

Draft Conservation Advice (incorporating listing advice) for Robertson Rainforest in the Sydney Basin Bioregion

1. The Threatened Species Scientific Committee (the Committee) was set up under the EPBC Act to give advice to the Minister for the Environment (the Minister) on the listing and conservation of threatened ecological communities, including under sections 189, 194N and 266B of the EPBC Act.
2. The Committee will provide its advice on the Robertson Rainforest in the Sydney Basin Bioregion ecological community to the Minister in 2019.
3. The Minister will decide whether to amend the list of threatened ecological communities under section 184 of the EPBC Act to include Robertson Rainforest in the Sydney Basin Bioregion ecological community.
4. This draft conservation advice will be made available for expert and public comment for a minimum of 30 business days. The Committee and Minister will have regard to all public and expert comment that is relevant to the consideration of the ecological community for listing.
5. New South Wales also lists this ecological community as threatened under State legislation.
6. This document was developed based on the available information at the time.



*Robertson Rainforest in the Sydney Basin Bioregion, Robertson Nature Reserve.
Photo credit: Peter Woodard, Wikimedia Commons *

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Threatened Ecological Communities

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1 CONSERVATION OBJECTIVE

To mitigate the risk of extinction of the *Robertson Rainforest in the Sydney Basin Bioregion* ecological community, and help recover its biodiversity and function through protecting it from significant impacts as a Matter of National Environmental Significance under national environmental law, and by guiding implementation of management and recovery, consistent with the recommended priority conservation and research actions set out in this advice.

This conservation advice contains information relevant to the conservation objective by:

- describing the ecological community and where it can be found
- identifying the key threats to the ecological community
- presenting evidence (listing advice) to support the ecological community being listed as nationally threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- outlining the priority conservation and research actions that could stop decline and support recovery of the ecological community

The information used in this Conservation Advice was relevant as at the time this assessment was completed.

2 DESCRIPTION OF THE ECOLOGICAL COMMUNITY AND THE AREA IT INHABITS

An ecological community is a group of plants, animals and other organisms interacting in a specific habitat, under similar environmental conditions. The complex range of interactions between the component species provides an important level of biological diversity in addition to genetics and species.

The Robertson Rainforest ecological community is a type of warm to cool temperate rainforest characterised by a low, dense tree canopy, a mesic¹ shrub stratum, lianas and a fern-dominated groundcover. It has a restricted distribution in the Southern Highlands of New South Wales, generally occurring on soils derived from basalt and basanite on the gently undulating Robertson Plateau and surrounds at altitudes between 500 and 800 metres above sea level.

This section describes the assemblage of native species that characterises the ecological community throughout its range at the time of listing. More comprehensive species lists are in Appendix A. However, even these do not include all of the species that make up the ecological community and many sites may have species that are not mentioned in this Conservation Advice. The ecological community also includes fungi and cryptogamic plants; however, these are less well documented.

Characteristic species may be abundant or rare and only a subset of the complete list of species recorded in known examples of the community. The number and identity of species recorded at a particular site is partly due to natural variation across the range of the ecological community and other environmental factors, such as disturbance, or the time of year. The species recorded can also be affected by sampling scale, effort and expertise. At some sites

¹ Mesic: A mesic habitat has a moderate or well-balanced supply of moisture.

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characteristic native species are now locally extinct and/or non-characteristic species have established themselves, or have become more abundant. In general, the number of species recorded is likely to increase with the size of the site.

Species presence and relative abundance (including dominance) vary from site to site, depending on a range of environmental factors, such as soil properties (chemical composition, texture, depth, drainage), topography and hydrology. They also vary over time, in response to factors such as disturbance (e.g. fire, logging, grazing), climate, and weather (e.g. flooding, drought, extreme heat or cold).

This Section also describes the area that the ecological community inhabits, including the location, physical environment and other factors that help determine where the ecological community occurs in nature.

2.1 Name of the ecological community

The name of the ecological community is the ‘**Robertson Rainforest in the Sydney Basin Bioregion**’ (hereafter called ‘Robertson Rainforest’, or the ‘ecological community’). This matches the name of the corresponding ecological community listed under NSW legislation.

2.2 Location and physical environment

The Robertson Rainforest in the Sydney Basin Bioregion is limited to the Sydney Basin IBRA² Bioregion, mainly known from the Moss Vale and Illawarra subregions, possibly extending into adjacent parts of the Burratorang and Ettrema subregions. It primarily occurs within the Wingecarribee and Shoalhaven local government areas (as designated at December 2018) but may occur elsewhere in adjacent areas of the bioregion (NSW Scientific Committee 2011; NSW OEH 2017a). The principal occurrence of the ecological community is on the Robertson Plateau around the town of Robertson on the Southern Highlands. There are also some other less extensive occurrences nearby, including on the escarpment further north, near Mt Kembla (west of Wollongong), and on the higher parts of the Cambewarra Range to the south of Robertson (NSW Scientific Committee 2011; NSW OEH 2017a).

The ecological community is found on highly fertile soils derived from Tertiary basalts, typically the Robertson Basalt but also Kangaroo Valley Basanite, at altitudes between 500 and 800 metres above sea level, on sites typically receiving high rainfall (1000–1600 mm per annum) (Mills & Jakeman 1995; NSW Scientific Committee 2011; NSW OEH 2017a).

2.3 Vegetation structure and flora

The following description of the vegetation generally relates to the less disturbed, or ‘reference’ condition, occurrences of the Robertson Rainforest. The Robertson Rainforest in the Sydney Basin Bioregion is classified within the Southern Warm Temperate Rainforest vegetation class (NSW OEH 2017b). This class of rainforests generally comprises closed-

² IBRA refers to the Interim Biogeographical Regionalisation of Australia. IBRA regions are large geographically distinct areas of similar climate, geology and landform with corresponding similarities in their vegetation and animal communities. The version current at the time of this advice is IBRA v7 (DSEWPac 2013), which divides Australia into 89 bioregions and 419 subregions, including offshore islands.

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canopied forests dominated by few tree species, over an open shrub layer, occasional lianas and epiphytes, and a dense ground layer of ferns.

The tree canopy of the ecological community is relatively low and dense (Tozer et al., 2010). The characteristic or common trees present include: *Quintinia sieberi* (Possumwood), *Polyosma cunninghamii* (Featherwood), *Doryphora sassafras* (Sassafras), *Acacia melanoxylon* (Blackwood), *Syzygium smithii* (Lillypilly) and occasionally *Ceratopetalum apetalum* (Coachwood) (NSW Scientific Committee 2011; NSW OEH 2017a; NSW OEH 2018a).

Common shrub species in the mid stratum include: *Melicactus dentatus* (Tree Violet), *Coprosma quadrifida* (Prickly Coprosma), *Tasmannia insipida* (Brush Pepperbush), *Myrsine howittiana* (Brush Muttonwood) and *Notelaea venosa* (Veined Mock-olive) (NSW OEH 2017a). There are also some components of the mid layer that are more typical of cool temperate environments, such as *Olearia argophylla* (Musk Daisy Bush), *Hedycarya angustifolia* (Native Mulberry), *Eucryphia moorei* (Eastern Leatherwood) and *Dicksonia antarctica* (Soft Tree-fern). Various climber and epiphytic species may occur on the trunks and stems of canopy trees and mid-storey shrubs. Climbing species include *Parsonsia brownii* (Mountain Silkpod), *Eustrephus latifolius* (Wombat Berry), *Marsdenia rostrata* (Milk Vine), *Pandorea pandorana* (Wonga Vine) and *Smilax australis* (Lawyer Vine) (NSW Scientific Committee 2011; NSW OEH 2018a). Epiphytic species include the ferns *Microsorium scandens* (Fragrant Fern) and *Pyrrosia rupestris* (Rock Felt Fern) (NSW Scientific Committee 2011; NSW OEH 2018a).

The ground cover typically comprises a dense cover of ferns and other herbs, including *Lastreopsis acuminata* (Shiny Shield Fern), *Lastreopsis microsora* (Creeping Shield Fern), *Microsorium pustulatum* subsp. *pustulatum* (Kangaroo Fern), *Asplenium flabellifolium* (Necklace Fern), *Pellaea falcata* (Sickle Fern) and *Urtica incisa* (Stinging Nettle) (NSW Scientific Committee 2011; NSW OEH 2018a).

A more comprehensive list of flora species that are likely to occur in the ecological community can be found in Table A1 at [Appendix A](#).

2.4 Fauna

Robertson Rainforest provides habitat for a range of vertebrates and invertebrates. These faunal components of the ecological community play critical roles in the functioning of the ecological community, for instance nutrient cycling and seed dispersal. Many fauna species in the ecological community will also use adjacent or nearby habitats, such as the nationally endangered Upland Basalt Eucalypt Forest of the Sydney Basin Bioregion that intergrades with rainforest, but there are some animals that are rainforest specialists.

The rainforest canopy and shrub layers support birds and arboreal mammals. *Pseudocheirus peregrinus* (common ringtail possum) and *Trichosurus vulpecula* (common brushtail possum) are arboreal mammals commonly found in rainforest in the Illawarra and Southern Highlands regions (Mills and Jakeman, 1995). Birds that live amongst rainforest trees and bushes include lorikeets, parrots and cockatoos, e.g. *Platycercus elegans* (Crimson Rosella), and smaller birds such as honeyeaters, wrens, robins and *Psophodes olivaceous* (Eastern Whipbird) The

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possums, cockatoos and parrots utilize tree hollows for shelter and nesting. The arboreal fauna variously feeds on nectar, flowers, leaves and fruit products of the canopy, as well as invertebrates that live on the leaves or beneath bark. Consequently, their activities in the canopy play important ecological roles for pollination, seed dispersal and regulation of insect populations.

The ecological community is likely to provide habitat for a range of bats, both microbats that typically are aerial insectivores, and flying foxes that feed on fruit and nectar, including the nationally vulnerable *Pteropus poliocephalus* (Grey-headed Flying-fox).

