Draft Conservation Advice (incorporating listing advice) for Coastal floodplain eucalypt forest of eastern Australia

1. The Threatened Species Scientific Committee (the Committee) was established under the EPBC Act and has obligations to present advice to the Minister for the Environment (the Minister) in relation to 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 Coastal floodplain eucalypt forest of eastern Australia to the Minister as a draft conservation advice 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 the Coastal floodplain eucalypt forest of eastern Australia.
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 relevant to the consideration of the ecological community for listing.
5. Components of this ecological community are listed as threatened under New South Wales *Biodiversity Conservation Act 2016* and recognised as endangered under Queensland Regional Ecosystem framework and Victorian Ecological Vegetation Communities approach.
6. This draft conservation advice has been developed based on the best available information at this time.

Coastal floodplain eucalypt forest in the South East Corner Bioregion, South Coast, NSW

Contents

1 CONSERVATION OBJECTIVE

To prevent further loss and degradation of the **Coastal floodplain eucalypt forest of eastern Australia**, and help recover its biodiversity, function and extent, by 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 national environment law; and
- outlining the priority conservation and research actions that could stop decline and support recovery of the ecological community.

2 DESCRIPTION OF THE ECOLOGICAL COMMUNITY

The ecological community varies in structure from a tall eucalypt forest to a eucalypt woodland that occurs on alluvial soils of the coastal floodplains of south-east Queensland, NSW and eastern Victoria. The characteristic features are a dominant canopy of eucalypts, typically an understorey of small trees, shrubs and climbers, as well as an abundant ground cover of forbs, grasses and scramblers. The groundcover may also include ferns and sedges in moister positions.

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 are only a subset of all the species in the ecological community. The number and identity of species at different sites varies because of disturbance or natural variation across the large latitudinal range, historical biogeography and local environmental gradients that influence soils, water and flood regimes. Contextual effects of adjacent vegetation are also important (i.e. the local species pool is strongly influenced by the surrounding vegetation).

The species recorded can also be affected by sampling scale, survey season and effort and expertise. At some sites 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 (e.g. 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 Coastal floodplain eucalypt forest of eastern Australia (hereafter referred to as "Coastal floodplain eucalypt forest" or the "ecological community"). The ecological community was originally placed on the 2016 Finalised Priority Assessment List as the 'River-Flat Eucalypt forest on coastal floodplains of New South Wales'. The name primarily refers to its riparian and floodplain landscape position and the dominant tree canopy genera being *Eucalyptus*, *Angophora* and/or *Corymbia*.

2.2 Location and physical environment

The ecological community is found within the following IBRA[1] Bioregions: South East Corner (SEC), Sydney Basin (SYB), NSW North Coast (NNC), and South East Queensland (SEQ). The ecological community usually occurs in warm to hot temperate (from east of Sale in Victoria, north to the Great Lakes on the New South Wales mid-north coast) and sub-tropical (north of the Great Lakes to the south of Gladstone) climatic zones on the eastern seaboard of Australia.[2]

The landscapes in which the ecological community occurs are Quaternary coastal floodplains[3], with mostly alluvial soils – that may be at least occasionally saturated, water-logged or inundated. They include the riparian zones around rivers and creeks, floodplains prone to inundation, older floodplain terraces, and floodplain depressions. The ecological community may extend onto localised colluvial fans that may overlay the alluvial floodplain.

The ecological community is typically found below 50 metres above sea-level (ASL), but also occurs on localised floodplain pockets up to, and occasionally beyond, 250 metres ASL.

Alluvial soils are very diverse and usually reflect the properties of their parent material in the upper catchment (Wilson & Taylor 2012). The ecological community is commonly found on deep (greater than one metre) Quaternary alluvial soils, including silts, clay loams and sandy loams, gravel and cobbles. Soils may be shallower on the margins of the floodplain and in the

[1] IBRA refers to the Interim Biogeographical Regionalisation of Australia. IBRA regions a 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 (DoE, 2013), which divides Australia into 89 bioregions and 419 subregions, including offshore islands.
[2] Based on the Australian Climate Classification www.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp#glance. Accessed 11 October 2018
[3] See glossary for more detailed definition of floodplain

smaller narrow alluvial systems. They may include in-situ subsoils, and colluvial processes on flats bounded by steep slopes.

In the field, the edge of the floodplain (and of the alluvial soils) is typically indicated by the break in slope between the river flat[1] (i.e. the net depositional zone) and the steeper foot slopes (i.e. the net erosional zone) of the adjoining higher land. Changes in slope within the depositional zone, i.e. because of localised terraces and river banks, are not indicative of the edge of the floodplain. However, as terrain slope decreases, it can be more difficult to locate the edge of the floodplain.

The edge of the floodplain may also be indicated by changes in the vegetation. Vegetation on alluvial deposits next to watercourses is typically more diverse than vegetation in the surrounding landscape; and it often has a denser tree canopy and ground layer, due to greater water availability. The greater diversity and abundance of groundcover, particularly of species associated with moister environments, including grasses, forbs, sedges and ferns, compared to adjacent slopes may be clearly visible.

2.3 Vegetation structure and flora

Structure

The structure of the ecological community is generally a tall open forest to woodland, but there may be localised areas of closed forest and/or low forest. The structure tends to be lower and less dense in the open floodplains, whereas taller denser forests occur in the upper floodplains that extend along stream flats among the hills surrounding the main part of the floodplain.

The canopy is dominated by eucalypt species, often with several species present. The canopy may exceed 40 m in height, but can be considerably shorter, for example in regrowth stands, or where growth in inhibited (such as on waterlogged sites or in areas with lower rainfall). When intact, the canopy is typically between 40 to 60 per cent crown cover, with large trees often containing hollows, but may be as low as 20 per cent. Areas of higher crown cover also occur, particularly where blue gums are dominant.

A mid layer of small trees or sub-canopy may be present with scattered to dense shrubs. For example, Melaleuca, Leptospermum and related genera may form dense thickets beneath eucalypt canopies or in gaps between trees. The mid layer may be sparser in lower rainfall areas, or where partially cleared, grazed or frequently burnt. The ecological community often has climbers and vines extending into the mid-storey and canopy.

The ecological community generally has a more diverse and abundant groundcover than locally adjoining slopes and typically includes grasses, forbs, ferns, sedges and scramblers. The intact ecological community may also have high litter cover and fallen logs.

[1] Flat is a planar landform element that is neither a crest nor a depression and is level or very gently inclined (<3% tangent approximately). Some flats and slopes may have the same inclination (1-3%). The slope line on a flat often runs parallel to the course line in a nearby open depression such as a stream channel or river. The slope line of a slope seldom does so, but makes an angle with the course line (Speight 2009).

The ecological community typically forms mosaics with other floodplain forest communities, lowland woodlands and treeless wetlands. There may be small areas (for example less than 30 m^2) within the ecological community that are dominated by other species or do not meet the key diagnostics but these areas are part of the ecological community. The local expression of the ecological community is influenced by its location relative to the riparian areas of the floodplain, frequency of inundation by stream flows, local climate, latitude and where alluvial soil deposits are typically found.

The natural vegetation responds to the dynamic nature of coastal environments and presents a corridor, as well as core habitat, for large number of species, notably wildlife and moisture-adapted plants. Due to the large latitudinal range of the ecological community there is substantial variation in community composition, with some common species being replaced with others, depending on the latitude (Bell, 2013; Bell, 2016; Keith and Scott, 2005; NSW EPA, 2016a, b). Hence there is regional variation and intergradation of key species, although the structure and function remain similar throughout the extent.

Canopy

The composition of the tree canopy of the ecological community varies across its extent and may be dominated by a single species or a mix of several species; however, those species that generally characterise the ecological community are *Eucalyptus*, *Angophora* and/or *Corymbia*, notably: *Angophora floribunda* (Rough-barked Apple), *A. subvelutina* (Broad-leaved Apple), and various members of the 'red gum' group of eucalypts (Exsertaria), notably *Eucalyptus amplifolia* (Cabbage Gum) and *E. tereticornis* (Forest Red Gum; Queensland Blue Gum, Red Irongum) (NSW OEH 2018; Keith & Scott 2005; NSW Scientific Determination 2011; Queensland Herbarium 2016).

In the southern warm temperate region of the distribution (from east of Sale in Victoria to Sydney in New South Wales), other eucalypt species may dominate or co-dominate the community including *E. baueriana* (Blue Box); *E. bosistoana* (Coast Grey Box), *E. botryoides* (Southern Mahogany/Bangalay); *E. botryoides* x *E. saligna*, *E. elata* (River Peppermint); *E. longifolia* (Woolybutt, may also occur in the ecological community further north), *E. ovata* (Swamp Gum) and *E. viminalis* (Ribbon Gum). The national and state listed Camden White Gum (*E. benthamii*) may be locally dominant but is restricted to parts of the Hawkesbury-Nepean River floodplain west of Sydney.

In the hot temperate and sub-tropical regions of the distribution (from north of Sydney to Gladstone), additional eucalypt species that may dominate or co-dominate the canopy include *Corymbia intermedia* (Pink Bloodwood), *E. grandis* (Flooded Gum), *E. moluccana* (Grey Box), *E. propinqua* (Grey Gum), *E. resinifera* (Red Mahogony), *E. saligna* (Sydney Blue Gum), *E. seeana* (Narrow-leaved Red Gum) and *E. siderophloia* (Grey Ironbark).

There is a transitional area through the Sydney Basin IBRA region to North Coast of NSW that may include a range of eucalypts from both warm to hot temperate and subtropical regions.

Other eucalypts may be present in a mixed eucalypt canopy throughout the range, but are typically not dominant, or may be co-dominant with the characteristic species of the

ecological community (see Table 6, Appendix B for full list of other eucalypt species). *Eucalyptus robusta* (Swamp Mahogany) may occur, but is not generally dominant in this ecological community and is more typically found in lower-lying swampier parts of the floodplain that are permanently waterlogged.

Other non-eucalypt species typically found in the subcanopy throughout the range, but not dominant, include: *Allocasuarina littoralis* (Black Sheoak) and *Elaeocarpus reticulatus* (Blueberry Ash, Blue Oliveberry) and various *Melaleuca* species. In NSW and Qld *Casuarina cunninghamiana* (River Oak, River Sheoak), *Casuarina glauca* (Swamp Oak, Swamp Sheoak), *Glochidion ferdinandi* (Cheese Tree) and *Lophostemon suaveolens* (Swamp Box) may also be found while *Alphitonia excelsa* (Red Ash) and *Allocasuarina torulosa* (Forest Oak) are typically found in the hot temperate or subtropical climatic zones.

Mid-layer

A range of paperbarks are characteristic in the sub-canopy and shrub layer of this ecological community including *Melaleuca linariifolia* (Flax-leaved Paperbark) and *M. styphelioides* (Prickly-leaved Paperbark) over the entire range with *M. alternifolia, M. decora (*White Feather Honey Myrtle) and *M. quinquenervia* (Broad-leaved Paperbark) in the hot temperature and subtropical zones. Other species characteristic of this ecological community include *Melicytus dentatus* (Tree Violet), *Notelaea longifolia* (Native Olive) and *Myrsine howittiana* (Brush Muttonwood) over the entire extent, while *Sannantha pluriflora, Coprosma quadrifida* (Prickly Currant-bush), *Cassinia trinerva* (3-veined Cassinia) and *Pomaderris aspera* (Hazel Pomaderris) occur more in the warm temperate zone.

Other shrubs that are widespread across a range of landscape positions are common in this ecological community including *Acacia floribunda, Breynia oblongifolia* (Breynia, Coffee Bush), *Bursaria spinosa* (Sweet Bursaria Blackthorn, Kurwan-D'harawal), *Goodenia ovata* (Hop Goodenia), *Pittosporum revolutum* (Hairy Pittosporum) and *Plectranthus parviflorus* (Cockspur flower). In warm temperate zones *Prostanthera lasianthos* (Victorian Christmas-bush) may also occur.

Climbing species and scramblers

Scrambler species such as *Desmodium varians* (Slender Trefoil) and *Veronica plebeia* (Trailing Speedwell) are found mainly in the ground-layer, whereas *Glycine clandestina* (Twining Glycine) and *Stephania japonica* var. *discolor* (Snake Vine) may climb into the sub-canopy or mid-layer. Other commonly occurring species include *Clematis glycinoides* (Headache Vine), *Cissus hypoglauca* (Water Vine), *Eustrephus latifolius* (Wombat Berry), *Geitonoplesium cymosum* (Scrambling Lily), *Gynochthodes jasminoides* (Morinda Vine), *Hibbertia scandens* (Climbing Guinea Flower), *Parsonsia straminea* (Common Silkpod), *Rubus parvifolius* (Native Raspberry) and *Smilax australis* (Native Sarsaparilla).

Understorey

Given this is a floodplain ecological community there are a number of understorey species adapted to the alluvial soils and comparatively higher soil moisture compared to surrounding slopes. These are mostly perennial forbs, grasses, sedges, rushes and ferns including: *Centella asiatica* (Pennywort), *Cheilanthes sieberi* subsp. *sieberi* (Poison Rock Fern, Mulga Fern),

Commelina cyanea (Scurvy-weed), *Cyanthillium cinereum, Dichondra repens* (Kidney Weed), *Einadae hastata* (Berry Saltbush, Saloop), *Entolasia marginata* (Bordered Panic), *Gahnia clarkei* (Tall Saw-sedge), *Lobelia purpurascens* (White root), *Lomandra longifolia* (Spiny-headed Mat-rush), *Microlaena stipoides* (Weeping Grass), *Oplismenus aemulus* (Basket Grass) *Viola banksia* (Wild Voilet) and *Viola hederacea* (Ivy-leaved Violet) (Good *et al.* 2017; Keith & Scott 2005; NSW Scientific Committee 2010, 2011; Miles J pers. comm.). In the sub-ropical regions grasses may dominate the groundcover including: *Themeda triandra* (Kangaroo Grass), *Imperata cylindrical* (Blady Grass), *Cymbopogon refractus* (Barbed Wire Grass), *Heteropogon contortus* (Black Spear Grass).

A species list of the characteristic, frequently occurring or threatened flora of the Coastal floodplain eucalypt forest is at Table 6 in Appendix B.

2.4 Fauna

The ecological community includes a wide range of species that depend on the canopy and subcanopy, the terrestrial components, soils and subsurface and those dependent on wetlands. The wide variety of habitat found within the national ecological community is important for food, nesting, roosting or hunting. Fauna species also play important roles as part of the ecological community, including pollination, seed dispersal and soil turnover. A list of fauna of the ecological community is in Table 7, Appendix B.

Canopy and subcanopy fauna

The eucalypt canopy is home to a range of species that are dependent on hollows and other habitat values supplied by mature plants. The tree hollows and crevices that form in mature trees are also of particular importance to arboreal mammals, birds, frogs, reptiles and invertebrates, including bees and butterflies, which form part of this ecological community (Good *et al*. 2017, Healthy Land and Water 2016, SEQ Catchments 2016a). Certain tree species found within the ecological community, such as Forest Red Gum, are preferred by a broad range of species including micro-bats, arboreal mammals and some reptiles (Gibbons & Lindenmayer, 2002). Many of the diagnostic eucalypt species are also important feed trees for *Phascolarctos cinereus* (Koala). Koalas generally favour habitats on soils with higher fertility and soil moisture such as Coastal floodplain eucalypt forest, particularly during times of high temperature and drought (Ellis *et al*. 1995).

Arboreal mammals play important roles in the ecological community, including pollination and seed dispersal for native plants (East Gippsland CMA 2013). The Coastal floodplain eucalypt forest include a number of arboreal mammals such as the *Pseudocheirus peregrinus* (Common Ringtail Possum), *Trichosurus vulpecula* (Common Brushtail Possum), *Acrobates pygmaeus* (Feathertail Glider), *Petaurus australis* (Yellow-bellied Glider), *Petaurus breviceps* (Sugar Glider) and *Petaurus norfolcensis* (Squirrel Glider), while threatened species include *Petauroides volans* (Greater Glider) and Koala. *Cercartetus nanus* (Eastern Pygmy Possum) is an active climber in the canopy and subcanopy. It uses its brush tipped tongue to feed on nectar and pollen, especially from *Banksia*, *Eucalyptus* and *Callistemon* species. It also feeds on insects, and will eat soft fruits when flowers are not available. *Phascogale tapoatafa* (Brush-tailed Phascogale) is an arboreal carnivore preying on smaller

mammals, birds, lizards and insects, as well as feeding on nectar from flowering trees in the ecological community (NSW OEH 2018).

The nationally listed *Pteropus poliocephalus* (Grey-headed Flying Fox) occurs across the entire extent of the ecological community. In autumn and winter the species congregates on coastal lowlands north of the Hunter Valley and occasionally on the south coast of NSW, while in summer the species spreads throughout the range. Together with *Pteropus scapulatus* (Little Red Flying Fox) and *Pteropus alectro* (Black Flying Fox), they feed primarily on nectar and pollen of *Eucalyptus* and *Corymbia* blossoms and are responsible for much of their pollination (DoEE 2019).

Microchiroptera (micro-bats) frequently forage across fertile floodplains and river/forest corridors of the ecological community. The threatened *Chalinolobus dwyeri* (Large-eared Pied Bat) is largely restricted on the east coast to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys or forested floodplain and riverine corridors (Pennay 2010 pers. comm. cited in TSSC 2012). *Myotis macropus* (Large-footed or Southern Myotis) is Australia's only true fishing bat and is listed as vulnerable in NSW. This bat may roost in small groups of 10 - 15 close to water in hollow-bearing trees or dense foliage, and forages over streams and pools catching insects and small fish by raking their feet across the water surface. (NSW OEH 2017b)

Understorey plants influence bird diversity because the shrubs and twiners provide shelter, nesting substrates, foliage and include seasonal flowers which attract birds and insects (SEQ Catchments 2016a). The nationally and state-listed *Anthochaera phrygia* (Regent Honeyeater) and *Grantiella picta* (Painted Honey-eater) inhabit eucalypt forests with a reliable nectar supply, including those with Rough-barked Apple. Other birds likely to be present include other honeyeaters, cuckoos, owls, doves, whistlers, fairywrens, scrubwrens and fantails. The ecological community also supports a range of cockatoos, lorikeets, rosellas and parrots such as the critically endangered *Lathamus discolour* (Swift Parrot) that forage on flowers and psyllid lerps in eucalypt forests. During periods of drought, the Coastal floodplain eucalypt forest is a particularly important refuge habitat for the Swift Parrot (Saunders and Tzaros 2011).

With a diverse range of fauna the community also supports birds of prey including: *Haliastur sphenurus* (Whistling Kite), *Haliastur indus* (Brahminy Kite), *Haliaeetus leucogaster* (White-bellied Sea-eagle), *Pandion haliaetus* (Osprey) and *Erythrotriorchis radiatus* (Red Goshawk) (Law *et al*. 2000; NSW Committee 2018; NSW OEH 2018). *Ninox strenua* (Powerful Owl), *Tyto tenebricosa* (Sooty Owl) and *Tyto novaehollandiae* (Masked Owl) are listed as threatened in Victoria and vulnerable in NSW. They prefer wetter, more timbered areas such as those provided by the ecological community in the upper floodplain and riparian corridors and roost and nest in large tree hollows near foraging areas. The Masked Owl is nocturnal and preys on rodents, small dasyurids, possums, bandicoots, rabbits, bats, birds, reptiles and insects. Foraging is primarily for terrestrial prey, however some prey is taken from the trees or in flight.

