Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (s266B)

Preliminary draft conservation advice (incorporating listing advice) of the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

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 and Energy (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 Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community to the Minister as a draft conservation advice by October 2017.
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 Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community.
4. This draft description of the conservation advice for this ecological community is now 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.

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1. DRAFT DESCRIPTION OF THE ECOLOGICAL COMMUNITY

1.1. Name of the ecological community

The proposed name of the ecological community is **Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland** (hereafter referred to as "Coastal Swamp Oak Forest" or the "ecological community"). The name refers to the landscape position, dominant canopy species (sometimes also referred to as swamp she-oak), typical vegetation structure and geographic areas which characterise the ecological community.

1.2. Location and physical environment

The ecological community occurs in sub-tropical, sub-humid and temperate climatic zones from Curtis Island (north of Gladstone) in Queensland to near Bermagui in New South Wales. The ecological community is found within the South Eastern Queensland (SEQ), NSW North Coast (NNC), Sydney Basin (SYB) and part of the South East Corner (SEC) IBRA7 bioregions (Commonwealth of Australia, 2012). See Appendix B for more information on relevant IBRA subregions and corresponding map units.

The extent of the ecological community corresponds to country (the traditional lands) of a number of Indigenous groups, including the Gureng Gureng, Bajtala, Gubbi Gubbi, Yuggera, Bundjalung, Gumbaynggirr, Dainggatti, Biripi, Worimi, Awabakal, Kurin-gai, Eora, Dharug, Tharawa/D'harawal and the Yuin, and the ecological community is of substantial cultural significance.

The ecological community occurs in coastal catchments, mostly at elevations of less than 20 m ASL which are typically found within 30 km of the coast. However, this distance varies by catchment; for example, low elevations can occur as far as 40 km inland on the Hawkesbury River, or more than 100 km on the Clarence River. On the mid and north coast of NSW the ecological community may also occur between up to 50 m ASL on floodplains of, or coastland flats associated with, former or current coastal river systems (DECC, 2007).

Coastal Swamp Oak Forest typically occurs on unconsolidated sediments, including alluvium deposits, and where soils formed during the Quaternary period as a result of sea level rises during the Holocene period (Sloss et al., 2007). These are most typically hydrosols, which are saturated with water for long periods of time (typically grey-black clay-loam and/or sandy loam soils). The ecological community can also occur on organosols (peaty soils). Occurrences of swamp oak on headlands or other consolidated substrates are not considered to be a part of the ecological community, but areas that transition into unconsolidated sediments may contain the ecological community.

The ecological community is typically found where groundwater is saline or brackish, but can occur in areas where groundwater is relatively fresh. It is typically found on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. These are typically associated with low-lying coastal alluvial floodplains and alluvial flats (Keith and Scott, 2005). Minor occurrences can be found on coastal dune swales or flats, particularly deflated dunes and dune soaks.

1.3. Vegetative components

Coastal Swamp Oak Forest is often found in association with other vegetation types such as coastal saltmarsh, mangroves, freshwater wetlands, littoral rainforests or swamp sclerophyll forests in a 'mosaic' of coastal floodplain communities.

The structure of Coastal Swamp Oak Forest can vary from forest to woodland depending on its location in the landscape. The local expression of the ecological community is influenced

by soils, history of inundation by tidal flows/estuarine system dynamics, groundwater salinity, site history, disturbance regime and current land management. Many remaining patches of the ecological community consist of regrowth from past clearance and other disturbances and/or due to naturally occurring river and coastal dynamics. Some patches, for example where drainage is more impeded, may be expressed as sedgeland or rushland, with a sparse canopy of predominately swamp oak. Other patches may just occur as canopy trees, possibly over dense needle litter and/or with sparse native groundcover.

Where groundwater is more saline, for example on estuarine and/or coastal lake fringes, the ecological community is typically expressed as a low woodland or tall shrubland. In these areas, the composition of the understory is more likely to include saline tolerant (including typically saltmarsh) species. In more freshwater areas, the ecological community is more likely to demonstrate greater structural diversity – often being expressed as a taller open or rarely closed forest with a diverse understory and groundcover.

Many patches have a sub-canopy of smaller trees, but the shrub layer is typically sparse. Climbing and epiphytic plant species are commonly observed and are characteristic of Coastal Swamp Oak Forest. The ecological community typically includes a continuous to semi-continuous ground layer that may include either forbs, sedges, grasses and/or plant litter (including branchlets[1], leaves, bark, twigs).

1.3.1. Canopy

The canopy layer is dominated[2] by *Casuarina glauca* (swamp oak, swamp she-oak). This may present as a relatively uniform upper layer of swamp oak, as a sub-canopy of smaller swamp oak beneath other canopy species (for example *Melaleuca* spp. or *Eucalyptus* spp.); or as juvenile swamp oak trees. In more freshwater variants of the ecological community, *Melaleuca* species may co-dominate[3] the canopy with *Casuarina glauca*.

1.3.2. Understorey

A sparse mid layer, or sub-canopy, of smaller trees may be present, typically composed of common canopy species, including juvenile swamp oak. Shrubs are typically sparse.

Other trees and tall shrubs occur in the sub-canopy, the individual species varying with latitude, with rainforest species more likely north of Sydney. Commonly occurring species include *Acmena smithii* (lilly pilly), *Alphitonia excelsa* (red ash), *Glochidion ferdinandi* (cheese tree), *Callistemon salignus* (bottlebrush), *Myoporum acuminatum* (mangrove boobialla) and *Melaleuca spp* (paperbarks), including *Melaleuca ericifolia, M. linariifolia, M. quinquenervia, M. stypheioides*. To the north, *Cupaniopsis anacardioides* (tuckeroo) is also common. A number of *Eucalyptus* spp. can emerge from the canopy, for example *Eucalyptus tereticornis* (forest red gum), *E. botryoides* (bangalay), *E. grandis* (flooded gum), *E. longifolia* (woollybutt), or *E. robusta*, (swamp mahogany).