Some butterflies may also be prominent in the rainforest as certain rainforest plants are food plants for them. These include [with their food plants in square brackets]: *Chaetocneme beata* (Common Red-eye) [Lillypilly]; *Cephrenes augiades* (Orange Palmdart) [Cabbage Palm]; *Graphium macleayanum* and *G. choredon* (Macleays Swallowtail, Blue Triangle) [Sassafras]; and *Euploea corinna* (Common Crow) [Fig species].

The sheltered ground layer remains damp and comprises a deep litter layer over moist soil. It provides for a mass of invertebrate and other animal life, which helps in the turnover of litter nutrients that become rich plant foods. Typical invertebrates in the ground layer of the Robertson rainforest include forest snails, such as the carnivorous land snail (*Austrothyrida capillacea*) and semi-slug (*Helicarion mastersi*), giant earthworms (*Notoscolex grandis*), millipedes and leeches. All these invertebrates play a role in the ecosystem, for instance by cycling nutrients among vegetation layers and the soil, by providing food sources for ground-dwelling insectivores and omnivores.

Ground-dwelling vertebrate species that are present in rainforests of the region include pigeons, brush-turkeys, wombats, bandicoots and potoroos. *Leucosarcia melanoleuca* (Wonga Pigeon) and *Chalcophaps indica* (Emerald Dove) both feed on the fruits of rainforest trees that lie fallen on the rainforest floor (Mills & Jakeman, 1995). In so doing, they help to remove litter and disperse seeds. *Alectura lathamii* (Australian Brush-turkey) builds mounds of litter within which the birds lay and incubate their eggs. Mounding fosters the breakdown of rainforest litter that serves to create sufficient temperature to incubate the eggs. Brush-turkeys are no longer common in the rainforests of the Illawarra and Southern Highlands regions possibly because of the decline in rainforest habitats and threats from hunting and predation by foxes and cats (Mills and Jakeman, 1995). Ground-dwelling mammals such as *Vombatus ursinus* (Common Wombat) and *Potorous tridactylus* (Long-nosed Potoroo) function as soil engineers that turn over soil and facilitate nutrient cycling and water infiltration as a result of their burrowing activities.

The ecological community is known to include habitat for a number of State and nationally-listed threatened species, including *Dasyornis brachypterus* (Eastern Bristlebird); *Chalinobius dwyeri* (Large-eared Pied Bat); *Dasyurus maculatus* (Spot-tailed Quoll); *Isodon obesulus* (Southern Brown Bandicoot); *Phascolarctos cinereus* (Koala); *Potorous tridactylus* (Long-nosed Potoroo); *Pteropus poliocephalus* (Grey-headed Flying-fox); *Litoria littlejohni* (Littlejohn's Tree Frog); *Mixophyes balbus* (Stuttering Frog); and *Hoplocephalus bungaroides* (Broad-headed snake).

A more comprehensive list of fauna species likely to occur in the ecological community is given in [Appendix A - Species lists](#).

3 IDENTIFYING THE NATIONALLY PROTECTED ECOLOGICAL COMMUNITY

This section provides additional information to help identify areas of the ecological community that are a matter of national environmental significance and so are protected under national environment law. This includes specifying diagnostic characteristics, defining ‘a patch’, sampling protocols, size and condition thresholds, and further information to consider when planning actions that may have ‘significant impacts’, or otherwise need approval under national environment law.

National listings complement State vegetation and other biodiversity protection laws by enhancing the protection of those components of Australia’s biodiversity most at risk of extinction. For ecological communities, national listings focus legal protection on areas that remain in at least moderate condition, and retain their natural composition and ecological function to a certain degree.

If a proposed action will or may have a significant impact on a threatened ecological community, it must be referred to the Australian Government for approval prior to undertaking that action.

Diagnostic characteristics (Section 3.1) assist in identifying a patch of native vegetation as being part of the Robertson Rainforest ecological community. These diagnostic characteristics summarise the main features of the ecological community, with more information provided in the other sections of this document.

Condition categories and thresholds (Section 3.2) are specified for many nationally-listed ecological communities. Taking into account the definition of an ecological community and that it may occur in various natural states, these further recognise that patches of an ecological community can differ in their quality, with some patches having undergone substantial degradation.

In order to be protected as a matter of national environmental significance, areas of the ecological community must meet both:

- the key diagnostic characteristics AND
- at least the minimum condition thresholds.

3.1 Key diagnostic characteristics

The key diagnostic characteristics presented here summarise the main features of the Robertson Rainforest, outlined in more detail under the Description section, above, and are intended to aid the identification of the ecological community. The key diagnostic characteristics of the Robertson Rainforest ecological community are:

- Distribution limited to the southern end of the Sydney Basin Bioregion in New South Wales. Known occurrences are mostly on the Robertson Plateau in the Wingecarribee

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local government area (as designated in December 2018). The ecological community is also likely to occur further south in the higher parts of the Cambewarra Range in the Shoalhaven local government area (as designated in December 2018), as well as further north in the ranges to the west of Wollongong.

- Landscape associations include:
 - presence on high nutrient soils, generally derived from Tertiary basalts (typically Robertson Basalt or Kangaroo Valley Basanite). Note that the ecological community has not been recorded on Wianamatta Shale.
 - typically present at higher altitude (500 to 800 metres above sea level) sites that typically receive high annual rainfall (>1000 mm/year)
- Vegetation is classified as a cool to warm temperate rainforest type that has these features:
 - a tree canopy dominated by one or more of: *Quintinia sieberi* (Possumwood), *Polyosma cunninghamii* (Featherwood), *Doryphora sassafras* (sassafras) and *Acacia melanoxylon* (Blackwood)
 - a mid storey with small trees and shrubs, sometimes with lianas and epiphytes. Typical species present may include *Syzygium smithii* (Lillypilly), *Ceratopetalum apetalum* (Coachwood), *Eucryphia moorei* (Eastern Leatherwood), *Melicytus dentatus* (Tree Violet), *Coprosma quadrifida* (Prickly Coprosma), *Tasmannia insipida* (Brush Pepperbush), *Olearia argophylla* (Musk Daisy Bush), *Hedycarya angustifolia* (Native Mulberry), *Dicksonia antarctica* (Soft Tree-fern) and *Parsonsia brownii* (Mountain Silkpod)
 - a ground layer that is typically dense with a high cover of ferns.

3.2 Condition thresholds for EPBC Act protection

National listing focuses legal protection on patches of the ecological community that are the most functional, relatively natural and in comparatively good condition. The minimum condition thresholds for this ecological community are designed to identify those patches that retain sufficient conservation values to be protected as a matter of national environmental significance.

In determining these conservation values, it is acknowledged that:

- there is very little Robertson Rainforest remaining;
- patches ≥ 0.1 ha in size that remain largely intact have significant conservation value;
- even patches with degraded understorey that retain the canopy characteristics of the ecological community need protecting;
- mature locally indigenous trees (and hollow bearing trees) are important for the range of habitats and resources they provide to species in the ecological community and the broader region;

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- large intact patches are relatively uncommon in this landscape and;
- connectivity to other native vegetation areas are typically beneficial.

Other indicators of conservation value are detailed in Section 3.3.5, below.

Consequently, the **minimum condition thresholds** for the Robertson rainforest are:

- a patch size of at least 0.1 ha (1000m²); AND
- a tree canopy of at least 50% projected canopy cover³; AND
- an understorey comprising at least 50% native plant species⁴.

These thresholds typically exclude heavily degraded patches with isolated trees; or small narrow stands of trees over weeds (or non-native pastures) that may serve as windbreaks or shelter belts on farms. Although not protected under the EPBC Act, stands or patches that do not meet the minimum condition thresholds may still retain important natural values and may be protected through state and local laws or schemes. In addition, patches that can be restored should not be excluded from recovery and other management actions. Suitable recovery and management actions may improve a patch's condition, such that it subsequently can be included as part of the ecological community fully protected by national environment law.

3.3 Further information to assist in determining presence and avoiding significant impacts

The following information should also be taken into consideration when applying the key diagnostic characteristics and condition thresholds to assess a site that may include the ecological community and determine the potential impacts on a patch.

Landuse history will have influenced the state in which a patch of the ecological community is expressed. The resulting structure (especially loss of structural elements) in turn affect species richness and diversity. The surrounding vegetation will also influence how important a patch of the ecological community is in the broader landscape. For example, whether it enables movement of native fauna or dispersal of plant material or supports other ecological processes, such as nutrient cycling.

3.3.1 Defining a patch

A patch is a discrete and mostly continuous area of the ecological community⁵. A patch may include small-scale variations, gaps and disturbances, such as tracks, paths or breaks

³ **Canopy cover** (measured as projective foliage cover) should be based on representative areas within the whole patch of the ecological community. Projective foliage cover is “the percentage of the sample site occupied by the vertical projection of foliage and woody branches” (National Committee on Soil and Terrain, 2009: p.81). When measuring canopy cover, include emergents, canopy and the subcanopy layer (everything above the ground layer, e.g. above 2m).

⁴ The **understorey** comprises all vegetation below the canopy and subcanopy (e.g. below 2m). **Native plant species**, as outlined in Appendix A, should comprise at least 50% of the total understorey vegetation, by either cover or stem density.

⁵ Note that NSW vegetation assessment tools have defined a ‘patch’ differently – i.e. as an area of native vegetation, of one or more different communities that occur together, separated by a gap of no greater than a set

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(including exposed soil, leaf litter, cryptogams and watercourses/drainage lines), or localised variations in vegetation that do not significantly alter the overall functionality⁶ of the ecological community.

Small breaks are generally included in patch size calculations. However, where there is a break in native vegetation cover, from the edge of the tree canopy of 50 m or more (e.g. due to permanent man-made structures, wide roads or other barriers; or due to water bodies typically more than 50 m wide), the two areas of the ecological community are typically treated as separate patches. Two patches of the ecological community can also be separated by a different type of native vegetation (e.g. native grassland, or a different type of forest or woodland such as a eucalypt forest).

Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and some areas of a patch (if considered in isolation) might not meet all the key diagnostic characteristics and condition thresholds. Average quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall vegetation condition and patch boundaries. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition that would apply across different parts of the site respectively. Where the average quality of a larger area falls below the minimum condition thresholds, the next largest area that meets the key diagnostics and minimum condition thresholds should be identified and protected. This may result in multiple patches of the ecological community being identified within the larger area first considered.