Some flowering plants provide large amounts of nectar for the ecological community. This attracts many insects (e.g. butterflies), which lay their eggs on the various food plants for

larvae and nymphs, including *Acacia* spp. (wattles), *Lomandra* spp., sedges like *Gahnia* spp. and *Carex* spp. and the vine *Hardenbergia violacea* (Purple Coral Pea). For example, *Trapezites symmomus* (Splendid Ochre), which is found across the whole extent of the ecological community feeds on *Lomandra* spp., most commonly *Lomandra longifolia* (Spiny-headed Mat-rush) (Braby 2004).

Ground dwelling fauna

The vegetation provides food and shelter for a wide range of ground-dwelling animals including kangaroos, wallabies, wombats, birds, native rats and mice, reptiles and many invertebrates (Healthy Land and Water 2016). Prior to European settlement, some areas of the ecological community in southeast Queensland also supported large birds such as Emus and Bustards that are now locally extinct (SEQ Catchments 2016b).

The understorey clumps of grasses, forbs, ferns and sedges provide cover for small to medium sized ground dwelling animals such as the *Isoodon macrourus* (Northern Brown Bandicoot), the threatened *Isoodon obesulus obesulus* (Southern Brown Bandicoot) and *Tachyglossus aculeatus* (Short-beaked Echidna). The diverse understorey also provides habitat for animals that also forage or dwell in rainforest (SEQ Catchments 2016a). Species such as *Pseudomys novaehollandiae* (New Holland Mouse) live in communal burrows and are found in habitats that are often high in floristic diversity especially leguminous perennials (Haering & Fox 1997; Kemper & Wilson 2008). The New Holland Mouse feeds primarily on seeds, though leaves, fungi and invertebrates are consumed based on seasonal or floristic characteristics of individual sites in the ecological community, and is thought to play an important role in seed dispersal and fungal spore dispersal (Seebeck *et al*. 1996; Smith & Quin 1996).

Predators such as the threatened *Dasyurus maculatus maculatus* (Spot-tail quoll) are adept at moving through the canopy, as well as at ground level, preying on possums and rabbit, as well as insects, lizards, crayfish, birds, small mammals, frogs, fish, plant material (Jones *et al*. 2001). *Antechinus agilis* (Agile Antechinus) and *Antechinus stuartii* (Brown Antechinus) are also part of the ecological community, living in forested habitats, with dense lower ground cover and low fire frequency. These small carnivores prey on invertebrates. Most species nest communally in tree-hollows but also move and hunt terrestrially.

Cyclodomorphus gerrardii (Pink-tongued Lizard), is part of the ecological community, sheltering beneath leaf litter, in hollow logs, and in crevices of rocks and trees. Its slender body and limbs are an adaptation for moving in thick undergrowth. A good climber, it uses its semi-prehensile tail as a supporting aid and, although only partially arboreal, climbing trees to feed when necessary. Another lizard species of the ecological community is the *Cyclodomorphus michaeli* (Mainland She-oak Skink), listed in Victoria as a threatened species, which inhabits the groundcover, sheltering amongst grass clumps, leaf-litter and logs (Lindenmayer *et al*. 2002; Shea 2004).

The invertebrates of the ecological community are poorly known but include *Meridolum corneovirens* (Cumberland Plain Land Snail)[1] which is listed as endangered in NSW. It lives

[1] https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10526

under litter of bark, leaves and logs, or shelters in loose soil around grass clumps and can dig several centimetres into soil to escape drought. It is a fungal specialist and, unlike the Garden Snail, does not eat green plants. It is generally active at night (NSW Scientific Committee 1997).

Soil fauna

The grasses, herbs and ferns and deep-rooted trees of the floodplain ecological community play a prominent role in intercepting, storing and recycling nutrients, protecting soil from erosion, reducing stream sediment loads during high intensity rainfall events and regulating ground water (SEQ Catchments 2016). A broad range of invertebrates and fungi are associated with the decomposition cycles in the moist, shaded conditions on the forest floor (SEQ Catchments 2016a).

Ground-dwelling and burrowing mammals such as bandicoots, *Vombatus ursinus* (Common or Bare-nosed Wombat) and Short-beaked Echidna also play many important roles in the forest ecosystem including the dispersal of fungal species important for plant growth, soil aeration and the breakdown of leaf litter through digging and raking (Fleming *et al*. 2014). In Western Sydney, wombats are increasingly favouring Coastal floodplain eucalypt forest as a refuge from high temperatures (P. Ridgeway pers. comm. 2019). The alluvial soil type of the ecological community may be an important indicator of suitability of habitat for species such as the New Holland Mouse, with deeper top soils and softer substrates being preferred for digging burrows (Wilson & Laidlaw 2003).

Water dependant fauna

The ecological community plays an important role in maintaining river ecosystems and riverbank stability and provides essential connectivity between the slopes and rivers and longitudinally along rivers. As an interface between terrestrial and aquatic habitats, the ecological community contains species intimately associated with water and streams such as *Intellagama lesueurii* (Water Dragon), *Hydromys chrysogaster* (Water Rat), *Ornithorhynchus anatinus* (Platypus), turtles and frogs. Waterbirds such as cormorants (*Phalacrocorax* spp.), egrets (*Ardea* spp. and *Egrettia* spp.) and kingfishers, *Ephippiorhynchus asiaticus* (Black-necked Stork) and the endangered *Botaurus poiciloptilus* (Australasian Bittern) are part of the ecological community, while mobile species take advantage of abundant food, shelter and water, such as honeyeaters, parrots and lorikeets. Fringing forests are also important roosting sites for flying foxes and for other species that may live in adjacent habitats but move through the ecological community to access water (Healthy Land and Water 2017).

The moist environment also supports a number of amphibians, particularly tree frogs such as the threatened *Litoria aurea* (Green and Golden Bell Frog), *Litoria brevipalmata* (Green-thighed Frog), *Mixophyes balbus* (Stuttering frog) and *Mixophyes iteratus* (Giant Barred-frog) (Healthy Land and Water 2016; SEQ Catchments 2016a). Green and Golden Bell Frogs have been found in differing habitat in NSW and Victoria and often found under debris on low, oft-flooded river flats. In NSW, the species commonly occupies disturbed habitats, and breeds largely in ephemeral ponds. However, in Victoria, the Green and Golden Bell Frog occupies habitats with little human disturbance and commonly breeds in permanent ponds, as well as ephemeral ponds (Pyke & White 1996). Other species such as *Limnodynastes peronii*

(Brown Striped-frog) and *Limnodynastes tasmaniensis* (Spotted Grass-frog) are found under debris in river-flats and the grassy borders of creeks (Cogger 2000; NSW Scientific Committee 2018).

Among the species known to occur within the ecological community is the state-listed *Petalura gigantea* (Giant Dragonfly)[1] which is endangered in NSW. The Giant Dragonfly is one of the largest dragonflies in the world, and occurs along the east coast of NSW. Larvae live in permanent swamps and bogs with some free water and open vegetation. Adults spend most of their time settled on low vegetation on or adjacent to the swamp. They hunt for flying insects over the swamp and along its margins (NSW Scientific Committee 1998).

3 IDENTIFYING AREAS OF COASTAL FLOODPLAIN EUCALYPT FOREST PROTECTED UNDER NATIONAL ENVIRONMENTAL LAW

The key diagnostic characteristics, condition thresholds and other information in this section are used to:

- identify patches of the threatened ecological community that are protected under national environment law (for example, to determine whether the referral, impact assessment, approval and/or compliance provisions of national environmental law are likely to apply to the patch); and
- distinguish between patches of different quality (to aid environmental protection and management decisions).

National listing focuses legal protection on areas or patches of the ecological community that are the most functional, in a relatively natural state and in comparatively good condition. Because the ecological community exhibits various degrees of disturbance and degradation, condition thresholds, classes and categories have been developed.

This section also includes guidance on defining a 'patch' and on sampling protocols; along with further information to have regard to when considering actions that may have a significant impact on the ecological community.

Protection as a matter of national environmental significance under national environment law is limited to areas of the ecological community that meet the key diagnostic characteristics and at least the minimum condition thresholds for this ecological community. If a proposed action will, or may have, a significant impact on the threatened ecological community, it must be referred to the Australian Government for approval prior to undertaking that action.

Although very degraded or modified patches are not protected under national environment law, some patches of the ecological community that do not meet the condition thresholds still have important natural values; and they may meet definitions for protection under state and local laws or schemes. These lower quality patches should not necessarily be excluded from recovery and other management actions, because these actions could improve the condition

[1] https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10600

of a patch to the point where it is protected under national environment law. Recovery and management actions should also be designed to restore patches to good or high condition.

In some cases, however, the loss and degradation are irreversible given changes in land use; or rehabilitation is impractical because too many natural characteristics have been lost. For example, most areas that have been converted to crops, exotic pasture or urban development are unlikely to be restored.

Key diagnostic characteristics (Section 3.1) summarise the main features of the ecological community. They are intended to help identify it, noting that more details are provided in the other sections of this document (for instance, where the ecological community occurs in nature and lists of species that characterise the ecological community). Species composition of this ecological community is influenced by, amongst other things: the size of the patch, proximity of remnant vegetation, seasonal conditions (e.g. rainfall and temperature), latitude, inundation frequency, hydrological conditions and disturbance history (including fire and grazing). Plant surveys conducted during spring and early summer will more easily identify understorey species in the ecological community and should be conducted at least 6-12 months post major disturbance. However, the key diagnostic characteristics and condition thresholds are designed to allow identification of the ecological community irrespective of the season.

Condition thresholds (Section 3.2) are designed to help identify the relatively good quality patches for protection under national environment law. Because the ecological community has been heavily cleared and fragmented, many remnants are small, isolated and in a modified condition. Any remnants that are largely intact (in terms of structure and/or diversity of characteristic species), or include mature trees, or are connected to other native vegetation and form a large patch, are a high priority for protection and management.

Very small, isolated or degraded patches (e.g. those subject to permanent or ongoing high disturbance) will not meet the minimum condition thresholds for protection under national environment law (for example, a few eucalypt trees on a farm or roadside, with limited diversity/structural elements).

The following steps outline how to identify patches of the ecological community that are protected under national environment law (e.g. for EPBC Act referral, assessment and compliance purposes). They are also useful to inform related activities, such as carrying out environmental impact assessments and projects to manage threats or restore the ecological community.

Step 1: Use the key diagnostic characteristics to determine whether the ecological community is present – Section 3.1.

Step 2: Determine the condition and size of the patch, using the criteria in Section 3.2 to determine whether it meets the minimum condition thresholds for protection under national environment law.

> **Note:** Boundaries for a patch may extend beyond a project site or property boundary, or beyond the potential area of impact for a proposed action. The entire patch as a whole should be considered.

Note: Section 3.3 (Further information to assist in determining importance and avoiding significant impacts) must also be taken into account when considering the importance of a patch of the ecological community and how to protect it under national environment law.

3.1 Step 1 - Key Diagnostics

Nature is an intergrading continuum and its ecological classification is a useful, but artificial representation of this continuum. All units of ecological classification exhibit variation within their perceived boundaries and in transition to other units.

This ecological community persists in a number of natural, modified and disturbed states. Also, environmental variables, such as climate (and the ecological community's response to them) fluctuate or change over time. For these and other reasons there will be 'atypical' occurrences of the ecological community; and so qualifiers such as "typically", "relatively" "unlikely", "rarely" and "often" are used in the key diagnostic characteristics. A judgement should therefore be made as to whether the ecological community is present or not, based on: the key diagnostic characteristics; along with the description of the ecological community and the area it inhabits, as described in Section 2 of this advice.

The ecological community[1] that is protected under national environment law consists of areas of vegetation (and associated biota) that meet the following key diagnostic characteristics:

- Occurs from east of Sale in Victoria north to Gladstone in Queensland including the South East Corner, Sydney Basin, NSW North Coast and South East Queensland IBRA v7 Bioregions.
- The ecological community is typically found below 50 metres above sea-level (ASL), but also occurs on localised floodplain pockets up to, and occasionally beyond, 250 metres ASL in coastal catchments.
- Occurs on coastal river floodplains[2] that may be occasionally saturated, water-logged or inundated. Includes riparian zones, creek lines, floodplain depressions, alluvial flats, fans, terraces, and localised colluvial fans on alluvial floodplains.
- Commonly occurs on deep (>1m) quaternary alluvial soils including silts, clay loams, sandy loams, gravel and cobbles. May be shallower on the margin of the floodplain and smaller narrow alluvial systems and floodplain pockets.
- Occurs as a tall closed or open forest, open forest, tall woodland or woodland. The canopy has a total crown cover[3] of at least 20 per cent[4].
- The composition of the tree canopy is dominated[5] by one or more species of eucalypts in the genera *Angophora*, *Corymbia* or *Eucalyptus*. One or more of the following species are present[6]: *Angophora subvelutina, A. floribunda, Corymbia intermedia, Eucalyptus amplifolia, E. baueriana, E. benthamii, E. bosistoana, E. botryoides, E. botryoides* x *E. saligna, E. elata, E. grandis, E. longifolia, E. moluccana, E. ovata, E. propinqua, E. resinifera, E. saligna, E. seeana, E. siderophloia, E. tereticornis, E. viminalis.*
- In addition to the eucalypts listed above, a list of diagnostic native plant species, and some of the key native fauna that make up the ecological community, is given in Appendix B; although particular species may be abundant or rare, or not necessarily present at every location.

[1] The EPBC Act defines an 'ecological community' as the "extent in nature in the Australian jurisdiction of an assemblage of native species that inhabits a particular area in nature" (e.g. a group of plants, animals and other organisms interacting in a specific habitat, under relatively similar environmental conditions).
[2] Refer to Section 2.2 and the Glossary for full description of floodplains.
[3] Crown cover is measured as the % covered by the total area of the tree crowns, where the tree crowns are considered to be solid (as per the National Committee on Soil and Terrain, 2009).
[4] **Note:** Recent disturbance, such as fire, may remove the living canopy and cause a shift to a regenerative state for the ecological community. Similarly, the ecological community may be regenerating after past disturbance. Under these circumstances, the loss of a tree canopy is likely to be a temporary phenomenon, if natural regeneration is not interrupted. There should be evidence that: (1) the dominant eucalypt species typical of the ecological community were formerly present at a site by the presence of stumps, logs, photos, past surveys/knowledge; and (2) that the tree canopy will regenerate from seedlings, saplings or epicormic regrowth. This temporary regenerative state is included as part of the ecological community when the other diagnostic features and condition thresholds are met, even when crown cover is less than 20%.
[5] A canopy dominated by Eucalypts is one where eucalypts are collectively the most abundant tree the canopy in terms of either crown cover (at least 50% of the canopy cover is comprised of Eucalypts), or stem density (at least 50% of the total number of trees comprising the canopy are eucalypts).
[6] **Note**: *Eucalyptus robusta* (Swamp Mahogany) may occur, but where it is dominant and on more infertile soils or in lower-lying swampier parts of the floodplain close to the coast that are permanently or frequently waterlogged, it is unlikely to be the Coastal floodplain eucalypt forest ecological community.

3.2 Step 2 - Condition thresholds

The minimum condition thresholds for this ecological community are designed to identify the better quality patches (i.e. moderate to high condition) for protection under national environment law (***Table 1***). There may be some patches of the ecological community likely to be in better condition, particularly those which have been subject to no or low impacts such as light grazing and those which retain hollow bearing trees. Remnants of the ecological community that have a low incidence of weeds, mature habitat trees (those with hollows) and a more diverse understorey, and/or those that support arboreal mammals, are a high priority for protection and management. Small, isolated patches that are subject to high disturbance and with a less diverse native understorey, do not contribute greatly to the conservation of the ecological community and may not meet the condition thresholds for national protection.

The following categories and thresholds provide guidance on whether a patch retains sufficient conservation values to be considered part of the protected ecological community:

- CATEGORY A HIGHEST QUALITY Patches with the best chance for longer-term survival that retain a high degree of intact vegetation, habitat value or connectivity. Such remnants are more able to provide buffers from disturbance, sources of material for natural regeneration, and natural wildlife corridors and habitats.
- CATEGORY B represents either large patches, or small and contiguous patches in GOOD condition, or small-sized patches in HIGH condition.
- CATEGORY C represents either large patches, or small and contiguous patches, in MODERATE condition, or small patches in GOOD condition. These are also protected and are good candidates for restoration.

Patches within any of the CATEGORIES A, B or C are subject to the referral, assessment, approval and compliance provisions of the EPBC Act. Only patches that do not fit within any of these categories are not protected under the EPBC Act.

As the ecological community has been heavily cleared, fragmented and degraded, many remnants are small, or isolated and/or modified. Small and isolated patches may contain disproportionately more unique or rare biodiversity values that may be irreplaceable (Wintle *et al*. 2018). Therefore, small and isolated patches that have the potential to be restored and reconnected through weed management and/or revegetation activities, such that they would meet the minimum (moderate) condition thresholds, could be priorities for management and recovery projects.

Table 1: Condition thresholds and categories for patches of Coastal floodplain eucalypt forest of eastern Australia.

Biotic thresholds ➔ / Patch size thresholds ➔	**High condition**[5]	**Good condition**	**Moderate condition**
	≥ 80% of its total understorey vegetation cover[1] is comprised of native species (exotic annuals are excluded from this assessment) AND ≥ 20 large trees[2] or tree hollows per ha AND Ground cover richness ≥ 10 native species per 0.04 ha sample plot[6] OR Evidence of 2 or more particular species of arboreal mammal[3] detected in the patch[4]	≥ 50% of its total understorey vegetation cover[1] is comprised of native species (exotic annuals are excluded from this assessment) AND At least ten large trees[2] or tree hollow per ha AND Ground cover richness ≥ 6 native species per 0.04 ha sample plot[6]	≥ 30% of its total understorey vegetation cover[1] is comprised of native species (exotic annuals are excluded from this assessment) AND Ground cover richness ≥ 4 native species per 0.04 ha sample plot[6]
Large patch Patch size ≥ 2 ha **Small contiguous patch** Patch size ≥ 0.5 ha within a patch of native vegetation ≥ 5 ha	**CATEGORY A** Large or contiguous patch in high condition	**CATEGORY B2** Large or contiguous patch in good condition	**CATEGORY C2** Large or contiguous patch in moderate condition
Small patch Patch size ≥ 0.5 ha	**CATEGORY B1** Small patch in high condition	**CATEGORY C1** Small patch in good condition	

[1] Understorey vegetation cover includes vascular plan species of both the ground layer and the shrub layer (where present). The ground layer includes herbs (graminoids and forbs) and low (≤ m) shrubs, but does not include cryptogams, leaf litter or exposed soil.

[2] Large eucalypt trees are greater than 45 cm dbh. This is used as a surrogate for tree hollows and habitat values.

