeper, Pale-headed Snake and Stephen's Banded Snake.

SPECIES		NSW Status	CW Status	OEH Identified Threats	Reserve Target Achieve ²
Masked Owl	Tyto novaehollandiae	V		Logging, grazing, burning	22%
Powerful Owl*	Ninox strenua	V		Logging, burning	61%
Barking Owl*	Ninox connivens	V		Logging, burning	14%
Sooty Owl	Tyto tenebricosa	V		Logging, grazing, burning	55%
Glossy Black-Cockatoo*	Calyptorhynchus lathami	V	V	logging, grazing	100%
Turquoise Parrot*	Neophema pulchella	V		Logging, burning	13%
Little Lorikeet	Glossopsitta pusilla	V		Logging, burning	-
Brown Treecreeper*	Climacteris picumnus victoriae	V		logging	-
Southern Greater Glider	Petauroides volans	E	E	Logging, burning	64%
Squirrel Glider	Petaurus norfolcensis	V		Logging, burning	17%
Yellow-bellied Glider	Petaurus australis	V	V	Logging	17%
Spotted-tailed Quoll	Dasyurus maculatus	V	E	logging	25%
Brush-tailed Phascogale	Phascogale tapoatafa	V		logging,	32%
Hoary Wattled Bat	Chalinolobus nigrogriseus	V		logging, grazing, burning	42%
Yellow-bellied Sheath-tail-bat	Saccolaimus flaviventris	V		logging	-
Greater Broad-nosed Bat	Scoteanax rueppellii	V		logging	38%
Southern Myotis	Myotis macropus	V			39%
Eastern False Pipistrelle	Falsistrellus tasmaniensis	V		logging	38%
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	V		logging	34%
Eastern Long-eared Bat	Nyctophilus bifax	V		Logging	59%
Pale-headed Snake	Hoplocephalus bitorquatus	V		logging, burning	9%
Stephen's Banded Snake	Hoplocephalus stephensii	V		logging, burning	43%

Table 3. Threatened Species Reliant upon Tree Hollows

1: Status: CE-Critically Endangered, E-Endangered, V-Vulnerable.

*** Species associated with inland woodlands that are in steep decline.**

2. Reserve Target Achievement: average target achievement across all populations (from Flint *et. al.* 2004)

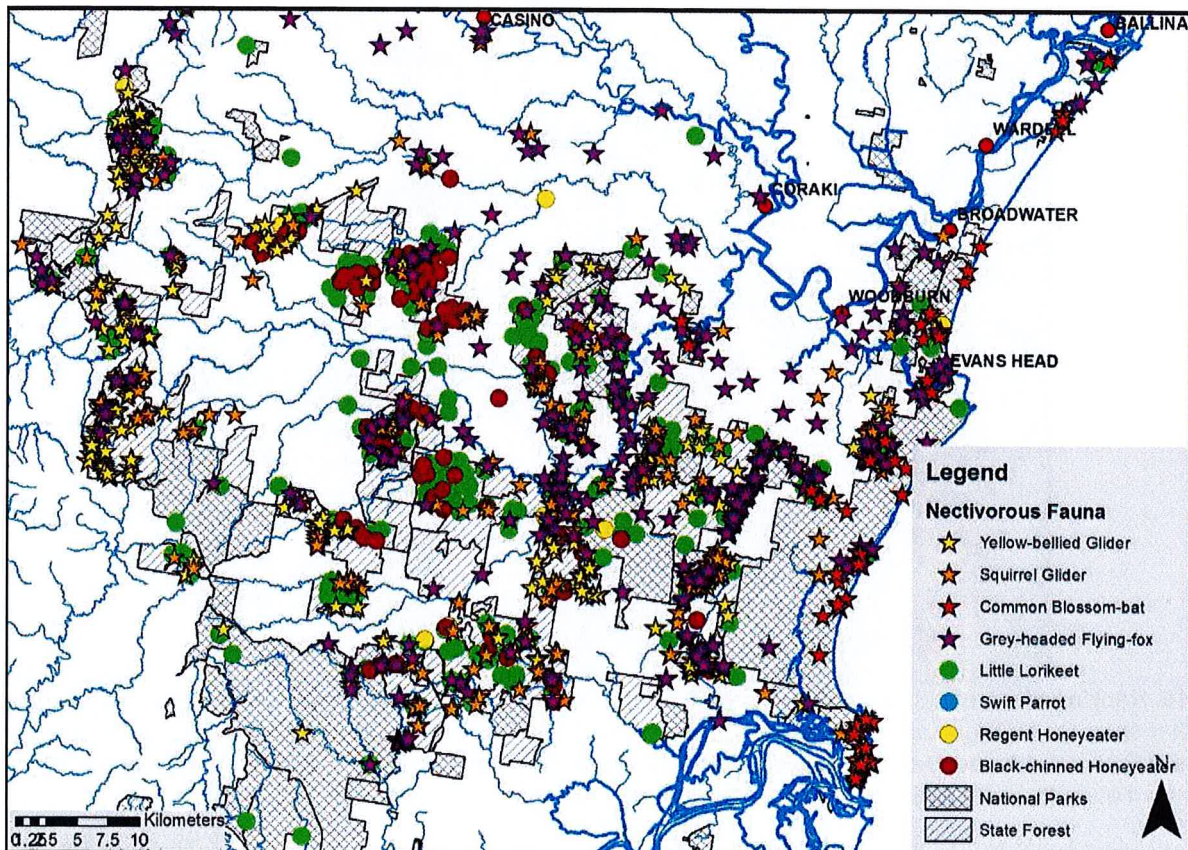
Of the 19 hollow-dependent species for which targets were set for inclusion of viable populations in the reserve system in the 2000 RFA, only one achieved its targeted area, 6 achieved less than a quarter of their targets, and eight achieved less than half their targets. This emphasizes the need for increased reservation for hollow-dependent species. The need for protection of extensive forested areas is particularly important to maintain populations of the mammals less able to disperse through cleared lands, such as the gliders.

It is important to recognize that many of these species also have a reliance upon mature trees for the abundance of food resources they provide. The South-eastern Glossy Black Cockatoo rely on individual trees selected by size and seed quality from species of sheoaks (*Allocasuarina* spp.) (North *et. al.* 2020). Southern Greater Glider has preferences for larger trees of certain tree species for eucalypt leaves (Eyre 2006, Youngentob *et. al.* 2011). Kavanagh (1987) found that Yellow-bellied Gliders primarily selected trees of certain species and secondarily trees of larger size for foraging, with 92% of trees used for foraging over 60 cm DBH and 58% over 80 cm DBH. Kavanagh (1987) found that larger trees provide a variety of resources:

Tree size. The size of trees used by foraging animals was influenced by the type of substrate being exploited (Fig. 5). Gliders were observed licking flowers mainly in medium to large trees, and licking honeydew from the branches of some very large trees. Large trees (> 80 cm DBH) were important as a source of sap: the diameters of important sap-site trees in the study area ranged from 56 to 164 cm in *E. viminalis* (mean ~SD1,10 ± 31.3 cm, n = 10), and from 74 to 143 cm in *E. fastigata* (105 ± 21.2 cm, n = 14). Decorticated bark provided a foraging substrate which gliders utilised from trees of a wide range of size, and was the only substrate to be exploited from small (<40 cm DBH) trees.

4.2. Nectar Dependence

Nectar is a key food that many vertebrate species depend upon. Eucalypt species can produce copious nectar though most flower unreliably, often at intervals of several years, so nectivorous species need to be able to track nectar across the landscape or switch to other foods when nectar is in short supply. Older trees produce significantly more flowers and nectar than young trees, and flower more regularly, and thus are of particular importance to fauna relying on these food sources.



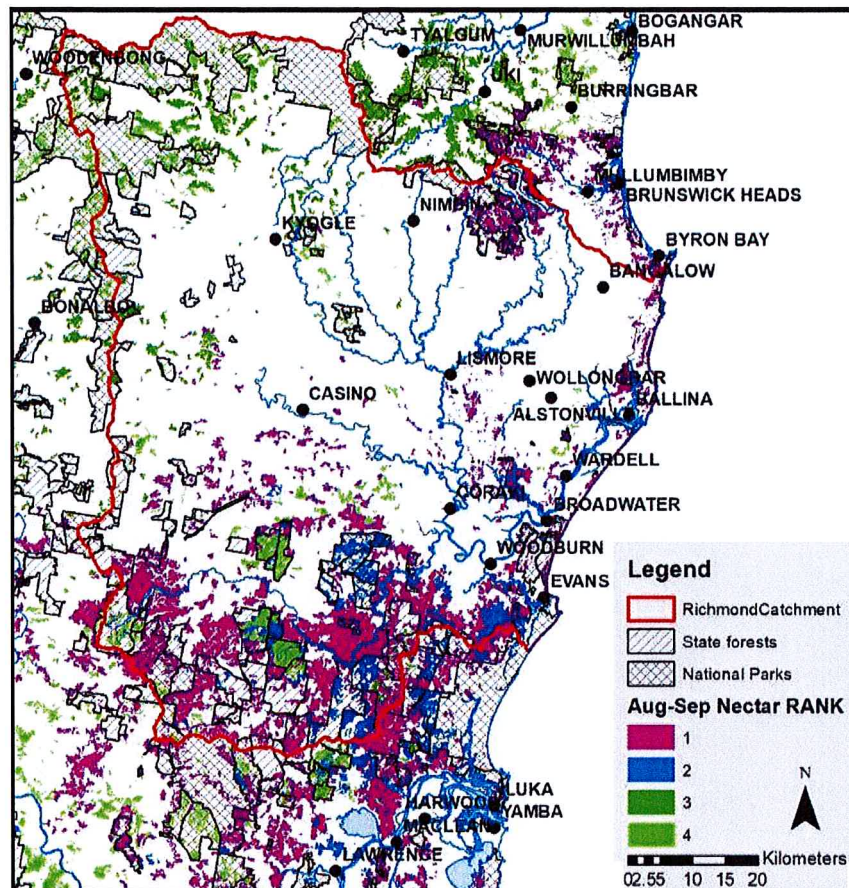
Map 15: Records of select threatened species that rely upon nectar. Note that only records within the assessment area are shown.

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For Mountain Ash trees Ashton (1975) found "The mature forest produced 2.15-15.5 times as many flowers as the pole stage trees, and 1.5-10 times as many as the spar stage forest". From her study of the flowering phenology displayed by seven Eucalyptus species in a Box-Ironbark forest, Wilson (2003) found "trees in size - classes >40 cm flowered more frequently, for a greater duration, more intensely and had greater indices of floral resource abundance than trees < 40 cm DBH".

For Spotted Gum (*Corymbia variegata*) forest in southern NSW, Law and Chidel (2007, 2008, 2009) found large trees (>40cm DBH) carried 3,600 flowers compared to 816 flowers on medium trees and 283 flowers on small trees (<25cm DBH), noting "mature forest produced almost 10 times as much sugar per ha as recently logged forest, with regrowth being intermediate". And for Grey Ironbark (*Eucalyptus paniculate*) forests large trees carried 12,555 flowers compared to 1024 flowers on medium trees and 686 flowers on small trees, noting "old regrowth forest (232 g sugar per night per 0.2 ha) produced just over 7 times the sugar of recently logged forest (32 g), while regrowth forest was intermediate (91 g)."

As well as producing more flowers larger trees also tend to flower more often (Law *et. al.* 2000, Law and Chidel 2007), for example Law *et. al.* (2000) found that large Spotted Gum flowered every 2.3 years whereas medium sized trees flowered every 5.9 years.



Map 16. Ranking of vegetation across the Richmond catchment for abundance of nectar during the key period of nectar shortage in August and September (Eby and Law 2008). This shows the national significance of southern Richmond for nectivorous species during this critical period, and the importance of retaining and restoring mature trees for their abundance of flowers and more reliable flowering.

Many studies have found that nectivores preferentially utilise large trees, for example Kavanagh (1987) found that Yellow-bellied Gliders primarily selected trees of certain species and secondarily

trees of larger size for foraging, with 92% of trees used for foraging over 60 cm DBH and 58% over 80 cm DBH. Kavanagh (1987) concluded:

The gliders in my study area selected the trees with the greatest number of flowers in which to forage for nectar; these would have been the older trees, because mature trees (c.200 years old) produce 2.2-15.5 times as many flowers as pole stage trees (c.25 years old).