3.3.2 Additional buffer zone around a patch

A buffer zone is an area immediately adjacent to a patch of the ecological community (but not part of the community) that is important for protecting it from likely negative impacts. Because the risk of damaging an ecological community is usually greater where actions occur close to a patch, a buffer zone helps shield the patch from nearby activity. For instance, a buffer zone will help protect the root zone of edge trees and other components of the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land), weed invasion, water runoff, soil erosion and other damage.

Ideally, a buffer zone should consist of other native vegetation that is kept wherever possible. However, the buffer zone is not part of the patch of the ecological community, so not formally protected as a Matter of National Environmental Significance (MNES⁷), unless the buffer zone itself is or contains another MNES. Buffer zones may also be degraded areas of non-native vegetation that surround a patch of the ecological community. Nevertheless,

distance (usually 100 m). Note that the national Threatened Species Scientific Committee uses the term 'patch' to describe an entire discrete remnant/area of the ecological community. This definition does not just consider the area directly impacted by an activity but also includes contiguous elements of the ecological community that are not impacted and lie outside of an action.

⁶ Functionality refers to processes such as the movement of wildlife and pollinators, the dispersal of plant propagules, activities of seed and plant predators and many others.

⁷ For more information on Matters of National Environmental Significance see: www.environment.gov.au/epbc/protect/index.html

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practical application of a buffer zone is strongly recommended. For instance, it is recommended that care be exercised in the buffer zone to minimise the risk of any significant adverse impacts extending into the ecological community, irrespective of the nature of the buffer zone.

To get EPBC Act approval, actions/changes in land use in the buffer zone must not have a significant impact on the ecological community; but there are exemptions for continuing use (e.g. existing cropping, grazing or maintaining fire breaks). If the use of an area next to a patch of the ecological community will be intensified and this is likely to impact adversely upon the patch, approval under the EPBC Act may also be required to ensure adverse impacts are avoided. The buffer zone may also be a suitable focus for revegetation or other restoration initiatives to extend the patch.

The recommended minimum buffer zone for the Robertson Rainforest ecological community is 30 m from the outer edge of the patch (as defined by the edge of the tree canopy) as this distance accounts for likely influences on the root zone. A larger buffer zone should be applied, where practical, to protect patches that are of very high conservation value or if patches are located below drainage lines or a source of nutrient enrichment or groundwater drawdown. Judgement should be exercised to determine an appropriate buffer distance depending on circumstances of how a patch may be impacted.

3.3.3 Revegetated areas and areas of regrowth

Revegetated or replanted sites, or areas of vegetation regrowth can be included as part of the listed ecological community, provided that the revegetated area meets the key diagnostic characteristics and condition thresholds. It is recognised that reconstruction/revegetation often requires long term effort and commitment and results are uncertain. Reconstructing a woodland or forest ecological community to a state that resembles appropriate reference sites can, at best, be extremely slow and ultimately prove unsuccessful (Wilkins et al. 2003).

However, rainforests are dynamic communities that can regenerate naturally following disturbance and structural damage. Some rainforest species store viable seed in the soil (although viability varies between species); but more commonly, rainforest species rely on rapid germination and seedlings that sit dormant in the understorey (Big Scrub Rainforest Landcare Group 2005). As canopy gaps appear, the availability of light removes any suppression to seedling growth, allowing them to grow rapidly to re-establish the canopy within the gap.

3.3.4 Sampling protocol

Thorough and representative on-ground surveys are essential to accurately assess the extent and condition of the ecological community. The Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain 2009) provides survey guidance. Patches can vary markedly in their shape, size, condition and features. As a general principle, sampling protocols and the number of sample plots/transects should include, or allow for, the following:

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- Sampling in area(s) with the highest apparent number of different native plant species to estimate native species richness of the whole patch;
- significant variation in the vegetation, landscape qualities and management history (where known) across the patch; for instance localised weed cover, drainage lines, grazed areas, saline zones but also localised variation in dominance of canopy species; and
- an appropriate size and number of plots or transects to provide a representative sample across the full extent of the patch (taking into consideration the shape and condition across the site, as well as providing a good representation of the species present).

Recording the search effort (identifying the number of person hours spent per plot/transect and across the entire patch; along with the surveyor's level of expertise and limitations at the time of survey) is useful for future reference.

Timing of surveys is an important consideration because ecological communities may vary in their appearance through the year and between years, depending on seasonal or climatic conditions. Ideally, surveys should be held in more than one season to maximise the chance of detecting all species present. For example, flowering may be necessary to identify plant species and active growth will indicate population sizes of annual weeds. Immediately after disturbance some species, or groups of species, may not be evident for a time. The presence and detectability of some species may be affected by the time since disturbance such as fire or storms, so surveys should be planned to occur after an adequate time for some recovery. At a minimum, it is important to note climate conditions and what kind of disturbance may have happened within a patch and when that disturbance occurred. Note that rainforests may take a long time to recover their structure after certain disturbances and transitional stages may persist for some time.

3.3.5 Surrounding environment, landscape context and other guidance for impact assessment and mitigation

Actions that have, or are likely to have, a significant impact on a matter of national environmental significance require approval. So, when planning actions that may have 'significant impacts', it is important to consider the surrounding environment and the landscape context of patches that may be negatively affected by new activities.

Patches that are more species rich and less disturbed are likely to provide greater biodiversity value. Additionally, patches that are linked to, or near, other native vegetation may contribute substantially to landscape connectivity and function, so are particularly important as ecological corridors and are vital to the longer-term survival of the ecological community. Conversely, patches that occur in areas where the ecological community has been most heavily cleared and degraded, or that are at the natural edge of its range, may also be important due to their rarity, genetic significance, or because of the absence of some threats.

The following indicators of the ecological context should be considered, both when assessing the impacts of actions or proposed actions under national environment law and when considering priorities for funding recovery and management projects.

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- Large size and/or a large area to boundary ratio. Patches with larger area to boundary ratios are less exposed to edge effect disturbances (such as weed invasion and storm damage) and may be more resilient. However, patches that occur in areas where the ecological community has been most heavily cleared and degraded, or that are at the natural edge of its range, may also be important due to their rarity, genetic significance, or because of the absence of some threats that are within larger patches;
- Evidence of recruitment of key native plant species or the presence of a range of age cohorts (including through successful assisted regeneration) – for example, tree canopy species are present in a range of sizes from saplings to large hollow-bearing trees;
- Good faunal habitat – as indicated by: diversity of landscape, the diversity of plant species and vegetation structure, patches containing mature trees (particularly those with hollows), logs, or natural rock outcrops;
- Patches within or near to a larger native vegetation remnant and that contribute to a mosaic of vegetation types present at a site. Areas of mosaic native vegetation provide a wider range of habitats that benefits flora and fauna diversity. Other patches are important as linkages between remnants, acting as ‘stepping stones’ of native vegetation in the landscape that can contribute to movement of fauna and transfer of pollen and seeds; Restoration works, such as native plantings in adjacent areas, can be used to improve the connectivity of remnant patches;
- Contributing to movement corridors (to individuals or to genetic material, including pollen and seeds). In particular, a patch in an important position between (or linking) other patches in the landscape (taking into account whether connectivity might exacerbate the incidence or spread of threats e.g. weeds);
- High native species richness – as shown by the variety of native plant and animal species present;
- Presence of EPBC-listed or state-listed threatened species, or key functional species such as key pollinator and dispersal animals;
- Areas with minimal weeds and feral animals, or where these can be efficiently managed;
- Patches that contain a unique combination of species and/or rare or important species in the context of the particular ecological community or local region (e.g. a variant of the patch with unique fauna and/or understorey flora composition – or a patch that contains flora or fauna that has largely declined elsewhere in the ecological community or region); and
- Patches that occur in areas where the ecological community has been most heavily cleared and degraded or that are at the edge of the range of the ecological community.

3.3.6 Area critical to the persistence of the ecological community

The areas considered critical to the survival of the Robertson Rainforest cover all patches that meet the key diagnostic characteristics and condition thresholds for the ecological

community. This is because the ecological community has a very restricted geographic extent, is highly fragmented and, therefore, is vulnerable to further loss and degradation.

Additional areas, such as adjoining native vegetation, especially buffer zones around patches (see 3.3.2, above), are also important to the survival of the ecological community. While these are not part of the listed ecological community, they should be taken into consideration as part of the broader surrounding environment and landscape context.

3.4 Relationship to other vegetation classification systems

3.4.1 Caveat

Ecological communities are complex to classify. Each State/Territory jurisdiction applies its own system to classify ecological communities and vegetation types. Reference to vegetation and mapping units as corresponding to an equivalent or partial degree with a national ecological community, at the time of listing, should be taken as indicative rather than definitive. A unit that is generally equivalent may include elements that do not meet the description. Conversely, areas mapped or described as units other than those referred to may sometimes meet the description. Judgement of whether a nationally-protected ecological community is present at a particular site should focus on how an area meets the description, particularly the key diagnostic characteristics and condition thresholds for the national ecological community described above.

3.4.2 NSW Vegetation Units that correspond to the ecological community

There have been some comprehensive studies that cover the area where the Robertson Rainforest occurs. In addition, NSW is compiling a comprehensive state-wide vegetation scheme based on identification of Plant Community Types (PCT).

The ecological community corresponds entirely or partly to the following mapped vegetation types as at December 2018:

- Tindall et al. (2004): RF 516
- Tozer et al. (2010): RF p516 Yarrowa Temperate Rainforest
- NSW Plant Community Types (PCTs):
 - 1128 Sassafras – Blackwood – Lilly Pilly temperate rainforest of the Robertson area, Sydney Basin Bioregion; and
 - 1129 Sassafras – Blackwood – Lilly Pilly temperate rainforest on basalt soils in the Robertson area, southern Sydney Basin Bioregion

3.4.3 Similar or related Vegetation Units (or intergrades)

As of the time of this assessment (2018-19), the range of the Robertson Rainforest ecological community potentially overlaps with two ecological communities listed under national environment law. Both differ from the Robertson Rainforest in that they are wet to dry sclerophyll forests and woodlands dominated by eucalypts rather than non-eucalypt species.