[3] Particular species of arboreal mammals include Feathertail Glider, Eastern Pygmy Possum, Greater Glider, Yellow bellied Glider, Sugar Glider, Squirrel Glider, Brush-tailed Phascogale, Koala, Mountain Brushtail Possum, but exclude Common Brushtail, Ringtail Possums or bats.

[4] Survey guidelines http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-mammals-guidelines-detecting-mammals-listed.

[5] High quality is based on the minimum benchmark conditions ("best on offer" condition for the community in the contemporary landscape) for all matched EVC (Victoria), PCT (NSW) and RE (Qld) (Eyre *et al*. 2015; NSW OEH 2017a).

[6] Includes combined species richness of native grasses, forbs, ferns and sedges per 0.04 ha (20 x 20 metre plot).

3.2.1 Defining a patch

A patch is a mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks (including exposed soil, leaf litter, cryptogams and watercourses/drainage lines), or localised variations in vegetation that do not significantly alter the overall functionality of the ecological

community. Where there is a narrow strip (<30 m) dominated by casuarina, allocasuarina or melaleuca on the edge, or within, this ecological community, it should be considered to be part of this ecological community. Such breaks are generally included in patch size calculations. Where there is a break in native vegetation cover from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30 m wide), then the gap typically indicates that separate patches are present.

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 are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches of the ecological community being identified within the overall area first considered. The patch may then be further divided into areas of high, good and moderate quality if that is useful to further conservation decision making.

3.2.2 Revegetated areas and areas of regrowth

Revegetated or replanted sites (or areas of regrowth) are not excluded from the listed ecological community, provided that the patch meets the key diagnostic characteristics and condition thresholds above. 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).

3.2.3 Sampling protocols

Thorough and representative on-ground surveys are essential to accurately assess the extent and condition of the ecological community. NSW Native Vegetation Type Standard (Sivertson 2009) and the Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain 2009) may provide guidance in some aspects. Patches can vary markedly in their shape, size, condition and features. The size, number and spatial distribution of plots or transects must be adequate to represent variation across the patch (e.g. sampling should include areas of different quality, localised areas of weed cover or other native vegetation, or disturbed areas). Sampling should address likely variation in species richness (any areas with apparently high native species richness should be included in the sample) and significant variation in the vegetation, landscape qualities and management history (where known) across the patch. Plots of 0.04 ha (quadrats of 20 x 20 m) would be suitable (Tozer 2003; Tozer *et al*. 2010). It is recommended to record the search effort

(identifying the number of person hours spent per plot and across the entire patch; along with the surveyor's level of expertise and limitations at the time of survey).

Fauna surveys should be conducted following best practice guidelines such as the Survey guidelines for Australia's threatened mammals (DSEWPC 2010) or equivalent.

Timing of surveys is a consideration because the ecological community can vary in its appearance through the year and between years, depending on climatic conditions. Ideally, surveys should be held in more than one season to maximise the chance of detecting all species present, particularly threatened species. Many species are easiest to detect or identify in spring and summer to early autumn, however, for some species, may require late winter survey to observe flowering. In years of low rainfall, assessors should recognise that many species may not be detected. In these situations it is preferable that surveys are carried out over more than one year.

In addition to the effects of rainfall variation, presence and detectability of some species may also be affected by the time since disturbance such as fire, slashing or grazing, so surveys should be planned to occur after an adequate time for some recovery (for example, at least six months post fire and within two months of effective rain). At a minimum, it is important to note recent climate conditions and what kind of disturbance may have happened within a patch and when that disturbance occurred.

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

The following information must also be taken into account when considering the importance of a patch of the ecological community and determining potential impacts and how to protect the patch under national environment law.

Land use and disturbance history will have influenced what remains of a patch of the ecological community. Its resulting structure (especially the loss of structural elements) will 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 Additional buffer zone around a patch

In addition to the patch itself, a minimum buffer zone that extends 30 m beyond the canopy of the outermost trees in the patch is essential to assist in the conservation of the patch. Its purpose is not specifically to extend the patch through regeneration, although this would be beneficial. A larger buffer zone should be applied, where practical, to protect patches that are of high conservation value, or if patches are located near 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.

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. The 30 m buffer zone encompasses an area large enough to protect the root zone of edge trees and other components of the ecological community from fertiliser, pesticide or herbicide applied or sprayed in adjacent land (e.g. spray drift), weed invasion, water runoff, soil erosion and most other damage and edge effects.

The buffer zone is not part of the patch of the ecological community, but should ideally consist of other native vegetation that is retained wherever possible. 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 approval under national environment law, 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 national environment law is also likely to 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.

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

The minimum condition thresholds outlined above are the minimum level at which patches are protected under national environment law. These thresholds do not represent the ideal state of the ecological community.

Patches that are larger, more species rich and less disturbed are likely to provide greater biodiversity value. However, small and isolated patches may contain disproportionately more unique or rare biodiversity values that may be irreplaceable (Wintle *et al*. 2018).

Additionally, patches that are spatially linked, whether ecologically or by proximity, are particularly important, both as wildlife habitat and corridors and to the viability of the ecological community into the future.

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.

So, in the context of actions that may have significant impacts and hence require approval under national environment law, it is important to consider the environment surrounding patches of the listed ecological community.

The following indicators should be considered when assessing the impacts of actions or proposed actions under national environment law – or when considering recovery, management and funding priorities for a particular patch:

- Larger patch size (for a patch of the ecological community and/or other surrounding native vegetation) and/or a large area to boundary ratio. Patches with larger area to boundary ratios are less exposed and more resilient to edge effect disturbances (such as weed invasion, other human impacts and storm damage).
- 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 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 patches containing mature (persistent residual) trees (particularly those with hollows), logs, watercourses, diversity of landscape, the diversity of plant species and vegetation structure, contribution to movement corridors, or natural rock outcrops.
- High native species richness – as shown by the variety of native species.
- Presence of nationally 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.
- Connectivity to other native vegetation remnants or restoration works. In particular, a patch in an important position between (or linking) other patches in the landscape. Areas of mosaic native vegetation provide a wider range of habitats that benefits flora and fauna diversity.
- Patches that occur in areas where the ecological community has been most heavily cleared and degraded, or that are at the edge of its range, are also important due to their rarity, genetic significance, or because of the absence of some threats.

3.3.3 Area critical to the persistence of the ecological community

Areas that meet Category A or B. These patches contain essential elements for survival of the entire ecological community and include large trees or tree hollows with a diverse understorey of sufficient size or contiguousness. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also considered important to the survival of the ecological community.

3.4 Relationship with other ecological communities

In the southern part of its range, the ecological community includes those parts of the NSW listed 'River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions' (NSW Scientific Committee 2011) and the Ecological Vegetation Communities in East Gippsland Lowlands in Victoria that meet the key diagnostics (Appendix A).

In the northern part of its range, the ecological community includes those parts of the NSW listed 'Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion' (NSW Scientific Committee 2010) and those parts of the Queensland Regional Ecosystems (Appendix A) that fit the key diagnostics.

The boundaries of coastal ecological communities may change over time due to the dynamic nature of these systems. This ecological community is often found in association with other vegetation types such as coastal swamps, freshwater wetlands, littoral rainforest or swamp sclerophyll forests in a 'mosaic' of coastal floodplain communities, and may also form mosaics with grassy woodlands, forests and rainforests on adjacent slopes and plains.

Nationally listed ecological communities that Coastal floodplain eucalypt forest can adjoin or intergrade with include:

- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Central Hunter Valley eucalypt forest and woodland
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) Grassy Woodland and Associated Native Grassland
- Illawarra and south coast lowland forest and woodland
- Illawarra-Shoalhaven Subtropical Rainforest (not yet listed)
- Littoral Rainforest and Coastal Vine thickets of Eastern Australia
- Lowland Grassy Woodland in the South East Corner Bioregion
- Lowland Rainforest of Subtropical Australia
- Subtropical and Temperate Coastal Saltmarsh
- Western Sydney Dry Rainforest and Moist Woodland on Shale
- Warkworth Sands Woodland of the Hunter Valley

There are several Ramsar wetlands that may intersect with, or are immediately downstream of, the ecological community:

- Gippsland Lakes in Victoria
- Great Sandy Strait (including Great Sandy Strait, Tin Can Bay and Tin Can Inlet) in Queensland
- Hunter Estuary Wetlands in New South Wales
- Moreton Bay in Queensland
- Myall Lakes in New South Wales
- Towra Point Nature Reserve in New South Wales

4 SUMMARY OF THREATS

Most of the remaining patches of the ecological community occur on productive agricultural land, or in close proximity to coastal areas, where continuing population growth and urban development is expected. Historically, clearing was primarily for agriculture, and actions such as culling of native fauna were undertaken largely to support agricultural productivity. The nature of some areas of the ecological community is likely to have changed structurally due to clearing, followed by regrowth that is likely to be subject to altered fire and water regimes and livestock grazing at some stage.

The other range of threats faced by the ecological community often interact, rather than act independently, and include:

- Clearing and fragmentation
- Invasive plant species (weeds)
- Invasive fauna
- Diseases, pathogens and dieback
- Impacts resulting from agricultural activities, including grazing and nutrient enrichment
- Changes to hydrology, including from flood mitigation and drainage works, roads and bridges, housing and industrial development and forestry.
- Inappropriate fire regimes
- Impacts resulting from urbanisation and recreational activity; and
- Climate change, including sea level rise, heat stress and changes to flow regimes.

Further details about the threats to the ecological community can be found in Appendix C – Description of threats.

5 DETAILED ASSESSMENT OF ELIGIBILITY FOR LISTING AGAINST THE EPBC ACT CRITERIA

This section presents an assessment of how the Coastal floodplain eucalypt forest of eastern Australia meets the listing criteria in the EPBC Act, with reference to the relevant regulations and guidelines for nationally threatened ecological communities (DoEE 2017). It forms the listing advice from the Threatened Species Scientific Committee to the Minister.

5.1 Criterion 1 – Decline in geographic distribution

Criterion 1 categories and thresholds			
Category	Critically endangered	**Endangered**	Vulnerable
Its decline in geographic distribution is **either**:	very severe	**severe**	substantial
a) Decline relative to the longer-term (beyond 50 years ago e.g. since 1750); **or**,	≥90%	**≥70%**	≥50%
b) Decline relative to the shorter-term (past 50 years).	≥80%	≥50%	≥30%
A past decrease sufficient to meet the criterion is considered to be a measurable change whereby: • the ecological community has contracted to less than some threshold proportion of its former range; or • the total area occupied by the community is less than the threshold proportion of its former area; or • less than the threshold proportion of the former area of the community is in patches of a size sufficiently large or well connected with other patches for them to be likely to persist beyond the *near future*.			

Eligible under Criterion 1 for listing as Endangered.

Evidence:

At least 70 per cent of native vegetation on the coastal floodplains of NSW has been destroyed since European settlement (Keith 2004; Keith & Scott 2005; Good *et al*. 2017). Along with lowland rainforests and Swamp Oak floodplain forest, Coastal floodplain eucalypt forest appears to have been more heavily depleted than the other floodplain assemblages (Keith & Scott 2005). In general, land clearing appears to have been slightly greater in the northern floodplains than in the south; and greater on the lower and middle reaches of floodplains, than on the upper floodplains and margins. In the Tweed lowlands, less than three per cent of the original floodplain forest and wetlands were estimated to remain in 1985 (Pressey & Griffith 1992) while in the Lower Hunter and Central Coast region, less than 25 to 40 per cent remained in 1992 (NPWS 2000). Recent estimates of the Cumberland Riverflat Forest (a part of the ecological community) suggest less than seven per cent remains on the Cumberland Plain (NSW OEH 2013a). Further south in the Eden region, about 30 per cent was estimated to remain in the mid-1990s (Keith & Bedward 1999). It is likely that there has been an overall decline of between 70 and 90 per cent of the ecological community over the longer-term.

In the Southeast Corner IBRA region within Victoria, the Ecological Vegetation Communities that are likely to contain the ecological community have been cleared by an estimated 64 per cent since European settlement (Table 4, Appendix A).

Southeast Queensland has seen one of the largest declines in the ecological community with less than 20 per cent remaining of estimated pre-European extent. Here, the Queensland Blue Gum (*Eucalyptus tereticornis*) dominated ecological community has seen a decline of over 90 per cent (Table 5, Appendix A).

Overall there has been a **severe** decline of approximately 75-80 per cent of the ecological community over the longer term, making it eligible for listing as **Endangered.**

5.2 Criterion 2 - Small geographic distribution coupled with demonstrable threat

Criterion 2 categories and thresholds			
Its geographic distribution is:	**Very restricted**	**Restricted**	**Limited**
2.1. Extent of occurrence (EOO)	< 100 km^2 = <10,000 ha	<1,000 km^2 = <100,000 ha	<10,000 km^2 = <1,000,000 ha
2.2. Area of occupancy (AOO)	< 10 km^2 = <1,000 ha	<100 km^2 = <10,000 ha	<1,000 km^2 = <100,000 ha
2.3. Average patch size	**< 0.1 km^2** **= <10 ha**	< 1 km^2 = <100 ha	-
AND the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in:			
the Immediate future [within 10 years, or 3 generations of any long-lived or key species, whichever is the longer, up to a maximum of 60 years.]	Critically endangered	Endangered	Vulnerable
the Near future [within 20 years, or 5 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years.]	**Endangered**	Endangered	Vulnerable
The Medium term future [within 50 years, or 10 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years.]	**Vulnerable**	Vulnerable	Vulnerable

Eligible under Criterion 2 for listing as Vulnerable to Endangered.

Criterion 2 aims to identify ecological communities that are geographically restricted to some extent. It is recognised that an ecological community with a distribution that is small and/or fragmented, either naturally or that has become so through landscape modification, has an inherently higher risk of extinction if it continues to be subject to ongoing threats that may cause it to be lost in the future. That there are demonstrable and ongoing threats to the Coastal floodplain eucalypt forest ecological community has been detailed in Section 4 and Appendix C.

The indicative measures that apply to this criterion are:

- the extent of occurrence, an estimate of the total geographic range over which the ecological community occurs
- the area of occupancy, an estimate of the area actually occupied by the ecological community, which generally equates with its present extent
- the patch size and distribution, an indicator of the vulnerability of small and/or isolated patches to particular threats, and

- an assessment of timeframes over which threats could result in further loss of the ecological community.

Evidence:

The Coastal floodplain eucalypt forest extends along the warm to hot temperature and subtropical regions of coastal eastern Australia, from east of Sale in Victoria, to Gladstone in Queensland. The **extent of occurrence** for the ecological community when measured as a minimum convex polygon is around 48.5 million hectares. This is above the threshold for a limited distribution, so is not eligible under criterion 2.1.

Similarly, the **area of occupancy** is also relatively large due to the large geographic extent of this community with an estimated area of all patches greater than 0.1 ha of approximately 214,000 ha. This is above the threshold for a limited distribution so is not eligible under criterion 2.2.

Despite the large geographic range of Coastal floodplain eucalypt forest, the ecological community is highly fragmented with a median patch size of 1.3 ha and over 88 per cent of patches smaller than 10 ha (Table 2). There are some larger patches, typically where the riparian areas of a stream network are largely intact and/or within reserves. Under criterion 2.3, the **average patch size** is **very restricted**.

The ecology community's range lies within a heavily cleared landscape (Victoria, NSW and Queensland coastal zone). The NSW Scientific Committee note that the ecological community has been extensively cleared and modified and the remaining stands are severely fragmented by past clearing and are further threatened by a range of ongoing threats including clearing, flood mitigation and drainage works, land-filling and earthworks associated with urban and industrial development. Continued pressure on rural-residential and urban areas throughout its range (as outlined in description of threats in Appendix C) suggest that the ecological community could be lost in the near to medium term making it eligible for listing as **Vulnerable to Endangered** under criterion 2.

Table 2: Number of patches by patch size range class for the Coastal floodplain eucalypt forest of eastern Australia, and in relation to thresholds for fragmentation under Criterion 2.

Thresholds		**Size range (ha)**	**% of area**	**Number of patches**	**% of patches**	**Cumulative % of patches**	
Restricted	Very Restricted	0.1 – 0.5	0.8	6204	22.5	88.5	99.1
		>0.5 - 1	1.5	4295	15.6		
		> 1 - 10	19.7	13842	50.3		
		> 10-100	36.4	2915	10.6		
		> 100	41.6	261	0.9		
		Total	**100**	**27517**	**100**		

5.3 Criterion 3 - Loss or decline of functionally important species

Criterion 3 categories and thresholds			
Category	Critically endangered	Endangered	Vulnerable
For a population of a native species likely to play a major role in the community, there is a:	very severe decline	severe decline	substantial decline
3.1 Estimated decline over the last 10 years or three generations, whichever is longer of:	at least 80%	at least 50%	at least 20%
to the extent that restoration of the community is not likely to be possible in:	the immediate future	the near future	the medium-term future
3.2: *restoration* of the ecological community as a whole is *unlikely* in	10 years, or 3 generations of any long-lived or key species, whichever is the longer, up to a maximum of 60 years.	20 years, or 5 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years.	50 years, or 10 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years.

Insufficient information available for listing under Criterion 3.

Evidence:

The dominant canopy of eucalypt species are functionally important across the range of the ecological community. It has undergone a decline in its extent in eastern Australia, synonymous with the decline in the ecological community, but remains common and dominant across the remaining extent of the ecological community. Eucalypt trees are lost as a result of losing entire patches of the ecological community, it is not the loss of eucalypts within remaining patches that is driving the decline of the ecological community. With the exception of *Eucalyptus benthamii*, none of the key eucalypt species are considered threatened as the time of this assessment. In some instances, the loss of large trees with hollows can reduce other parts of the ecological community such as arboreal mammals, insectivorous bats and other species that rely on tree hollows.

Groundcover and understorey species are also functionally important, providing food and shelter as well as turnover of organic matter, soil protection and retention of soil moisture. Inappropriate fire regimes, grazing by stock and invasive herbivores, invasion by weeds, and hydrological alteration may result in the loss of groundcover and understorey structure and species to the detriment of the ecological community. The loss of the groundcover and understorey may negatively impact on ground-dwelling fauna that play key roles in the ecological community. For example, soil aeration and the breakdown of leaf litter through digging and raking; along with the dispersal of fungal species and soil microbes. These ecosystem services are all essential to soil fertility. Fallen timber and litter are also important as habitat for ground-dwelling fauna as well as carbon turnover and can be selectively removed for firewood, particularly close to urban centres. As well as loss of vegetation cover,

predation by invasive species has considerably reduced native fauna numbers and the compromised the ecosystem services they provide.

Birds and arboreal mammals such as Black Flying-fox, Little Red Flying-fox and Grey-headed Flying-fox feed on the nectar and pollen of native blossoms and are beneficial to the health of vegetation as they spread seeds and pollinate native plants. The Grey-headed Flying-fox is listed as Vulnerable under national environment law and has suffered recent large declines due to heat stress. As a key pollinator of the ecological community, this decline may impact on regeneration of key vegetation species in the ecological community (OEH 2019).

Insects are functionally important within the ecological community and recent studies have demonstrated a large decline with over 40 per cent of insect species declining and a third endangered globally. The analysis also indicated that the loss in biomass was in the order of 2.5 per cent annually which can impact on many birds, reptiles, amphibians and fish that eat insects (Sanchez-Bayo & Wyckhuys 2019). This could further compromise the ecological community through cascade effects through the food chain of the ecological community.