These forests are an important over-wintering site for migratory and nomadic nectivores. Hawkins (2017) consider "The one consistent feature of the annual nectar cycle was a period of scarcity in late winter and spring (August-September); this has also been identified as a time of scarcity in northern New South Wales by Law et al. (2000)". Law et al (2000) comment:

shortages commonly occur from late winter to spring. Species that flower reliably in this period include Eucalyptus robusta, Eucalyptus tereticornis and Eucalyptus siderophloia in late winter and E. siderophloia and E. acmenoides in spring.

Flying foxes are a key nectar feeding species, Eby (1999) considers:

... more reliable resources are produced in lowland coastal woodlands in northern New South Wales and in southern Queensland dominated by E. tereticornis, E. robusta, M. quinquenervia and Banksia integrifolia (Clemson 1985; Pressey and Griffith 1992). In approximately 30% of years the only significant winter foraging resources available in New South Wales occur in coastal woodlands at low elevations and large numbers of flying-foxes congregate in these areas, as illustrated by this study. Grey-headed Flying foxes are known to migrate from camps many hundreds of kilometres away to utilize these winter resources (Eby 1991).

Grey-headed Flying-foxes are additionally impacted by incremental reductions in food availability throughout their range as a result of forest clearing and degradation, forestry practices, eucalypt dieback, drought, fire and the vulnerability of nectar flow to fluctuations in temperature and rainfall".

For the Grey Headed Flying Fox, Eby and Law (2008) consider:

Winter presents the greatest food resource bottleneck for the species. In winter, productive areas are concentrated in coastal floodplains, coastal dunes and inland slopes in SEQ and northern NSW. The majority of winter habitats are heavily cleared, poorly conserved and recognised as endangered vegetation communities.

It is important to recognise that the north coast forests with an abundance of these winter flowering species are of increased importance for nectivores during droughts, when drier western forests are too drought stressed to produce much nectar. For Swift Parrots Saunders and Heinsohn (2008) found:

The greatest variability in use of habitat in this study occurred on the central and northern coasts of NSW. Although these coastal regions often supported small numbers of Swift Parrots, this changed dramatically during drought conditions in 2002 (Bureau of Meteorology 2002; Bureau of Meteorology 2006). The numbers of Swift Parrots foraging in these coastal regions increased substantially during this year, with a large proportion of the population apparently using these areas as drought refuges. Our study draws attention to the importance of these refuge areas for the long-term viability of the Swift Parrot population, as for other fauna dependent on highly variable environments

Nectar availability in late Winter and Spring is also important for resident species. From radio-tracking Sharpe and Goldingay (2007) concluded "the spatial organisation of home ranges of squirrel gliders at Bungawalbin was strongly influenced by the distribution of key winter- and spring-flowering trees". Sharpe (2004) concluded "The over-harvesting of E. siderophloia in timber

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production forests would have the potential to adversely affect nectarivorous species, such as the squirrel glider and the yellow-bellied glider, both of which are listed as threatened in NSW".

The nationally Critically Endangered Regent Honeyeater and Swift Parrot are winter migrants to these forests and woodlands. There are 18 records of Regent Honeyeaters, with the most recent in 2004 and 2008. There are two records of Swift Parrots, with the most recent in 2018.

The abundance of nectar provided by mature trees (>40 cm DBH) is vital for these and six other Vulnerable nectivores: Yellow-bellied Glider, Squirrel Glider, Grey-headed Flying Fox, Common Blossom-bat, Black-chinned Honeyeater and Little Lorikeet.

Of the 6 nectarivorous species for which targets were set for inclusion of viable populations in the reserve system, none achieved their targeted area, 2 achieved less than a quarter of their targets, and three achieved less than half their targets. This emphasizes the need to increase the protection for flowering eucalypts.

Note that the Brush-tailed Phascogale also extensively utilizes nectar as a seasonal resource where available.

SPECIES		NSW Status	CW Status	OEH Identified Threats	Reserve Target Achieve ²
Swift Parrot*	Lathamus discolor	E	CE	Logging, burning	30%
Little Lorikeet	Glossopsitta pusilla	V		Logging, burning	-
Regent Honeyeater*	Anthochaera phrygia	CE	CE	logging, grazing, burning	31%
Black-chinned Honeyeater*	Melithreptus gularis gularis	V		grazing	-
Squirrel Glider	Petaurus norfolcensis	V		Logging, burning	17%
Yellow-bellied Glider	Petaurus australis	V	V	Logging	17%
Grey-headed Flying Fox	Pteropus poliocephalus	V	V		79%
Common Blossom-bat	Syconycteris australis	V			41%

Table 4. Threatened Species Reliant Upon Nectar.

1: Status: CE-Critically Endangered, E-Endangered, V-Vulnerable.

* Species associated with inland woodlands that are in steep decline.

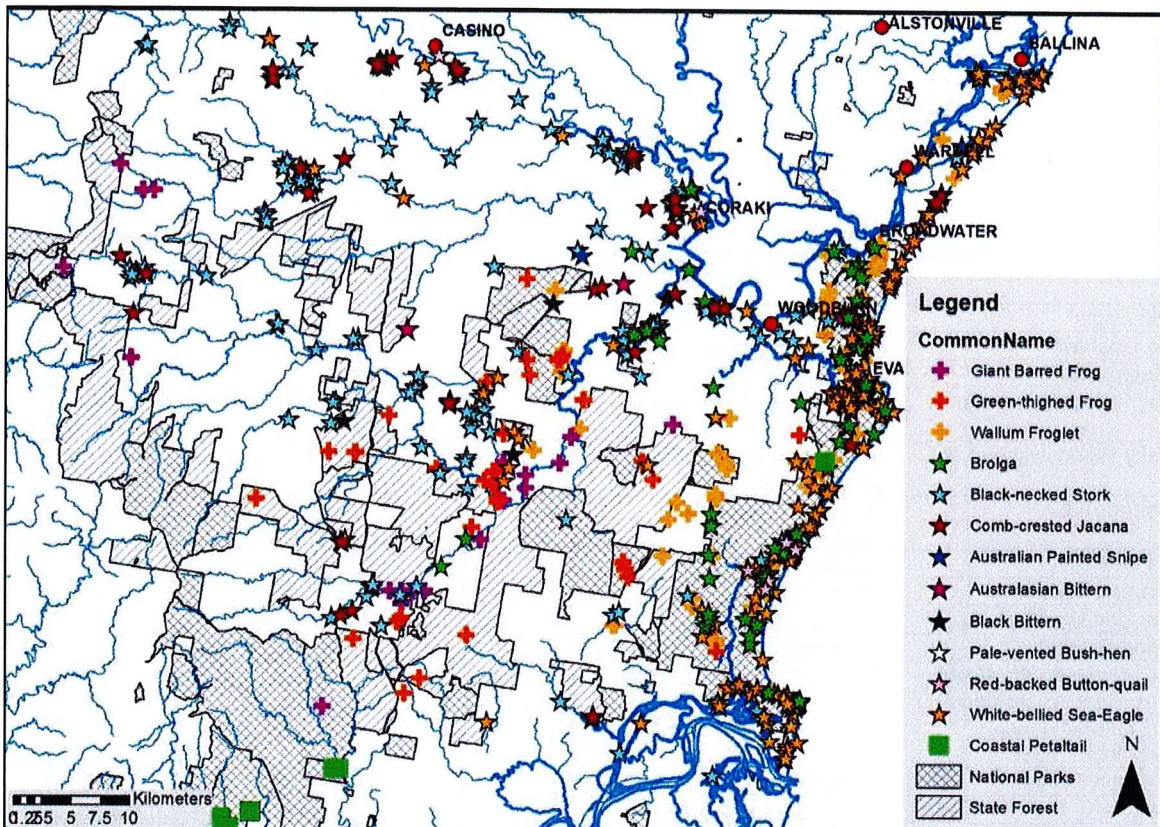
2. Reserve Target Achievement: average target achievement across all populations (from Flint *et. al.* 2004)

4.3. Wetland Dependence

Twelve threatened species are considered to be associated with inland wetlands, and to varying extents surrounding forests: the Endangered Black-necked Stork, Australasian Bittern and dragonfly Coastal Petaltail, along with the Vulnerable White-bellied Sea eagle, Brolga, Black Bittern, Pale-vented Bush-hen, Red-backed Button Quail and Comb-crested Jacana. The Endangered Giant Barred Frog forages in forests around streams, the Vulnerable Green-thighed Frog forages in forests using temporary waterbodies for breeding, and the Vulnerable Wallum Froglet is primarily associated with coastal acidic wetlands though also utilises inland streams.

Three Endangered fish are known to inhabit the streams and wetlands of the southern Richmond: [Oxleyan Pygmy Perch](#) *Nannoperca oxleyana*, [Eastern Freshwater Cod](#) *Maccullochella ikei*, and [Southern Purple Spotted Gudgeon](#) *Mogurnda adspersa*.

Species not considered: the Vulnerable Olongburra Frog is common in the wetlands in Bundjalung and Broadwater National Parks, but not recorded inland. In this area the Vulnerable Blue-billed Duck, Freckled Duck and Magpie Goose are relatively rare and associated with the main rivers.



Map 17: Records of select species associated with wetlands. Note that only records within the assessment area are shown.

THREATENED SPECIES ASSOCIATED WITH FORESTS AND WETLANDS

SPECIES	NSW Status	CW Status	OEH Identified Threats	Reserve Target Achieve ²
White-bellied Sea-Eagle	Haliaeetus leucogaster	V		-
Brolga	Grus rubicunda	V		-
Black-necked Stork	Ephippiorhynchus asiaticus	E	drainage	8%
Australasian Bittern	Botaurus poiciloptilus	E	E drainage	-
Black Bittern	Ixbrychus flavicollis	V	drainage	53%
Pale-vented Bush-hen	Amaurornis moluccana	V		-
Comb-crested Jacana	Irediparra gallinacea	V	drainage	-
Red-backed Button Quail	Turnix maculosus	V	grazing, burning	-
Giant Barred Frog	Mixophyes iteratus	E	E logging, grazing	43%
Green-thighed Frog	Litoria brevipalmata	V	logging	17%
Wallum Froglet	Crinia tinnula	V		88%
Coastal Petaltail	Petalura litorea	E	burning	-

Table 5. Threatened Species Associated with Forests and Wetlands.

1: Status: CE-Critically Endangered, E-Endangered, V-Vulnerable.

2. Reserve Target Achievement: average target achievement across all populations (from Flint *et. al.* 2004)

4.4. Other Threatened Fauna

There are a variety of threatened forest species that are in significant decline in western regions for which the southern Richmond will become an increasingly important refuge into the future. The dry grassy forests provide important habitat for a suite of [threatened woodland species](#) including the

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Vulnerable Square-tailed Kite, Little Eagle, Grey-crowned Babbler, Diamond Firetail, Scarlet Robin, Dusky Woodswallow and Varied Sittella. These are in addition to the afore mentioned Barking Owl, Powerful Owl, Glossy Black-Cockatoo, Black-chinned Honeyeater, and Brown Treecreeper, along with the Critically Endangered Swift Parrot and Regent Honeyeater. These forests also represent important refuges for declining woodland mammals such as the Rufous Bettong and hollow-dependent Brush-tailed Phascogale,

SPECIES		NSW Status	CW Status	OEH Identified Threats ³	Reserve Target Achieve ²
Square-tailed Kite*	Lophoictinia isura	V		Logging, grazing, burning	31%
Little Eagle*	Hieraetus morphnoides	V			-
Red Goshawk	Erythrotriorchis radiatus	CE	V	Logging	23%
Spotted Harrier	Circus assimilis	V			-
Grey Crowned Babbler*	Pomatostomus temporalis temporalis	V		grazing, burning	68%
Dusky Woodswallow*	Artamus cyanopterus cyanopterus	V		logging, grazing	-
Hooded Robin*	Melanodryas cucullata cucullata	V		logging, grazing, burning	14%
Scarlet Robin*	Petroica boodang	V		grazing	-
Diamond Firetail*	Stagonopleura guttata	V		grazing, burning	-
Speckled Warbler*	Chthonicola sagittata	V		grazing, burning	-
Varied Sittella*	Daphoenositta chrysoptera	V		grazing, burning	-
Emu - New South Wales North Coast Bioregion and Port Stephens local government area	Dromaius novaehollandiae	E-Population			-
Common Planigale	Planigale maculata	V		grazing, burning	100%
Koala	Phascolarctos cinereus	V	V	burning	83%
Rufous Bettong	Aepyprymnus rufescens	V		logging, grazing, burning	18%
Black-striped Wallaby	Macropus dorsalis	E		grazing, burning	36%
Long-nosed Potoroo	Potorous tridactylus	V	V	Logging, burning	26%
Brush-tailed Rock-wallaby	Petrogale penicillata	E	V	burning	16%
Red-legged Pademelon	Thylogale stigmatica	V		logging, grazing, burning	33%
Little Bent-wing Bat	Miniopterus australis	V		burning	100%
Large Bent-wing Bat	Miniopterus orianae oceanensis	V			100%
Large-eared Pied Bat	Chalinolobus dwyeri	V		Logging, burning	31%
Golden-tipped Bat	Phoniscus papuensis	V		Logging, burning	25%
Eastern Cave Bat	Vespadelus trougtoni	V		Logging, burning	13%
New Holland Mouse	Pseudomys novaehollandiae		V		48%
White-crowned Snake	Cacophis harriettae	V		logging, burning	-
Shorter Rainforest Ground-beetle	Nurus brevis	E			-

Table 6. Other Threatened Fauna Species known from Southern Richmond Forests.