The climbing plant species that is most typical of the community is *Parsonsia straminea* (common silkpod). Other climbing species that may occur include *Geitonoplesium cymosum* (scrambling lily), *Stephania japonica* (snake vine), and, in the north, *Cynanchum carnosum* (mangrove vine). Epiphytic plants, such as *Platycerium bifurcatum* (elk/staghorns), *Dendrobium teretifolium* (pencil orchids) and *Amyema cambagei* (she-oak mistletoe) could also be present.

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[1] The branchlets act as leaves and can also be referred to as "needles" (Costermans, 1983).

[2] For the purposes of this definition, a canopy dominated by *Casuarina glauca* occurs where *C. glauca* is the most abundant tree in the canopy and/or sub-canopy in terms of percentage cover or stem density.

[3] For the purposes of this definition, a canopy co-dominated by *C. glauca* and *Melaleuca ssp.* occurs where *C. glauca* and *Melaleuca* together represent the most abundant trees in the canopy and/or sub-canopy in terms of percentage cover or stem density, AND where *C. glauca* is more abundant than *Melaleuca* in this mix.

1.3.3. Ground layer

The ground layer is typically a continuous to semi-continuous cover of either forbs, ferns, sedges, grasses and/or plant litter (including swamp-oak branchlets), but can also often be "patchy," particularly where the ecological community is regenerating. The composition of the ground layer is also influenced by groundwater salinity.

Under less saline conditions, prominent species include *Blechnum indicum* (swamp water fern), *Carex appressa* (tussock sedge), *Centella asiatica* (pennywort), *Commelina cyanea*, *Dianella caerulea* (blue flax lily), *Entolasia* spp., (panic grasses), *Gahnia clarkei* (saw sedge), *Hypolepis muelleri* (bats wing fern, harsh ground fern), *Imperata cylindrica* (blady grass), *Lomandra longifolia* (spiny-headed mat-rush), *Microlaena stipoides* (weeping grass), *Oplismenus imbecillis* (creeping beard grass), *Persicaria decipiens* (slender knotweed) and *Viola banksii* (wild violets) (NSW Scientific Committee, 2004; Sheringham et al., 2008; Tozer et al., 2010; Miles, 2006).

Under more saline conditions, for example on the fringes of estuaries, common species include *Alternanthera denticulata* (lesser joyweed), *Baumea juncea* (bare twig rush), *Cynodon dactylon* (sand couch), *Juncus kraussii* subsp. *australiensis* (sea rush), *Phragmites australis* (common reed), *Samolus repens* (creeping brook or bushweed), *Selliera radicans* (swamp weed), and *Suaeda australis* (austral seablite). Where the ecological community intergrades with saltmarsh, *Atriplex australasica* (native orache), *Enchylaena tomentosa* var. *glabra* (ruby salt bush), *Fimbristylis dichotoma* (tall fringe rush), *Sarcocornia spp* (samphire), *Sesuvium portulacastrum* (sea purslane), *Sporobolus virginicus* (sand or salt couch) or *Tetragonia tetragonoides* (warrigal greens or New Zealand spinach) often occur.

In the mid north coast of New South Wales, the rare *Alexfloydia repens* (Floyd's grass) can dominate of the ecological community at some sites (NPWS, 1999a). The endangered *Persecaria eliator* (knotweed, pink smartweed) which grows on sandy, alluvial soil in swampy areas and riparian herblands along watercourses and lake edges has also been recorded in the ecological community (J. Miles, pers. comm, March 2017; Department of Environment and Energy, 2008b).

For a more comprehensive list of plants likely to occur in the ecological community see the species lists in Appendix A.

1.4. Faunal components

The vegetation of the Coastal Swamp Oak Forest provides diverse habitat values for a wide range of fauna, particularly the crevices and hollows within older trees. Most fauna species that form a part of the Coastal Swamp Oak Forest also inhabit adjacent wetlands, grasslands, woodlands and forests. Many fauna species within the ecological community are now listed as threatened under State and/or Commonwealth legislation.

1.4.1. Mammals

The ecological community includes a wide range of mammals, some of which are threatened. Arboreal species such as bats roost in the swamp oak and emergent trees and utilise the sub-canopy and nearby water bodies. Typical arboreal species include *Cercartetus nanus* (eastern pygmy possum), *Myotis adversus* (large-footed or southern myotis), *Phascogale tapoatafa* (brush-tail phascogale), *Pteropus poliocephalus* (grey-headed flying-fox) and *Sycoyncteris australis* (common blossom bat) (DECC, 2008; Van Dyck and Strahn (eds), 2008). Stands of swamp oak have been identified as a possible secondary habitat for *Phascolarctos cinereus* (koala) populations, which is likely due to intergradation with river flat eucalypt forests and the presence of preferred eucalypts, such as forest red gum, as emergents in the canopy (Millard, 2012).

Typical ground dwelling species, which utilise the clumping and often dense ground cover, include *Antechinus stuartii* (brown antechinus), *Peramales nasuta* (long-nosed bandicoot), *Potorous tridactylus* (long-nosed potoroo), *Pseudomys novaehollandiae* (New Holland mouse) and *Rattus lutreolus* (Australian swamp rat) (OEH, 2015). In south-east Queensland and around the border of northern NSW *Xeromys myoides* (water mouse or false water rat) is also likely to be a part of the ecological community when it is adjacent to areas dominated by mangroves (DERM, 2010).

1.4.2. Reptiles

Lizards that form a part of the ecological community, typically include *Cyclodomorphus michaeli* (mainland she-oak skink) and *Egernia mcpheei* (tree skink). Snakes are also likely to occur in most patches, including *Boiga irregularis* (brown tree snake), *Hemiaspis signata* (black-bellied swamp snake), *Hoplocephalus bitorquatus* (pale-headed snake), *Pseudechis porphyriacus* (red-bellied black snake) and *Tropidechis carinatus* (Clarence River snake or rough-scaled snake) (Cogger, 2014; OEH, 2015).