Despite evidence of these declines, there is **insufficient data** at this time on the rate of loss of these species, to what extent they are functionally important and over what time frames this may impact on the ecological community.

5.4 Criterion 4 - Reduction in community integrity

Criterion 4 categories and thresholds			
Category	Critically endangered	**Endangered**	Vulnerable
The reduction in its integrity across most of its geographic distribution is:	very severe	**severe**	substantial
as indicated by degradation of the community or its habitat, or disruption of important community processes, that is:			
such that restoration is unlikely (even with positive human intervention) within	the immediate future (10 years or 3 generations)	the near future (20 years or 5 generations)	the medium-term future (50 years or 10 generations)

Eligible under Criterion 4 for listing as Endangered.

Evidence:

Coastal floodplain eucalypt forest has been extensively cleared and experienced a loss of around 75–80 per cent of its original extent (see criterion 1) and the remaining patches are severely fragmented by past clearing of the ecological community and surrounding vegetation. Over 20 species of fauna are listed as threatened under national environment law, with many more identified as threatened by state jurisdiction. Many of these species have been shown to be a functionally important part of the ecological community.

The ecological community is further threatened by continuing clearing and fragmentation, weed invasion, invasive fauna, disease and pathogens, grazing and nutrient enrichment,

changes to hydrology from development, inappropriate fire regimes, impacts from urbanisation and recreational activities and climate change, including sea level rise, heat stress and changes to flow regimes, as outlined in the description of threats in Appendix C. 'Transformer' perennial exotic grasses are a particular threat, as is soil nutrient enrichment associated with past and present dairy farming.

Existing fragmentation and loss, and ongoing degradation of the ecological community due to the significant threats, are likely to result in a severe reduction in community integrity. Therefore, the ecological community is eligible for listing as **Endangered** under criterion 4.

5.5 Criterion 5 - Rate of continuing detrimental change

Criterion 5 categories and thresholds			
Category	Critically endangered	Endangered	**Vulnerable**
Its rate of continuing detrimental change is:	very severe	severe	**substantial**
as indicated by a) degradation of the community or its habitat, or disruption of important community processes, that is:			
or b) intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:			
5.1 An observed, estimated, inferred or suspected *detrimental change* over the *immediate*[#] past or projected for the *immediate* future of at least:	80%	50%	**30%**

[#] The immediate timeframe refers to10 years, or 3 generations of any long-lived or key species believed to play a major role in sustaining the community, whichever is the longer, up to a maximum of 60 years.

Eligible under Criterion 5 for listing as Vulnerable

Evidence:

Historically the primary change affecting the ecological community has been clearing for agriculture and grazing. In recent decades the primary cause of clearing has been urbanisation and coastal development. These pressures are ongoing, particularly with the increasing development along the northern NSW and southern Queensland coasts. Population growth has been fastest along the coast, with an increase of approximately 300,000 people to the area within 30km of the coast in NSW and Qld each year since 1991 (Clark & Johnston 2016a). Coastal development follows this increase in population. For example, between 2011 and 2016, over 145,000 new urban lots were created within 30 km of the coast in NSW and Qld as rural and other land was replaced with urban development (Clark & Johnston 2016b).

As a consequence of this growth in population; housing, jobs, agribusiness and related infrastructure such as roads and airports are expected to increase substantially over the next 20 years, particularly on the NSW north coast where the population is expected to increase by 76,000 (NSW Department of Planning and Environment 2017). This will require an estimated 46,000 new residential dwellings and constitute a 16 per cent increase along the North Coast (to the Queensland border), particularly in the Tweed, Coffs Harbour and Port Macquarie-Hastings LGAs. Associated with this population growth, the Pacific Highway upgrade,

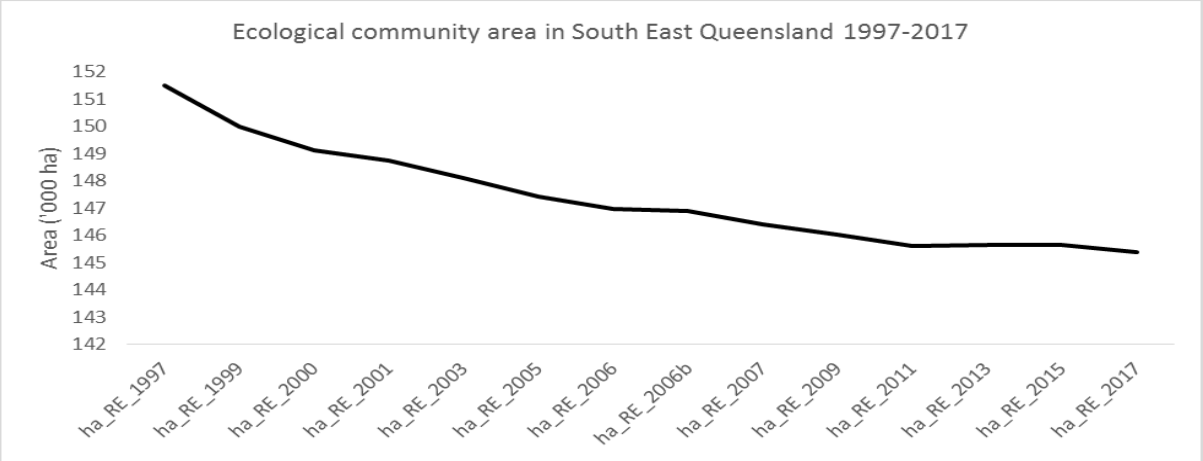
between Newcastle and Queensland, is expected to cater for an 83 per cent increase in freight transport and is likely to substantially affect drainage, hydrological connectivity and tidal inflows (NSW OEH 2016a).

In the Cumberland Plains region of Southwest Sydney, the ecological community is estimated to have declined by six per cent in 15 years. If this rate of clearing continues it is likely that there would be a decline due to clearing alone of 16-24 per cent over the immediate future (for example, three generations to a maximum of 60 years).

The NSW south coast is also expecting a substantial population increase over the next 25 years. For example, the Illawarra-Shoalhaven region is anticipating needing an additional 35,400 new homes by 2036 to meet the demands of population growth and demographic change (NSW Department of Planning and Environment 2015), and an additional 60,000 people (representing a population increase of nearly 40 per cent) are expected to move to the coastal centres of Batemans Bay, Bega, Ulladulla, Moruya, Narooma, Merimbula and Vincentia (NSW DECCW 2010). This is likely to cause considerable impact as much of the ecological community in these areas has already been cleared (Tozer *et al*. 2010).

Likewise, Queensland is expecting its population to increase significantly within the next 20 years. South east Queensland is one of the fastest growing areas in Australia and is predicted to have an additional one million people settled there by 2026, bringing the total population to 3.7 million (Qld Department of Natural Resources and Mines 2006). The mean annual population change is expected to be at least 20 per cent for each local government area from the Fraser Coast to Gladstone and 17 per cent for the Sunshine and Gold Coast council areas (Office of Economic and Statistical Research 2011). In South East Queensland, the rate of removal of the ecological community continues to be around 0.2 per cent per year. From 1997 to 2017 there was a four per cent decline for matched regional ecosystems in south east Queensland with over 6100 ha transformed to pasture, crops, settlement, mining, infrastructure or forestry (Figure 1).

Figure 1: Declines in area of matched REs[1] 1997-2017 (Source: Qld DES 2018.)



With additional decline and degradation due to weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, changes to

[1] For a list of matched REs see Appendix A

hydrology from flood mitigation and drainage works, inappropriate fire regimes, removal of dead wood and rubbish dumping and climate change it is highly likely that there will be substantial detrimental change in the geographic distribution and substantial degradation across most of its geographic distribution of the ecological community.

It is highly likely that the ecological community is eligible for listing as **Vulnerable** under Criterion 5.

5.6 Criterion 6 - Quantitative analysis showing probability of extinction

Criterion 6 categories and thresholds			
Category	Critically endangered	Endangered	Vulnerable
A quantitative analysis shows that its probability of extinction, or extreme degradation over all of its geographic distribution, is:	at least 50% in the immediate future.	at least 20% in the near future.	at least 10% in the medium-term future.

Insufficient information available for listing under Criterion 6.

No quantitative analysis has been undertaken showing likelihood of extinction for this ecological community. Therefore there is **insufficient information** available to determine eligibility against any category for this criterion.

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 prevent further loss and degradation of the **Coastal floodplain eucalypt forest of eastern Australia** and help recover its biodiversity, function and extent, by 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 good 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 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)[1]. They outline the principles that convey the main ecological, biological, technical, social and ethical underpinnings of

[1] Society for Ecological Restoration: http://www.seraustralasia.com/standards/home.html

ecological restoration practice. More specific guidance regarding restoration of Coastal floodplain eucalypt forest, or information that is regionally specific, may also become available. As restoration ecology is continually developing, it is important to reflect on the experience of others who have worked on restoring the ecological community, or other eucalypt or floodplain communities, 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 undertaken 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.
- 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 ecological community. They highlight general but key actions required to at least maintain survival of the ecological community at the time of preparing this 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.
- Some patches occur in isolation and require protection, as well as priority actions, to link them with other patches.
- 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.
- Manage fire appropriately in 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 overgrazing and that incorporate a buffer to protect remnants and allow 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.
- 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.

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.
- Identify potential new weed incursions early (particularly transformer species) and manage for local eradication, where possible.
- 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.

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 overgrazing and human disturbance.
- Work with landholders to restore and reconnect patches of the ecological community and include buffers.

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.

- 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. For example, work with relevant authorities to suppress rabbit, pig, deer, goat, cat and fox numbers, in line with regional pest management strategies.
- Control invasive species using best practice bush regeneration techniques by qualified bush regenerators.

Manage grazing

- The ecological community naturally occurs with a variety of understorey structural and floristic characteristics. In some cases, occcasional grazing may be used to reduce grass cover manage shrub regeneration, encouraging herb growth. It may be used to assist in management of some weeds such as African olive. However, effects must be closely monitored and grazing carefully managed in accordance with recommendations for biodiversity conservation, as it is also broadly associated with loss of biodiversity in grassy woodlands of eastern Australia (Dorrough *et al*. 2004).
- Ensure that timing allows regeneration of plants: allow moderate to high intensity grazing for a short period of time, usually in early spring, and wherever possible avoid grazing during peak native plant flowering and seeding times for many species (late spring and summer);
- Integrate appropriate grazing management regimes with fire management requirements.

Undertake restoration

- Undertake restoration, including bush regeneration and revegetation, of poorer and moderate quality patches to restore them to good or 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 (or are also included in planting and restoration).
- Seed collections should follow appropriate national guidelines and protocols with long-term storage of germplasm in an appropriate State facility.
- 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 the Coastal floodplain eucalypt forest ecological community.
- 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.
- 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 regional authorities and local councils to work on threat management planning and projects in collaboration with neighbouring authorities.
- 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 appropriately managing 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.

Research

- Conduct basic ecological research into how these forests function and sustain their biota. For example, research into hydrological dependencies, vegetation dynamics and movement would inform management of the remaining fragments.

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 the ecological community and surrounding fire-dependent and/or fire sensitive 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.
- Research into potential impacts of climate change on the current distribution of the ecological community.

Monitoring

- Monitor for incursions by new weeds and pest animals.
- Monitor for myrtle rust and signs of new disease outbreaks and appropriate containment actions undertaken.
- 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 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:

- NSW OEH [Office of Environment and Heritage] (2018) *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. Draft Saving Our Species project, August 2018.* Available on the Internet at: www.environment.nsw.gov.au/savingourspeciesapp/Project.aspx?results=c&ProfileID=10787 Accessed May 2019.
- NSW OEH [Office of Environment and Heritage] (2018) *Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion. Draft Saving Our Species project, August 2018.* Available on the Internet at:

www.environment.nsw.gov.au/savingourspeciesapp/Project.aspx?results=c&ProfileID=10944 Accessed May 2019.

Recovery plans, threat abatement plans and wildlife conservation plans

- NSW DECCW [Department of Environment, Climate Change and Water] (2010d) *Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region.* Department of Environment, Climate Change and Water NSW, Sydney. http://www.environment.gov.au/resource/northern-rivers-regional-biodiversity-management-plan
- DoEE [Department of the Environment and Energy] (2017b) *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)*. Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/threatened/publications/tap/feral-pig-2017
- DoE [Department of the Environment] (2015a) *Threat abatement plan for predation by feral cats*. Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats
- DEWHA [Department of the Environment, Water, Heritage and the Arts] (2008a) *Threat abatement plan for predation by the European red fox*, Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/threatened/publications/tap/predation-european-red-fox
- DoEE [Department of the Environment and Energy] (2016a) *Threat abatement plan for competition and land degradation by rabbits*. Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016
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- DSEWPC [Department of Sustainability, Environment, Water, Population and Communities] (2011) *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads*. Commonwealth of Australia, Canberra.

www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-biological-effects-including-lethal-toxic-ingestion-caused-cane-toads

- DoEE [Department of the Environment and Energy] (2018) *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi – 2018* Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/threatened/publications/threat-abatement-plan-disease-natural-ecosystems-caused-phytophthora-cinnamomi-2018
- DoE [Department of the Environment] (2015c) *Arrive Clean, Leave Clean: guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems.* Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/invasive-species/publications/arrive-clean-leave-clean

Regional conservation or natural resource management (NRM) plans

- SEQC [South East Queensland Catchments] (2016) *Managing Natural Assets for a Prosperous South East Queensland 2014 - 2031*. hlw.org.au/download/managing-natural-assets-for-a-prosperous-south-east-queensland-2014-2031/
- NSW DECCW [Department of Environment, Climate Change and Water] (2010a) *Far North Coast Regional Conservation Plan*. www.environment.nsw.gov.au/biodiversity/20100982fncrcp.htm
- NSW DECCW [Department of Environment, Climate Change and Water] (2010b) Draft *Mid North Coast Regional Conservation Plan*. www.environment.nsw.gov.au/biodiversity/20100999dmncrcp.htm
- NSW DECCW [Department of Environment, Climate Change and Water] (2010c) *South Coast Regional Conservation Plan.* www.environment.nsw.gov.au/biodiversity/20101000scrcp.htm

APPENDIX A - ADDITIONAL INFORMATION ON MAP UNITS AND REGIONS

Table 3: NSW Endangered Ecological Communities and matched vegetation types as at May 2019 that may contain the ecological communities where key diagnostics are met.

Note: There are a number of classification systems that have been used in NSW and PCTs are currently being reviewed. We will continue to consult with NSW OEH and/or NSW Scientific Committee to ensure the best alignment (the table below represents the matched communities in the determinations website and currently available in BioNet). Species matched through EPA assessment of Coastal floodplains TEC on NSW Crown Forest Estate reports are included in the species lists (NSW EPA 2016a, 2016b).

Name	Vegetation formations	Vegetation classes	Vegetation types	Classification
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (RFEF) (NDSW Office of Environment 2018) IBRA Bioregions NSW North Coast Sydney Basin South East Corner	Wet sclerophyll forests (shrubby sub-formation)	South Coast Wet Sclerophyll Forests	River Peppermint - Rough-barked Apple moist open forest on sheltered sites, southern South East Corner Bioregion	PCT 1109 (OEH 2018) DSF e19 (Tozer *et al*. 2006)
			Swamp Gum - Ribbon Gum open forest on flats of the coastal and hinterland lowlands, southern South East Corner Bioregion	1228 (OEH 2018) FoW e17 (Tozer *et al*. 2006)
		North Coast Wet Sclerophyll Forests	Sydney Blue Gum - Deane's Gum - River Peppermint shrubby riparian tall forest of the lower Colo River, Sydney Basin Bioregion	1504 (OEH 2018)
	Forested wetlands	Coastal Floodplain Wetlands	Floodplain wetlands of the coastal lowlands, southern South East Corner Bioregion	828 (OEH 2018) FoW e60 (Tozer *et al*. 2006)
			Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	835 (OEH 2018) FoW 33 (Tindall *et al*. 2004)
			Mountain Blue Gum - Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion	941 (OEH 2018) FoW p31 (Tozer *et al*. 2006)
			Rough-barked Apple - red gum grassy woodland of the MacDonald River Valley on the Central Coast, Sydney Basin Bioregion	1386 (OEH 2018) 10af (Ryan *et al*. 1996)
		Coastal Swamp Forests	Bangalay - Smooth-barked Apple / She-oak open forest on sandy alluvium in coastal parts of the Sydney region	1794 (OEH 2018) S_FoW01 (OEH 2013a)
			Forest Red Gum - Woollybutt - Pithy Sword-sedge swamp woodland in dune swales near Pambula, southern South East Corner Bioregion	839 (OEH 2018)
			Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	1232 (OEH 2018) FoW p105 (Tozer *et al*. 2006)
		Eastern Riverine Forests	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	1108 (OEH 2018) FoW p30 (Tozer *et al*. 2006)
			Water Gum - tea-tree- River Peppermint riparian scrub along streams, far southern South East Corner Bioregion	1293 (OEH 2018) FoW e38 (Tozer *et al*. 2006)
			White Sally Wattle - Leptospermum emarginatum riparian scrub of the Bega and Towamba valleys, southern South East Corner Bioregion	1318 (OEH 2018) FoW e39 (Tozer *et al*. 2006)

Name	Vegetation formations	Vegetation classes	Vegetation types	Classification
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (SCFF) (Office of Environment 2018). IBRA Bioregions NSW North Coast South Eastern Queensland	Dry sclerophyll forests (shrub/grass sub-formation)	Clarence Dry Sclerophyll forests	Grey Box - Grey Ironbark grassy open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	PCT 852 (OEH 2018) FE 21 (NPWS 1999)
			Orange Gum (*Eucalyptus bancroftii*) open forest of the NSW North Coast Bioregion	1062 (OEH 2018) NRAC Floristic Group 83 (NRAC 1995)
			Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion	1091 (OEH 2018) FE 71 (in part) (NPWS 1999)
			Yellow Box - Grey Box grassy open forest in the Glenugie area of the NSW North Coast Bioregion	1333 (OEH 2018)
		Hunter-Macleay Dry Sclerophyll Forests	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	1215 (OEH 2018)
	Dry sclerophyll forests (shrubby sub-formation)	Sydney Hinterland Dry Sclerophyll Forests	Grey Gum - Rough-barked Apple alluvial flat woodland in the upper Hunter Valley, mainly Sydney Basin Bioregion	621 (OEH 2018)
	Forested wetlands	Coastal Floodplain Wetlands	Forest Red Gum grassy open forest on floodplains of the lower Hunter	1598 (OEH 2018) MU080 (Siverstsen *et al*. 2011)
		Coastal Swamp Forests	Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion	1227 (OEH 2018)
			Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	1230 (OEH 2018) FE 142 (NPWS 1999)
	Grassy Woodlands	Coastal Valley Grassy Woodlands	Cabbage Gum open forest or woodland on flats of the North Coast	762 (OEH 2018)
			Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	837 (OEH 2018) FE 73 (NPWS 1999)
			Narrow-leaved Red Gum woodlands of the lowlands of the North Coast	971 (OEH 2018) NRAC Floristic Group 19 (NRAC 1995)