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- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion (listed as Endangered in 2011). The Upland Basalt Eucalypt Forests occurs at sites of similar altitude, rainfall and basalt-derived soils to the rainforest, and may include rainforest elements in the vegetation, for instance the presence of individual sassafras trees in the mid-storey or canopy, and ferns in the understorey. However, these forests are dominated by a range of eucalypt species.
- Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion (listed as Critically Endangered in 2015). The Southern Highlands Shale Forest community includes several forms, one of which is a tall, wet form that may include rainforest elements. These occurrences of rainforest species, however, are not typically common, diverse or dominant and the eucalypt canopy is always the key dominant feature that distinguishes these forests from the Robertson Rainforest.

There are other rainforest communities in the Sydney Basin bioregion that also are nationally listed or currently under assessment. The Western Sydney Dry Rainforest and Moist Woodland on Shale ecological community was listed as Critically Endangered in 2013. It occurs in drier, lower elevation locations on Wiannamatta shale, from around Picton into the Cumberland Plain, so occurs in landscapes further north than the Robertson Rainforest. The plant species reflect a commensurately drier composition with *Melaleuca* species (Tea-trees) *Brachychiton populneus* (Kurrajong) and emergent eucalypts being common components of the Western Sydney Dry Rainforest.

The Illawarra and Shoalhaven Subtropical Rainforest community, currently under assessment for national listing, occurs typically below the escarpments, on the coastal side of the Great Dividing Range in the Illawarra and Shoalhaven regions. The Robertson Rainforest, therefore, lies further inland from the escarpment than do the Illawarra rainforests.

At the state level, Robertson Rainforest is closely related to Intermediate Temperate Rainforest (RF p116), which occupies fertile clay soils derived from shale on the Southern Highlands plateau or narrow bands of shales/volcanics/coal seams on the upper Illawarra Escarpment (Tozer et al. 2010). Robertson Rainforest occurs in conjunction with Southern Highlands Basalt Forest (WSF p266) (which includes the NSW-listed endangered ecological communities Robertson Basalt Tall Open-forest and Mount Gibraltar Forest) and their distributions may reflect historic fire frequencies (Tozer et al. 2010). These NSW-listed communities are included within the nationally listed Upland Basalt Eucalypt Forest that was discussed above.

3.5 Existing protection

3.5.1 Protection through reservation

The majority of the remaining area of the ecological community occurs on private land. About 30 ha of the ecological community is known to be reserved (Tozer et al. 2010) in Robertson Nature Reserve (NSW Scientific Committee 2011), representing 3 to 7% of the estimated remaining extent and less than 2% of the original (pre-1750) extent.

3.5.2 Protection through State/Territory legislation

At the time of national listing, the Robertson Rainforest in the Sydney Basin Bioregion is listed as an Endangered Ecological Community under the NSW *Biodiversity Conservation Act 2016*.

3.5.3 Listed threatened flora and fauna species

The ecological community provides habitat for a range of flora and fauna listed as threatened under state or national laws; NSW OEH (2018c) record 44 species as being present within the Southern Warm Temperate Rainforests vegetation class. Between them, PCTs 1128 and 1129 are recorded by NSW OEH (2018a) as having 33 state and/or nationally listed threatened species, including most of the 44 recorded for the Southern Warm Temperate Rainforests vegetation class. These 33 species include four plants, three amphibians, one reptile, 11 birds and 14 mammals (10 bats and four marsupials). The 44 species listed in NSW include: seven plants, six frogs, one reptile, 15 birds and 15 mammals. Sixteen of these are also listed as nationally threatened species.

A list of threatened species that are known to or may occur in the ecological community can be found in Table A3 at [Appendix A](#).

4 KEY THREATS

The key threats to the ecological community are mainly associated with agriculture in the past and ongoing peri-urban and urban development in the Robertson and Southern Highlands region generally.

4.1 Clearing, degradation and fragmentation

The ecological community has been extensively cleared for agriculture and development. About 400-870 ha or about 15-30% of its original extent is estimated to remain in an increasingly fragmented distribution, mostly on private land (NSW OEH 2017a; NSW Scientific Committee 2011; Tozer et al. 2010). Across the Illawarra and Southern Highlands region rainforests are estimated to have undergone a decrease of approximately 75%, from approximately 23,000 ha prior to European colonisation to about 7000 ha (Mills and Jakeman 1995). Continued rural and urban development is likely to result in further clearance, fragmentation and run-off. For instance the ecological community may be impacted by pollution present in spray drift or run-off, as a result of urban and agricultural activities.

Remnants with exposed edges are particularly susceptible to light and wind intrusion which impacts on floristic composition due to the naturally closed nature of this ecological community.

‘Tidying up’ is a common activity in the increasingly park-like Southern Highlands, and generally involves the removal of dead trees, fallen logs and branches, rock and leaf litter from forest and woodland areas. It is an activity which is often mistakenly considered to be part of good land management (ANZECC, 2001) and is sometimes carried out for fire hazard reduction purposes. The collection of firewood may also be undertaken. The removal of these elements from an ecosystem significantly reduces habitat values for many animal species.

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These elements are also essential for maintaining nutrient cycling within rainforests since they provide the raw materials and habitat for the many organisms (insects, fungi and micro-organisms) which break down this material into soil. The equipment used for tidying and firewood collection also can spread weeds and diseases through spores and seeds in the machinery. Dumped rubbish can also spread weeds and smother understorey species. Pet animals can predate on fauna and damage flora.

Bush rock collection is also a threat to this ecological community (NSW OEH 2017a) – the action of removing rocks can damage the understorey and soil and destroy valuable habitat for fauna that may use rocky outcrops for shelter.

4.2 Introduced pest species

The ecological community is impacted by non-native environmental weeds, including Chinese Privet (*Ligustrum sinense*), English Ivy (*Hedera helix*), Japanese Honeysuckle (*Lonicera japonica*) and European Holly (*Ilex aquifolium*) (NSW Scientific Committee 2011; NSW OEH 2017a). Weed incursion in the Southern Highlands region is associated with grazing and agricultural land uses as well as residential development (DoE 2015). In some native vegetation remnants in or adjoining residential areas in the Southern Highlands, residents introduce exotic species as an extension of their gardens, and remove native vegetation due to fear of fire or undesirable native animals such as snakes (Bray, cited in TSSC 2011). Species such as English Ivy and Japanese Honeysuckle can smother native vegetation, killing plants and suppressing regeneration. European Holly produces berries that are spread by birds, bats and/or foxes. These plants can continually re-invade native bushland and may outcompete natives if left unmanaged (TSSC 2011), which typically leads to a decline in the diversity and regenerative capacity of a native ecosystem. This in turn impacts on habitat values for fauna by affecting the type and availability of resources such as food (e.g. nectar, seeds and fruit), shelter from predators or weather, and nesting sites (DoE 2015). Further, the use of herbicides and pesticides to control weeds and agricultural insect pests can kill native flora and disrupt natural food webs, hence also impacting on many fauna (DoE 2015).

Barberry (*Berberis vulgaris*), Firethorn (*Pyracantha* spp.), Broom (*Genista* spp.), Blackberry (*Rubus fruticosus* aggregate), Bridal Creeper (*Asparagus asparagoides*), Chilean Needle Grass (*Nassella neesiana*), Serrated Tussock (*N. trichotoma*), Gorse (*Ulex europaeus*), Hawthorn (*Crataegus* spp.) and Sweet Pittosporum (*Pittosporum undulatum*) are weeds also known to occur within the Southern Highlands region (TSSC 2011; DoE 2015).

Myrtle rust (*Austropuccinia psidii*), an introduced fungal pathogen of plants, poses an increasing threat within the region. Among the characteristic species of the ecological community, *Syzygium smithii* (Lillypilly) is a known host, although it is regarded as relatively tolerant to moderately susceptible (Makinson 2018). Other myrtaceous species occurring in the ecological community include *Eucalyptus fastigata* (Brown Barrel), *E. smithii* (Gully Gum) and *Tristaniopsis collina* (Mountain Water Gum). However, these are not dominant species in the rainforest and their susceptibility to Myrtle Rust *in situ* is unknown at this time.

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A range of feral animal species have been identified in the Southern Highlands region, notably rabbits (*Oryctolagus cuniculus*), pigs (*Sus scrofa*), goats (*Capra hircus*), cats (*Felis catus*), dogs (*Canis lupus familiaris*) and foxes (*Vulpes vulpes*) (Eco Logical Australia, cited in TSSC 2011). These feral animals are known to impact adversely upon native plant and/or animal species and it can be inferred that they are highly likely to impact upon the Robertson Rainforest ecological community. Rabbits, pigs and goats graze and degrade vegetation that provides food and shelter for them and other native species. They can disturb the soil, promoting weed invasion and reducing regeneration. Dogs, foxes and cats affect native animal species via predation, competition for food and shelter, destroying habitat, and spreading disease (DEWHA 2010). Several aggressive bird species, including the introduced Indian Myna (*Acridotheres tristis*) and the native Sulphur-crested Cockatoo (*Cacatua galerita*), Magpie (*Cracticus tibicen*), Red Wattlebird (*Anthochaera carunculata*), Pied Currawong (*Strepera graculina*) and Noisy Miner (*Manorina melanocephala*), have spread throughout the largely cleared landscapes of south eastern New South Wales, including the Southern Highlands. These species can outcompete or aggressively exclude other native woodland bird species in areas of fragmented vegetation, further contributing to a decline in biodiversity (DoE 2015).

4.3 Grazing and trampling and ‘underscrubbing’

Degradation of remnants by grazing stock and feral pigs, rabbits, goats and deer (*Cervus* spp.) is an ongoing threat that results in losses of plant species (simplification of the understorey and ground layer and suppression of overstorey), erosion and other soil changes including increased nutrient status (NSW OEH 2017a). Stock grazing can also selectively remove the more palatable species from the ecological community, which can then affect the suitability of the habitat for native fauna (Tozer et al. 2010). Grazing and trampling can impact on recovery by limiting plant regrowth and seedling establishment. The deliberate removal of the understory beneath the tree canopy (underscrubbing) to open areas up (e.g. to stock and/or enhance grazing, or to create lawns in peri-urban areas), can also cause a lot of damage to the ecological community.