1: Status: CE-Critically Endangered, E-Endangered, V-Vulnerable.

2. Reserve Target Achievement: average target achievement across all populations (from Flint *et. al.* 2004)

*** Species associated with inland woodlands that are in steep decline.**

Other identified threatened species recorded within these forests include the Green-thighed Frog, White-crowned Snake, Common Planigale, Long-nosed Potoroo, Brush-tailed Rock-wallaby, Large-eared Pied Bat, Golden-tipped Bat, Eastern Cave Bat, Little Bent-winged Bat, Large Bent-winged Bat, and New Holland Mouse. The Shorter Rainforest Ground-beetle is known from rainforest in Mallanganee National Park and Cherry Tree State Forest. Sheltering in rainforest, though often feeding in more open habitat, are the Endangered Black-striped Wallaby and Vulnerable Red-legged Pademelon. These drier forests are also home to the NSW endangered Emu population in

the New South Wales North Coast Bioregion and Port Stephens local government area. The Red Goshawk is now likely extinct in NSW.

Seventeen of these species had targets set for inclusion of viable populations in the reserve system: three achieved their targeted area, six achieved less than a quarter of their targets, and another six achieved less than half their targets. This demonstrates the inadequacies of the existing reserve system for forest fauna..

4.5. Koala

The principal motivation for this assessment is concern for the Banyabba Area of Regional Koala Significance (ARKS). Since NEFA identified and stopped logging of multiple Koala High Use Areas in Royal Camp State Forest in 2012 we have focussed on better defining and protecting this poorly known population. It was identified as an ARKS and as a Nationally Important Kola Area (NIKA) due to its *high-quality and relatively intact Koala habitat and potential for long-term viability*. The State forests of the southern Richmond lowlands contain 27,630ha (half their area) identified as NIKA, and their importance is still being revealed, in part through NEFA surveys.

These forests provide exceptional habitat because of their extent, high densities of preferred Koala feed trees, extensive shallow water-table, and limited threats from urban interactions. Koalas will feed on a wide variety of trees in these forests, though they primarily rely upon a handful of species, and from these they prefer mature trees >30cm Diameter at Breast Height (DBH); Preferred Koala Feed Trees (PKFTs). These too are preferred by the loggers.

The 2018 CIFOA logging rules require that, at best, 5 Koala feed trees >20 cm DBH need to be retained during logging of State forests in the southern Richmond, meaning most of the 39/ha PKFTs >30cm DBH identified in the proposed Sandy Creek Koala Park (Pugh 2020) and 34/ha identified in Cherry Tree SF (unpublished) can be logged, as retention can be met from smaller trees. By removing the mature trees preferred by Koalas, past logging has significantly reduced the numbers of Koalas these forests can support, further logging will increase population declines by removing current and future feed trees, drying the forest and increasing fire risk.

For over a decade NEFA have been actively trying to protect Koalas in the southern Richmond. We had some early success identifying and protecting Koala High Use Areas (KHUAs), which were defined by a high density of Koala scats. Based on our findings, in 2014 NEFA first proposed Carwong and Royal Camp State Forests be protected for Koalas, with an EPA (2016) assessment finding they constitute source habitat for Koalas, with 80% of Carwong and 58% of Royal Camp State Forests utilised. NEFA continued to find evidence of Koalas in most forests we surveyed until finding another patch with an exceptional density of scats and thus KHUAs in Braemar State Forest. As we pleaded with the Premier to protect it, they instead redid the harvesting plan to apply the new rules which no longer required the identification and protection of KHUAs. Based on our surveys, NEFA proposed an expanded Sandy Creek Koala Park.

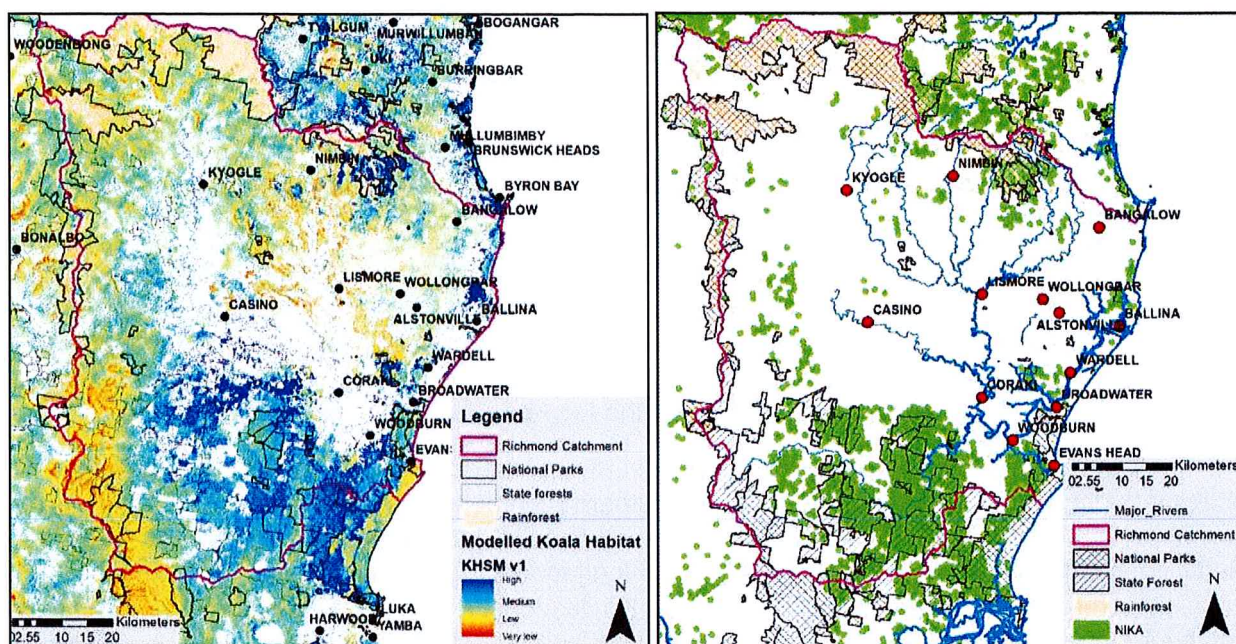
As the Government changed the rules to remove any requirement to protect the best Koala habitat, NEFA can now only appeal to the Government's goodwill, which doesn't exist for Koalas on State forests. Most recently NEFA have resorted to legal challenges, stopping logging in Braemar and Myrtle State Forests until a judgement is delivered.

The Banyabba Koala population was severely and extensively impacted by the 2019/20 wildfires, it is likely that over half the Koalas on State Forests were killed, with many core groups eliminated. A significant proportion of mature feed trees were killed. It is apparent that populations are slowly

recovering, though the process will take decades. The last thing the recovering population needs is to have their mature feed trees logged.

4.5.1. The importance of the southern Richmond

There have been various attempts to identify Koala habitat across the southern Richmond, though they can only broadly characterise likely habitat, primarily because the distribution of occupied habitat is largely related to the occurrence of mature Preferred Koala Feed Trees (PKFTs) (combined with soil fertility and soil moisture), which can be patchily distributed within ecosystems, and then the occupation of a patch can be related to historical factors (logging, wildfires, fragmentation, predation).



Maps 18 and 19: Models of Koala habitat across the Richmond catchment show the extent and importance of Koala habitat in the southern Richmond; (LEFT) OEH Koala Habitat Suitability Model ranking of Koala habitat across the Richmond River catchment (dark blue is highest), (RIGHT) Nationally Important Koala Areas (NIKAs) (green) mapped by the NESP Threatened Species Recovery Hub (Runge *et. al.* 2021). Note that a rainforest mask was applied for clarity as rainforest is generally not considered suitable habitat, though it is recognised that marginal areas with eucalypt (PKFTs) dominants can be important habitat.

Priority actions identified in the [National Recovery Plan for the Koala *Phascolarctos cinereus* \(combined populations of Queensland, New South Wales and the Australian Capital Territory\)](#) (DAWE 2022), include:

- Identify nationally important populations and habitat across the listed koala range under current conditions, and considering future impacts of climate change such as drought, heatwave, and fire, assessed by undertaking habitat distribution, population modelling and analysis (including abundance/density and genetic diversity), allowing for iterative updates using a robust scenario-based approach.
- Increase the overall area of protected koala habitat by dedication of Crown land and purchasing land identified as priority koala habitat for incorporation into the state protected areas. Priority areas include those that support viable populations and those that have the greatest potential for population-level recovery.

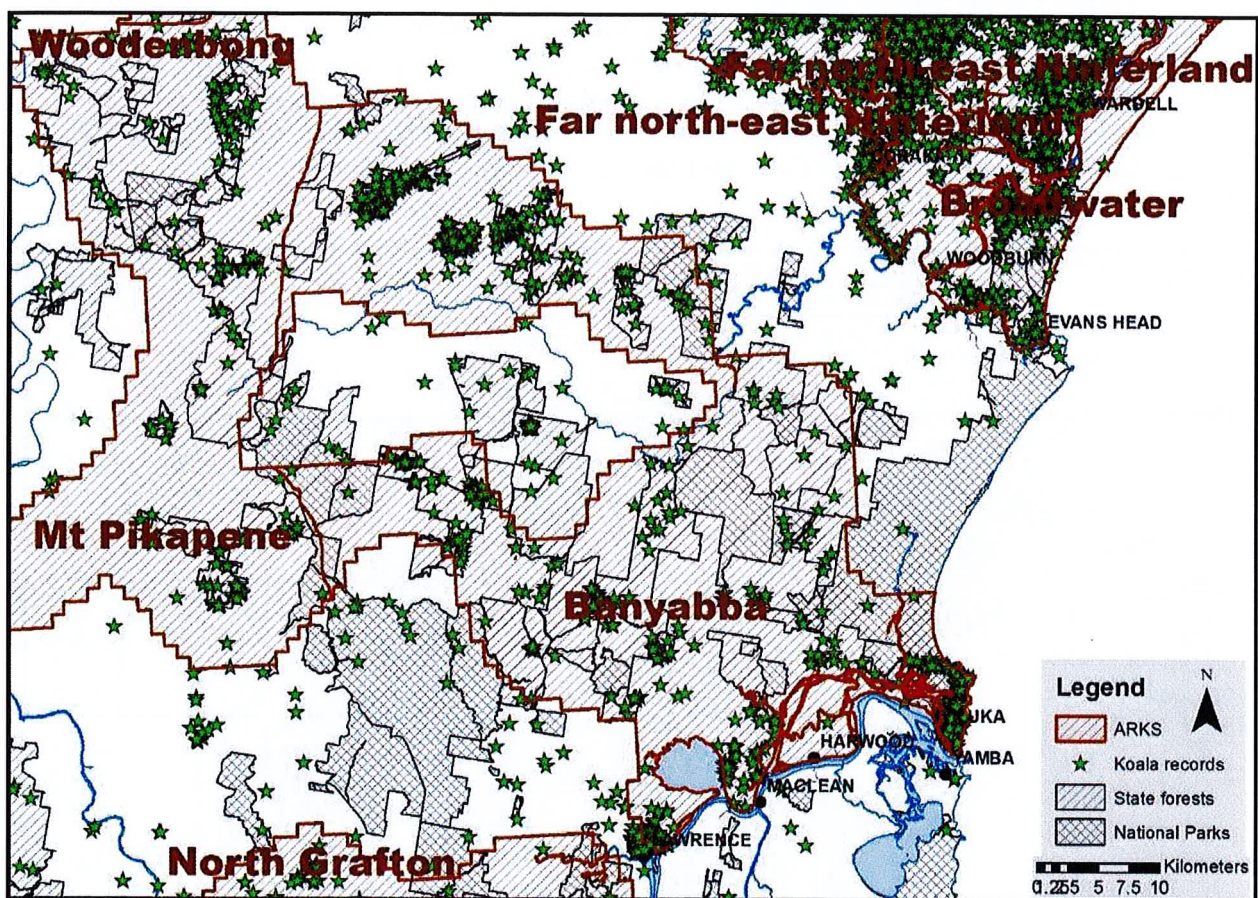
DAWE (2022) includes as action 1a 'Identify nationally important populations and habitat for recovery across the listed koala range under current and future conditions'. To implement this action

the NESP Threatened Species Recovery Hub (Runge et. al. 2021) has mapped Nationally Important Koala Areas (NIKA). The report notes:

The purpose of such areas is to delineate broad regions within which Commonwealth conservation activities and funding for koala recovery could be prioritised, and to provide guidance for states, local government authorities and non-government organisations for regions which are important for long-term koala persistence.