Name	Vegetation formations	Vegetation classes	Vegetation types	Classification
Other plant community types that have been matched to NSW Threatened Ecological Communities RFEF and/or SCFF (BioNet 2018) but not listed in NSW determination	Dry sclerophyll forests (shrub/grass sub-formation)	Hunter-Macleay Dry Sclerophyll Forests	Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast	1588 MU070 (Sivertsen *et al*. 2011)
	Dry Sclerophyll Forests (Shrubby sub-formation)	Coastal Dune Dry Sclerophyll Forests	Blackbutt - Smooth-barked Apple shrubby open forest on coastal sands of the southern NSW North Coast Bioregion	687 FE 27 and 129 (NPWS 1999)
			Scribbly Gum heathy open forest of coastal lowlands of the NSW North Coast Bioregion	1139 FE 74 (NPWS 1999);
			Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	1646 MU128 (Sivertsen *et al*. 2011)
			Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula	1648 MU130 (Sivertsen *et al*. 2011)
			Smooth-barked Apple - White Stringybark - Red Mahogany - *Melaleuca sieberi* shrubby open forest on lowlands of the lower North Coast	1618 MU100 (Sivertsen *et al*. 2011)
		North Coast Dry Sclerophyll Forests	Rough-barked Apple grassy open forest on valley flats of the NSW North Coast Bioregion and Sydney Basin Bioregion	1120 FE 122 (NPWS 1999)
			Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern NSW North Coast Bioregion and northern Sydney Basin Bioregion	1251 FE 11, 130 and 145 (NPWS 1999);
	Forested wetlands	Coastal Floodplain Wetlands	Forest Red Gum - Rough-barked Apple open forest on poorly drained lowlands of the Central Coast, Sydney Basin Bioregion	836 REMS Map unit 38 (NPWS 2000)
			Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter	1594 MU076 (Sivertsen *et al*. 2011)
			Cabbage Gum - Forest Red Gum - Flax-leaved Paperbark Floodplain Forest of the Central Coast	1720 MU202 (Sivertsen *et al*. 2011)
			Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	1800 S_FoW07 (OEH 2013)
		Coastal Swamp Forests	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	1064 FE 112 (NPWS 1999)
			Woollybutt - Paperbark sedge forest on alluvial plains of the Central Coast, Sydney Basin Bioregion	1325 Map unit 19 (Bell 2002)
		Eastern Riverine Forests	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	1106 FE 120 (NPWS 1999)
	Grassy woodlands	Coastal Valley Grassy Woodlands	Cabbage Gum - Broad-leaved Apple open forest of the eastern escarpment, NSW North Coast Bioregion and South Eastern Queensland Bioregion	761 FE 46 (NPWS 1999)
			Cabbage Gum open forest or woodland on flats of the NSW North Coast Bioregion and New England Tableland Bioregion	763 FE 46 (NPWS 1999)

Name	Vegetation formations	Vegetation classes	Vegetation types	Classification
			Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast	848 FE 54 (NPWS 1999)
			Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	1326 GW p3 (Tozer *et al*. 2006)
	Wet sclerophyll forests (shrubby sub-formation)	North Coast Wet Sclerophyll Forests	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	686 FE 72 (NPWS 1999)
	Wet Sclerophyll Forests (Grassy sub-formation);	Northern Hinterland Wet Sclerophyll Forests	Blackbutt - Tallowwood dry grassy open forest of the southern NSW North Coast Bioregion	691 FE 34 (NPWS 1999)
			Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	1092 FE 117 (NPWS 1999)
			Tallowwood - Smooth-barked Apple - Blackbutt grass tall open forest of the Central and lower North Coast	1556 MU038 (Sivertsen *et al*. 1999)
		Southern Lowland Wet Sclerophyll forests	Spotted Gum - Grey Ironbark - Woollybutt grassy open forest on coastal flats, southern Sydney Basin Bioregion and South East Corner Bioregion	1212 WSF p86 (Tozer *et al*. 2006)

Table 4: Victoria – Ecological Vegetation Communities (EVC) that may contain patches of the ecological community where key diagnostics are met (as at May 2019).

EVC	Name	Status[1] (Vic)	Extent remaining %	Area (ha) pre-1750 (where on alluvial geology)	Area (ha) current (where on alluvial geology)
4	Coastal Vine-rich Forest	Vulnerable	10-30	tbc	2
15	Limestone Box Forest	Vulnerable	10-30	tbc	1044
18	Riparian Forest	Depleted	30-50	tbc	7155
30	Wet forest	Least Concern	>50	tbc	22
47	Valley Grassy Forest	Depleted	30-50	tbc	206
151	Plains Grassy Forest	Endangered	<10%	tbc	6
169	Dry Valley Forest	Vulnerable	10-30	tbc	428
			(est ~35%)	tbc	8863

[1] Endangered: Contracted to less than 10% of former range; OR less than 10% pre-European extent remains OR Combination of depletion, degradation, current threats and rarity is comparable overall to the above

Vulnerable: 10-30% pre-European extent remains; OR Combination of depletion, degradation, current threats and rarity is comparable overall to the above.

Depleted: Greater than 30% and up to 50% pre-European extent remains; OR Combination of depletion, degradation and current threats is comparable overall to the above.

Note: many of these EVCs extend beyond the alluvial floodplains, so only a portion of them would meet the key diagnostics and be included in the ecological community.

Table 5: Queensland –Regional Ecosystems (RE) that may contain the ecological communities where key diagnostics are met as at May 2019 (Queensland Herbarium 2018)

RE	Name	Biodiversity status[2]	Extent remaining	Ha (pre 1750)	Ha (current)
12.3.3	Queensland Blue Gum woodland to open forest on alluvial plains	Endangered	9%	418859	38673
12.3.3a	*Eucalyptus crebra*, *Corymbia tessellaris* woodland to open forest. May include diagnosis eucalypts. It is limited to creek flats where the alluvial soils are higher in the catchment and slightly drier.		8%	3565	288
12.3.3d	12.3.3d *Eucalyptus moluccana* woodland typically occurs on the margins of floodplains, where the geology underlying the shallow alluvial soils is sedimentary rock. Gum-topped Box is more common than Queensland Blue Gum.		8%	13835	1176
12.3.7	Queensland Blue Gum and River Oak fringing woodlands	Of concern	50%	111033	55572
12.3.11	Queensland Blue Gum +/- Queensland Grey Ironbark and Pink Bloodwood open forest on alluvial plans usually near the coast	Of concern	24%	171266	41681
12.3.11a	Open forest of Queensland Blue Gum and/or Queensland Grey Ironbark with a vine understorey. Usually associated with drainage lines or depressions in the broader landscape		38%	608	234
12.3.11b	Open forest of Queensland Blue Gum and/or Scribbly gum with Queensland Grey Ironbark and a dense understorey of prickly-leaved paperbark		13%	706	92
12.3.19	12.3.19 is found on heavy alluvial soils on floodplains. *Eucalyptus moluccana* (Gum-topped Box) is more common than Queensland Blue Gum. The endangered *Melaleuca irbyana* (Swamp Tea-tree) also occurs here.	Endangered	9%	3068	268
12.3.2	*Eucalyptus grandis* tall open forest on alluvial plains	Of concern	34%	21667	7387
Sum			**20%**	**744608**	**145370**

[2] https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/biodiversity-status

APPENDIX B – SPECIES LISTS

Scientific names for vascular plants are nationally accepted names as per the Australian Plant Census (Council of Heads of Australasian Herbaria 2019) and NSW Flora Online (Royal Botanic Gardens and Domain Trust 2019). Note, the total vascular plant species list of the ecological community is considerably larger than the species listed here.

Due to the large latitudinal range of this community, some species will only be relevant in certain parts of the coast. The approximate extent of the species are noted for some species as typically over the entire extent (E), hot temperate and subtropical typically north of Sydney (S) or warm temperate typically south of Sydney (T). Where the species is limited in extent the IBRA code is indicated (for example SYB is Sydney Basin)

Table 6: Characteristic, frequently occurring or threatened flora of the Coastal floodplain eucalypt Forest of eastern Australia

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
Key diagnostic canopy species (eucalypt)							
Angophora floribunda (E)	Rough-barked Apple	Vic (r)	✓		✓		✓
Angophora subvelutina (E)	Broad-leaved Apple		✓	✓	✓		✓
Corymbia intermedia (S)	Pink Bloodwood			✓	✓		✓
Eucalyptus amplifolia (E)	Cabbage Gum		✓	✓	✓		
Eucalyptus baueriana (T)	Blue box		✓		✓	✓	
Eucalyptus benthamii (SYB)	Bentham's Gum	EPBC V NSW V	✓		✓		
Eucalyptus bosistoana (T)	Coast Grey Box	Vic (r)	✓		✓		
Eucalyptus botryoides (T)	Bangalay		✓		✓	✓	
Eucalyptus botryoides x E. saligna (T)					✓		
Eucalyptus elata (T)	River Peppermint		✓		✓	✓	
Eucalyptus grandis (S)	Flooded Gum, Rose Gum		✓				✓
Eucalyptus longifolia (T)	Woollybutt		✓		✓		
Eucalyptus moluccana (S)	Grey Box, Gum-topped Box		✓	✓	✓		
Eucalyptus ovata (T)	Swamp Gum		✓		✓	✓	
Eucalyptus propinqua (S)	Grey Gum			✓	✓		
Eucalyptus resinifera (S)	Red Mahogany			✓	✓		
Eucalyptus saligna (E)	Sydney Blue Gum		✓		✓		
Eucalyptus seeana (S)	Narrow-leaved Red Gum			✓	✓		✓
Eucalyptus siderophloia (S)	Grey Ironbark			✓	✓		✓
Eucalyptus tereticornis (E)	Forest Red Gum, Queensland Blue Gum,		✓	✓	✓	✓	✓
Eucalyptus viminalis (T)	Ribbon Gum, Manna Gum		✓		✓	✓	

[1] EPBC Act and NSW Act: V = vulnerable, E = endangered, CE = critically endangered, M=migratory
Qld Act: LC = least concern, NT = near threatened, V=vulnerable, E=endangered
Vic Act: L = threatened, Vic advisory list (): k = poorly known, r = rare, v = vulnerable, e = endangered
[2] See appendix A for matched Ecological Vegetation Communities in Victoria, Plant Community Types and associated mapping units in New South Wales and Regional Ecosystems in Queensland.

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
Other eucalypt canopy species							
Angophora costata (E)	Smooth-barked Apple				✓		
Angophora inopina (S)	Charmhaven Apple	EPBC V NSW V					
Angophora leiocarpa (S)	Rusty Gum						✓
Angophora paludosa (S)				✓	✓		
Angophora woodsiana (S)	Smudgy Apple			✓			
Corymbia gummifera (E)	Red Bloodwood				✓		
Corymbia henryi (S)	Large-leaved Spotted Gum				✓		
Corymbia maculata (E)	Spotted Gum	Vic (v)			✓		
Corymbia variegata (S)					✓		
Corymbia tessellaris (S)	Moreton Bay Ash, Carbeen						✓
Eucalyptus acmenoides (S)	White Mahogany			✓	✓		
Eucalyptus angophoroides (T)	Apple-topped Gum				✓		
Eucalyptus bancroftii (S)	Bancrofts Red Gum, Orange Gum				✓		
Eucalyptus capitellata (T, not Vic)	Brown Stringybark				✓		
Eucalyptus crebra (S)	Narrow-leaved Ironbark						✓
Eucalyptus croajingolensis (T)	Gippsland Peppermint				✓	✓	
Eucalyptus cypellocarpa (T)	Monkey Grey Gum, Mountain Grey Gum				✓	✓	
Eucalyptus fibrosa (S)	Red Ironbark				✓		
Eucalyptus globoidea (T)	White Stringybark				✓	✓	
Eucalyptus microcorys (S)	Tallowwood				✓		✓
Eucalyptus muelleriana (T)	Yellow Stringybark				✓		
Eucalyptus paniculata (T, not in Vic)	Grey Ironbark				✓		
Eucalyptus parramattensis (SYB)	Parramatta Red Gum, Drooping Red Gum				✓		
Eucalyptus pilularis (E)	Blackbutt				✓		
Eucalyptus piperita (SYB)	Sydney Peppermint				✓		
Eucalyptus racemosa (S)	Scribbly Gum						✓
Eucalyptus robusta (E)	Swamp Mahogany				✓		
Eucalyptus scias (E, NSW only)	Large-fruited Red Mahogany				✓		
Eucalyptus umbra (S)	Broad-leaved Whie Mahogany				✓		
Other canopy trees							
Allocasuarina littoralis (E)	Black Sheoak				✓	✓	✓
Allocasuarina torulosa (S)	Forest Oak			✓	✓		
Alphitonia excelsa (S)	Red Ash			✓	✓		✓
Brachychiton populneus (E)	Kurrajong			✓			
Callitris columellaris (S)	a native Cypress Pine			✓			
Casuarina cunninghamiana (E, not Vic)	River Oak, River Sheoak		✓		✓		✓
Casuarina glauca (E, not Vic)	Swamp Oak, Swamp Sheoak		✓	✓	✓		

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
Drypetes australasica (S)	Yellow Tulipwood			✓			
Elaeocarpus reticulatus (E)	Blueberry ash, Blue Oliveberry			✓	✓	✓	
Ficus macrophylla (S)	Moreton Bay Fig			✓			
Ficus obliqua (E, not Vic)	Small-leaved Fig			✓			
Ficus superba var. *henneana (E, not Vic)*	Deciduous Fig			✓			
Glochidion ferdinandi (E, not Vic)	Cheese Tree			✓	✓		✓
Lophostemon confertus (S)	Brush Box						✓
Lophostemon suaveolens (S)	Swamp Box			✓	✓		✓
Mallotus philippensis (S)	Red Kamala			✓			
Syncarpia glomulifera (E, not Vic)	Turpentine				✓		
Sub-canopy and mid-layer (highly variable)							
Acacia concurrens (S)	Curracabah			✓	✓		✓
Acacia disparrima (S)				✓			✓
Acacia filicifolia (S)	Fern-leaved Wattle				✓		
Acacia fimbriata (E)	Fringed Wattle, Brisbane Wattle						✓
Acacia floribunda (E)	White Sally Wattle, Gassomer Wattle		✓		✓		
Acacia irrorata (E)	Green Wattle				✓		
Acacia leiocalyx (S)					✓		
Acacia longifolia (E)	Sydney Golden Wattle				✓		
Acacia maidenii							
Acacia mearnsii	Black Wattle						
Acacia melanoxylon (E)	Blackwood, Black Wattle, Mudgerabah				✓	✓	
Acacia parramattensis (T)	Parramatta wattle, Sydney Green Wattle				✓		
Androcalva fraseri	Brush Kurrajong			✓	✓		
Backhousia myrtifolia (E, not in Vic)	Grey Myrtle, Ironwood		✓		✓		
Banksia integrifolia	Coast Banksia				✓		✓
Billardiera scandens (E)	Appleberry, Snotberry	Vic (r)			✓	✓	
Breynia oblongifolia (E, not Vic)	Breynia, Coffee Bush		✓	✓	✓		✓
Bursaria spinosa (E)	Sweet Bursaria Blackthorn (Kurwan - D'harawal)		✓		✓	✓	
Callistemon salignus	White Bottlebrush			✓	✓		✓
Callistemon viminalis (syn. Melaleuca viminalis)	Weeping Bottlebrush			✓			✓
Cassinia trinerva	3-veined Cassinia				✓		
Commersonia bartramia	Brown Kurrajong			✓			
*Coprosma quadrifida** (T)*	Prickly Currant-bush				✓	✓	
Cordyline congesta	Tooth-leaved Palm Lily			✓			
Cupaniopsis anacardioides	Tuckaroo			✓			
Cupaniopsis parvifolia	Small-leaved Tuckaroo			✓			
Cyathea australis	Rough Tree-fern				✓	✓	
Dodonaea triquetra	Large-leaf Hop-bush				✓		✓

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
Goodenia ovata (E)	Hop Goodenia				✓	✓	
Hibiscus diversifolius	Swamp Hibiscus			✓			
Hibiscus tiliaceus	Cottonwood Hibiscus			✓			
Hovea acutifolia	a native pea			✓			✓
Leptospermum polygalifolium	Tantoon				✓		✓
Livistona australis (E)	Cabbage Palm	Vic L (v)	✓		✓		
*Melaleuca alternifolia** (S)*	a paperbark			✓	✓		
*Melaleuca decora**(S)*	White Feather Honey Myrtle		✓	✓	✓		
Melaleuca ericifolia	Swamp Paperbark				✓	✓	
*Melaleuca linariifolia**(E)*	Flax-leaved Paperbark		✓		✓		✓
Melaleuca nodosa	A paperbark			✓	✓		
*Melaleuca quinquenervia**(S)*	Broad-leaved Paperbark			✓	✓		✓
Melaleuca sieberi					✓		✓
*Melaleuca styphelioides** (E)*	Prickly-leaved Paperbark		✓	✓	✓		
Melia azedarach	White cedar, Chinaberry Tree		✓		✓		
*Melicytus dentatus** (E)*	Tree Violet		✓		✓		
*Myrsine howittiana** (E)*	Brush Muttonwood				✓		
*Notelaea longifolia** (E)*	Native Olive			✓	✓		
Notelaea venosa (E)	Mock Olive				✓	✓	
Ozothamnus diosmifolius	Ball Everlasting, Rice Flower		✓		✓		
Persoonia linearis (T)	Narrow-leaved Geebung				✓		
Persoonia stradbrokensis	a geebung			✓	✓		
Phyllanthus gunnii	Scrubby Spurge		✓		✓		
Pimelea linifolia	Rice Flower			✓			
Pittosporum revolutum (E)	Hairy Pittosporum	Vic (r)		✓	✓		
Pittosporum undulatum (E)	Sweet Pittosporum					✓	
Plectranthus parviflorus (E)	Cockspur Flower		✓		✓		
*Pomaderris aspera** (T)*	Hazel Pomaderris				✓	✓	
Pomax umbellata	Pomax				✓		
Prostanthera incisa (E)	Cut-leaved Mint-Bush	Vic (r)			✓		
Prostanthera lasianthos(T)	Victorian Christmas-bush				✓	✓	
Pultenaea retusa	Notched Bush-pea		-ve		✓		
Pultenaea villosa	Hairy Bush-pea				✓		
Rubus rosifolius	Rose-leaf Bramble, Native Raspberry				✓		
*Sannantha pluriflora** (T)*	Tall Baeckea				✓		
*Syzygium smithii** (E)*	Lilly Pilly		✓	✓			
Trema tomentosa var *aspera*	Native Peach		✓				
Tristaniopsis laurina	Water Gum		✓		✓	✓	
Wikstroemia indica	Bootlace Bush			✓			