Freshwater turtles are likely to inhabit the ecological community, as it sits in close proximity to both freshwater and brackish waterbodies which can be inundated for periods of time. The vegetation of the ecological community is important in stabilising river sand banks and islands where turtles lay their eggs. Commonly occurring species likely to occur in the ecological community are *Chelodina longicollis* (eastern long-necked turtle) and, in rivers in the northern NSW-Sydney region, *Emydura macquarii* (Murray River turtle). The ecological community is also likely to provide habitat for threatened species such as *Elseya albagula* (white throated snapping turtle – SEQ only), *Elusor macrurus* (Mary River turtle) and *Myuchelys georgesi* (Bellinger River turtle) (Department of Environment and Energy, 2008a, 2014; OEH 2017a).

1.4.3. Amphibians

The standing vegetation and patches of dense ground cover, fallen plant material, tree crevices, small hollows and rocks within Coastal Swamp Oak Forest provide diverse habitat for a number of tree frogs (Gibbons and Lindenmayer, 2002; NSW Scientific Committee, 2004; Cogger, 2014). One species found along the southern part of the extent of the ecological community is *Litoria fallax* (eastern dwarf tree frog), which can be often heard calling from deep within *Gahnia* (saw-sedge). Larger frogs, such as *Litoria caerulea* (green tree frog), may inhabit moist crevices in large, older trees during the day, emerging at night to hunt. On the New South Wales south coast, the threatened *Litoria aurea* (green and golden bell frog) has been observed moving through the ecological community at night (P. Craven, pers. comm., National Parks and Wildlife Service, OEH; expert field trip, 2017).

Frogs with more limited distribution within the range of the ecological community include *L. olongburensis* (Olongburra frog), found from Woolgoolga (northern NSW) to Lake Woongeel on Fraser Island and other parts of south-east Queensland, *L. chloris* (red-eyed tree frog) and *L. freycinetti* (Freycinet's frog or wallum rocket frog) both found from north of Sydney into south-east Queensland. Other species that may be present in the ecological community include *Crinia tinnula* (wallum froglet) and *Pseudophryne coriacea* (red-backed toadlet) (Meyer et al, 2006; Cogger, 2014; OEH, 2016).

1.4.4. Birds

The ecological community includes many birds, which utilise its important shelter and food resources, particularly honey-eaters, insectivores and some waterbirds, including species which specialise in foraging from plants typically associated with the ecological community, such as *Amyema cambagei* (she-oak mistletoe) (Higgins, 1999; Watson, 2011). Examples

include the threatened *Anthochaera phrygia* (regent honeyeater) and *Dicaeum hirundinaceum* (small mistletoebird).

A commonly occurring insectivore is *Pachycephala rufiventris* (rufous whistler), which forages in the canopy and may use the grasses, pieces of vine and twigs to build nests in the forks of tall trees. Other common insectivores include *Acrocephalus australis* (Australian reed warbler), *Atricornus rufensis* (rufous scrub-bird), *Malurus* spp (fairy wrens*), Petroica phoenica* (flame robin) and *Stipiturus malachurus malachurus* (southern emu wren), which can nest in the tussocky understorey plants (Higgins, Peter and Steele, 2001; Menkhorst et al, 2017).

Seed eating species include *Neochmia temporalis* (red browed firetail), which utilise the abundant sedges, rushes and grasses (Higgins and Peter, 2002). Some parrots are associated with the ecological community, particularly the endangered *Lathamus discolour* (swift parrot), *Pezoporus wallicus wallicus* (eastern ground parrot) and *Trichoglossus* spp. (lorikeets). The NSW Scientific Committee note that the ecological community can sometimes provide food for the *Calyptorhynchus lathami lathami* (glossy black cockatoo) and *Calyptorhynchus funereus* (yellow-tailed black cockatoo) (Marchant and Higgins, 1990; Higgins, 1999; Gibbons and Lindenmeyer, 2002; NSW Scientific Committee, 2004).

Medium sized birds of prey, such as *Accipiter* spp. (goshawks) may use the emergent eucalypts associated with the ecological community to hunt for frogs, reptiles and birds (Marchant and Higgins, 1993).

Whilst Coastal Swamp Oak Forest is not a significant habitat for waterbirds (NSW Scientific Committee, 2004), some species are known to utilise food resources and roost in standing and fallen trees within the ecological community. Examples include *Ardea striata* (striated heron), *Botaurus poiciloptilus* (Australasian bittern), *Ixobrychus flavicollis* (black bittern), *Numenius madagascariensis* (eastern curlew), and *Rostrulata australis* (Australian painted snipe) (Marchant and Higgins, 1993; Higgins and Davies, 1996).

1.4.5. Invertebrates

The moist leaf and plant litter, typical of the ecological community, provides food and habitat for a wide range of invertebrates, including gastropods, arachnids, flying insects and their larvae. Many plants found in the ecological community, provide food for butterflies and moths.

A broad range of butterflies, particularly *Nymphalidae* (Browns), utilise the grasses and some trees (for example, tuckeroo) as larval food plants. The endangered small skipper, *Ocybadistes knightorum* (black grass dart butterfly), is endemic to riparian zones on the NSW mid-north coast, from Coffs Harbour to Scotts Head. The butterfly is restricted to where its larval food plant, the also endangered Floyd's grass, occurs (Braby, 2004). This species occurs predominately in swamp oak or sclerophyll forest where swamp oak and/or broad-leaved paperbark dominate the canopy (OEH, 2017).

Adult butterflies and other insects, including *Trigona carbonaria* (native stingless bees) also pollinate flowering plants and colonise larger trees further up in the canopy. These insects provide food for a number of spiders including *Neophila* spp (the golden orb weavers), which make suspended, sticky, wheel-shaped orb webs between trees and shrubs to trap their prey.