...
Recovery requires increasing birth rates and/or lowering mortality rates to increase koala numbers and/or increasing carrying capacity. This research takes a landscape-scale approach to conservation that seeks to maintain healthy habitat and stable koala numbers ...

...
The technical criteria for NIKA proposed here prioritises large, connected areas of high-quality and relatively intact koala habitat and areas likely to remain climatically suitable for koalas



Map 20: The southern Richmond encompasses the Banyabba Area of Regional Koala Significance (ARKS), and most of the Mt Pikapene ARKS to the west. Koala records, in part, reflect observer bias, with relatively more records in more settled areas.

As part of developing a Koala Strategy the then Office of Environment and Heritage undertook a variety of studies, including a bioregional assessment (Rennison 2017). This identified that the NSW section of the South Eastern Queensland Bioregion with an estimated 10% of Koalas in reserves, this is a "Low". The population was categorised as having declined by 50%. The region was ranked as a "Moderate-High" priority for increased reservation for Koalas.

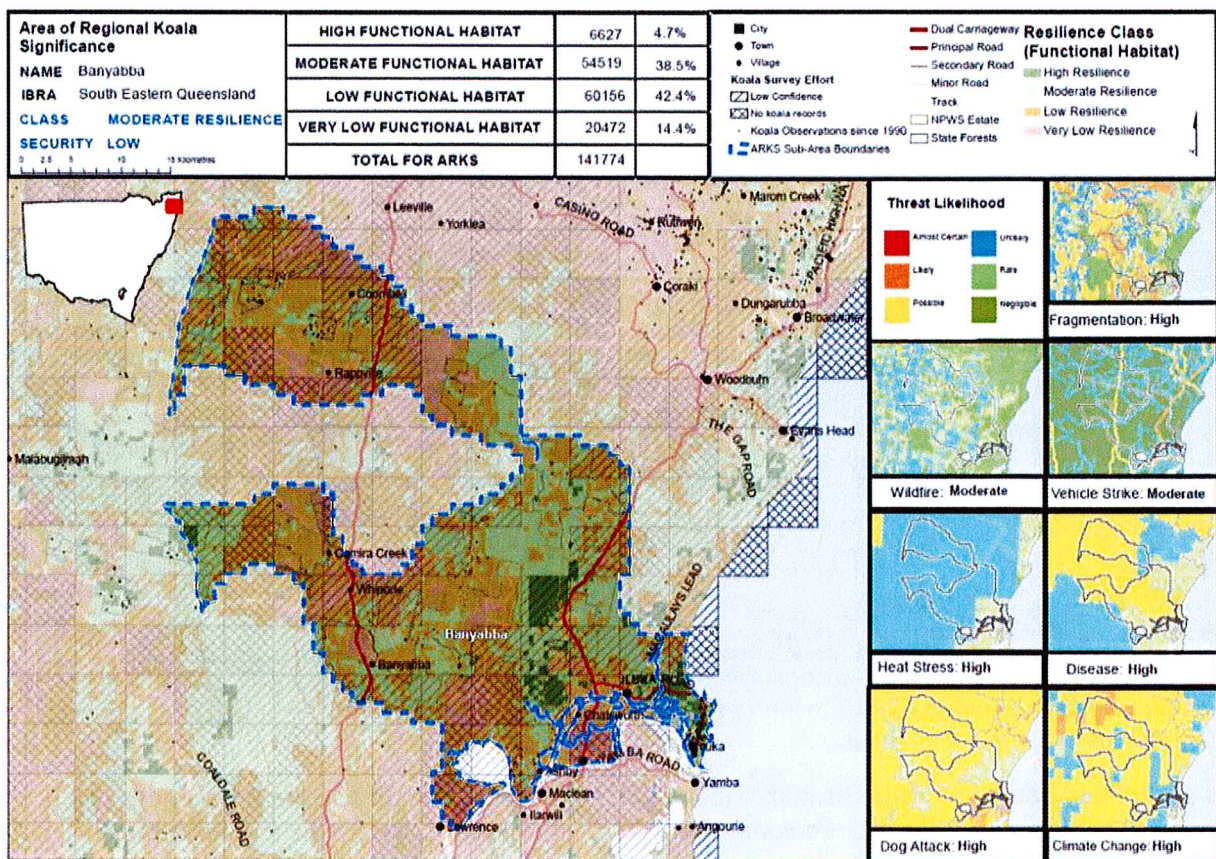
A complimentary state-wide assessment was undertaken by Rennison and Fisher (2018) to identify Areas of Regional Koala Significance (ARKS). ARKS are "key koala populations and management

Protecting the Southern Richmond

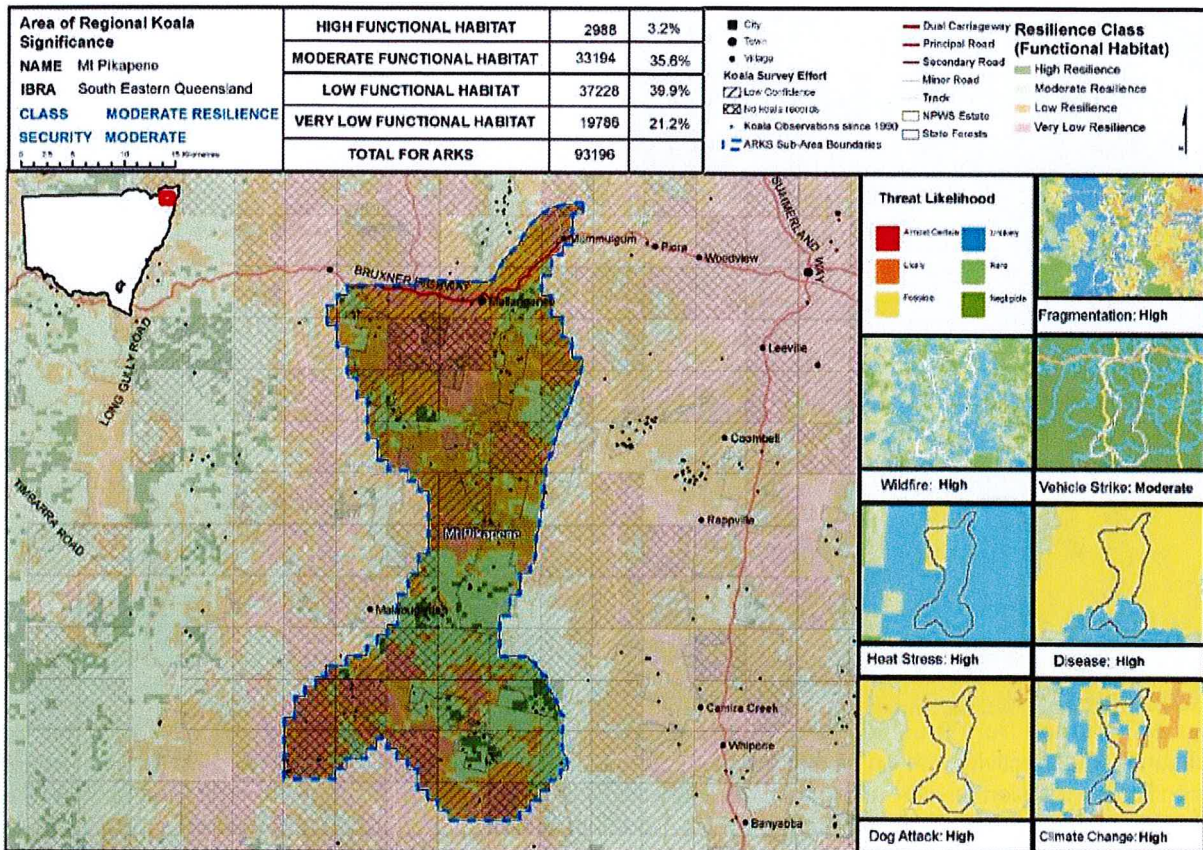
areas which have the potential for long-term viability". Altogether, 4,195,549 hectares, around 5% of NSW, is mapped as being of significance for Koalas in 48 ARKS. This southern Richmond encompasses the Banyabba ARKS, and most of the Mt Pikapene ARKS to the west. Note that the hole in the Banyabba ARKS is an artefact of the low numbers of records in those areas at the time the ARKS were identified, and that the significant records made by NEFA since then means the omitted areas would now qualify.

Biolink (2022) undertook a broad field survey for Koalas, using SAT methodology, at 350 regularly spaced sites on a 5 km grid across the Richmond River, Kyogle, Lismore, Ballina, Byron and Tweed local government areas, which incorporates the whole of the Richmond River catchment. For the Richmond Valley LGA Biolink (2022) sampled 107 sites, finding koala scats on 28 of these giving a naïve occupancy estimate of 26%. In total 83 of the field sites contained Preferred Koala Feed Trees (PKFTs), of which 25 had Koala scats, giving a habitat occupancy rate of 30%. This is a high strike rate given the significant impacts of the 2019/20 wildfires on the LGA's Koalas, and that their population is yet to recover. Based on their broad assessment Biolink (2022) found:

The broadscale area supporting the greatest significant (medium and high) koala activity is located across southern Lismore LGA, extending from south Ballina LGA to the east, through-out the entirety of south Lismore LGA and into the Richmond Valley LGA to the south and west, an area which is generally reflective of the location of the fertile Richmond River Floodplain.



Map 21: Banyabba ARKS is one of the nineteen populations identified under the NSW Koala Strategy for 'immediate investment' as "relatively large koala populations supported by good levels of knowledge but subject to significant threats".



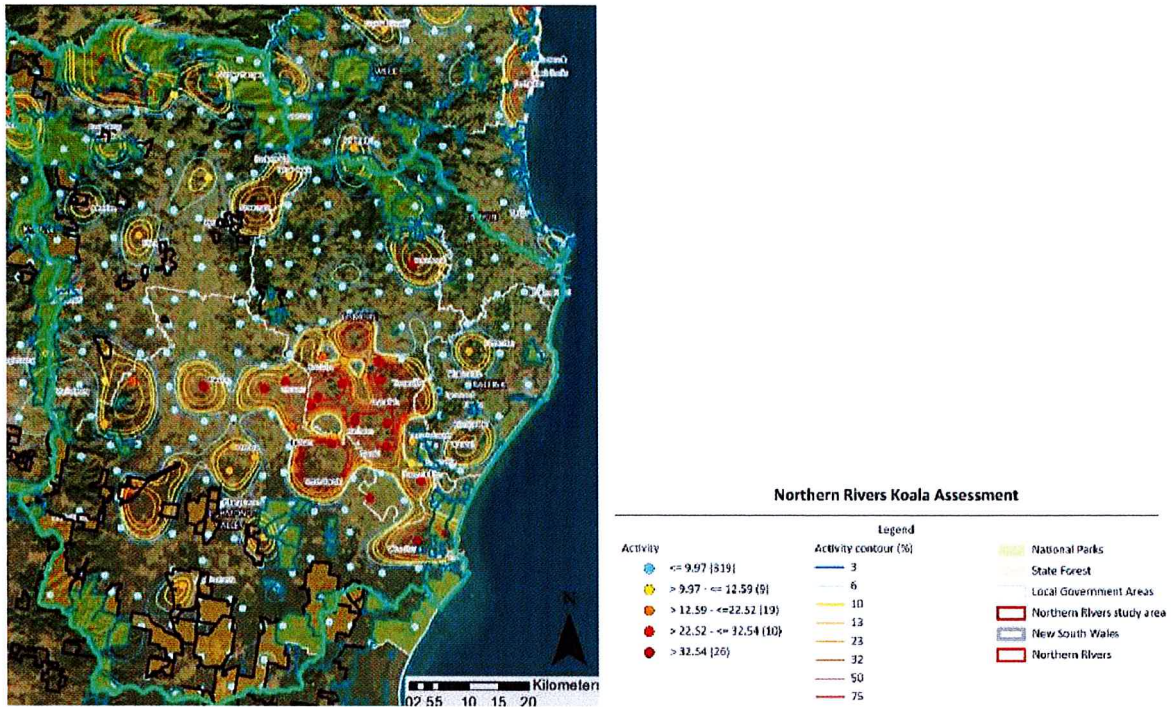
Map 22. Mt Pikapene ARKS

In 2023 NEFA engaged Biolink to undertake assessments using their rapid SAT methodology, targeting clumps of PKFTs at >500m intervals, in proposed logging areas in Braemar and Myrtle State Forests. Biolink (unpublished) found active habitat utilisation by Koalas at 4 of 5 field sites in Myrtle State Forest and at 4 of 6 field sites in Braemar State Forest, showing that Koalas are recovering since the fires and again utilising most available habitat. Importantly the results showed the importance of more intensive sampling (than a 5 km grid used by Biolink 2022) to identify Koala activity.