4.4 Altered fire regimes

Destruction or degradation of remnants by wildfire is an ongoing threat to the ecological community (NSW OEH 2017a). The Robertson rainforest is sensitive to fire and can take many years if not decades to recover composition and structure, or show a range of transitional stages. The composition and overall structure of the ecological community is threatened by increasingly more fires, that can be more intense and at more times of the year in the Southern Highlands. Destruction or degradation of remnants related to the popularity of pile burning on peri-urban blocks is also an issue (NSW OEH 2017a) due to both ‘tidying up’ (as mentioned in Section 4.1) and fires getting out of control. Overall, fire impacts will be exacerbated by other threats such as urban development, weeds and climate change (as covered in Section 4.5).

4.5 Climate change

Climate change poses a serious long-term threat to terrestrial ecosystems with the potential to change the ecology of these environments through changes to species composition and community structure and function – including changes in timing and amount of precipitation and increased drying winds, and increased storm events (Dunlop et al. 2012; NSW OEH 2017a). Projections by the CSIRO and Bureau of Meteorology for climate change in Australia’s NRM regions (CSIRO & BOM 2015; Grose et al. 2015) indicate that for the Southern Slopes sub-cluster within which Robertson Rainforest occurs, there will be:

- continuing increase in average temperatures in all seasons
- more hot days and warm spells, with fewer frosts
- generally less rainfall in the cool season
- increased intensity of extreme rainfall events
- harsher fire-weather climate in the future.

The fragmented nature of the ecological community greatly increases its vulnerability to the effects of a changing climate. For example, movement of native species is limited. In addition to threatening species that cannot adapt, climate change could also exacerbate existing threats such as habitat loss, altered fire regimes and the spread of invasive species (DoE 2015). It is also likely to gradually change the composition of the Robertson Rainforest, with less of the cool temperate species (including complete loss of some species locally) and more warm temperate species. While the ecological community is likely to be negatively impacted by the effects of climate change, in a regional context it is likely to increasingly play an important role in supporting ecological adaptation by providing refuge for species displaced from their preferred habitat. Vegetation such as this ecological community is also important in mitigating extreme hot temperatures in local areas through shading, evaporative cooling and other attenuating processes (DoE 2015).

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4.6 Key Threatening Processes

National and State-listed Key Threatening Processes relevant to the Robertson Rainforest ecological community include:

EPBC Act	NSW BC Act
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (<i>Manorina melanocephala</i>)	Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners, <i>Manorina melanocephala</i> (Latham, 1802)
Competition and land degradation by rabbits	Competition and grazing by the feral European Rabbit, <i>Oryctolagus cuniculus</i> (L.)
Competition and land degradation by unmanaged goats	Competition and habitat degradation by Feral Goats, <i>Capra hircus</i> Linnaeus 1758
Land clearance	Clearing of native vegetation
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	Anthropogenic Climate Change
Novel biota and their impact on biodiversity	Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae
Predation by European red fox	Predation by the European Red Fox <i>Vulpes Vulpes</i> (Linnaeus, 1758)
Predation by feral cats	Predation by the Feral Cat <i>Felis catus</i> (Linnaeus, 1758)
Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs	Predation, habitat degradation, competition and disease transmission by Feral Pigs, <i>Sus scrofa</i> Linnaeus 1758
	Bushrock removal
	Herbivory and environmental degradation caused by feral deer
	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
	Invasion and establishment of exotic vines and scramblers
	Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>

5 RECOMMENDATIONS BY THE THREATENED SPECIES SCIENTIFIC COMMITTEE

5.1 Recommendation on eligibility for listing against the EPBC Act criteria.

On the basis of a preliminary assessment of available scientific information, it is recommended that the *Robertson Rainforest in the Sydney Basin Bioregion* ecological community is **eligible** for listing as **Endangered**. This was the highest conservation category triggered at the time of this assessment.

Criterion 1 – Decline in geographic distribution

The Robertson Rainforest ecological community has undergone an estimated reduction in extent of 70–85% of its original pre-European extent. The ecological community has undergone at least a ‘severe’ decline in its geographic extent, and is therefore **eligible** for listing as **Endangered** under this criterion.

Criterion 2 – Limited geographic distribution coupled with demonstrable threat

The ecological community has a very restricted distribution: an estimated area of occurrence of less than 1000 ha; an estimated extent of occurrence of less than 10 000 ha; and a median patch size of less than 10 ha. The ecological community has been extensively cleared and modified and the remaining stands are severely fragmented and are further threatened by a range of ongoing threats. In addition, the nature of its geographic distribution and ongoing threats are such that the ecological community is likely to be lost in the ‘near’ future unless more actions are taken to protect and restore the ecological community. Therefore, the ecological community is **eligible** for listing as at least **Endangered** under this criterion.

Criterion 3 – Loss or decline of functionally important species

Whilst there has been significant overall loss of area and degradation in the Robertson Rainforest ecological community, evidence for loss of particular functionally important species within remnants is not available at this stage of assessment. There is **insufficient information to determine the eligibility** of the ecological community for listing under this criterion.

What is known is that the dominant tree canopy species and lower stratum tree species that are key structural and functional elements of the ecological community are not considered to be threatened in their own right. The functions and importance of most other species in this ecological community are, at best, poorly understood and documented in the literature.

Criterion 4 – Reduction in community integrity

As mentioned previously, the ecological community has been extensively cleared and modified. The remaining patches are less diverse, severely fragmented by past clearing and are further threatened by continuing degradation, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals. This has resulted in a severe reduction in integrity such that restoration is unlikely within the near future even with positive human intervention. Therefore, the ecological community is **eligible** for listing as **Endangered** under this criterion.

Criterion 5 – Rate of continuing detrimental change

There is **insufficient information to determine the eligibility** of the ecological community for listing under this criterion.

Criterion 6 – Quantitative analysis showing probability of extinction

There are no quantitative data available to assess this ecological community under this criterion. As such, there is **insufficient information to determine the eligibility** of the ecological community for listing under this criterion.

5.2 Recommendation on whether to have a recovery plan

A recovery plan is **not recommended** for this ecological community at this time.

The main threats to the ecological community and the priority actions required to address them are largely understood. The Conservation Advice and existing NSW documents sufficiently outline the priority actions needed for this ecological community. Enhancing and better resourcing existing mechanisms is likely to be a more effective and efficient way to address recovery of the ecological community than developing a national recovery plan.

Taking into account the benefits of supplementing existing protection with national listing and implementing the priority research and conservation actions outlined in this advice, a separate recovery plan for the ecological community is not required at this time.

6 PRIORITY RESEARCH AND CONSERVATION ACTIONS

6.1 Conservation Objective

The conservation objective (see section 1 above) provides the goal and rationale for the priority actions identified here. The objective is:

To mitigate the risk of extinction of the Robertson Rainforest in the Sydney Basin Bioregion ecological community, and help recover its biodiversity and function through protecting it from significant impacts as a Matter of National Environmental Significance under national environmental law and, by guiding implementation of management and recovery, consistent with the recommended priority conservation and research actions set out in this advice.

6.2 Principles and standards

In undertaking priority actions to meet the conservation objective, the overarching principle is that it is preferable to maintain existing areas of the ecological community that are relatively intact and of high quality. There are good, practical reasons to do so. It is typically more successful and cost-effective to retain an intact remnant than to allow degradation and then attempt to restore it or another area. The more disturbed and modified a patch of the ecological community, the greater the recovery effort that is required. Also, intact remnants are likely to retain a fuller suite of native plant and animal species, and ecological functions. Certain species may not be easy to recover in practice, if lost from a site.

This principle is highlighted in the National Standards for the Practice of Ecological Restoration in Australia (Standards Reference Group SERA, 2017):

“Ecological restoration is not a substitute for sustainably managing and protecting ecosystems in the first instance.

The promise of restoration cannot be invoked as a justification for destroying or damaging existing ecosystems because functional natural ecosystems are not transportable or easily rebuilt once damaged and the success of ecological restoration cannot be assured.”

Standards Reference Group SERA (2017) – Appendix 2.

The principle discourages ‘offsets’ where intact remnants are removed with an undertaking to set aside and/or restore other, lesser quality, sites. The destruction of intact sites always results in a net loss of the functional ecological community because there is no guarantee all the species and ecological functions of the intact site can be replicated elsewhere.

Where restoration is to be undertaken, it should be planned and implemented with reference to the *National Standards for the Practice of Ecological Restoration in Australia*). These Standards guide how ecological restoration actions should be undertaken and are available online from the Standards Reference Group SERA (2017)⁸. They outline the principles that

⁸ Society for Ecological Restoration: <http://www.seraustralasia.com/standards/home.html>

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convey the main ecological, biological, technical, social and ethical underpinnings of ecological restoration practice. More specific guidance regarding restoration of Robertson Rainforest, or information that is regionally specific, may also become available. As restoration ecology is continually developing, it is also important to reflect on the experience of others who have worked on restoring the ecological community, as well as adapting restoration projects as site-level experience accumulates.

To achieve cost-effective investments in conservation management it is important to consider the likely interaction of the various management actions being taken at any one site, as these may be synergistic or antagonistic. There are also likely to be interactions between sites. Additionally, when allocating management resources it is important to consider what is the minimum investment required for success and the follow-up required to secure long-term recovery (for example, for how many years should weed management be repeated).

6.3 Priority actions

Priority actions are recommended for the abatement of threats and supporting recovery of the ecological community. These recommended actions are designed to provide guidance for:

- planning, management and restoration of the ecological community by landholders, NRM and community groups and other land managers;
- determining conditions of approval for relevant controlled actions under national environment law; and
- prioritising activities in applications for Australian Government or other funding programs.

Detailed advice on actions may be available in other documents, such as management plans for weeds, fire or certain parks or regions. The most relevant are listed in section 6.4 below.

This conservation advice identifies priority conservation actions under the following key approaches:

- **PROTECT** the ecological community to prevent further losses;
- **RESTORE** the ecological community by active abatement of threats, appropriate management, restoration and other conservation initiatives;
- **COMMUNICATE, ENGAGE WITH AND SUPPORT** people to increase understanding of the value and function of the ecological community and encourage their efforts in its protection and recovery; and,
- **RESEARCH AND MONITORING** to improve our understanding of the ecological community and the best methods to aid its management and recovery.