For more information see species lists in Appendix A.

2. DRAFT IDENTIFICATION OF THE ECOLOGICAL COMMUNITY

Key diagnostic characteristics and condition thresholds are used to identify a patch of native vegetation as being the threatened ecological community; determine whether the referral, assessment, approval and compliance provisions of the EPBC Act are likely to apply to a patch, and; distinguish between patches of different quality (to aid environmental management decisions).

Coastal Swamp Oak Forest can intergrade with nearby or similar ecological communities (see section 2.4). Using the key diagnostic characteristics should assist to distinguish between these ecological communities.

National listing focuses legal protection on patches of the ecological community that are the most functional, relatively natural and in comparatively good condition. Because the ecological community exhibits various degrees of disturbance and degradation, condition classes, categories and thresholds have been developed. These provide guidance on whether a patch retains sufficient conservation values to be considered as a Matter of National Environmental Significance (MNES), as defined by the EPBC Act.

In order to be considered a MNES, areas of the ecological community must meet:

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

Very degraded patches which do not meet the minimum condition thresholds will be largely excluded from national protection. In many cases, the loss and degradation is irreversible or rehabilitation is impractical because natural characteristics have been removed. For instance, areas permanently converted to improved pastures and/or once swampy areas that have been 'reclaimed' for building purposes, are unlikely to be rehabilitated.

Although very degraded or modified patches are not protected as part of the ecological community listed under the EPBC Act, it is recognised that some patches that do not meet the condition thresholds may still retain important natural values and may be protected through state and local laws or schemes. In addition, patches that can be restored should not be excluded from recovery and other management actions. Suitable recovery and management actions may improve a patch's condition, such that it subsequently can be included as part of the ecological community fully protected under the EPBC Act. Management actions should also be designed to restore patches to high condition.

Provided that the patch meets the key diagnostic characteristics and condition thresholds, revegetated or replanted sites or areas of regrowth are not excluded from the listed ecological community. Much of the current distribution of Coastal Swamp Oak Forest is comprised of regrowth initiated in response to changes in drainage, including sites which may not have previously supported the ecological community. These developing stands are important as very little 'old growth' remains, and are included as a part of the ecological community.

Species composition of this ecological community is influenced by (amongst other things) latitude, the size of the patch, landscape position and the type of surrounding vegetation or land-use, recent rainfall, degree of saline influence, drought conditions and disturbance history (including fire, grazing and flooding). However, the key diagnostic characteristics and condition thresholds are designed to allow identification of the ecological community irrespective of the season.

2.1. Key Diagnostics

The key diagnostic characteristics presented here are the features that define the ecological community, noting that more details are provided in the other sections of this document. Patches that do not meet the key diagnostics are not the nationally listed ecological community. The other diagnostic characteristics may also help to identify the ecological community.

The national ecological community is defined as patches of native vegetation that meet the following key diagnostic characteristics:

- Occurs within the South Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions (see Appendix B).
- Occurs in coastal catchments at elevations up to 50 m ASL, typically less than 20 m ASL.
- Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils).
- Occurs on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. Minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks.
- Has a forest or woodland structure, with a total canopy cover of at least 10%.
- Has a canopy dominated[4] by *Casuarina glauca* (swamp-oak, swamp-she oak).

2.2. Other diagnostics

Other characteristics that may help identify the ecological community include:

- Typically occurs where groundwater is saline or brackish.
- In more freshwater variants of the ecological community, *Casuarina glauca* may co-dominate[5] with *Melaleuca* species.
- Occurs typically within 30km of the coast, but in some areas along tidal river catchments the ecological community can occur more than 100km inland.
- Does not occur on headlands, sea cliffs or other consolidated sediments but may occur in transitional soils or catenas where unconsolidated sediments border lithic substrates.

2.3. Condition thresholds

The condition thresholds for this ecological community (Table 1) are designed to identify the best patches for national protection. Large patches of Coastal Swamp Oak Forest or those parts of large native vegetation patches with excellent quality native understorey are a higher priority for protection and management.

[4] For the purposes of this definition, a canopy dominated by *Casuarina glauca* occurs where *C. glauca* is the most abundant tree in the canopy and/or sub-canopy in terms of percentage cover or stem density.

[5] For the purposes of this definition, a canopy co-dominated by *C. glauca* and *Melaleuca ssp.* occurs where *C. glauca* and *Melaleuca* together represent the most abundant trees in the canopy and/or sub-canopy in terms of percentage cover or stem density, AND where *C. glauca* is more abundant than *Melaleuca* in this mix.

As the ecological community has been heavily cleared, fragmented and degraded, many remnants are small, or isolated and/or modified. Very small, narrow and/or isolated patches that are subject to high disturbance and without native ground layer, do not contribute so greatly to the conservation of the ecological community and may not meet the condition thresholds for national protection. However, very small and isolated patches that have the potential to be restored and reconnected through weed management and/or revegetation activities could be priorities for management and recovery projects.

Category A describes patches of the ecological community in 'high condition'. These are the highest priorities for protection and provide examples to guide restoration of lower condition patches.

Categories B and C are considered good or moderate condition and subject to the referral, assessment, approval and compliance provisions of the EPBC Act.

Categories A2, B2 and C2 comprise a smaller patch of the ecological community within close proximity (within at least 100 m) of other native vegetation patches that collectively, form a larger area of native vegetation.

Patches that do not fit within any of these condition classes are not subject to the referral, assessment, approval and compliance provisions of the EPBC Act.

When assessing a patch of the ecological community for the key diagnostics and condition, it important to consider other matters such as patch definition as outlined in Appendix C.