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
Climbing and Scrambling							
Cayratia clematidea	Native Grape		✓		✓		
Cissus hypoglauca (E)	Water Vine			✓	✓		
Clematis aristata	Old Man's Beard		✓		✓	✓	
Clematis glycinoides (E)	Headache Vine		✓		✓		
Desmodium gunnii			✓				
Desmodium rhytidophyllum				✓			✓
Desmodium varians (E)	Slender tick-trefoil	Vic (k)	✓	✓	✓		
Eustrephus latifolius (E)	Wombat Berry		✓	✓	✓	✓	
Geitonoplesium cymosum (E)	Scrambling Lily		✓	✓	✓		
Glycine clandestine (E)	Twining Glycine		✓	✓	✓		✓
Glycine microphylla	Small-leaf Glycine		✓		✓		
Glycine tabacina	a scrambler		✓		✓		✓
Gynochthodes jasminoides (E)	Morinda Vine			✓	✓		
Hardenbergia violacea	False Sarsparilla		✓	✓	✓		
Hibbertia dentate							
Hibbertia scandens (E, not Vic)	Climbing Guinea Flower			✓	✓		✓
Kennedia rubicunda	Red Kennedy Pea			✓	✓		
Maclura cochinchinensis	Cockspur Thorn			✓			
Pandorea pandorana	Wonga Wonga Vine		✓				
Parsonsia straminea (E)	Common Silkpod			✓	✓		✓
Rubus parvifolius (E)	Native Raspberry, Small-leaved Bramble		✓		✓		
Smilax australis (E)	Native Sarsparilla, Lawyer vine, Wait-a-while			✓	✓	✓	
Smilax glyciphylla	Sweet Sarsparilla			✓			
Stephania japonica var. *discolor (E, not in Vic)*	Snake Vine		✓	✓	✓		
Tylophora barbata	Bearded Tylophora				✓		
Veronica plebeia (E)	Trailing /Creeping Speedwell		✓		✓	✓	
Understorey (Grasses)							
Alloteropsis semialata	Cockatoo Grass						✓
Aristida vagans	Three-awn Speargrass			✓			
Austrostipa ramosissima	Stout Bamboo-grass		✓		✓		
Capillipedium spicigerum	Scented-top Grass						✓
Chrysopogon filipes					✓		
Cymbopogon refractus (E)	Barbed-wire Grass		✓	✓	✓		✓
Dichelachne micrantha (E)	Shorthair Plume Grass		✓	✓	✓		
Digitaria parviflora (E, not in Vic)	Small-flowered Finger Grass		✓	✓	✓		✓
Echinopogon caespitosus var. *caespitosus (E)*	Tufted Hedgehog-grass	Vic (e)	✓	✓			
Echinopogon ovatus (E)	Forest Hedgehog-grass		✓		✓		
Entolasia marginata (E)	Bordered Panic grass		✓	✓	✓	✓	
Entolasia stricta (E)	Wiry Panic	Vic (k)	✓	✓	✓		✓

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
Entolasia whiteana							✓
Eragrostis leptostachya (E)	Paddock Love-grass	Vic (k)	✓	✓	✓		
Eremochloa bimaculata	Poverty Grass						✓
Hemarthria uncinata	Mat Grass				✓		
Heteropogon contortus	Black Spear Grass						✓
Hierochloe rariflora	Cane Holy-grass				✓	✓	
Imperata cylindrica (E)	Blady Grass		✓	✓	✓		✓
Ischaemum australe					✓		
Microlaena stipoides (E)	Weeping Grass		✓	✓	✓	✓	✓
Oplismenus aemulus (E)	Creeping Shade grass		✓	✓	✓		
Oplismenus hirtellus				✓	✓		
Ottochloa gracillima					✓		✓
Panicum effusum	Hairy panic						✓
Panicum simile (E)	Two-colour panic	Vic (v)		✓	✓		
Paspalidium distans (E, not in Vic)	a paspaladium	Vic (e)	✓		✓		✓
Paspalum orbiculare	Ditch Millet				✓		
Paspalum scrobiculatum							✓
Poa ensiformis (T)	Purple-sheathed Tussock-grass				✓		
Sacciolepis indica	Indian cupscale grass				✓		
Tetrarrhena juncea	Forest Wire-grass				✓	✓	
Themeda triandra (E) (syn. *T. australis*)	Kangaroo Grass		✓	✓	✓	✓	✓
Understorey (Forbs)							
Acmella grandiflora var. *brachyglossa*					✓		
Brunoniella australis	Blue Trumpet			✓	✓		✓
Caladenia catenata	White Caladenia				✓		
Caladenia tessellata (T)	Thick-lip Spider Orchid	EPBC V NSW E Vic (v)					
*Centella asiatica ** (E)*	Pennywort		✓	✓	✓		
Commelina cyanea (E, not in Vic)	Scurvey-weed, Wandering Jew	Vic (e)	✓	✓	✓		
Cyanthillium cinereum (E) (syn. Vernonia cinerea)		Vic (k)	✓	✓	✓		✓
Cymbidium suave	Snake Orchid			✓	✓		
Dianella caerulea (E)	Blue Flax Lily, Paroo Lily			✓-	✓	✓	✓
Dianella longifolia	a flax lily			✓	✓		
Dianella tasmanica	Tasman Flax-lily				✓	✓	
Dichondra repens (E)	Kidney Weed, Yilibili (D'harawal)		✓	✓	✓	✓	✓
Eclipta platyglossa					✓		
Einadia hastata (E)	Berry Saltbush, Saloop		✓		✓		
Einadia trigonos	Fishweed		✓		✓		
Euchiton japonicus							
Euchiton sphaericus	Cudweed		✓				

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
Galium leiocarpum	Maori bedstraw		✓				
Geranium homeanum					✓		
Geranium solanderi	Native Geranium		✓		✓		
Gonocarpus tetragynus					✓	✓	
Gonocarpus teucrioides	Germander Raspwort				✓	✓	
Goodenia paniculata	Branched Goodenia				✓		
Hybanthus stellarioides					✓		
Hydrocotyle peduncularis	Native Pennywort		✓				
Hydrocotyle sibthorpioides					✓		
Hydrocotyle tripartita					✓	✓	
Isotoma armstrongii					✓		
Lagenophora stipitata	Common Bottle-daisy			✓	✓	✓	
Laxmannia gracilis (E)		Vic (r)		✓			
Lomandra filiformis (E)	Wattle Mat-rush		✓	✓	✓	✓	
Lomandra longifolia (E)	Spiny-headed Mat-rush		✓	✓	✓	✓	✓
Lomandra multiflora subsp. *multiflora (E)*	Many-flowered Mat-rush		✓	✓	✓		
Murdannia graminea	Grass Lily				✓		✓
Opercularia aspera	Coarse Stinkweed				✓	✓	
Opercularia diphylla	Stinkweed		✓				
Oxalis chnoodes					✓		
Oxalis perennans	Native Sorrel		✓		✓		
Persicaria spp.	Slender Knotweed		✓		✓		
Philydrum lanuginosum (E)	Woolly Waterlily, Frog's Mouth	Vic (v)			✓		
Phyllanthus hirtellus					✓	✓	
Phyllanthus virgatus				✓	✓		
Poranthera microphylla	Small Poranthera		✓		✓	✓	
*Lobellia purpurascens** (E) (syn. Pratia purpurascens)*	Whiteroot	Vic (r)	✓	✓	✓		
Rannunculus amphitirichus							
Ranunculus inundatus	River Buttercup				✓		
Rannunculus plebeius							
Scutellaria mollis (E)	Soft Skullcap	Vic (r)			✓		
Sigesbeckia orientalis	Indian Weed		✓	✓			
Solanum prinophyllum	Forest Nightshade		✓		✓		
Solaunum pungetium							
Stellaria flaccida					✓		
Stylidium debile	Frail Triggerplant				✓		
Stylidium tenerum					✓		
Tricoryne elatior				✓		✓	
Viola banksii	Wild Voilet				✓		
*Viola hederacea ** (E)*	Ivy leaved Violet		✓	✓	✓		
Wahlenbergia gracilis	Australian Sprawling Bluebell		✓		✓		
Understorey (Ferns)							

Scientific name	Common name	Listing status as at March 2019[1]	NSW determination		Matched communities [2]		
			RFEF	SCFF	NSW	VIC	Qld
*Adiantum aethiopicum*** *(T)*	Maiden-hair Fern		✓		✓	✓	
Blechnum cartilagineum (T)	Gristle Fern				✓	✓	
Calochlaena dubia (T)	Common Ground-fern				✓	✓	
Cheilanthes sieberi subsp. *sieberi (E)*	Poison Rock Fern		✓	✓	✓		
Doodia aspera (T)	Prickly Rasp Fern		✓		✓		
Hymenophyllum cupressiforme	Common Filmy Fern					✓	
Hypolepis glandulifera	Downy Ground Fern				✓		
*Hypolepis muelleri*** *(T)*	Harsh Ground Fern		✓		✓		
Pellaea falcata	Sickle Fern						
Pteridium esculentum (E)	Bracken Fern		✓	-ve	✓	✓	✓
Understorey (Sedges/rushes)							
*Baumea articulata ** (E)*	Jointed Twigrush				✓		
*Baumea rubiginosa ** (E)*	Soft Twigrush				✓		
Carex appressa							
Carex gaudichaudiana	Fen Sedge				✓		
*Carex longebrachiata** *(T)*	Australian Sedge				✓		
*Chorizandra cymbaria **(E)*	Heron Bristle Sedge				✓		
Cyperus enervis				✓			
Cyperus haspan					✓		
Cyperus pilosus					✓		
Fimbristylis cinnamometorum					✓		
Fimbristylis dichotoma (E)	Common Fringe-sedge	Vic (v)			✓		✓
Gahnia aspera (E, not in Vic)	Rough Saw-sedge			✓	✓		
*Gahnia clarkei** *(E)*	Tall Saw-sedge			✓	✓	✓	
*Gahnia melanocarpa** *(E)*	Black-fruit Saw-sedge				✓	✓	
Juncus spp.					✓		
Lepidosperma laterale (E)	Variable Saw-sedge				✓	✓	

Table 7: Characteristic, frequently occurring or threatened fauna of Coastal floodplain eucalypt forest of eastern Australia

Scientific name	Common name	Listing status as at April 2019			
		EPBC Act.	NSW Act	Qld Act.	Vic Act (Advisory)
Mammals					
Acrobates pygmaeus	Feathertail Glider				
Aepyprymnus rufescens	Rufous Bettong		V		T (RE)
Antechinus agilis	Agile Antechinus				
Antechinus flavipes	Yellow-footed Antechinus				
Antechinus stuartii	Brown Antechinus				
Cercartetus nanus	Eastern Pygmy Possum		V		NT
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	V	
Chalinolobus nigrogriseus	Hoary Wattled Bat		V		
Dasyurus maculatus	Spot-tailed Quoll	E	V	V	T (E)
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V		
Hydromys chrysogaster	Water Rat				
Isoodon macrourus	Northern Brown Bandicoot				
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E		T (NT)
Macropus giganteus	Eastern Grey Kangaroo				
Micronomus norfolkensis	Eastern Free-tail Bat		V		
Miniopterus australis	Little Bentwing Bat		V		
Miniopterus orianae oceanensis	Eastern Bentwing Bat		V		(V)
Mormopterus lumsdenae	Northern Free-tailed Bat		V		
Myotis macropus	Large-footed Myotis, Southern Myotis		V		(NT)
Notamacropus dorsalis	Black-striped Wallaby		E		
Notamacropus parma	Parma Wallaby		V		
Notamacropus rufogriseus	Red-necked Wallaby				
Nyctophilus bifax	Eastern Long-eared Bat		V		
Ornithorhynchus anatinus	Platypus			NT	
Perameles nasuta	Long-nosed Bandicoot				
Petauroides volans	Greater Glider	V	V	V	T (V)
Petaurus australis	Yellow bellied Glider		V		
Petaurus breviceps	Sugar Glider				
Petaurus norfolcensis	Squirrel Glider		V		T (E)
Phascogale tapoatafa	Brush-tailed Phascogale		V		T (V)
Phascolarctos cinereus	Koala	V	V	V	
Phoniscus papuensis	Golden-tipped Bat		V		
Planigale maculata	Common Planigale		V		
Potorous tridactylus	Long-nosed Potoroo	V	V	V	T (NT)
Pseudocheirus peregrinus	Common Ringtail Possum				

Scientific name	Common name	Listing status as at April 2019			
		EPBC Act.	NSW Act	Qld Act.	Vic Act (Advisory)
Pseudomys novaehollandiae	New Holland Mouse/Pookila	V	V		T (V)
Pteropus alecto	Black Flying Fox				
Pteropus poliocephalus	Grey-headed Flying Fox	V	V		T (V)
Pteropus scapulatus	Little Red Flying Fox				
Rattus lutreolus	Swamp Rat				
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat		V		T
Scoteanax rueppellii	Greater Broad-nosed Bat		V		
Sminthopsis leucopus	White-footed Dunnart		V	V	T (NT)
Syconycteris australis	Eastern blossom-bat		V		
Tachyglossus aculeatus	Short-beaked Echidna			NT	
Trichosurus caninus	Mountain Brushtail Possum, Short-eared Possum, Bobuck				
Trichosurus cunninghami	Mountain Brushtail Possum, Southern Bobuck				
Trichosurus vulpecula	Common Brushtail Possum				
Vombatus ursinus	Common Wombat				
Xeromys myoides	Water Mouse, False Water Rat, Yirrkoo	V		V	
Birds					
Accipiter novaehollandiae	Grey Goshawk				T (V)
Amaurornis moluccana	Pale-Vented Bush-Hen		V		
Anthochaera phrygia	Regent Honeyeater	CE	CE	E	T (CE)
Ardea ibis	Cattle Egret				
Ardea modesta	Eastern Great Egret				T(V)
Botaurus poiciloptilus	Australasian Bittern	E	E		T (V)
Callocephalon fimbriatum	Gang Gang Cockatoo		V		
Calyptorhynchus funereus	Yellow-Tailed Black-Cockatoo				
Calyptorhynchus lathami lathami	Glossy Black-Cockatoo		V		T (V)
Carterornis leucotis	White-Eared Monarch		V		
Ceyx azureus	Azure Kingfisher				NT
Climacteris picumnus victoriae	Brown Treecreeper		V		NT
Coracina lineata	Barred Cuckoo-Shrike		V		
Coturnix ypsilophora	Brown Quail				
Daphoenositta chrysoptera	Varied Sitella		V		
Dasyornis brachypterus	Eastern Bristlebird	E	E	E	T
Dicaeum hirundinaceum	Mistletoebird				
Dromaius novaehollandiae	Emu				(NT)

Scientific name	Common name	Listing status as at April 2019			
		EPBC Act.	NSW Act	Qld Act.	Vic Act (Advisory)
Egretta garzetta	Little Egret				T
Egretta novaehollandiae	White-Faced Heron				
Ephippiorhynchus asiaticus	Black-Necked Stork		E		
Erythrotriorchis radiatus	Red Goshawk	V	CE	E	
Gymnorhina tibicen	Australian Magpie				
Haliaeetus leucogaster	White-Bellied Sea-Eagle		V		T (V)
Haliastur indus	Brahminy Kite				
Haliastur sphenurus	Whistling Kite				
Hieraaetus morphnoides	Little Eagle		V		
Ixobrychus flavicollis	Black Bittern		V		
Lathamus discolor	Swift Parrot	CE	E	E	T (E)
Leucosarcia melanoleuca	Wonga Pigeon				
Lophoictinia isura	Square-Tailed Kite		V		T (V)
Malurus cyaneus	Superb Fairy Wren				
Malurus lamberti	Variegated Fairy Wren				
Malurus melanocephalus	Red-Backed Fairy Wren				
Manorina melanocephala	Noisy Miner				
Manorina melanophrys	Bell Miner				
Melithreptus gularis gularis	Black-Chinned Honeyeater		V		(NT)
Merops ornatus	Rainbow Bee-Eater				
Neochmia temporalis	Red Browed Firetail				
Neophema chrysogaster	Orange-Bellied Parrot	CE	CE		T (CE)
Neophema pulchella	Turquoise Parrot		V		T (NT)
Nettapus coromandelianus	Cotton Pygmy Goose		E		
Ninox connivens	Barking Owl		V		T
Ninox strenua	Powerful Owl		V	V	T (V)
Numenius madagascariensis	Eastern Curlew	CE, M		E	T (V)
Nycticorax caledonicus	Nankeen Night Heron				
Oxyura australis	Blue-Billed Duck		V		T (E)
Pachycephala rufiventris	Rufous Whistler				
Pandion cristatus	Eastern Osprey	M	V		
Pandion cristatus	Osprey		V		
Parvipsitta pusilla	Little Lorikeet		V		
Petroica boodang	Scarlet Robin		V		
Petroica phoenicea	Flame Robin		V		
Pezoporus wallicus	Eastern Ground Parrot		V	V	T (E)
Phalacrocorax spp.	Cormorants				
Pomatostomus temporalis temporalis	Grey-Crowned Babbler		V		(E)

Scientific name	Common name	Listing status as at April 2019			
		EPBC Act.	NSW Act	Qld Act.	Vic Act (Advisory)
Ptilinopus superbus	Superb-Fruit Dove		V		
Rhipidura albiscapa	Grey Fantail				
Rostratula australis	Australian Painted Snipe	E	E	V	T (CE)
Stagonopleura guttata	Diamond Firetail		E		T (NT)
Stictonetta naevosa	Freckled Duck		V		T (E)
Stipiturus malachurus	Southern Emu Wren			V	
Threskiornis spinicollis	Straw-Necked Ibis	M			
Todiramphus chloris	Collared Kingfisher		V		
Todiramphus sanctus	Sacred Kingfisher				
Trichoglossus chlorolepidotus	Scaley Breasted Lorikeets				
Trichoglossus haematodus	Rainbow Lorikeet				
Tringa nebularia	Common Greenshank	M			(V)
Tringa stagnatilis	Marsh Sandpiper	M			(V)
Turnix maculosa	Red-Backed Button-Quail		V		
Tyto longimembris	Eastern Grass Owl		V		
Tyto novaehollandiae	Masked Owl		V		T
Tyto tenebricosa	Sooty Owl		V		T
Xenus cinereus	Terek Sandpiper	M	V	LC	T (E)
Reptiles					
Amphibolurus muricatus	Jacky Lizard				
Bellatorias major	Land Mullet				
Boiga irregularis	Brown Tree Snake				
Chelodina longicollis	Eastern Long-Necked Turtle				
Cyclodomorphus gerrardii	Pink-tongued Lizard				
Cyclodomorphus michaeli	Mainland She-Oak Skink				T (NT)
Egernia mcpheei	Eastern Crevice Skink				
Elseya albagula	White-Throated Snapping Turtle	CE		E	
Elusor macrurus	Mary River Turtle	E		E	
Emydura macquarii	Murray River Turtle				(V)
Hemiaspis signata	Black-Bellied Swamp Snake				
Hoplocephalus bitorquatus	Pale-Headed Snake		V		
Intellagama lesueurii	Eastern Water Dragon				
Pseudechis porphyriacus	Red-Bellied Black Snake				
Pseudonaja textilis	Eastern Brown Snake				
Tiliqua nigrolutea	Blotched Blue Tongue Lizard				
Tropidechis carinatus	Rough-Scaled Snake				

Scientific name	Common name	Listing status as at April 2019			
		EPBC Act.	NSW Act	Qld Act.	Vic Act (Advisory)
Varanus rosenbergi	Rosenberg'S Goanna		V		T (E)
Wollumbinia georgesi	Bellinger River Snapping Turtle	CE	CE		
Amphibians					
Crinia tinnula	Tinkling Frog, Wallum Froglet		V	V	
Heleioporus australiacus	Giant Burrowing Frog	V	V		T (CE)
Lechriodus fletcheri	Fletcher's Frog				
Limnodynastes dumerilii	Eastern Banjo Frog (Pobblebonk)				
Limnodynastes peronii	Brown-striped Frog				
Limnodynastes tasmaniensis	Spotted Grass-frog				
Litoria aurea	Green and Golden Bell Frog	V	E		(V)
Litoria brevipalmata	Green-thighed Frog		V		
Litoria caerulea	Green Tree Frog				
Litoria chloris	Red-eyed Tree Frog				
Litoria citropa	Blue Mountains Tree Frog				
Litoria dentata	Bleating Tree Frog				(V)
Litoria ewingii	Brown Tree Frog				
Litoria fallax	Dwarf Green Tree Frog				
Litoria freycineti	Freycinett's Tree Frog, Wallum Rocket Frog			V	
Litoria jervisiensis	Jervis Bay Tree Frog				
Litoria latopalmata	Broad-palmed Frog				
Litoria revelata	Revealed Tree Frog				
Mixophyes balbus	Stuttering frog, Southern Barred Frog	V	E		T (CE)
Mixophyes iteratus	Giant Barred Frog	E	E	E	
Platyplectrum ornatum	Ornate Burrowing Frog				
Invertebrates					
Argynnis hyperbius inconstans	Laced Fritillary	CE	E	E	
Meridolum corneovirens	Cumberland Plain Land Snail		E		
Ocybadistes knightorum	Black Grass-Dart/Knight'S Dart		E		
Petalura gigantea	Giant Dragonfly		E		
Petalura litorea	Coastal Petaltail		E		
Thersites mitchellae	Mitchell'S Rainforest Snail	CE	E		
Trapezites symmomus	Splended Ochre			NT	
Australothele nambucca	Large Curtain Web Spider				

Scientific name	Common name	Listing status as at April 2019			
		EPBC Act.	NSW Act	Qld Act.	Vic Act (Advisory)
Delias aganippe	Spotted Jezebel				
Hypochrysops delicia	Moonlight Jewel				
Megadolomedes australianus	Giant Water Spider				
Nephila spp.	Golden Orb Weaving Spider				
Psychonotis caelius taygetus	Small Green-Banded Blue				
Spodoptera picta	Lily Caterpillar				
Tisiphone abeona	Varied Sword Grass Brown				
Trigona carbonaria	Stingless Native Bees				

Sources: Marchant & Higgins (1990, 1993); Higgins & Davies (1996); Higgins (1999); Higgins, Peter & Steele (2001); Higgins & Peter (2002); Van Dyck & Strahan (2008); Watson (2011); Cogger (2014); DoEE (2019); NSW OEH (2019).