Within the proposed [Sandy Creek Koala Park](#), (which includes Royal Camp and Carwong SFs), NEFA (2020) recorded an average of 39.2 Preferred Koala Feed Trees (PKFT) >30 cm DBH per hectare, representing around 43% of canopy species. These relatively high numbers of mature PKFTs partly explain why these forests represent high quality Koala habitat.

In Cherry Tree SF, NEFA (unpublished) recorded an average of 33.8 PKFT >30 cm DBH per hectare, representing around 35% of canopy trees, as well as an additional 27 trees per ha (28%) known to be utilised to varying extents for food. Significantly, as well as large numbers of PKFTs, NEFA identified 2 live Koalas, numerous trees with Koala scats, and numerous Grey Gums with Koala scratches in Cherry Tree SF, despite it only being modelled as medium-low quality habitat. This highlights the problem of models being based on forest type mapping that does not adequately show the distribution of PKFTs.

PKFTs are unevenly distributed throughout the forests, with high densities and diversities in some stands and occasional trees in others. Koala home ranges likely reflect the distribution of PKFTs, focused on patches with high densities of PKFTs. Any losses of PKFTs will affect the carrying capacity of the forest, particularly the loss of core areas.



Map 23: Adapted from Biolink (2022): Figure 4 showing the distribution of koala survey points, with the location of koala activity with significant (medium and high) koala activity shown in yellow, orange and red and insignificant / transient activity shown in blue. The activity contours shown in yellow, orange and red show the location of known breeding aggregates of koalas. The 5km sampling grid missed many areas of Koala activity, as shown by sampling at 500m intervals such as in Myrtle and Braemar. Note that the survey was undertaken after the 2019/20 fires significantly impacted Koalas in the southern Richmond.

Groundwater resources mirror the floodplain. This is particularly important for species such as Koalas and Greater Gliders who obtain most of their water needs from the leaves of trees that can tap into the groundwater in droughts.

4.5.2. Preferred Koala Feed Trees

The key determinants of potential Koala habitat are considered to be Preferred Koala Feed Trees (PKFTs). Within a given area, only a few of the available *Eucalyptus* species will be preferentially browsed, while others, including some non-eucalypts, may be incorporated into the diet as supplementary browse or utilised for other purposes such as shelter. The secondary parameter of most importance is tree size, with Koalas found to prefer trees >30 cm DBH (Diameter at Breast Height) in many studies, including in the Banyabba area.

For their assessment of the Richmond River, Kyogle, Lismore, Ballina, Byron and Tweed local government areas (which incorporates the whole of the Richmond River catchment) Biolink (2022) considered PKFTs to comprise:

- *Eucalyptus robusta* (Swamp Mahogany, including the naturally occurring *E. robusta* x *E. tereticornis* hybrid)
- *E. tereticornis* (Forest Red Gum),
- *E. microcorys* (Tallowwood),
- *E. moluccana* (Coastal Grey Box), and
- *E. propinqua* (Small-fruited Grey Gum) and allied species

The EPA (2016) found that in Royal Camp and Carwong State forests, Koalas are primarily reliant upon Small-fruited Grey Gum (*E. propinqua*), Forest Red Gum (*Eucalyptus tereticornis*), Slaty Red Gum (*E. glaucina*) and Coastal Grey Box (*E. moluccana*) as feed trees. Tallowwood (*E. microcorys*)

are rare in the area, though used when available. Koalas also frequently utilise a large variety of different tree species for occasional browse and roosting.

NEFA (Pugh 2020) found that the primary Koala feed trees within the proposed [Sandy Creek Koala Park](#) are Small-fruited Grey Gum (*E. propinqua*), Coastal Grey Box (*E. moluccana*), and the red gums Forest Red Gum (*E. tereticornis*) and Slaty Red Gum (*Eucalyptus glaucina*) (which were generally not differentiated and classed as Red Gums in the assessment). Together these made up 91% of the 477 trees identified by NEFA with Koala scats: Grey Gum 35%, Grey Box 34% and Red Gum 22%. Large-leaved Spotted Gum (*Corymbia henryi*) comprised most of the balance.

McAlpine *et. al.* (2023) undertook an assessment of Koala habitat requirements in the Lismore, Ballina, Byron and Tweed local government areas (encompassing the north-eastern Richmond catchment), finding the most preferred trees were larger sized Small-fruited Grey Gum *E. propinqua*, Swamp Mahogany *E. robusta*, Forest Red Gum *E. tereticornis*, Tallowwood *E. microcorys* and Flooded Gum *E. grandis* (primarily in Lismore LGA).

Further south in Pine Creek State Forest, Radford Miller (2012) found that '*Faecal cuticle analysis confirmed that Eucalyptus microcorys, E. saligna, E. propinqua and Allocasuarina torulosa were the primary koala feed tree species (KFTS) in this forest with tallowwood found in 100% of faecal pellet samples analysed and the other three species each appeared in over 75% of faecal pellet samples*'.

Many studies have identified the Koala's preference for larger trees (Hindell and Lee 1987, Lunney *et. al.* 1991, Sullivan *et. al.* 2002, Moore *et. al.* 2004b, Smith 2004, Moore and Foley 2005, Matthews *et. al.* 2007, Ellis 2009, Radford Miller 2012, EPA 2016, Gallahar *et. al.* 2021, Law *et. al.* 2022). Tree size has been found to be the most significant variable after tree species in a number of studies.

For Royal Camp and Carwong State Forests the [EPA \(2016\)](#) found a strong positive relationship between the size class of feed trees and usage by koalas, noting "*Analysis of size class data for Carwong, Royal Camp and Clouds Creek indicate that koalas preference for utilisation of feed trees by koalas is towards larger trees (higher diameter at breast height >30 centimetres)*". The EPA found that Koala usage of Small-fruited Grey Gum increased from 1 in 6 trees <20 cm diameter to 1 in 4.5 trees 20-55 cm diameter, to 1 in 2 trees >55 cm diameter, and that Koala usage of Grey Box increased from 1 in 13.5 trees <20 cm diameter, to 1 in 7.5 20-50 cm diameter and 1 in 5 >50cm diameter.

The EPA (2016) also found Koalas had a clear preference for areas with >50% mature and over mature trees in the vicinity, noting "*Seventy-four per cent (74%) of all activity resides in the high class of structural maturity*" (p.62). This demonstrates the Koala's preference for forests with significant numbers of larger trees.

From their studies in Royal Camp and Carwong State Forests, along with 2 other State Forests, the EPA (2016) concluded:

While resident populations of koala were found in all pilot areas, habitat utilisation was variable across the landscape. Areas of higher activity positively correlated with greater abundance and diversity of local koala feed trees, trees and forest structure of a more mature size class, and areas of least disturbance.

Within the proposed [Sandy Creek Koala Park](#), NEFA found that aside from species, the most obvious influence on tree usage by Koalas was tree size. Of the 475 trees found to be used by Koalas (where species and diameters were recorded), 85% were 30 cm diameter (DBH) or larger. Despite being most abundant, trees under 20 cm DBH comprised only 2.7% of trees used. Overall tree usage increased with tree size relative to tree availability.

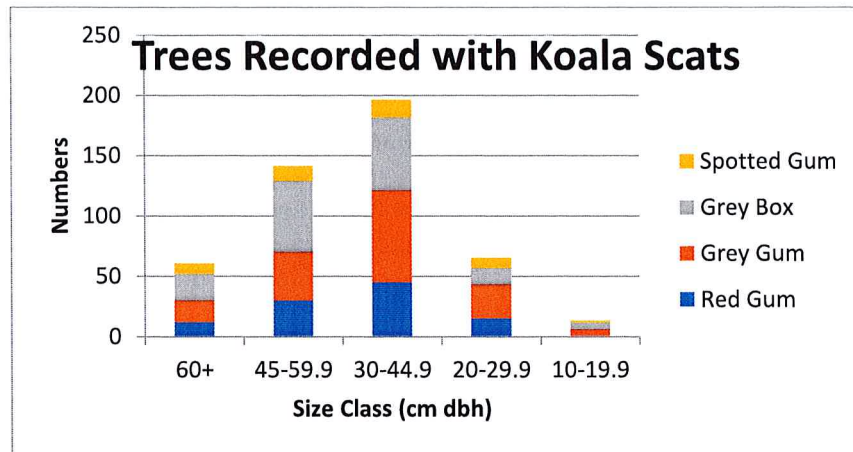


Fig 3. Size classes and species of trees found with Koala scats across all NEFA's searches in the proposed Sandy Creek Koala Park. Note that their use of trees is relative to their availability, with proportion of trees used increasing with tree size.

Radford Miller (2012) found differences between males and females, noting:

Female koalas included more, larger-sized trees in their home ranges, increasing the basal area and decreasing the stem count. The females also gained access to the habitat with both tallowwood and grey gum which may indicate some sexual segregation in home range selection such that females establish smaller ranges on the higher quality habitat.

McAlpine et al. (2023) note "larger trees have greater access to soil nutrients including moisture, potentially greater leaf volumes and more options for browse selection and shelter", concluding:

Given that our results indicate that medium-sized trees of the preferred eucalypt species are the most used resource for koalas, we should maximize their protection and plan for the long-term restoration of mature forest ecosystem types that support these species.

Biolink (2022) consider;

vegetation communities without PKFTs simply cannot permanently sustain free-ranging koala populations, while the removal of PKFTs from within areas being utilised by koalas can result in nutritional stress, elevated levels of disease and a reduced reproductive output.

In an affidavit for NEFA's court case against the Forestry Corporation over logging of Myrtle and Braemar State Forests, Dr. Steve Phillips (31 July 2023) stated:

Specifically, for local koala populations seeking to consolidate and recover from the impacts of the bushfires, losing koala browse food trees will delay the ability of the populations to consolidate and recover from the impacts of the 2019-20 bushfire events, which include social dissolution, injury and/or death from misadventure and heightened risks of predation.

...

In areas where there are koalas, my research data now being the subject of a research grant with the NSW Government confirms that 100% of the koala browse feed trees are being utilised at the local population level by individual koalas comprising the local population. This means that any reduction in koala browse trees will impact the ability for koala populations to meet their nutritional needs. With possible dire consequences for individuals and populations including loss of fitness, increasing susceptibility to diseases and nutritional stress and reduction in reproductive output.

From assessments of representative plots, NEFA identified 39 PKFTs/ha >30cm DBH in the proposed Sandy Creek Koala Park (Pugh 2020) and 34 PKFTs/ha in Cherry Tree SF (Pugh 2023 - unpublished). These high densities of mature PKFTs explain why these forests are so important for Koalas. The 2018 CIFOA requires that for Koalas, at best, 5 Koala feed trees/ha >20 cm DBH need

to be retained during logging in the southern Richmond. In most areas this requirement can be satisfied from trees <30 cm DBH, with only occasional PKFTs required to be retained where they have hollows. This is a prescription for Koala extinction, not recovery.