Table 1: Condition thresholds for patches of Coastal Swamp Oak Forest

Category and rationale	Patch size thresholds	Biotic thresholds
A. High condition class		
A1. A large patch that meets **key diagnostics** and has excellent quality native understorey	The patch is at least 2 ha	Non-native species comprise **less than 20%** of total understorey vegetation cover*
A2. A small patch that meets **key diagnostics** and has excellent quality native understorey and is contiguous with another area of native vegetation***.	The patch is at least 0.5 ha within a larger patch of native vegetation of at least 2 ha	
B. Good condition class		
B1. A large patch that meets **key diagnostics** and has good quality native understorey	The patch is at least 1 ha	Non-native species comprise **less than 50%** of total understorey vegetation cover* AND transformer species** comprise **less than 30%** of total understorey vegetation cover
B2. A small patch that meets **key diagnostics** and has good quality native understorey and is contiguous with another area of native vegetation***.	The patch is at least 0.5 ha within a larger patch of native vegetation of at least 2 ha	

C. Moderate condition class		
C1. A large patch which meets **key diagnostics** and has moderate quality native understorey	The patch is at least 5 ha	Non-native species comprise **less than 80%** of total understorey vegetation cover* AND transformer species** comprise **less than 50%** of total understorey vegetation cover
C2. A small patch that meets **key diagnostics** and has moderate quality native understorey and is contiguous with another area of native vegetation***.	The patch is at least 1 ha within a larger patch of native vegetation of at least 5 ha	
*Refers to total perennial understorey vegetation cover for the patch. Includes vascular plant species of both the ground layer and the shrub layer (where present) with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile canopy species, but does not include annuals, cryptogams, leaf litter or exposed soil. **Transformer species (e.g. *Chrysanthemoides monilifera, Asparagus spp, Pennisetum spp, Ipomea spp* etc) may change the character, condition, form or nature of patches of the ecological community. See page 13 for further information on weeds, including transformer species. ***Contiguous means the patch is connected to or in close proximity (within 100 m) to another area of native vegetation.		

2.4. Relationship to other ecological communities

In New South Wales, the ecological community corresponds with those parts of the NSW-listed threatened ecological community 'Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions' (listed as endangered) (Swamp oak floodplain forest Endangered Ecological Community; NSW Scientific Committee, 2004), where the canopy is dominated[6] by *Casuarina glauca*, and where the other key diagnostics and condition thresholds are met. Those parts of the NSW-listed community where *Melaleuca* spp. dominate the canopy, particularly as found south of Bermagui, will not meet the key diagnostics and are not included as a part of the of the national Coastal Swamp Oak Forest ecological community.

In Queensland, the ecological community coincides with two Regional Ecosystems:

- RE 12.1.1 (*Casuarina glauca* +/- mangroves woodland) (listed as of concern) and
- areas where the canopy is dominated[4] by *Casuarina glauca* within RE 12.3.20 (*Melaleuca quinquenervia, Casuarina glauca* +/- *Eucalyptus tereticornis, E. siderophloia* open forest on low coastal alluvial plains) (listed as endangered) (DSITIA 2017).

The boundaries of coastal ecological communities may be difficult to distinguish due to the dynamic nature of the system. This ecological community is often found in association with other vegetation types such as coastal saltmarsh, mangroves, freshwater wetlands, littoral rainforests or swamp sclerophyll forests in a 'mosaic' of floodplain communities.

[6] For the purposes of this definition, a canopy dominated by *Casuarina glauca* occurs where *C. glauca* is the most abundant tree in the canopy and/or sub-canopy in terms of percentage cover or stem density.

Nationally listed ecological communities that Coastal Swamp Oak Forest can adjoin or intergrade with include:

- Littoral Rainforest and Coastal Vine thickets of Eastern Australia
- Illawarra and south coast lowland forest and woodland
- Lowland Grassy Woodland in the South East Corner Bioregion
- Subtropical and Temperate Coastal Saltmarsh
- Lowland Rainforest of Subtropical Australia
- Eastern Suburbs Banksia Scrub of the Sydney Region
- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland.

In NSW Coastal Swamp Oak Forest may adjoin or intergrade with several other NSW listed ecological communities, including:

- River-flat Forest on Coastal Floodplain of the North Coast, Sydney Basin and South East Corner bioregions (also under consideration for national listing as at July 2017);
- Swamp Sclerophyll Forest on Coastal Floodplain of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Freshwater Wetlands on Coastal Floodplain of the NSW North Coast, Sydney Basin and South East Corner bioregions.

2.5. Area critical to the survival of the ecological community

The area most critical to the survival of the ecological community are those patches that are of a reasonable size and in the best condition (i.e. high condition class in Table 1). These represent those parts of the ecological community closest to the benchmark state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function.

However, this does not mean that areas that otherwise meet the minimum condition thresholds (i.e. good to moderate condition classes in Table 1) are unimportant for the survival of the ecological community. Many of these patches may contain suites of species or habitat features that are important in a regional or local context. Some of these elements can still be critical to the survival of the ecological community.

Additional areas such as buffer zones around patches (see information on buffer zones in Appendix C), particularly adjoining native vegetation, and areas that meet the description of the ecological community but not the condition thresholds, are also important to the survival of the ecological community. They should still be taken into consideration as part of the surrounding environment and landscape context.

3. DRAFT SUMMARY OF THREATS

Historically, the landscape where the ecological community occurs was cleared primarily for agriculture and small coastal settlements. The result is that the ecological community occurs within a 'mixed use' landscape with most of the remaining patches occurring on productive agricultural land, or in close proximity to coastal areas where population growth and urban development is expected to continue at a rapid rate, particularly in the northern part of the extent.

The range of threats faced by the ecological community is briefly described in a list here. These threats often interact, rather than act independently.

Clearing and fragmentation

Extensive land clearing and landscape modification for agricultural and coastal development over the past 200 years has reduced the extent of the ecological community. This remains an ongoing threat as most of the remaining ecological community, as well as potential regrowth areas, occur on productive agricultural land or in close proximity to regional centres.