These approaches overlap in practice; and form part of an iterative approach to management that includes research, planning, management, monitoring and review.

The actions below do not necessarily encompass all actions in detail that may benefit the Robertson Rainforest ecological community. They highlight general but key actions required to at least maintain survival of the ecological community at the time of preparing this

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Conservation Advice. Actions inconsistent with these actions and that are likely to significantly adversely affect the ecological community should be avoided.

6.3.1 PROTECT the ecological community.

This key approach includes priorities intended to protect the ecological community by preventing further losses to extent and integrity.

Conserve remaining patches

- Protect and conserve remaining areas of the ecological community, including protecting potential areas of natural or managed retreat.
- Avoid further clearance and destruction of the ecological community.
- Retain other native vegetation remnants, near patches of the ecological community, where they are important for connectivity, diversity of habitat and act as buffer zones between the ecological community and threats or development zones.
- Protect patches identified as the most intact wildlife refuges or of regional importance in formal conservation reserves. Consider other remnants for less formal conservation tenures, preferably ones that aim for protection over the long-term. This includes investigating formal conservation arrangements, management agreements and covenants to protect patches on private land. This is particularly important for larger patches or areas that link to other patches of native vegetation and are part of wildlife corridors or migration routes.
- Exclude fire from patches of the ecological community.
- Where regrowth is occurring, provide measures that will support the regrowth to mature (e.g. provide fencing to minimise the risk of damage).
- Construct wildlife friendly fences to exclude cattle and that incorporate a buffer to protect rainforest remnants and allowing for recruitment and enhanced connectivity.

Plan strategically to minimise further clearing

- Remnants should be properly taken into account during the early stages of zoning and development planning decisions, including strategic planning documents at state, regional and local levels.
- Liaise with local councils and State authorities to ensure that cumulative impacts on the ecological community are reduced as part of broader strategic planning or large projects (e.g. road works, developments).

Manage actions to minimise impacts

Apply the mitigation hierarchy to avoid, then mitigate, then offset potential impacts on the ecological community from development or other actions. The priority is to avoid further clearance and fragmentation of remnants with offsetting as the last resort.

- Plan projects to avoid the need to offset, by avoiding significant impacts to the ecological community.

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- In circumstances where impacts cannot be totally avoided, then they should be minimised by:
 - retaining and avoiding damage to high quality patches, which should be managed to retain their benchmark state; and
 - protecting important habitat features, such as large mature trees or trees with hollows as these take many decades to develop and cannot be quickly replaced.
- Where impacts are unavoidable, offsets should be used as a last resort to compensate for the adverse impacts of the action deemed unavoidable. The outcomes of offsetting activities are generally highly uncertain. Any proposals considering offsets for this ecological community should aim to:
 - minimise the need to offset the ecological community by designing development around the ecological community and applying buffers;
 - retain patches of the ecological community that meet the condition thresholds, rather than offset them (particularly with lower quality offset sites);
 - focus on retaining remnants of the ecological community with mature trees;
 - manage and protect offset areas in perpetuity in areas dedicated for conservation purposes – avoid risks that may reduce their size, condition and ecological function in the future;
 - select offset sites as close as possible to the impact site, to allow for local and regional variation in the ecological community;
 - increase the area and improve ecological function of existing patches, for example by enhancing landscape connectivity, habitat diversity and condition;
 - extend protection to otherwise unprotected sites (e.g. sites that are currently too small or degraded to meet the condition thresholds for national protection, but can reasonably be restored to a better, more intact condition); and
 - monitor offset areas and the outcomes they deliver over the long-term, to manage them adaptively and improve understanding of the best ways to manage offsets to deliver biodiversity benefits.

Minimise indirect impacts

- Minimise the risk of indirect impacts to the ecological community from actions outside but near to patches of the ecological community.
- Protect and apply appropriate buffers, particularly of other native vegetation, around patches of the ecological community to minimise off-site impacts; wider buffers may be required where there is larger scale landscape change, such as changes to catchment hydrology. Buffers also serve as important landscape connections, such as wildlife corridors.

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Prevent the introduction and spread of exotic species

- Support strong border biosecurity and avoid importing or accidentally introducing invasive species and pathogens into Australia that may have a serious adverse impact on this ecological community.
- Prevent planting of known or potentially invasive species (particularly known transformer species) in gardens, developments and landscaping near the ecological community.
- Avoid planting highly invasive (e.g. bird dispersed) species in or near remnants.
- When conducting activities in or around the ecological community, practise good biosecurity hygiene to avoid spreading weeds or pathogens. For example, keep vehicles and machinery to dedicated roads and out of remnants wherever possible. If vehicles must be taken into remnants ensure vehicles are washed first to remove soil, potential fungal pathogens and weed seeds. Use plants from accredited nurseries (e.g. accredited through the Nursery and Garden Industry Australia's Nursery Industry Accreditation Scheme).
- Minimise unnecessary soil disturbance that may facilitate weed establishment.
- Prevent dumping of garden waste into bushland, especially in or near patches of the ecological community.
- If new incursions do occur, detect and control them early, as small infestations are more likely to be eradicated.
- Limit or prevent access of grazing animals to patches of the ecological community (e.g. construct fences) where practicable.
- Prevent further introduction of feral animals and, where possible, contain pets in nearby residential areas.
- Work with relevant authorities to suppress deer and goat numbers, in line with the regional pest management strategy.
- Control invasive species using best practice bush regeneration techniques by qualified bush regenerators.

6.3.2 RESTORE the ecological community

This key approach includes priorities to restore the ecological community by active abatement of threats, appropriate management, restoration and other conservation initiatives.

- Liaise with landholders and undertake and promote programs that ameliorate threats such as grazing and human disturbance.
- Work with landholders to restore and reconnect patches of the ecological community and include buffers.

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Manage weeds and pests

- Implement effective integrated control and management techniques for weeds affecting the ecological community and manage sites to prevent the introduction of new, or further spread of, invasive weeds.
- Identify potential new weed incursions early (particularly transformer species) and manage for local eradication, where possible.
- Prioritise weed control in patches for which management is most urgent.
- Target control of key weeds that threaten the ecological community using appropriate methods.
- Encourage appropriate use of local native species in developments in the region through local government and industry initiatives and best practice strategies.
- Ensure chemicals, or other mechanisms used to manage weeds and pathogens, do not have significant adverse, off-target impacts on the ecological community or adjacent waterbodies.
- Control introduced pest animals through coordinated landscape-scale control programs.

Exclude trampling, browsing and grazing

- Promote regeneration by avoiding grazing..
- Strategically manage total herbivore grazing (by native and domestic animals), for instance by fencing off regrowth and revegetation areas.

Undertake restoration

- Undertake restoration, including bush regeneration and revegetation, of poorer and medium quality patches to restore them to high quality.
 - Plan and implement restoration with reference to the *National Standards for the Practice of Ecological Restoration in Australia* (Standards Reference Group SERA, 2016).
 - Use local native species in restoration/revegetation projects for the ecological community and restore understorey vegetation to a structure and diversity appropriate to the site.
 - In general, use locally collected seeds, where available, to revegetate native plant species. However, choosing sources of seed closer to the margins of their range may increase resilience to climate change.
 - Ensure commitment to follow up after planting, such as the care of newly planted vegetation by watering, mulching, weeding and use/removal of tree guards.
 - Consider the landscape context and other relevant species and communities when planning restoration works. For example, ensure adjacent ecological communities and threatened species are not adversely impacted by tree planting or other restoration activities.

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- Develop a collection program and collect seed from the ecological community for the Australian Seedbank Partnership⁹ and/or other relevant programs.
- Implement effective adaptive management regimes using information from available research and management guidelines, for example, see the National Standards for the Practice of Ecological Restoration in Australia, relevant research or advice from local authorities.

6.3.3 COMMUNICATE, ENGAGE WITH AND SUPPORT

This key approach includes priorities to promote the ecological community to build awareness and encourage people and groups to contribute to its recovery. This includes communicating, engaging with and supporting the public and key stakeholders to increase their understanding of the value and function of the ecological community and to encourage and assist their efforts in its protection and recovery. Key groups to communicate with include landholders, land managers, land use planners, researchers, community members and Indigenous communities, particularly Traditional Owner groups.

Raise awareness

- Educate landholders about the ecological values of and threats to Robertson Rainforest in the Sydney Basin Bioregion.
- Encourage landholders to protect patches through long term private land conservation mechanisms.
- Communicate with landholders/managers, relevant agencies and the public to emphasise the value of the ecological community, the key threats, its significance, and appropriate management. Encourage landholders to talk with local NRM organisations and other knowledgeable groups.
- Undertake effective community engagement and education to highlight the importance of minimising disturbance.
- Inform landholders about incentives, such as conservation agreements, stewardship projects, funding and government NRM programs etc. that may apply to help look after sites on private lands.

Provide information

- Develop education programs, information products and signage to help the public recognise the presence and importance of the ecological community, and their responsibilities under state and local regulations and national environmental law. This includes preparation of identification guidelines for the ecological community.
- Install signage to discourage damaging activities such as the removal of rocks and dead timber, dumping garden waste and other rubbish, creating informal paths and tracks, and the use of off-road vehicles in patches of the ecological community.

⁹ Australian Seedbank Partnership: www.seedpartnership.org.au

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- Install significant vegetation markers along roads to designate areas of the ecological community to protect and prevent inappropriate road side maintenance from occurring.
- Promote knowledge about local weeds and what garden plants to avoid planting. Recommend local native species for revegetation and landscaping or safe alternative garden plants.

Coordinate efforts

- Encourage local participation in restoration and ‘landcare’ efforts through local conservation groups, creating ‘friends of’ groups, field days and planting projects, etc.
- Liaise with local fire management authorities and agencies and engage their support in removing the risk of fire to the ecological community. Ensure land managers are given information about how to manage fire risks to conserve any threatened species and ecological communities.
- Support opportunities for traditional owners or other members of the Indigenous community to manage the ecological community.