4.5.3. NEFA's surveys

NEFA have undertaken numerous audits and surveys of proposed and active logging operations on State forests across the southern Richmond. These have focussed on assessing compliance with the logging rules, pre-emptive identification of Koalas and attempts to force the Forestry Corporation to undertake Koala surveys (back when they were required). This chronology highlights the assessments undertaken, though focusses on Koalas.

In 2010 NEFA audited logging in [Doubleduke State Forest](#), though did not search for Koalas.

NEFA first became aware of the outstanding significance of the southern Richmond for Koalas when a [brief audit](#) of active logging in Royal Camp State Forest in August 2012 identified a Koala High Use Area (KHUA) being logged and four KHUAs proposed for logging. At that time the Forestry Corporation was required to thoroughly search for Koala scats so as to identify and protect patches with high numbers of scats as KHUAs. The Environment Protection Authority (EPA) confirmed these as Koala HUAAs and logging was stopped, and ultimately the EPA found that the Forestry Corporation had not adequately looked for Koala scats and had logged 61 trees and constructed 405m of snig tracks within a Koala HUA, issuing 3 Penalty Notices, amounting to a total of \$900 in fines (see [NEFA 2014](#)).

In 2013 the Forestry Corporation proposed logging another part of Royal Camp SF claiming there were no Koalas, a [NEFA assessment](#) identified multiple Koala High Use Areas. The EPA (24 July 2013) again confirmed NEFA's findings, informing the Forestry Corporation that they found "areas that indicate koala high use that is ongoing and contemporary", noting "Based upon these findings and recent findings made from investigations undertaken in compartments 14, 15 and 16 of Royal Camp State Forest, the EPA considers these areas contain koala habitat and play an important role to Koala populations in the region", once again stopping logging.

The then Minister for the Environment requested the EPA to determine the regional significance of the koala population, with the subsequent report by Dr. Steve Phillips (2014) for the EPA finding a resident koala population within Royal Camp that "should be considered important at all levels of assessment" due to the koala populations of the encompassing Richmond Valley Local Government Area being found to be "endangered on the basis of international, national and state-based conservation criteria". The EPA (M. Gifford, 1 July 2014) provided Dr. Phillips' report to the Forestry Corporation, noting "The EPA recommends that no forestry activities occur in Royal Camp State Forest until such time as ... Regional refinement of the EPAs koala habitat mapping project is undertaken in the Royal Camp area".

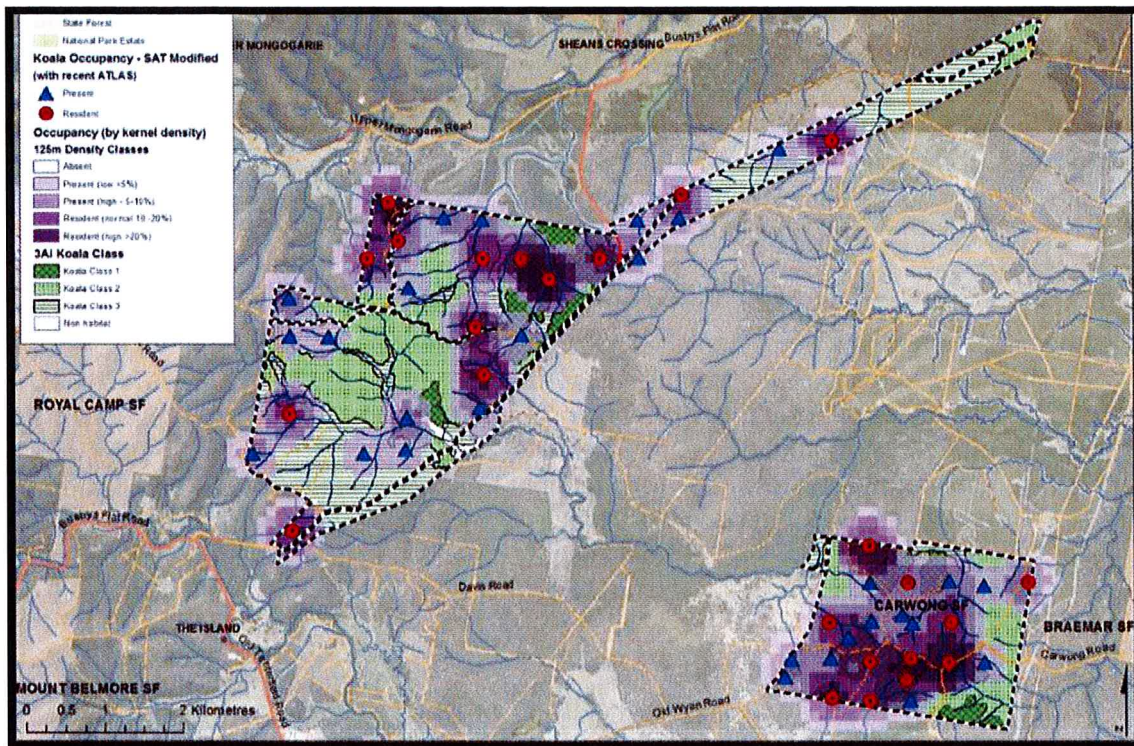
Based on Koala records, in November 2014 NEFA first proposed the creation of the 2,100 ha [Sandy Creek National Park](#) incorporating both Royal Camp and Carwong State Forests.

In 2015 the [EPA \(2016\)](#) included Royal Camp and Carwong State Forests in a detailed study of Koalas in four State forests as part of a detailed study intended to identify the feasibility of modelling Koala habitat, in the process verifying that Royal Camp and Carwong State Forests have significant populations of resident Koalas:

The activity results and Phillips' (2013) report both indicate that Royal Camp and Carwong state forests support extensive areas of koala occupancy and habitat utilisation, and that in compartment 13, at least 50% of the habitat is utilised and conforms to optimal utilisation of secondary habitat by a low density population. The project found that 80% of Carwong and 58% of Royal Camp State Forest is utilised, which supports Phillips' (2013) results. On this

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basis it can be concluded that habitat in Royal Camp and Carwong is source habitat, where reproduction exceeds mortality on average over time. (p84)



Map 24. EPA (2016) mapping of Koala habitat classes and 'present' and 'resident' Koalas in Royal Camp and Carwong State Forests.

In 2015 NEFA undertook [audits of logging in Cherry Tree SF](#) finding numerous egregious breaches of the logging rules, while observing a Koala, three high use trees and numerous trees with scratches. Our principal concerns for Koalas were that the dense lantana precluded Koala scat searches in many areas and Forestry Corporation were not searching for scats where they could.

In 2017 NEFA undertook [audits of logging in Gibberagee SF](#), though did not search for Koalas.

In early 2019 NEFA undertook [assessments of an active logging operation](#) in another part of Gibberagee State Forest, this time focussing on Koalas. finding a number of trees with Koala scats and numerous trees with Koala scratches. A principal focus was trying to get the Forestry Corporation to undertake the required pre-logging scat surveys. While we were unable to force the Forestry Corporation to undertake surveys, after [repeated surveys](#) and extensive pressure we managed to have the area classified as "intermediate use" so that the token five Koala feed trees per hectare would be retained, and eventually achieved the protection of a small KHUA NEFA identified.

In 2019 NEFA undertook scat surveys of proposed logging in [Braemar State Forest](#) (adjacent to Carwong SF) and found an exceptional density of Koala scats, identifying that over half the logging area was likely to qualify as Koala High Use Areas and should be protected. It was apparent that this was part of the same population as in Royal Camp and Carwong State forests, so NEFA began sampling patches of Preferred Koala Feed Trees (PKFTs) elsewhere in Braemar SF and the adjacent Ellangowan State Forest, identifying high occupancy of suitable habitat. This assessment was curtailed by the October 2019 wildfire. NEFA was able to see the devastating impacts of the fires on Koalas first-hand, with the impacts intensified by the continuation of the drought for two and a half months. Despite the loss of many Koalas, NEFA completed a proposal for a 7,000ha [Sandy](#)

[Creek Koala Park](#), on the understanding that the Banyabba Koala population could recover over time if given a reprieve from logging.

Following the fires NEFA became alarmed at proposals to log burnt koala habitat in Bungawalbin, Doubleduke and Myrtle State Forests, under Site Specific Operating Conditions (SSOCs) approved by the EPA. NEFA prepared a 2020 report [Saving Banyabba's Koalas](#), which included results of a brief and successful search for evidence of Koalas in the remaining unlogged patch of Bungawalbin State Forest, asking the EPA to place a moratorium on logging of burnt forests until assessments of the impacts on Koalas had been undertaken.

In 2020 NEFA undertook a [pre-logging survey in Myrtle State Forest](#), alarmingly finding that the Forestry Corporation had protected the most intensively burnt forest as a 'Wildlife Habitat Clump' rather than the least intensively burnt, as supposedly required, and that the EPA would do nothing about it. After finding some Koala scats, NEFA undertook further [pre-logging Koala surveys](#) of Myrtle State Forest to demonstrate the need for pre-logging Koala surveys to identify areas to prioritise for protection, identifying a 14 ha area with high Koala usage (part of a larger area).

In November 2021 NEFA assessed an unburnt [area proposed for logging](#) in Cherry Tree State Forest as core Koala habitat that should be protected, though our appeals fell on deaf ears. A finding that has since been confirmed by more intensive work (unpublished).

In a complaint to Minister for Environment in January 2022 NEFA assessed the only patch of unburnt/lightly-burnt forest in Camira State Forest and located three trees with Koala scats and many with scratches. NEFA complained that the forest least affected by burning was being logged while the worst affected forest was being set aside as a voluntary "fire offset" (which were meant to be the least affected). It was logged.

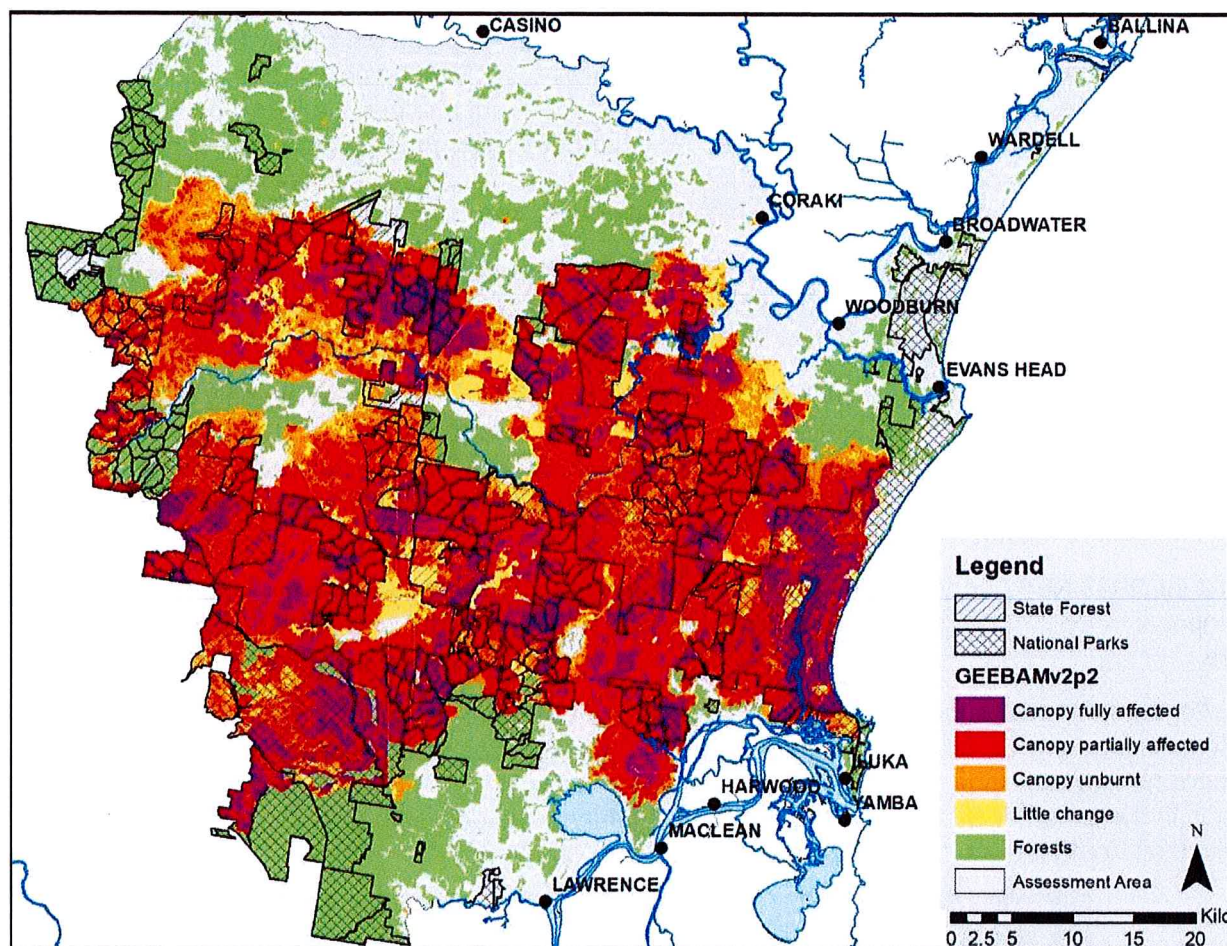
In June 2023 NEFA undertook a [reassessment of Braemar State Forest](#) in response to another proposal to log it, finding that Koalas widespread but at significantly lower densities than before the fire.