Clearing continues for housing and light industrial developments and associated infrastructure, upgraded and redirected transport corridors, recreational access and amenity, and in some areas, sandmining. Some waterfront areas (typically on crown land), have suffered the illegal removal of the ecological community by adjacent landowners, usually to open up coastal views.

The ongoing loss of remnants of the ecological community, plus a decreased size of remaining remnants, leads to greater vulnerability to threats due to fragmentation and the impacts of edge effects.

Weeds

Invasion by non-native plant species is a major threat to this ecological community and is typically a result of physical disturbance to the vegetation structure of the community; landfill associated with adjacent urban and industrial infrastructure, including sporting fields; soil disturbance; dumping of building or excavation waste, rubbish and garden refuse; encroachment of garden plants with spread assisted by birds, wind, water and altered drainage patterns; polluted runoff from urban and agricultural areas; construction of roads and other utilities; and grazing by domestic livestock or feral animals. Invasion of some species can also be a result of changed fire regimes (DSITIA, 2017), for example, in Queensland and parts of NSW, *Lantana camara* (lantana) can contribute to more frequent low intensity fires (DSITIA, 2017).

Some weeds can transform the character, condition, or nature of the ecological community by competing with native species for resources (water, light, or oxygen) promoting or suppressing fire, stabilising sand, promoting erosion, colonising intertidal sediments, or accumulating litter and/or salt (Richardson et al., 2000). For example, *Asparagus asparagoides* (bridal creeper) which encourages the accumulation of litter and nutrients, and *Chrysanthemoides monilifera* (bitou bush and boneseed) which stablise sediments, are identified species that can dominate the ecological community in NSW (NSW Scientific Committee 2004). *Pennisetum ssp* (feathergrasses and mission grasses) and *Ipomea spp* (morning glories) are also transformative weeds in this ecological community.

Feral animals

The ecological community is subject to a range of impacts from feral 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, deer and other feral herbivores.

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. Large areas that formerly supported this community are 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 can suffer from weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock.

Changes to hydrology, including from flood mitigation and drainage works

A number of wetlands that encompass the ecological community have been, or are at risk of being, drained of their water to enhance urban, peri-urban and agricultural development (DECC, 2008; Tozer et al, 2010). Large areas of habitat formerly occupied by the ecological community have been directly drained by construction of artificial channels (e.g. Pressey, 1989; Boulton and Brock, 1999). By the early 1900s, drainage unions or trusts were formed on the major floodplains to enable adjacent landholders to arrange for co-ordinated drainage systems, which were designed and constructed by the NSW Department of Public Works.

Additional areas that have not been directly drained may have been altered hydrologically by changed patterns of flooding and drainage following flood mitigation works, particularly the construction of drains, levees and floodgates (Pressey and Griffith, 1992). Other water regulation activities and works in coastal areas, including water held in storage for consumptive use and the construction of roads and buildings, result in hydrological changes which can impact the form and function of the ecological community. The construction of extensive roads and motorways along the east-coast, particularly raised motorways and railways, has also substantially affected drainage, hydrological connectivity and tidal inflows.

Fire

Fire regimes have been changed throughout the extent of the ecological community in association with agriculture and urban development. In rural areas, fire can be used to promote green pick for livestock and in urban areas, arson and hazard reduction management can increase the ignition rates. The amount of fallen timber and other plant litter can be diminished during such burns.

The impact of this upon the ecological community is poorly known (DSITIA, 2016), but changes in the fire regime may result in species decline and changes to vegetation structure, as well as promoting the spread of other species, particularly invasive weeds. The resulting habitat changes are also likely to detrimentally impact on resident fauna (Tozer et al., 2010).

Recreational activity

Visitor disturbance includes soil compaction and disturbance, erosion from foot, cycle, trail bike and four wheel drive tracks, 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 has the potential to cause weed infestation.

Climate change

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 (Dunlop and Brown, 2008; Auld and Keith, 2009).

A particular threat to Coastal Swamp Oak Forest is potential contraction resulting from sea level rise, 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. 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.

3.1. Key threatening processes

Key threatening processes (KTPs) have been defined at the national level under the EPBC Act and for NSW under state legislation. Those most relevant to Coastal Swamp Oak Forests are listed in Table 2**.**

Table 2: Potentially relevant key threatening processes.

EPBC Act	NSW
Land clearance	Clearing of native vegetation
	Removal of dead wood and dead trees
	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
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 of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)
	Invasion and establishment of exotic vines and scramblers
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)*
	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

4. DRAFT SUMMARY OF ELIGIBILITY FOR LISTING AGAINST EPBC ACT CRITERIA

4.1. Criterion 1 – decline in geographic distribution

Much of the landscape where the ecological community occurs is suitable for agriculture and is in close proximity to coastal settlements. Thus it has been extensively cleared for agriculture and coastal development.

Based on a compilation of regional vegetation maps, the current extent of the ecological community is around 22,500 ha. This compares to an estimated pre-1750 extent of Coastal Swamp Oak Forest of around 85,000 ha. This represents a decline of approximately 74%.

As the ecological community is considered to have undergone a 'severe' decline (more than 70%) in its geographic extent over the long term, it is likely to be eligible for listing as **endangered** under this criterion.

4.1. Criterion 2 – limited geographic distribution coupled with demonstrable threat

Based on a compilation of regional vegetation maps, the current area of occupancy is estimated to be around 22,500 ha, which is considered to be 'limited.' However, the ecological community is highly fragmented, both naturally and as a result of past disturbance. The median patch size is around 1.5 ha and 96% of patches are less than 10 ha, which is considered to be 'very restricted.'

Coastal Swamp Oak Forest typically occurs as a part of a mosaic with other vegetation types, often expressed as relatively linear, narrow patches between estuaries or wetlands and areas of coastal development. It is subject to a range of threats that are exacerbated by its very restricted distribution and its landscape position, including clearing for coastal development or agriculture, climate change, sea level rise and the continuing degradation of remaining patches.