Table 8: Weed species that may be a threat in the Coastal floodplain eucalypt forest of eastern Australia.

Weed Species	Common Name	State[1]	Notes[2]
Canopy trees			
Cinnamomum camphora	Camphor Laurel	Qld, NSW S	
Gleditsia triacanthos	Honey Locust	NSW T	
Pinus elliottii	Slash Pine	Qld	
Salix babylonica	Weeping Willow	Qld	
Ulmus parvifolia	Chinese Elm	Qld	
Sub-canopy and mid-layer			
Solanum pseudocapsicum	Madeira Winter-cherry	Vic	
Baccharis halimifolia	Groundsel Bush	Qld, NSW S	
Crataegus monogyna	Hawthorn	Vic	
Fraxinus spp.	Ash	Vic	
Leucaena leucocephala	Lead Tree, Coffee Bush	Qld	
Ligustrum lucidum	Broad-leaved Privet	Qld, NSW	
Ligustrum sinense	Small-leaved Privet	NSW	
Olea europaea subsp. cuspidata	African Olive	NSW	
Prunus cerasifera	Cherry Plum	Vic	
Psidium guajava	Guava	Qld	
Ricinus communis	Castor Oil	Qld	
Rubus fruticosus agg.	Blackberry	Vic, NSW	WONS
Sansevieria trifasciata	Mother in Law's Tongue	Qld	
Schinus terebinthifolius	Broad-leaved Pepper Tree	Qld	
Senna pendula var. glabrata	Easter Cassia	Qld, NSW	
Solanum mauritianum	Wild Tobacco	Qld, NSW S	

[1] NSW T: typically in the temperate zones in NSW, NSW S: typically in the subtropical zones in NSW.
[2] WoNS: Weeds of National Significance. (Invasive Plants and Animals Committee 2016).

Weed Species	Common Name	State[1]	Notes[2]
Thevetia peruviana	Yellow Oleander	Qld	
Opuntia spp.	Prickly Pears	NSW	WONS
Scrambler or Climber			
Anredera cordifolia	Madeira Vine	Qld, NSW	WONS
Araujia sericifera	Moth Plant	NSW	
Asparagus asparagoides	Bridal Creeper	NSW	WONS
Asparagus plumosus	Climbing Asparagus Fern	NSW S	WONS
Cardiospermum grandiflorum	Balloon Vine	Qld, NSW	
Dolichandra unguis-cati	Cats Claw Creeper	Qld, NSW	WONS
Galium aparine	Cleavers	Vic	
Ipomoea spp.	Morning Glories	NSW	
Lantana camara	Lantana	Qld, NSW	WONS
Lonicera japonica	Japanese Honeysuckle	NSW	
Passiflora subpeltata	White Passionfruit	Qld	
Tradescantia fluminensis	Wandering Jew	Vic, NSW	
Grass			
Agrostis capillaris	Brown-top Bent	Vic	
Anthoxanthum odoratum	Sweet Vernal-grass	Vic	
Aristida spp.	Wiregrass	Qld	Native
Axonopus spp.	Carpet Grasses	NSW	
Briza maxima	Large Quaking-grass	Vic	
Bromus catharticus	Prairie Grass	Vic	
Ehrharta erecta	Panic Veldt-grass	Vic	
Eragrostis curvula	African Lovegrass	Qld	
Holcus lanatus	Yorkshire Fog	Vic	
Hymenachne amplexicaulis	Hymenachne, Marsh Grass	Qld	WONS
Lolium perenne	Perennial Rye-grass	Vic	
Megathyrsus maximus	Green Panic , Guinea Grass	Qld	
Urochloa mutica	Para Grass	Qld	
Paspalum dilatatum	Paspalum	Vic, NSW	
Paspalum distichum	Water Couch	Vic	native
Cenchrus clandestinum	Kikuyu	NSW	
Setaria parviflora	Slender Pigeon Grass	NSW	
Setaria sphacelata	Pigeon Grass	Qld	
Sporobolus creber	Native Rats Tail Grass	Qld	native
Sporobolus natalensis	Giant Rats Tail Grass	Qld	
Sporobolus pyramidalis	Giant Rats Tail Grass	Qld	
Forb			
Ageratum houstonianum	Blue Billygoat Weed	Qld	
Ambrosia artemisiifolia	Annual Ragweed	Qld	
Aster subulatus	Aster-weed	Vic	
Bidens pilosa	Cobbler's Peg	NSW	
Centaurium erythraea	Common Centaury	Vic	
Centaurium tenuiflorum	Slender Centaury	Vic	
Cerastium glomeratum	Common Mouse-ear Chickweed	Vic	
Cirsium vulgare	Spear Thistle	Vic, NSW T	

Weed Species	Common Name	State[1]	Notes[2]
Conyza spp.	Fleabanes	NSW	
Heliotropium amplexicaule	Blue Heliotrope	Qld	
Helminthotheca echioides	Ox-tongue	Vic	
Hypochaeris radicata	Cat's Ear	Vic, NSW	
Leontodon taraxacoides	Hairy Hawkbit	Vic	
Modiola caroliniana	Red-flower Mallow	Vic	
Plantago lanceolata	Ribwort, Plantain	Vic, NSW T	
Polycarpon tetraphyllum	Four-leaved Allseed	Vic	
Prunella vulgaris	Self-heal	Vic	
Ranunculus repens	Creeping Buttercup	Vic	
Rorippa palustris	Marsh Yellow-cress	Vic	
Rumex conglomeratus	Clustered Dock	Vic	
Rumex crispus	Curled Dock	Vic	
Senecio madagascariensis	Fireweed	NSW	WONS
Sida rhombifolia	Paddy's Lucerne	NSW	
Solanum nigrum	Black-berry Nightshade	NSW S	
Sonchus oleraceus	Common Sow-thistle	Vic, NSW T	
Taraxacum officinale spp. agg.	Garden Dandelion	Vic	
Trifolium repens	White Clover	Vic	
Verbena bonariensis	Purple-top Verbena	Vic, NSW	
Sedge			
Cyperus eragrostis	Drain Flat-sedge, Umbrella Sedge	Vic	
Aquatic			
Salvinia molesta	Salvinia	Qld	WONS

Sources: Tozer 2003; Keith & Scott 2005; Healthy Land and Water 2017; Healthy Land and Water 2016; SEQ Catchments 2016a; SEQ Catchments 2016b.

APPENDIX C – DESCRIPTION OF THREATS

- Clearing and fragmentation
- Invasive plant species (weeds)
- Invasive fauna
- Disease, pathogens and dieback
- Impacts resulting from agricultural activities, including grazing and nutrient enrichment
- Changes to hydrology, including from flood mitigation and drainage works, roads and bridges, housing and industrial development and forestry
- Inappropriate fire regimes
- Impacts resulting from urbanisation and recreational activity; and
- Climate change, including sea level rise, heat stress and changes to flow regimes.

Clearing and fragmentation

Coastal floodplains were severely cleared and modified primarily for agricultural development soon after European occupation. Large areas of forested wetlands are now occupied by exotic pastures grazed by cattle, market gardens, sorghum, poplars, turf, cane fields and other cropping enterprises. Overall at least 70 per cent of native vegetation on the coastal floodplains in New South Wales has been destroyed since European settlement (Keith 2004; Keith & Scott 2005; Good *et al*. 2017). As the floodplain eucalypt forest occurs on the most productive floodplain landscapes of the forested wetlands, it is likely that an even greater portion of this this ecological community has been cleared. The remaining native vegetation is often degraded and has a patchy distribution across its range.

Clearing has tended to be greater in the northern subtropical areas than in the south. In the Tweed lowlands, Pressey & Griffith (1992) estimated that less than three per cent of the original floodplain forest remained in 1985 while in Queensland less than nine per cent of the Queensland Blue Gum (*Eucalyptus tereticornis*) alluvial forest remain (SEQ Catchments 2016). In the Lower Hunter and Central Coast region less than 25 per cent to 40 per cent of coastal floodplain forest and wetlands remained during 1992 (NPWS 2000). Only seven per cent was estimated to remain on the Cumberland Plain in 2013 (NSW OEH 2013a) and less than 20 per cent for the Sydney-South Coast region in mid 1990s (Tindall *et al*. 2004). Further south less than 30 per cent is estimated to remain in the Eden region (Keith & Bedward 1999) while in Victoria around 36 per cent of the ecological community is estimated to remain.

In areas now protected (for example, state forests and national parks) there is evidence of early clearing of pockets of floodplain vegetation prior to areas being protected, leaving native forest and woodlands on the slopes with mostly cleared river flats. It is estimated from indicative mapping that less than 15 per cent of the ecological community is within the national reserve system as at May 2019.

Outside of protected areas, land clearing continues to threaten the ecological community as rural enterprises and hobby farms expand into the upper reaches of floodplains and through the expansion of major cities and rural centres with the construction of new housing estates, industrial development and recreational facilities. In recent years, clearing rates have been

highest in southern Queensland and northern New South Wales (Bradshaw 2012 in Good *et al*. 2017), as well as on the Cumberland Plains in South West Sydney. Remnants are often only vegetation left in a cleared landscape and may be a small strip along rivers and creeks which has been less suitable for development, however with increasing pressure for land, and hydrological alteration, these areas are seeing increased development and may be at risk in the future. As the Coastal floodplain eucalypt forest often occur as small patches in a mosaic environment, connectivity with other patches of the ecological community within the mosaic, as well as to the adjacent rivers and streams, is important. Longitudinal patches along rivers and creeks provide connectivity between uplands and lowlands and between scattered remnants of the ecological community along the floodplain (Healthy Land and Water 2017). Few individual patches that remain are large enough on their own to provide sufficient species and genetic diversity to ensure their long term survival. The loss of individual small patches therefore also has an impact on surrounding patches and the ecological community overall as this connectivity is broken. The ongoing loss of remnants of the ecological community, plus the decreased size of remaining remnants, lead to greater vulnerability to threats due to fragmentation and the impacts of edge effects. Where this ecological community persists as a long, narrow patch along rivers and waterways, the edge effects can be even greater. Small or linear patches have a large edge to area ratio which is likely to allow the introduction of weeds and incursions by feral animals, and alter microclimates, making the ecological community more vulnerable to damage during droughts. The associated loss in physical and ecological connectivity is likely to limit regeneration if there are no nearby sources of seeds and may also affect animals that require connected links to disperse, or have a large home range.

Invasive plant species (weeds)

Invasion by non-native plants is a major threat to this ecological community (Keith & Scott 2005; Tozer *et al*. 2010). It is often the result of physical disturbance to the vegetation structure of the community; dumping of landfill/rubbish and garden refuse; construction of roads and other utilities, polluted runoff from urban and agricultural areas and grazing by domestic livestock and cropping. In Western Sydney, the ecological community in the Hawkesbury-Nepean has seen a recent invasion by Prickly Pear and Tiger Pear (Ridgeway P pers. comm. 2019). Floodplain communities are also susceptible to weeds following natural disturbance such as flooding. Weed seeds can be transported by water, wind and by birds.

Physical disturbance reduces the ability of native plant communities to compete with invading species, while also directly providing bare soil and resource to allow non-native species to establish. Once established weeds can change nutrient cycling, species composition, structure, habitat values and fire regimes in the ecological community (Good *et al*. 2017).

The ecological community is prone to invasion by a number of environmental weeds that have a capacity to alter the species composition of the ecosystem through time. The high risk species include *Baccharis halimifolia* (Groundsel Bush), *Pinus elliottii* (Slash Pine), *Lantana camara* (Lantana) and *Cinnamomum camphora* (Camphor Laurel). Many other weeds have the potential to invade patches that are close to urban settlement, especially if the ecosystem

has not been burnt for a long time, including *Ulmus parvifolia* (Chinese Elm), *Thevetia peruviana* (Yellow Oleander) and *Schinus terebinthifolius* (Broad-leaved Pepper Tree) (Healthy Land and Water 2017).

In rivers, streams and wetlands within the ecological community, native aquatic and semi-aquatic plants and algae can become a nuisance due to excessive growth that occurs when shade is removed and where there are increased levels of nutrients and sediments. The number of introduced species that have become established in waterways is higher in urban areas due to garden escapees and nutrient rich run-off. (Healthy Land and Water 2016).

The high levels of fertility and moisture make the ecological community highly suited to the growth of serious environmental weeds including shade tolerant species. Lantana is a well-known and ubiquitous weed species in the subtropical extent, but other weeds may include *Cinnamomum camphora* (Camphor Laurel), *Ligustrum lucidum* (Broad-leaved Privet), *Psidium guajava* (Guava), *Baccharis halimifolia* (Groundsel Bush), *Solanum mauritianum* (Wild Tobacco), *Senna pendula var. glabrata* (Easter Cassia), *Melinis minutiflora* (Molasses Grass), *Ageratina adenophora* (Crofton Weed), *Ageratum houstonianum* (Blue Billygoat Weed), *Passiflora subpeltata* (White Passionfruit) and introduced pasture grasses and legumes (SEQ Catchments 2016a).

A list of weeds species that are found in the ecological community are provided in Table 6 in appendix B.

Invasive fauna

Like other coastal ecological communities, the Coastal floodplain eucalypt forest is subject to a range of impacts from invasive animals. These include:

- Predation, habitat destruction through trampling and soil disturbance, competition and disease transmission by feral pigs;
- Predation and spread of invasive plant species by dogs, foxes, cats, and other feral species;
- Grazing and trampling pressures from rabbits, goats, deer and other feral herbivores, which can leave the ecological community open to erosion and weed invasion;
- Competitive or lethal impacts to faunal elements from invasive noisy miners, honeybees, cane toads and diseases.

Feral pigs (*Sus scrofula*) are a serious environmental and agricultural pest across Australia and are noted as a particular threat to the Coastal floodplain eucalypt forest. They are found in all states and territories, particularly around wetlands and river systems. They prey on native animals and plants, dig up large expanses of soil and vegetation in search of food, cause streambank erosion and foul fresh water. Feral pigs will eat many things including small mammals, birds, reptiles, frogs, crayfish, eggs, earthworms and other invertebrates, and all parts of plants including the fruit, seeds, roots, tubers, bulbs and foliage. A particular problem in Coastal floodplain eucalypt forest is predation on turtle eggs. Feral pigs can host animal diseases that can be transmitted to other species. In dirt on their feet and fur, they can also spread plant pathogens such as *Phytophthora cinnamomi*, which causes plant dieback (DoEE 2017)

Predatory mammals such as foxes and feral cats present a major threat to a number of fauna species within the ecological community, such as the nationally listed threatened Spot-tailed Quoll and Long-nosed Potoroo; as well as to the the survival of over 140 native species in Australia through predation, competition and disease transmission. They have caused the extinction of some ground-dwelling birds and small to medium-sized mammals (DEWHA 2008a; East Gippsland CMA 2013). Wild dogs are also known to predate upon a range of native fauna including other threatened species such as Koalas (NSW Scientific Committee 2009).

Feral herbivores, such as rabbits, goats and deer, have direct impacts on both flora and fauna that form the ecological community. By grazing on native vegetation, they remove plants, prevent regeneration and compete with reptiles and other grazing species for food and shelter. They can overgraze areas, which contributes to slope instability and soil erosion (DoEE 2016a), and invasive weed seeds can be carried in their dung. Faecal matter also contributed to high nutrient load in waterbodies (DEWHA 2008b). Rabbits have secondary effects, such as supporting populations of introduced cats and foxes, and exposing burrowing species to increased predation.

Aggressive exclusion of birds from the ecological community by over-abundant *Manorina melanocephala* (Noisy Miners). The noisy miner is a native honeyeater species that defends habitat aggressively, excluding smaller birds from favoured habitat. Noisy miners prefer open structure at habitat edges, and thus have been favoured by extensive fragmentation of woodland habitat into small patches, with high edge:interior ratio. In such fragmented habitats, the diversity and abundance of smaller bird species is substantially reduced (TSSC 2014). *Manorina melanophyrs* (Bell Miners) are another native honeyeater that can become over-abundant and threaten the ecological community, as described below in relation to dieback.

Cane Toads (*Bufo marinus*) are a threat to fauna in the ecological community because they: poison many native animals whose diet includes frogs, tadpoles and frogs' eggs; prey on native fauna, compete for food with vertebrate insectivores such as small skinks, and may carry diseases that are can be transmitted to native frogs and fishes. They are abundant in south east Queensland and Cane Toads were also found as far south as Yamba and Port Macquarie in 2003, with records in the Atlas of Living Australia (2019) suggesting they have been found as far south as Sydney.