In August 2023 NEFA took the Forestry Corporation to court to stop active logging in Braemar and Myrtle State Forests. Dr. Steve Phillips (31 July 2023) undertook brief assessments, identifying active habitat utilisation by Koalas at four of five field sites in Myrtle State Forest and four of six field sites in the Braemar State Forest, recommending surveys to delineate active Koala habitat within which all Koala browse trees >30 cm DBH should be protected.



5.WILDFIRE

The region was extensively burnt in the 2019/20 wildfires. The forests had dried out and were under stress from a record drought, when in October 2019 the Busby's Flat fire began burning its way through the western forests of the southern Richmond. It then morphed into the Myall Creek Road fire that burnt through the coastal forests. Then the Coombadjha wildfire came from the west to burn up to the crest of the Richmond Range. When combined with a few smaller fires, the outcome was that two thirds of the southern Richmond forests were burnt, increasing to 86% of State Forests.



Map 25. Burn intensity (GEEBAM v2 p2) of the 2019/20 wildfires across the southern Richmond assessment area, where 66% of forests were burnt. Most arboreal mammals and trees were likely lost in the 41,000 ha of forests (16%) where the canopy was fully affected, and significantly reduced in the 85,000 ha (34%) experiencing partial canopy loss. For State forests the impacts were greater with 86% burnt, 18% suffering full canopy affects and 50% partial canopy loss.

The southern Richmond assessment area encompasses 250,832 ha of forests and woodlands, of which GEEBAM v2 p2 shows 165,188 ha as having been burnt, with 41,000 ha of forests (16%) where canopy was fully affected, and 85,000 ha (34%) with partial canopy loss. For State Forests within this area, the impacts were far worse, with of 48,500 ha (86%) of forests and woodlands affected, across 10,000 ha (18%) the canopy was fully affected, and across 28,000 ha (50%) there was partial canopy loss.

On State forests the floodplain woodlands and swamp forests were most heavily impacted, with only 7% of woodlands and no swamp forests escaping burning. The fire was most intense here with 73%

of woodlands and 80% of swamp forests suffering full or partial canopy loss. The dry forests fared marginally better with 15% escaping burning and 68% suffering full or partial canopy loss.

The rainforests and wet forests were significantly affected with 37% and 27% respectively escaping burning, and 12% and 46% respectively suffering full or partial canopy loss. The extent of impacts were lessened as Cherry Tree and Mt. Pikapene State Forests were not burnt. Though for affected forests the impacts would be most severe due to the increased vulnerability of rainforest species to fire.

FOREST GROUP		SOUTHERN RICHMOND		STATE FOREST	
		ha	%	ha	%
Dry Forest	Canopy Fully Affected	29297	17	7680	17
	Canopy Partially Affected	61449	35	22911	51
	Canopy Unburnt	23462	13	6693	15
	Little Change	3950	2	727	2
	Unaffected	56647	32	6766	15
SUB TOTAL		174805		44777	
Rainforest	Canopy Fully Affected	41	1	9	2
	Canopy Partially Affected	94	3	52	10
	Canopy Unburnt	282	9	212	43
	Little Change	51	2	37	8
	Unaffected	2501	84	185	37
SUB TOTAL		2969		495	
Swamp Forest	Canopy Fully Affected	2506	18	121	24
	Canopy Partially Affected	2792	20	286	56
	Canopy Unburnt	1672	12	100	19
	Little Change	535	4	6	1
	Unaffected	6686	47	0	0
SUB TOTAL		14191		513	
Wet Forest	Canopy Fully Affected	1619	12	181	12
	Canopy Partially Affected	2664	20	522	34
	Canopy Unburnt	1290	9	345	23
	Little Change	256	2	68	4
	Unaffected	7798	57	410	27
SUB TOTAL		13627		1526	
Woodland	Canopy Fully Affected	7388	16	2028	22
	Canopy Partially Affected	17674	39	4702	51
	Canopy Unburnt	6806	15	1687	18
	Little Change	1361	3	150	2
	Unaffected	12011	27	597	7
SUB TOTAL		45240		9164	
TOTAL BURNT		165188	66	48517	86
TOTAL		250832		56475	

Table 7. Fire impacts on forests of the southern Richmond, derived from GIS interrogation of GEEBAMv2. Note that the Governments preferred FESM fire mapping could not be used because it erroneously shows large areas known to have been burnt as unburnt.

The Forestry Corporation (2020) consider the fires had a significant impact on Far North Coast State forests by killing an estimated average of 100% of trees <30 cm DBH and 50% >30 cm DBH in the 19% of forests subject to a crown fire and 50% of trees <30 cm DBH and 10% of trees >30 cm DBH in the 30% of forests subject to a hot burn. Further noting:

Plots falling into tracts where harvesting was undertaken between 2015 and 2019 are assumed to have 90 per cent of trees present immediately killed by fire.

In relation to Spotted Gum forests the Forestry Corporation (2020) notes:

The Spotted Gum resource on the North Coast was heavily affected by fire, with large tracts of the species impacted by the crown fires experienced in supply zones one and two. Spotted Gum also grows significantly slower than Blackbutt, typically taking more than 80 years for a native forest site dominated by Spotted Gum that has been reset by fire to reach

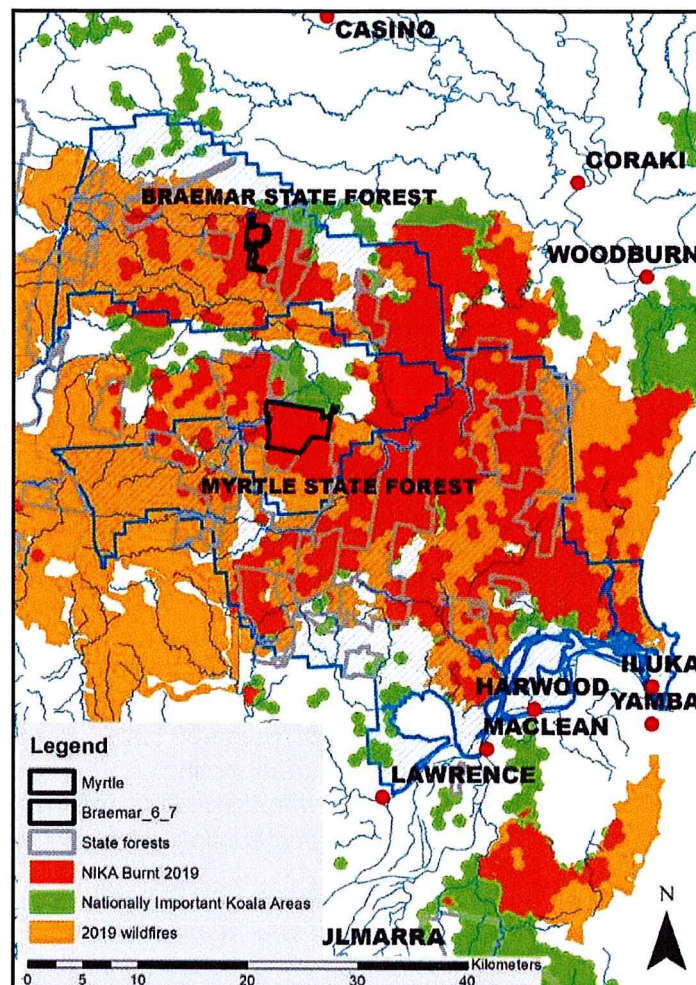
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maturity again. The combination of these factors means Spotted Gum supply is projected to be 17 per cent lower than the pre-fire forecast that was completed in 2019.

The GEEBANG v2 statistics for Canopy Fully Affected and Partially Affected seem comparable to the Forestry Corporation (2020) categories. So, based on over 10,000 ha (18%) of the southern Richmond State forests having their canopies fully affected and 28,000 ha (50%) partially affected, it can be expected that these State forests lost 14% of trees >30 cm DBH and 43% of trees <30cm DBH. This indicates a significant loss of mature trees relied upon as sawlogs for loggers and by nectivores, Koalas and Greater Gliders for food, along with hollow-bearing trees that numerous species depend on. Further to this, it indicates there will be a significant hiatus in new recruitments to the mature age cohort for many decades.

In this region Milledge and Soderquist (2022) found 22.6% large trees and stags ($\geq 60\text{cm}$ DBH) were lost or severely damaged in burnt forests, including 38.1% of trees >100 cm DBH.

After the Busby Flat fires, drought persisted for two and a half months, the ground remained covered in black ash and trees did not resprout, compounding the fire impacts. In the heavily burnt forests many trees and most Koalas, gliders and possums were killed. Fire impacts are cited as a reason for up listing the threatened status of many species, such as Koala, Southern Greater Glider, Yellow-bellied Glider and South-eastern Glossy-black Cockatoo.



Map 26. Nationally Important Koala Areas (NIKAs), overlaid with the 2019/20 fires identified mapped in [NPWS Fire History](#), and NSW's mapped Banyabba [Area of Regional Koala Significance](#) (datasets available on the SEED site), showing the extent of burning of NIKA and the Banyabba ARKS, showing the significant impacts. Those parts of Braemar and Myrtle State Forests subject to the 2023 court case are highlighted.

The Conservation Advice (DAWE 2022b) for Koala states:

Koala monitoring records from north-east New South Wales following the 2019/2020 bushfires, indicate that sites characterised by high-severity fire (e.g., canopy scorch) had zero koala occupancy (i.e., zero return/recovery) immediately post fire. At sites where koalas have been detected following fire, refuge areas were present in the surrounding landscape, or fire severity was lower (NSW Government 2021b). While koala's have returned to bushfire impacted locations it is likely to take many years before populations are fully re-established.

NEFA (Pugh 2020) undertook a variety of pre-fire assessments across their proposed [Sandy Creek Koala Park](#), assessed canopy loss, then monitored Koala activity for two and half months of drought after the 2019 Busby's Flat fire. Based on this NEFA considered there was a loss of all Koalas from the heavily burnt forests, and estimated that there has been a 60-90% loss of Koalas from the partially burnt forests. Application of this to the burn intensity across the southern Richmond State Forests indicates over half the Koalas are likely to have been killed.

From comparisons of pre- and post- fire plots Phillips *et. al.* (2021) found "the median reduction in naïve occupancy levels was approximately 71%" in burnt forests.

The Koala is only one of the numerous species that will have suffered significant population level impacts in the southern Richmond. For example, the Conservation Advice (DCCEEW 2022) for Southern Greater Glider states:

*The full impact of the 2019-20 bushfires has yet to be determined. However, an estimated 40% of the distribution of the greater glider (southern and central) overlapped with the areas affected by the bushfires (Legge *et al.* 2021). A population decline analysis for the greater glider (southern and central) that incorporates spatial variation in fire severity plus estimated declines for differing fire severity classes, provided an estimate of overall decline for the taxon of 24% (range 17-31%) one year after the fire, assuming current management conditions (Legge *et al.* 2021).*

The Conservation Advice (DAWE 2022) for Yellow-bellied Glider states:

*This is most clearly evidenced by the catastrophic bushfires of 2019–20, where an unusually large area burned at high severity, (DPI 2020) intersecting with 41 percent of the distribution of the yellow-bellied glider (Legge *et al.* 2021).*

... Site-level population declines from the 2019–20 bushfires are estimated at 82 percent for severely affected sites using expert elicitation, and post-fire on-ground surveys suggests that declines may be up to 83–97%

The [Conservation Advice \(DCCEEW 2022\)](#) for South-eastern Glossy-black Cockatoo states:

*The subspecies has undergone a substantial reduction (30–50%) in the last three generations (Cameron *et al.* 2021). This reduction in population was mostly caused by the 2019/2020 bushfires, and a result of historical and ongoing habitat loss. ...*

... 10% was burnt in high to very high severity fire, and a further 15% was burnt in low to moderate severity fire ... suggest that one year after the fire, the subspecies has experienced an overall decline of 15% from pre-fire levels, but that the decline could be as large as 32% (upper bound of 80% confidence limit). After three generations, the estimate for the overall population decline relative to the pre-fire population is predicted to be 22%, but potentially as much as 46% (upper bound of 80% confidence limit) ...