A rise in sea level (estimated to be 0.4 metres in some areas by 2050) and increase in the frequency of storm events are considered severe threats to coastal ecological communities such as Coastal Swamp Oak Forest. Saltwater intrusions will influence the extent of tidal limits inland, with a subsequent shift in the salinity gradients of wetland systems and the unconsolidated sediments on which the ecological community occurs. Coupled with existing permanent development structures on the inland side of the ecological community, and the forecast increase in coastal development for the east coast of Australia, the capacity of Coastal Swamp Oak Forests to retreat from the impacts of sea-level rise is seriously compromised.

Given these pressures, Coastal Swamp Oak Forest is likely to experience the ongoing loss of patches in good condition across the full extent of occurrence, such that the ecological community could be lost within the near future. Therefore, due to the nature of its distribution and the threats operating on it, the ecological community may be eligible for listing as **endangered** under this criterion.

4.2. Criterion 3 – loss or decline of functionally important species

The loss of fauna species from the ecological community is likely to have had a negative effect on ecological function, however, specific data related to the decline of functionally important species is not available. As such, **insufficient information** is available to determine eligibility against any category for this criterion at this time.

4.3. Criterion 4 – reduction in community integrity

The integrity of the ecological community has been severely compromised through various types of local degradation and broad-scale landscape changes. There is a high incidence of weed invasion, and in many locations changes to hydrological processes are making areas unsuitable for the ecological community.

Much of the damage is irreversible and many of the underlying threats continue. While active intervention can contribute to its conservation, complete restoration of the ecological functions underpinning the ecological community is unlikely in the near or medium term future. Therefore the ecological community may be eligible for listing as **vulnerable or endangered** under this criterion.

4.4. Criterion 5 – rate of continuing detrimental change

The ecological community has experienced substantial clearing and fragmentation due to coastal development and agriculture. Pressures associated with these land uses continue, particularly with the increasing development along the New South Wales and Queensland coasts.

While detrimental change is likely to continue, there is **insufficient information** available on the rates of loss in the recent past, or planned for the immediate future, across the range of the ecological community, to determine eligibility against any category for this criterion at this time.

4.5. Criterion 6 – quantitative analysis showing probability of extinction

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.

5. DRAFT PRIORITY RESEARCH AND CONSERVATION ACTIONS

5.1. Conservation objective

The conservation objective is to mitigate the risk of extinction of Coastal Swamp Oak Forest, and help recover its biodiversity and function through: protecting it from significant impacts as a Matter of National Environmental Significance under national environmental law; and by guiding implementation of management and recovery through the recommended priority conservation and research actions set out in this advice.

5.2. Principles and standards

To undertake priority actions to meet the conservation objective, the overarching principle is that it is preferable to maintain existing areas of the ecological community that are relatively intact and of high quality. There are good, practical reasons to do so. It is typically more 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 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, 2016):

> "**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. Many projects that aspire to restoration fall short of reinstating reference ecosystem attributes for a range of reasons including scale and degree of damage and technical, ecological and resource limitations."
>
> *Standards Reference Group SERA (2016) – Appendix 2.*

The principle discourages 'off-sets' where intact remnants are removed with an undertaking to set aside and/or restore other, lesser quality, sites. The destruction of intact sites represents 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 (2016)[7]. They outline the principles that convey the main ecological, biological, technical, social and ethical underpinnings of ecological restoration practice.

[7] Society for Ecological Restoration: Website: http://www.seraustralasia.com/standards/contents.html (Accessed 22 May 2017).

5.3. Priority actions

Priority actions are recommended for the abatement of threats and supporting recovery of the ecological community. As Coastal Swamp Oak Forest is located around watercourses, actions to protect it often need to be undertaken both upstream and upslope 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;
- conditions of approval for relevant controlled actions under the EPBC Act; and
- prioritising activities in applications for Australian Government funding programs.

Detailed advice on actions may be available in specific plans, such as management plans for weeds, fire or certain parks or regions. The most relevant are listed in section 5.4 below.

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

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

5.3.1. PROTECT the ecological community.

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

Conserve remaining patches

- Protect and conserve remaining areas of the ecological community, including protecting potential areas of natural retreat (e.g. upslope and upstream of current occurrences).
- 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 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.
- Investigate formal conservation arrangements, management agreements and covenants to protect patches on private land. This is particularly important for larger patches or areas that link to other patches of native vegetation and are part of wildlife corridors or migration routes.
- Exclude fire from patches of the ecological community.

- Where regrowth is occurring, provide measures that will support the regrowth to mature (e.g. provide fencing to minimise damage risk).

Planning 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).
- Liaise with planning authorities to promote the inclusion of Coastal Swamp Oak Forest protection and projected tidal inundation zones in their plans/responses to climate change and sea level rise and in coastal zone management generally.

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 stags 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 medium and higher quality patches of the ecological community, 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 reduce may 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;
    - focus on the restoration of medium quality patches of the ecological community to achieve high quality 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 delivery 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. Buffers also serve as important landscape connections, such as wildlife corridors.
- Avoid activities that could cause significant hydrological change to patches of the ecological community:
    - Avoid constructing levees, culverts, floodgates etc. that will lead to permanent inundation or permanent tidal restriction of patches of the ecological community, or that will otherwise adversely alter existing inundation/tidal regimes.
    - Avoid constructing outlets/drains that direct stormwater discharge into or near patches of the ecological community.
    - Avoid building roads, weirs, bridges and other structures in a way that alters the natural hydrology.
    - Avoid draining of coastal wetlands.

Prevent the introduction and spread of exotic species

- Minimise unnecessary soil disturbance that may facilitate weed establishment.
- Prevent planting of known or potentially invasive species in gardens, developments and landscaping near the ecological community.
- 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.

Manage recreational pressures

- Where practical, restrict or prevent recreational vehicle access (including bicycles) to patches of the ecological community and assist through public education measures such as signs.
- Support the use of existing tracks and paths (e.g. erect educational signs and information points and promote their use).
- If constructing new access tracks across patches of the ecological community, implement best practice measures (e.g. use raised platforms) and ensure that access paths/tracks are not inundated at times of high tide.