6.3.4 RESEARCH AND MONITORING

This key approach includes priorities for research into the ecological community, and monitoring, to improve understanding of the ecological community and the best methods to aid its recovery through restoration and protection.

Mapping

- Collate existing vegetation mapping information and associated data for this ecological community and identify gaps in knowledge.
- Identify and map the fire interval status of surrounding fire-dependent vegetation.
- Undertake or support and enhance survey programs to:
 - Improve mapping of sites where the ecological community is known or likely to be present.
 - Conduct targeted field surveys and ground-truth to fill data gaps and clarify the presence and condition of remnants.

Options for managing threats

- Research into appropriate and integrated methods to manage weeds that affect the ecological community.

Monitoring

- Monitor for incursions by new weeds and pest animals.
- Monitor for myrtle rust and signs of new disease.
- It is important that any monitoring is planned before management commences and considers what data are required to address research questions. Monitoring must also be

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resourced for management activities, especially for those using a novel approach, and applied during and following the management action.

- Monitor changes in the composition, structure and function of the ecological community, including response to all types of management actions and use this information to increase understanding of the ecological community and inform recommendations for future management.

6.4 Existing plans relevant to the ecological community

A number of existing plans relate to management and/or recovery of the ecological community or its component species. These prescriptions were current at the time of publishing. Please refer to the relevant agency's website for any updated versions or new information that has been published.

Plans prepared for the management and/or recovery of the ecological community (or its component vegetation units and State-listed equivalent communities) include:

Eco Logical Australia Pty Ltd (2003) Wingecarribee Biodiversity Strategy – Phase 1.

Consultants report prepared by Eco Logical Australia Pty Ltd for the Wingecarribee our Future Environment Program.

Available on the Internet at:

<https://www.wsc.nsw.gov.au/services/environment/reports-and-resources/wingecarribee-biodiversity-strategy>

Accessed November 2018

Guymer K (2017) Private Land Biodiversity Strategic Plan 2014-2019 (Revision 1, August 2017), prepared for Wingecarribee Shire Council.

Available on the Internet at:

<https://www.wsc.nsw.gov.au/private-land-biodiversity-strategic-plan-20142019>

Accessed November 2018

NSW Office of Environment and Heritage (2017). Robertson Rainforest in the Sydney Basin Bioregion – profile.

Available on the Internet at:

<http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10733>

Accessed February 2018.

NSW Office of Environment and Heritage (2018a). Robertson Rainforest in the Sydney Basin Bioregion. Draft Saving Our Species project, September 2018

Available on the Internet at:

<https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10733>

Accessed October 2018.

NSW Office of Environment and Heritage (2018b). Help save the Robertson Rainforest in the Sydney Basin Bioregion. Saving Our Species strategy, published 9 October 2018

Available on the Internet at:

<https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=973>

Accessed October 2018.

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Wingecarribee Shire Council (2012) Wingecarribee Environment Strategy 2012 – 2017:
Enhancing our Natural Assets and Capacity.

Available on the Internet at:

<https://www.wsc.nsw.gov.au/services/environment/reports-and-resources/environment-strategy-2012-2017>

Accessed November 2018

Recovery plans prepared for species occurring in the ecological community include:

Hunter D and Gillespie GR (2011) National Recovery Plan for the Stuttering Frog *Mixophyes balbus*. Department of Sustainability and Environment, Melbourne.

NSW Office of Environment and Heritage (2012) National Recovery Plan for Eastern Bristlebird *Dasyornis brachypterus*. Office of Environment and Heritage, Department of Premier and Cabinet (NSW), Sydney.

Queensland Department of Environment and Resource Management (2011) National recovery plan for the large-eared pied bat *Chalinolobus dwyeri*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Victorian Department of Environment, Land, Water and Planning (2016) National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus*. Australian Government, Canberra.

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APPENDICES

APPENDIX A – SPECIES LISTS

All species lists presented in this appendix are indicative rather than comprehensive lists of relevant species that comprise the ecological community. A particular patch may not include all species on the list or may include other species not listed. Scientific names are valid as at November 2018. Some local Indigenous names have also been provided.

Table A1. Native plant species of the ecological community.

Not all of these species need be present at any particular site, with species composition varying with factors such as the size of the site and its recent disturbance history.

Scientific name	Common name
Trees and tall shrubs	
<i>Acacia melanoxylon</i> #	Blackwood
<i>Acronychia oblongifolia</i>	Common Acronychia, Yellow Wood, White Aspen
<i>Alectryon subcinereus</i>	Native Quince, Wild Quince, Bird's Eye, Smooth Rambutan
<i>Alphitonia excelsa</i>	Red Ash, Soap Tree
<i>Ceratopetalum apetalum</i>	Coachwood, Scented Coachwood, Scented Satinwood, Tarwood
<i>Cryptocarya glaucescens</i>	jackwood, Silver Sycamore, Native Laurel, Bolly Laurel, Brown Laurel, Brown Beech
<i>Cyathea australis</i>	Rough Tree-fern, Black Tree-fern, Pooet (Koorie)
<i>Cyathea leichhardtiana</i>	Prickly Tree-fern
<i>Dicksonia antarctica</i>	Soft Tree-fern, , Brown Tree-fern, Woolly Fern-tree, Common Tree-fern, Kombadik (Koorie)
<i>Diospyros australis</i>	Black Plum, Grey Plum, Yellow Persimmon, Black Persimmon
<i>Diplazium australe</i>	Austral Lady Fern
<i>Doryphora sassafras</i> #	Sassafras
<i>Elaeocarpus holopetalus</i>	Black Olive Berry, Mountain Blueberry, Mountain Quandong
<i>Elaeocarpus kirtonii</i>	Silver Quandong, White Quandong, Brown-hearted Quandong, Brownheart, Mountain Beech, Mowbullan Whitewood, Pigeonberry Ash, White Beech, Whitewood
<i>Elaeocarpus reticulatus</i>	Blueberry Ash, Ash Quandong, Blue Olive Berry, Fairy Petticoats, Fringe Tree, Koda, Lily Of The Valley Tree, Scrub Ash
<i>Eucalyptus fastigata</i>	Brown Barrel, Cut-tail
<i>Eucalyptus smithii</i>	Gully Gum
<i>Eucryphia moorei</i>	Eastern Leatherwood, Southern Leatherwood, Mainland Leatherwood, Pinkwood, Stinkwood, Plumwood, Yulbah, White Sally, Acacia Plum
<i>Ficus coronata</i>	Sandpaper Fig, Creek Sandpaper Fig, Creek Fig, Figwood
<i>Guioa semiglauca</i>	Guioa, Wild Quince
<i>Gymnostachys anceps</i>	Settler's Flax, Settlers' Twine, Boorgay, Caterpillar Flower
<i>Hedycarya angustifolia</i>	Austral Mulberry, Australian Mulberry, Native Mulberry, Djelwuck (Koorie)
<i>Helicia glabriflora</i>	Smooth Helicia, Pale Helicia, Pale Oak, Leather Oak, Brown Oak
<i>Livistona australis</i>	Cabbage Palm, Cabbage Tree Palm, Cabbage Fan Palm, Australian Fan Palm, Fan Palm, Daranggara (Cadigal)
<i>Myrsine howittiana</i> (syn. <i>Rapanea howittiana</i>)	Brush Muttonwood
<i>Notelaea venosa</i>	Veined Mock-olive, Smooth Mock-olive, Large-leaved Mock-olive
<i>Olearia argophylla</i>	Musk Daisy Bush, Native Musk, Silver Shrub, Silverleaf
<i>Ozothamnus ferrugineus</i>	Tree Everlasting

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Scientific name	Common name
<i>Pennantia cunninghamii</i>	Brown Beech
<i>Pittosporum revolutum</i>	Wild Yellow Jasmine, Rough Fruit Pittosporum, Yellow-flowered Pittosporum, Yellow Pittosporum, Downy-leaved Pittosporum, Curled Pittosporum, Hairy Pittosporum, Lemon-fruit Pittosporum, Mock Orange
<i>Pittosporum spinescens</i> (syn. <i>Citriobatus pauciflorus</i>)	Orange Thorn
<i>Pittosporum undulatum</i>	Native Daphne, Sweet Pittosporum, Snowdrop Tree (Lord Howe), Mock Orange, White Holly, Wave Leaved Pittosporum, Native Laurel, Engraver Wood
<i>Polyosma cunninghamii</i> #	Featherwood
<i>Polyscias murrayi</i>	Pencil Cedar, Pencilwood, Umbrella Tree, White Basswood, Chinky Pine, Celerywood
<i>Polyscias sambucifolia</i>	Elderberry Panax, Ornamental Ash, Elderberry Ash
<i>Polystichum proliferum</i>	Mother Shield Fern
<i>Prostanthera lasianthos</i>	Christmas Bush, Victorian Christmas Bush, Mint Tree, Mint Bush, Mountain Lilac
<i>Quintinia sieberi</i> #	Poosumwood
<i>Sambucus australasica</i>	Native Elder, Native Elderberry, Yellow Elderberry
<i>Schizomeria ovata</i>	Crabapple, White Birch, White Cherry, Snowberry, Squeaker, Humbug
<i>Stenocarpus salignus</i>	Scrub Beefwood, Killarney Beefwood, Red Silky Oak
<i>Sticherus lobatus</i>	Spreading Shield Fern, Spreading Fan Fern
<i>Symplocos thwaitesii</i>	Buff Hazelwood
<i>Synoum glandulosum</i>	Scentless Rosewood, Bastard Rosewood, Red Sycamore
<i>Syzygium smithii</i> (syn. <i>Acmena smithii</i>)	Lillypilly, Midjuburi (Cadigal)
<i>Tristaniaopsis collina</i>	Mountain Water Gum, Hill Kanuka
Low to medium shrubs	
<i>Cassinia trinerva</i>	Three-veined Cassinia
<i>Celastrus australis</i>	Staff Climber
<i>Coprosma quadrifida</i>	Prickly Currant Bush, Native Currant
<i>Gynochthodes jasminoides</i> (syn. <i>Morinda jasminoides</i>)	Jasmine Morinda, Sweet Morinda
<i>Melicytus dentatus</i> (syn. <i>Hymenanthera dentata</i>)	Tree Violet
<i>Ozothamnus diosmifolius</i>	White Dogwood, Rice Flower, Sago Bush, Pill Flower
<i>Pimelea ligustrina</i>	Tall Rice Flower
<i>Rubus moluccanus</i> var. <i>trilobus</i>	Molucca Bramble
<i>Rubus rosifolius</i>	Rose-leaf Bramble, Native Raspberry
<i>Senna acclinis</i>	
<i>Tasmannia insipida</i>	Brush Pepperbush, Dorrigo Pepper, Pepper Tree
Vines, scramblers, lianas and epiphytes	
<i>Aphanopetalum resinsum</i>	Gum Vine
<i>Asplenium australasicum</i>	Bird's Nest Fern, Crow's Nest Fern
<i>Cissus hypoglauca</i>	Native Grapes, Jungle Grape, Five-leaved Grape, Water Vine, Giant Water Vine, Five-leaved Water Vine, White-leaved Water Vine, Jungle Vine, Billangai
<i>Clematis aristata</i>	Old Man's Beard, Traveller's Joy
<i>Clematis glycinoides</i>	Headache Vine, Guwalyari (D'harawal)
<i>Eustrephus latifolius</i>	Wombat Berry, Orange Vine
<i>Fieldia australis</i>	Fieldia
<i>Hibbertia scandens</i>	Climbing Guinea Flower, Twining Guinea Flower, Golden Guinea Vine, Snake Vine