There can be no doubt that because of their extent and intensity, the 2019/20 wildfires had a very significant impact on most of the threatened forest fauna in the southern Richmond, with many

individuals killed, and long-term consequences due to the loss mature feed trees and hollow-bearing trees. As identified above, in these forests 22 species threatened with extinction utilize tree hollows, and eight threatened species rely upon the abundance nectar provided by mature trees. Others also rely upon mature and old trees for the more abundant and higher quality resources they provide, including the Southern Greater Glider, South-eastern Glossy Black Cockatoo, Yellow-bellied Glider and Koala.

The real problem is that for most species there have been few systematic pre-fire surveys to act as benchmarks to assess impacts against, and no post-fire surveys to assess how well species survived the fires. Despite this, the Forestry Corporation go on logging their habitat as if nothing happened.

Logging makes forests more vulnerable to wildfires and increases their flammability by drying them, increasing fuel loads, promoting more flammable species, and changing forest structure. Stopping logging will reduce future fire intensities and impacts on wildlife. In their review of the impacts of logging on fires, Lindenmayer *et. al.* (2023) state:

Several studies, encompassing a range of datasets in different jurisdictions, contain evidence that logged forests are at risk of an increased probability of high-severity wildfire ... stands aged between ~10 and 40 years of age had a seven times increased risk of high-severity wildfire relative to very young and long-undisturbed forest ...

The cessation of industrial logging from native forests is one of the key steps governments can take to reduce the problem of high fire severity.

5.1. Coping with the aftermath

In February 2020 the Commonwealth's [Wildlife and Threatened Species Bushfire Recovery Expert Panel](#) identified 'protecting unburnt areas within or adjacent to recently burnt ground that provide refuges' and carrying out rapid ground assessments of remnant populations as 'essential' for the 113 animal species identified as needing urgent help to survive in the wake of devastating bushfires.

After the fires, the EPA (website <https://www.epa.nsw.gov.au/your-environment/native-forestry/bushfire-affected-forestry-operations>) identified:

The [Coastal Integrated Forestry Operation Approval \(IFOA\)](#) was not designed to moderate the environmental risks associated with harvesting in landscapes that have been so extensively and severely impacted by fire. This required us to issue additional site-specific conditions that tailored protections for the specific circumstances of these burnt forests.

After negotiations with the Forestry Corporation, and in accordance with the CIFOA, the EPA began issuing Site Specific Operating Conditions (SSOCs) for logging burnt forests. For Myrtle, Doubleduke and Bungawalbin State Forests the EPA issued generic north coast SSOCs on 25 May 2020.

The EPA commissioned Dr. Andrew Smith (Smith 2020) to evaluate whether the CIFOA, both with and without SSOCs provides adequate mitigation for ecological and environmental impacts from timber harvesting in areas impacted by the 2019/20 wildfires. He found that the standard logging conditions fail to guarantee ecologically sustainable forest management and are likely to cause an ongoing decline and significant impact on biodiversity, primarily due to the increased logging intensity they allow and inadequate exclusions. Smith (2020) states:

It can be concluded that the standard CIFOA will not deliver ecologically sustainable management as required under the objectives of the Forestry Act 2012 and is likely to cause

a significant impact under the NSW Biodiversity Conservation Act 2016 and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Smith (2020) identified seven key conditions he considered should be applied to all timber production forests, including protecting all mapped unburnt and lightly burnt forests within state forests for a minimum period of 20 years, protecting an average of 50% of each compartment (including fire refugia), and reducing logging intensity:

- 1) That timber harvesting be excluded from all mapped unburnt and lightly burnt forests within state forests for a minimum period of 20 years.*
- 2) That all timber harvesting be limited to a maximum average 50% of compartment area (with a maximum of 75% within individual compartments) and maximum 50% of the total local landscape Area.*
- 3) That the pattern of harvesting at the compartment and landscape scales be modified to ensure that all retained forest patches > 5 ha in size are connected by permanent corridors and that all gaps in corridors created by roads, rivers and other non-forest areas do not create barriers to glider movement and dispersal.*
- 4) That fire refuge areas be modelled and mapped across all compartments and landscape areas to identify and protect those areas of each forest type within each compartment considered least likely to burn or with the lowest burn frequency, and where such areas will initially (for the next 20 years) include all areas unburnt or lightly burnt in the 2019/20 fires.*
- 5) That intensive harvesting (all forms of logging that remove more than 40% of the natural (unlogged) tree stem basal area) be limited to Blackbutt and Alpine Ash forest types, and the size of harvesting patches be limited to "gaps" of 10 hectares or less where gaps are defined as areas wholly surrounded by either unlogged forest or low intensity logged forest that retains 60% or more of the natural tree basal area across all tree size classes.*
- 6) That harvesting intensity under selective harvesting in all [Dry Sclerophyll Forest] be limited to retention of 60% or more of the natural stand basal area across all medium and large tree size classes to ensure that biodiversity is maintained within the net harvest area.*
- 7) That all compartments are subject to comprehensive pre-logging surveys at least once every logging rotation to gather all essential information for application of mitigation conditions and that post logging surveys are undertaken at repeat intervals of 1 to 10 years after harvesting at a minimum representative selection of sites sufficient for statistical analysis and feedback for adaptive management at compartment and landscape scales.*

In May 2020 the Forestry Corporation issued a Harvest and Haul Plan for compartments 10-16 of Myrtle State Forest in which the largest group of Wildlife Habitat Clumps (required to encompass 5% of the net logging area), meant by the CIFOA to include "valuable" habitat and by the **SSOC** to prioritise the inclusion of unburned or partially burned areas, were comprised of the most heavily burnt forests. [NEFA's complaints \(Pugh 2020\)](#) to the EPA made no difference, and while most trees died over extensive areas they remain as Wildlife Habitat Clumps.

The Forestry Corporation decided not to proceed with logging Myrtle, Doubleduke and Bungawalbin State Forests under the SSOCs, and they expired 12 months after they were issued. The Forestry Corporation decided they did not want to accede to the EPA's request to extend the SSOCs, and instead intended to adopt their own voluntary safeguards. The EPA were not impressed (<https://www.epa.nsw.gov.au/your-environment/native-forestry/bushfire-affected-forestry-operations/update-february-2021>):

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The EPA is not aware what these voluntary measures are, and we will not be able to regulate against these. The EPA advised against FCNSW's proposal, on the basis that additional site-specific operating conditions have been essential to ensuring harvesting activities in fire-impacted forests are carried out in an ecologically sustainable manner, and therefore meet the requirements of the Forestry Act 2012, the CIFOA and relevant Regional Forest Agreements.

To resolve the dispute between the EPA and Forestry Corporation, the Government directed the Natural Resources Commission (NRC) to report on adjustments to logging of State forests in response to 2019/20 wildfires. The Natural Resources Commission (NRC 2021) report '[Final report Coastal IFOA operations post 2019/20 wildfires, June 2021](#)' ranked Forestry management zones according to risk, with variable requirements for retention of unburnt and lightly burnt forests in firegrounds for up to 3 years. The Casino Management Zone (MZ), encompassing these forests, received a "medium" ranking, the NRC (2021) stating:

Management zones that receive medium or high risk ratings can have limited harvesting once there are sufficient additional temporary refuges (preferably unburnt and lightly burnt forest) retained at the local landscape area to mitigate the impacts of additional disturbance. ... In medium risk management zones, a variable additional retention requirement is applied based on localised impacts, expected to be approximately 65 percent on average of a local landscape area.

Most significantly the NRC (2021) recognised the significant loss of hollow-bearing trees in the fires, and their increased mortality in logging operations, recommending:

- a. *retain a minimum of eight hollow-bearing trees per hectare where they exist (as per the requirement in the standard Coastal IFOA prescriptions)*
- b. *if hollow-bearing trees are not available, then retain suitable substitutes, in priority order being, potential future hollow-bearing trees, the largest mature tree in the stand or a regrowth tree that is not suppressed*
- c. *retain two recruitment trees per retained hollow-bearing tree*

For Casino MZ the requirements were for retention of temporary refuges in forest mapped as unburnt, low severity and moderate severity, and where the required eight hollow-bearing trees per hectare aren't available retaining the largest trees to increase retention to a minimum of eight large trees per hectare, and retention of two mature recruitment trees for each hollow-bearing tree:

These additional temporary refuges are located in unburnt and lightly burnt forest with the intent of maintaining an equivalent area of functional habitat in retained areas (i.e. where harvesting is not permitted) as provided by exclusions prior to the 2019/20 wildfires.

...

For a minimum period of 10 years, retain 2 recruitment trees per hollow-bearing tree required to be retained under standard Coastal IFOA prescriptions. If 8 hollow-bearing trees per hectare are not available retain suitable substitutes (in priority order: potential future hollow-bearing tree, largest mature tree in the stand, regrowth tree that is not suppressed).

The NSW Government refused to act on the NRC recommendations. Instead allowing the Forestry Corporation to adopt their own [Voluntary Safeguards](#) in October 2021. These remove the SSOC's protection for unburnt refugia, reduce temporary exclusions (and criteria) from 7% to 5%, and remove increases in exclusions on Class 1 classified drainage lines from 5m to 20m and Class 2 drainage lines from 20m to 30m. These are not overseen by the EPA or legally enforceable, they only apply to burnt forests in six Management Areas (Zones), and only apply until the Forestry Corporation considers recovery adequate. They applied a very different criteria for ranking than the NRC (2021) to identify the risk to Management Areas. The Casino Management Area is identified as the third most affected by high and extreme fires, and thus requires additional post fire measures.

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A Voluntary Safeguard is that Local Landscape Area (LLA) Offset Exclusion Zones covering a minimum of 50% of the gross area of the LLA be set aside from harvesting, with the criteria identified as “*lowest fire severity, recovered forest and other priority habitat*”. Being voluntary this is open to interpretation.

In February 2020 the Forestry Corporation sought permission from the EPA to log in [Doubleduke SF](#), and in early March the EPA issued Site Specific Operating Conditions (SSOCs) requiring a variety of additional measures, including protection of all hollow-bearing trees and all mapped unburned and partially burned forests. The most intact forests mapped by the EPA for protection were in a topographically protected site in the Lower Slopes Road valley, including an important and rare stand of tall oldgrowth forest, which was clearly a fire and climate refugia.

The Forestry Corporation waited for the SSOC’s to expire before preparing a new harvesting plan that proposed logging the area of unburnt forest identified for protection by the EPA. With the Forestry Corporation poised to log this identified refugia, in [February 2023 NEFA \(Pugh 2023\)](#) wrote to the EPA pleading with them to reinstate its protection. They refused to do so and it was logged.

Under the Voluntary Safeguards the Forestry Corporation have consistently created their temporary Offset Exclusion Zones over adjacent areas they had no intent of logging and over the most intensively burnt forests, while keeping the unburnt patches and *lowest fire severity* areas for logging. The Forestry Corporation’s targeting of these essential refugia for logging is the most outrageous act.

The legality of the Forestry Corporation’s reliance upon their own voluntary safeguards, rather than obtaining SSOC’s from the EPA as required by the CIFOA, is one of the key questions NEFA are seeking to be resolved through our challenge to the Harvest and Haul Plans for Braemar and Myrtle State Forests in the NSW Land and Environment Court.

The 2019/20 wildfires have compounded the impacts of logging and left the forests of the southern Richmond in a highly vulnerable state. Over extensive areas habitat has been degraded, feed and hollow-bearing trees killed, and populations of many species decimated. Dense regrowth, particularly of wattles, has increased the risk of more severe fires for decades to come. Further logging will diminish remaining food trees, spread lantana, and further increase fire risk. Threats are growing as climate heating increases the frequency and intensity of droughts and wildfires.

The forests of the southern Richmond need a reprieve and targeted rehabilitation (i.e. lantana removal), to give them an opportunity to regain their natural resilience and populations of native species a chance to rebuild, so they can better withstand the next wildfire.



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