Disease, pathogens and dieback

A number of diseases and pathogens can affect the eucalypt canopy of the ecological community. Dieback caused by *Phytophthora cinnamomi* is a potential threat to the ecological community and is listed as a key threatening process. This plant pathogen can spread easily, causing disease, death and potential extinction in susceptible plants, and loss of habitat for animals. The disease, Phytophthora dieback, is often difficult to detect and can cause permanent damage to ecosystems and landscapes before it is identified. *Phytophthora cinnamomi* can remain dormant for long periods during dry weather and is impossible in most situations to eradicate from infested areas, so it is critical to prevent further spread. Any activity that moves soil, water or plant material can spread Phytophthora – this includes

recreational activities such as bushwalking, off-road vehicle use and gardening, as well as other activities such as road building, land management, timber harvesting and mining. *Phytophthora cinnamomi* was first associated with plant deaths in native vegetation in NSW in the late 1940s (Fraser 1956). The pathogen appears to be widespread in coastal forests (Arentz 1974; Blowes 1980; Gerrettson-Cornell 1986; McDougall & Summerell 2003).

Bell miner associated dieback is another process that can result in forest dieback. This type of dieback is strongly associated with sap-feeding insects called psyllids and psyllids are strongly associated with the native bell miner or bellbird. Bell miners are a natural part of eucalypt forests, and they normally have a minor (and positive) impact on forests. However, bell miner populations have increased in size, and the birds have become more widely distributed. Bell miners have been implicated in the spread of dieback, in addition to other factors such as: tree stress; psyllid infestation; myrtle rust, dense forest understories; weed invasion; drought; logging; road construction; pasture improvement; loss of biodiversity (both plants and animals); soil nutrient changes; changing fire patterns and changing grazing regimes. Bell miner associated dieback is spreading though forests on public and private lands from South-East Queensland to Victoria (Silver & Carnegie 2017).

Chytridiomycosis is an infectious disease that affects amphibians worldwide. It is caused by the chytrid fungus (*Batrachochytrium dendrobatidis*), a fungus capable of causing sporadic deaths in some amphibian populations and 100 per cent mortality in others. Chytridiomycosis has been found in all Australian states and in the Australian Capital Territory, but not in the Northern Territory. Currently, it appears to be mainly confined to the relatively cool and wet areas of Australia, such as along the Great Dividing Range and adjacent coastal areas in the eastern mainland states of Queensland, New South Wales, Victoria, eastern and central Tasmania, southern South Australia, and south-western Western Australia. The Coastal floodplain eucalypt forest ecological community includes a wide range of amphibians that are at high risk from chytrid fungus. The disease has been implicated in the mass die-offs and species extinctions of frogs since the 1990s, but its origin and true impact on frog populations remains uncertain and continues to be investigated.

Psittacine beak and feather disease is also known as psittacine circovirus or Psittacine Circoviral Disease. It is the most common and highly infectious viral disease among parrots. The disease appears to have originated in Australia and its distribution is Australia-wide, including Tasmania. Psittacine beak and feather disease can cause very high death rates in nestlings both in captivity and the wild. It can cause long-term immunological suppression, as well as cause feather and beak abnormalities. It can be spread by food sharing through the bird’s crop, fresh or dried excrement and feather and skin particles. The virus is extremely stable in the environment and can survive in nest hollows for years. Threatened species such as the Swift Parrot (*Lathamus discolor*) are impacted by Psittacine beak and feather disease. There is a very high density (19-21 species) of non-threatened species which may be affected by the disease in the ecological community (DoEE 2016).

Impacts resulting from agricultural activities, including grazing

Many of the alluvial areas along the east coast of Australia have been grazed and forested since the early to mid-19th century. The need for land for agriculture has driven both the

clearing of the ecological community and draining the wetlands it is a part of. Large areas that formerly supported this ecological community are now occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, etc.) and, on the far north coast, cane fields. Remaining stands of the ecological community within this landscape can suffer from weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock which is known to have a strong negative influence on riparian and floodplain vegetation (Good *et al*. 2017).

Overgrazing can degrade the ecological community through vegetation loss (grazing and trampling), soil compaction (hard hoofed stock), disturbing sediments and increasing nutrient levels. In addition, water has been diverted for irrigation of crops and to fill farm dams (Keith & Scott 2005; Pressey and Griffith 1992).

Changes to hydrology, including from flood mitigation and drainage works, extraction and river regulation.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is recognised as a major factor contributing to loss of biological diversity and ecological function in aquatic ecosystems, including floodplains. Alteration to natural flow regimes can occur through reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels (Walker 1985; Cadwallader & Lawrence 1990; Gehrke *et al*. 1995; Kingsford 1995; Maheshwari *et al*. 1995; Poff *et al*. 1997; Boulton & Brock 1999; Robertson *et al*. 1999, 2001). Natural flow regimes are determined by the climate, run-off, catchment size and geomorphology without the impacts of dams, weirs, extraction and river management.

Three anthropogenic processes have predominantly altered flows in streams, rivers and their floodplains and wetlands. These are:

- The building of dams (including all dams and weirs and off-river storages). In the 41 coastal river basins that encompass the Coastal floodplain eucalypt forest ecological community in Victoria, NSW and Queensland, there are over 200 mapped dam walls[1].
- Diversion of flows by structures or extraction and,
- Alteration of flows on floodplains with levees and structures (including those on wetlands to allow water storage).

Such alterations to natural flow regimes can be intentional or unintentional, affecting all orders of streams and rivers and the Coastal floodplain eucalypt forest. The alteration of flow has a variety of impacts which include:

- Reduction of habitat due to change in area, frequency and duration of flooding of floodplains;

[1] Dam Wall: A barrier of earth and rock, concrete or masonry constructed to form a reservoir for water storage purposes or to raise the water level. (Source: GEODATA TOPO250K (c) Geoscience Australia 2006)

- Increased flows causing more permanent flooding of some floodplain habitats;
- Riparian zone degradation through altered flow patterns;
- Increased habitat for invasive species, and
- Loss or disruption of ecological function.

The South East Queensland region is the most densely populated area of Queensland and water use is predominantly managed for urban use around Brisbane and the Gold Coast, with irrigated agriculture being a major water user within the rural portion of the region. The water resources are highly developed with 22 major storages and a combined capacity of over 2.5 million ML (BOM 2019). Some areas have been leveed to expand agricultural production which can reduce connectivity with the floodplain and result in concentrated channel flow during high flows. There are also irrigation channels in the flatter areas of the catchment further draining the floodplains. (Qld DES 2016).

In coastal NSW, large areas of coastal floodplain habitat have been directly drained by construction of artificial channels. By the early 1990s there were coordinated drainage systems on the major floodplains, while additional areas that have not been directly drained may have been altered hydrologically by changed patterns of flooding and drainage following flood mitigation works (Keith & Scott 2005).

In Victoria, the Index of Stream Condition (Vic DEPI 2014) reports on the hydrological modification of catchments. Least stressed streams are in Far East Gippsland with natural or near natural flow regimes. The Betka River supplies domestic water to coastal town of Mallacoota while both Tambo and Mitchell have natural to moderate hydrological modification.

Hydrological changes created through levee and weir construction, artificial drainage and irrigation, can also trigger acid sulphate soils. This has the potential for severe impacts on the vegetation and fauna of the ecological community, as well as water quality (NSW DECCW 2010a).

Inappropriate fire regimes

Fire regimes have been changed throughout the extent of the ecological community in association with the growth of agriculture and urban development. In rural areas, fire is used to promote green pick for livestock and in urban areas, and hazard reduction management can increase fire frequency. The amount of fallen timber and other plant litter can be diminished during such burns. Arson can also be an issue, particularly on urban fringes. Alternately, fire management, altered land practices and vegetation changes can decrease fire frequency.

In areas where the ecological community has a more grassy understorey, such as the Queensland Blue Gum (*Eucalyptus tereticornis*) woodland to open forest of alluvial plains, fire may be more frequent or may have been used as a management regime to maintain the higher levels of species richness of native pasture species. However in areas of the ecological community with fringing riparian vegetation, or wetter areas with a mesic understorey and shrub layer, fire is typically less frequent and can have a negative effect on the ecological community.

High intensity or frequent fires may slow or prevent regeneration of some species in the ecological community and lead to lower species richness. High intensity fire may kill functionally important trees such as Flooded Gum, as well as fauna and threatened endangered plants within the ecological community (Queensland Herbarium 2018; NSW OEH 2017). The resulting habitat changes are also likely to detrimentally impact on resident fauna such as bandicoots, gliders and potoroos (Tozer *et al*. 2010; NSW OEH 2017).

Impacts resulting from urbanisation and recreational activity

Urbanisation of the landscapes that adjoin the ecological community may have significant hydrological effects. The 'hardening' of surfaces through development such as road building and development surrounding the ecological community results in increased runoff. This can change stream flow patterns, causing erosion and often penetrates adjacent bushland and carries high nutrient and sediment loads, which can encourage weed invasion (NSW DECCW 2010b). Increased levels of phosphorus are a particular threat, originating from fertiliser use, excrement from domestic pets, dumped refuse and garden waste, stormwater and sewer discharges. Increased nutrients in the soil is virtually impossible to reverse.

Urbanisation can also result in an 'urban heat island effect' whereby heat is absorbed then radiated by urban structures, such as houses and paved, concreted and asphalted areas, leading to elevated temperatures. This effect has been shown to be operating in western Sydney (Beshara 2008) but is likely in any urban environment. Where patches of the Coastal floodplain eucalypt forest occur within the urban environment they are important as a means of mitigating extreme temperatures in the local area through evaporation and cooling influences, as well as shading of the associated waterways which reduces water temperatures.

In the built environment, there is also less natural water retention due to an increase in run-off from largely non-porous surfaces such as roofs and roads. Evaporative cooling is reduced, which contributes further to higher local air temperatures. The small remnant occurrences of native vegetation in many built landscapes are not sufficient to function in a role of cooling the surrounding environment. Altering the local micro-climate in turn may impact on remnants of the ecological community within and adjacent to urban developments. This process operates separately to any temperature rise due to global climate change.

Especially in rural-residential areas, remnants of the ecological community are often mowed, slashed or scrubbed for bushfire fuel reduction, grazing and perceived aesthetics. These activities can deplete the soil seed bank (James 1994) and contribute to the spread of weeds.

The threat of recreational activity includes impacts from a range of activities where people access areas of the ecological community. Visitor disturbance results in soil compaction and disturbance, erosion from foot, cycle, trail bike and four wheel drive tracks, fishing and boat ramp access points, the introduction of pests and the creation of new planned and unplanned tracks. Increased visitation to adjacent beaches and watercourses results in increased demand for and use of visitor facilities, such as walking tracks, viewing platforms, toilet blocks and picnic areas. Other impacts in such areas include the dumping of cars, rubbish and garden waste, which can cause weed infestation. Local governments along the extent of the

ecological community have been dealing the impacts of recreational activities by undertaking on-ground works, community education and planning.

Climate change, including sea level rise and changes to flow regimes.

Major impacts of climate change are likely to be played out through interactions with other threatening processes, including habitat loss and degradation, invasion of exotic species and changes to hydrological and fire regimes (Auld & Keith 2009; NSW DECCW 2010; Dunlop & Brown 2008). Rising sea-levels, changes to salinity and invasive animal and plant species are likely to cause widespread changes in biodiversity along coastal fringes (NSW DECCW 2010). The phenology of vegetation and behaviour of many species are also linked to climate variables such as temperature which are likely to change under climate change, resulting in wide-ranging impacts on coastal ecosystems (DCC 2009).

A generally warming and drying climate is likely to have other consequences for Australian coastal ecosystems. For example, reduced rainfall and increased evaporation in southern and eastern Australia will significantly reduce run-off to coastal rivers and streams (DCC 2009).

Some fauna species of the ecological community, such as Black Flying-fox, Little Red Flying-fox and Grey-headed Flying-fox, can suffer heat stress with reported deaths when temperatures exceed 42°C. The impact of temperature extremes is likely to be reduced in the presence of understorey and midstorey vegetation, dense crown vegetation and access to water (OEH 2019).

A particular threat to coastal ecological communities resulting from climate change is the threat of sea-level rise. Projections (Table 7) indicate that sea-levels are likely to rise between 90 and 270mm above 1990 levels by 2050, and up to 810mm above 1990 levels by the end of the century (CSIRO 2012). Although much of the ecological community is above the level likely to be directly impacted by sea-level rise, low-lying areas may be affected as tidal influences reach further inland.

Table 7: Projected sea-level rise since 1990

Year	Minimum projected sea-level rise (mm)	Maximum projected sea-level rise (mm)
2020	40	100
2030	60	150
2040	80	200
2050	90	270
2070	130	450
2100	180	810

Source: CSIRO (2012).

Sea-level rise will lead to inundation of parts of the coastal zone, accelerated erosion and saline intrusion into coastal waterways and wetlands. Low-elevation coastal deltas, floodplains and estuaries will be affected. If the land is uninhabited, there is an opportunity for landward migration of many coastal communities as sea-levels rise. However, if there are built structures, such as roads or settlements, that prevent this migration landward (as in much of south-eastern Australia), these communities are likely to be reduced by a process called

'coastal squeeze'. Even where there may be limited opportunity for migration inland, this is likely to be at the expense of other higher terrain ecosystems (DCC 2009).

This 'coastal squeeze' is a particular threat to low-lying areas of the Coastal floodplain eucalypt forest, as it may be replaced by more littoral communities migrating landward, such as saltmarsh or mangroves, while the landward areas have been converted to pasture or replaced by development. There is some evidence already for land migration of mangroves at the expense of other communities squeezed between higher land or built structures and the invading mangroves (DCC 2009).

Latitudinal shift in the distribution of this ecological community is also a plausible response to climate change, but the area to shift into may not be available or suitable, because of coastal development, soil types or competition with other vegetation communities (Paice & Chambers 2016). Groundwater salinity is considered a potential influence of regrowth dynamics for the ecological community. This can be affected by both altered hydrology and potentially sea water incursion as result of rising sea-levels (Keith & Scott 2005).

Key threatening processes

There are a number of national key threatening processes (KTPs) under the EPBC Act and for NSW under state legislation. Those most relevant to Coastal floodplain eucalypt forest are listed in Table 9.

Table 9: Potentially relevant key threatening processes

EPBC Act-listed key threatening processes	NSW-listed key threatening processes
Land clearance	Clearing of native vegetation
	Removal of dead wood and dead trees
	Loss of hollow bearing trees
	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	Anthropogenic climate change
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
Novel biota and their impact on biodiversity	Invasion, establishment and spread of *Lantana camara*
	Invasion of native plant communities by exotic perennial grasses
	Invasion and establishment of exotic vines and scramblers
	Competition from feral honeybees *Apis mellifera* L.
	Herbivory and environmental degradation caused by feral deer
	Predation and hybridisation by Feral Dogs, *Canis lupus familiaris*
Predation, habitat degradation, competition and disease transmission by feral pigs	Predation, habitat degradation, competition and disease transmission by feral pigs
Predation by feral cats	Predation by the feral cat (*Felis catus*)
Predation by European red fox	Predation by the European red fox (*Vulpes vulpes*)
Competition and land degradation by rabbits	Competition and grazing by the feral European rabbit *(Oryctolagus cuniculus)*
Competition and land degradation by unmanaged goats	Competition and habitat degradation by Feral Goats *Capra hircus*
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala*
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	Infection by Psittacine Circoviral (beak and feather) disease affecting endangered psittacine species and populations
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
Dieback caused by the root-rot fungus (*Phytopthora cinnamomi*)	Infection of native plants by *Phytophthora cinnamomi*
The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*)	Invasion and establishment of the Cane Toad *Bufo marinus*
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations

GLOSSARY

Terrace (Alluvial terrace, fill terrace)	Typically a relatively flat marginal feature that is perched above the contemporary channel and/or floodplain (Fryers & Brierly 2013).
Alluvial	Sediment transported and deposited by channeled or overbank stream flow (Speight & Isbell 2009).
Colluvial	Unconsolidated material at the base of a slope due mainly to gravity which includes sheet wash as a result of diffuse overland sheet erosion and deposition (Speight & Isbell 2009).
Floodplain (alluvial flat, river-flat)	Lies adjacent to or between active or abandoned channels and the valley margin. Typically tabular and elongated parallel to active channels, but be may highly variable, ranging from featureless, flat-topped forms, to included forms (typically tilted away from the channel), to irregularly reworked (scoured) forms. May be coarse grained, fine grained or intercalated. (Fryers & Brierly 2013). Floodplains, also termed alluvial flats, are areas of sediment accumulation made up of alluvial materials between the channel banks and the valley margin. Floodplains are often poorly drained, acting as a stilling basin in which fine-grained suspended sediments settle out from over-bank flows. Older, elevated floodplain deposits along valley margins are referred to as alluvial terraces. Typically a relatively flat feature, these palaeo-floodplain surfaces are not actively formed or reworked under the current flow regime (Fryirs & Brierley 2013). The presence of floodplains along a longitudinal profile mark a transition in the processes from erosion and transportation in the steeper valley confined settings, to the transfer zone where reduced slope and greater valley width promote the dissipation of transfer energy, enabling suspended load materials to be stored outside the channel on floodplains. Floodplains typically occur as isolated pockets in the middle to upper catchment and as discontinuous, alternating pockets in the transfer zone. These pockets tend to alternate as the river switches from one side of the valley to the other, creating planform-controlled floodplain pockets. As slope decreases further downstream, and the valley widens further, floodplain pockets become more frequent, eventually becoming continuous along both banks (Fryirs & Brierley 2013).
Open forest	Greater than 30% to 70% projected foliage cover or greater than 50% to 80% crown cover or crown class (i.e. mid-dense) Tree height greater than 10 m to 30 m (Neldner *et al*. 2017)
Quaternary	The last 0 -2.5 million years
Quaternary alluvial	Quaternary alluvial systems include landform patterns such as alluvial fan, alluvial plain, anastomotic plain, bar plain, covered plain, delta, flood plain, meander plain, playa plain, stagnant alluvial plain, and terrace. Each landform pattern contains one or more landform elements including back plain, bank (stream bank), bar (stream bar), channel bench, drainage depression, fan, flood-out, lagoon, lake, levee, lunette, ox-bow, playa, prior stream, scroll, stream bed, stream channel, swamp, terrace flat, terrace plain, and valley flat. In all these landforms, there may be frequent active erosion and aggradation by channel and overbank stream flow, or the landforms may be relict from these processes (Speight 2009)
Tall open forest	Greater than 30% to 70% projected foliage cover or greater than 50% to 80% crown cover or crown class (i.e. mid-dense) Tree height greater than 30 m (Neldner *et al*. 2017)
Tall woodland	Greater than 10% to 30% projected foliage cover or greater than 20% to 50% crown cover or crown class (i.e. sparse) Tree height greater than 30 m (Neldner *et al*. 2017)
Woodland	Greater than 10% to 30% projected foliage cover or greater than 20% to 50% crown cover or crown class (i.e. sparse) Tree height greater than 10 m to 30 m (Neldner *et al*. 2017)

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