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Scientific name	Common name
<i>Marsdenia rostrata</i>	Milk Vine
<i>Muellerina eucalyptoides</i>	Creeping Mistletoe
<i>Palmeria scandens</i>	Anchor Vine, Pomegranate Vine
<i>Pandorea pandorana</i>	Wonga Wonga Vine, Wonga Vine, Spearwood, Lance Wood, Boat Vine
<i>Parsonsia brownii</i>	Mountain Silkpod, Twining Silkpod
<i>Parsonsia straminea</i>	Common Silkpod, Monkey Rope
<i>Ripogonum album</i>	White Supplejack
<i>Rubus nebulosus</i>	Green-leaved Bramble
<i>Sarcopetalum harveyanum</i>	Pearl Vine, Big-leaf Vine
<i>Smilax australis</i>	Lawyer Vine, Wait-a-while, Barbwire Vine, Austral Sarsaparilla, Sweet Sarsaparilla
Ferns, forbs, graminoids and mosses	
<i>Arthropteris palisotii</i>	
<i>Arthropteris tenella</i>	Jointed Fern
<i>Asplenium attenuatum</i>	Simple Spleenwort
<i>Asplenium flabellifolium</i>	Necklace Fern, Fan-leaved Fern, Fan-leaved Spleenwort, Butterfly Fern
<i>Asplenium flaccidum</i>	Weeping Spleenwort, Drooping Spleenwort
<i>Australina pusilla</i>	Small Shade Nettle
<i>Austrocynoglossum latifolium</i>	Forest Hound's Tongue, Forest Hound's Tooth
<i>Blechnum nudum</i>	Fishbone Waterfern, Wyeebo Gaggawar (Koorie)
<i>Blechnum patersonii</i>	Strap Waterfern
<i>Blechnum wattsi</i>	Hard Waterfern, Gaggawar (Koorie)
<i>Carex appressa</i>	Tall Sedge, Southern Cutty Grass
<i>Calomnion complanatum</i>	
<i>Dendrobium pugioniforme</i>	Dagger Orchid
<i>Dennstaedtia davallioides</i>	Lacy Ground Fern
<i>Doodia aspera</i> (syn. <i>Blechnum neohollandicum</i>)	Prickly Rasp Fern
<i>Elatostema reticulatum</i>	Rainforest Spinach
<i>Galium leiocarpum</i>	
<i>Geitonoplesium cymosum</i>	Scrambling Lily
<i>Geranium homeanum</i>	Rainforest Crane's-bill
<i>Histiopteris incisa</i>	Bat's Wing Fern, Oak Fern
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort, Shitweed
<i>Hydrocotyle sibthorpioides</i>	
<i>Hymenophyllum cupressiforme</i>	Common Filmy Fern
<i>Hymenophyllum flabellatum</i>	Shiny Filmy Fern, Fan-like Filmy Fern
<i>Lastreopsis acuminata</i>	Shiny Shield Fern, Creeping Shield Fern, Glossy Shield Fern
<i>Lastreopsis hispida</i>	Bristly Shield Fern
<i>Lastreopsis decomposita</i>	Trim Shield Fern
<i>Lastreopsis microsora</i>	Creeping Shield Fern
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
<i>Microsorium pustulatum</i> subsp. <i>pustulatum</i>	Kangaroo Fern, Hound's Tongue
<i>Microsorium scandens</i>	Fragrant Fern
<i>Notogrammitis billardierei</i> (syn. <i>Grammitis billardierei</i>)	Finger Fern, Common Finger-fern
<i>Pellaea falcata</i>	Sickle Fern, Australian Cliff Brake
<i>Plantago debilis</i>	Shade Plantain
<i>Plectorrhiza tridentata</i>	Tangle Orchid
<i>Polyphlebium venosa</i>	Veined Bristle-fern
<i>Pteris umbrosa</i>	Jungle Brake
<i>Pyrrosia rupestris</i>	Rock Felt Fern

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Scientific name	Common name
<i>Ranunculus lappaceus</i>	Buttercup, Australian Buttercup, Common Buttercup, Yarrakalgamba (D'harawal)
<i>Ranunculus plebeius</i>	Buttercup
<i>Sarcochilus falcatus</i>	Orange-blossom Orchid
<i>Solanum aviculare</i>	Kangaroo Apple
<i>Solanum pungetium</i>	Eastern Nightshade
<i>Stellaria flaccida</i>	
<i>Tylophora barbata</i>	Bearded Tylophora
<i>Urtica incisa</i>	Stinging Nettle, Scrub Nettle, Tall Nettle
<i>Veronica plebeia</i>	Creeping Speedwell, Trailing Speedwell
<i>Viola hederacea</i>	Ivy-leaved Violet, Ivy-leaf Violet, Ivy Violet, Native Creeping Violet, Australian Native Violet

Sources: NSW Scientific Committee (2011); NSW OEH (2017a) ; NSW OEH (2018a & b)

– Dominant canopy species

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Table A2. Native animal species of the ecological community.

Scientific name	Common name
Amphibians	
<i>Litoria brevipalmata</i>	Green-thighed Frog
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog
<i>Mixophyes balbus</i>	Stuttering Frog, Southern Barred Frog
Birds	
<i>Alectura lathamii</i>	Australian Brush-turkey
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo
<i>Calyptorhynchus lathamii</i>	Glossy Black-cockatoo
<i>Chalcophaps indica</i>	Emerald Dove
<i>Daphoenositta chrysoptera</i>	Varied Sittella
<i>Dasyornis brachypterus</i>	Eastern Bristlebird
<i>Glossopsitta pusilla</i>	Little Lorikeet
<i>Hieraaetus morphnoides</i>	Little Eagle
<i>Leucosarcia melanoleuca</i>	Wonga Pigeon
<i>Ninox strenua</i>	Powerful Owl
<i>Pachycephala olivacea</i>	Olive Whistler
<i>Platycercus elegans</i>	Crimson Rosella
<i>Psophodes olivaceus</i>	Eastern Whipbird
<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove
<i>Tyto novaehollandiae</i>	Masked Owl
<i>Tyto tenebricosa</i>	Sooty Owl
Mammals	
<i>Cercartetus nanus</i>	Eastern Pygmy-possum
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat
<i>Dasyurus maculatus</i>	Spot-tailed Quoll
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)
<i>Phoniscus papuensis</i>	Golden-tipped Bat
<i>Miniopterus australis</i>	Little Bent-wing Bat
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat
<i>Myotis macropus</i>	Southern Myotis
<i>Phascolarctos cinereus</i>	Koala
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)
<i>Pseudocheirus peregrinus</i>	Common Ring-tailed Possum
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox
<i>Saccolaimus flaviventris</i>	Yellow-Bellied Sheath-tail Bat
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
<i>Trichosurus vulpecula</i>	Common Brush-tailed Possum
Reptiles	
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake

Sources: DoEE (2018); NSW OEH (2018a & b)

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Table A3. Threatened species that are known to occur or may occur in the ecological community.

Scientific name	Common name	EPBC Act*	BC Act*
Fauna			
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow		V
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo		V
<i>Calyptorhynchus lathamii</i>	Glossy Black-cockatoo		V
<i>Cercartetus nanus</i>	Eastern Pygmy-possum		V
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V
<i>Daphoenositta chrysoptera</i>	Varied Sittella		V
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E
<i>Dasyurus maculatus</i>	Spot-tailed Quoll	E	V
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle		V
<i>Glossopsitta pusilla</i>	Little Lorikeet		V
<i>Hieraaetus morphnoides</i>	Little Eagle		V
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	V	E
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E	E
<i>Kerivoula papuensis</i>	Golden-tipped Bat		V
<i>Litoria brevipalmata</i>	Green-thighed Frog		V
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V
<i>Miniopterus australis</i>	Little Bent-wing Bat		V
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat		V
<i>Mixophyes balbus</i>	Stuttering Frog, Southern Barred Frog	V	E
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat		V
<i>Myotis macropus</i>	Southern Myotis		V
<i>Ninox strenua</i>	Powerful Owl		V
<i>Pachycephala olivacea</i>	Olive Whistler		V
<i>Phascolarctos cinereus</i>	Koala	V	V
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	V	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove		V
<i>Saccolaimus flaviventris</i>	Yellow-Bellied Sheath-tail Bat		V
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat		V
<i>Tyto novaehollandiae</i>	Masked Owl		V
<i>Tyto tenebricosa</i>	Sooty Owl		V
Flora			
<i>Arthropteris palisotii</i>			E
<i>Calomnion complanatum</i>			E
<i>Lastreopsis hispida</i>	Bristly Shield Fern		E
<i>Senna acclinis</i>			E

Sources: DoEE (2018); NSW OEH (2018a & c)

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