5.3.2. RESTORE the ecological community

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

- Liaise with landholders and undertake and promote programs that ameliorate threats such as grazing and human disturbance.
- Identify and prioritise other specific threats and undertake appropriate on-ground site management strategies where required.

Manage weeds and pests

Implement effective integrated control and management techniques for weeds affecting the ecological community and manage sites to prevent the introduction of new, or further spread of, invasive weeds.

- Identify potential new weed incursions early and manage for local eradication, where possible.
- Prioritise weed and patches for which management is most urgent.
- Target control of key weeds that threaten the ecological community using appropriate methods. Particularly, undertake weed control for bitou bush and boneseed, lantana and exotic vines and scramblers.
- 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, do not have significant adverse, non-target impacts on the ecological community.
- Control introduced pest animals through coordinated landscape-scale control programs:
    - Particularly, instigate pig control programs.

Manage trampling, browsing and grazing

- Retire high conservation areas from grazing and follow up with weed management
- Develop and implement appropriate grazing regimes, including rotational grazing, or 'spelling', for the ecological community if grazing is to continue. These practices will also protect the agricultural values of the patch.
    - Promote regeneration by avoiding prolonged or heavy grazing. Short periods of intense grazing are preferable to leaving stock in for long periods.
    - Strategically manage total herbivore grazing (by native and domestic animals), for instance by fencing off regrowth, revegetation areas, or high value sites to restrict grazers.
    - If stock could carry weeds into the remnant, then it is preferable to exclude stock altogether or admit them only at times when none of the weeds are releasing viable seed. If moving stock to patches of the ecological community, ensure stock are purged of weed seeds (e.g. hold stock in paddocks free from major weed seeds for an appropriate time prior to introduction).
    - Avoid grazing during native plant flowering and seeding times (late spring and summer).

Manage fire

- The overall priority is to exclude fire from patches of the ecological community.
- Implement appropriate fire management regimes for the landscapes surrounding the ecological community, taking into account results from research:
    - Use available ecological information to understand how fire may impact on key species in the ecological community; for instance, do not burn areas adjacent to the ecological community when threatened or functionally important flora and fauna are reproducing.
    - Apply mosaic burning patterns, where feasible, during controlled burning of natural vegetation adjacent to the ecological community to increase habitat variability.
    - Do not burn adjacent to the ecological community if soil moisture is very low, or dry conditions are predicted for the coming season as recovery will be too

slow and erosion may occur or weeds become established while the ground is bare.

Undertake restoration

- Undertake restoration, including bush regeneration and revegetation, of poorer and medium quality patches to restore them to high quality.
    - 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.
- Develop collection program and collect seed from the ecological community for the Australian Seedbank Partnership8 and/or other relevant programs.
- Implement effective adaptive management regimes using information from available research and management guidelines (for example, the National Standards for the Practice of Ecological Restoration in Australia, Standards Reference Group SERA (2016)), relevant research or advice from local authorities.
- Investigate options to restore natural hydrological regimes to patches of the ecological community that have been adversely impacted and implement wetland restoration where appropriate.

5.3.3. 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

- 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 (e.g. during recreational activities) and of minimising pollution and littering (e.g. via signage).
- 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

[8] Website for Australian Seedbank Partnership: http://www.seedpartnership.org.au/

responsibilities under state and local regulations and the EPBC Act. This includes preparation of identification and impact assessment guidelines for the ecological community.
- Install signage to discourage damaging activities such as the removal of 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 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 fire management of 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.

5.3.4. RESEARCH AND MONITORING

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

Mapping

- Collate existing vegetation mapping information and associated data for this ecological community and identify gaps in knowledge.
- Identify and map areas of the ecological community most vulnerable to sea level rise to inform planning that will protect areas that allow the ecological community to retreat landward.
- 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 truthing to fill data gaps and clarify the presence and condition of remnants.
    - Identify where the best, high quality remnants of the ecological community occur.

Options for managing threats

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

Understanding regrowth

- Research to gain a better understanding of how regrowth stands develop and how they can best be managed alongside other ecological communities, particularly those typically dominated by *Melaleuca* species in the canopy.

- Research the development of regrowth stands of the ecological community to improve understanding of their rate and trajectory of development and evaluate convergence with undisturbed reference states.

Monitoring

- 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.

5.4. Existing plans relevant to the ecological community

Existing plans relevant to this ecological community exist in the form of regional natural resource management plans, conservation plans and plans of management for National Parks estate that include areas of Coastal Swamp Oak Forest, as well as regional planning documents.

Recovery plans

- DECCW (2010d) *Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region.* Department of Environment, Climate Change and Water NSW, Sydney. *Available from* http://www.environment.gov.au/system/files/resources/4b79fa42-5c8f-4dfe-9e79-07ed5832a056/files/northern-rivers.pdf
- DECCW (2010) Border Ranges Rainforest Biodiversity Management Plan - NSW & Queensland, Department of Environment, Climate Change and Water NSW, Sydney. Available from: http://www.environment.gov.au/system/files/resources/4249147f-26eb-416b-ae78-e982a7099e4f/files/brrb-management-plan.pdf

Regional Natural Resource Management (NRM) plans

- The *Burnett Mary Regional Group for Natural Resource Management* provides relevant information on wetland management. Available from: wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/nrm-burnett-mary-regional-group-for-nrm/
- SEQC (2016). *Managing Natural Assets for a Prosperous South East Queensland*. Part of the *South East Queensland Natural Resource Management Plan 2009–2031*. Available from: www.seqcatchments.com.au/seq-nrm-plan-1/the-seq-nrm-plan
- Northern Rivers CMA (2013). *Northern Rivers Catchment Action Plan.* Available from: northcoast.lls.nsw.gov.au/home

Regional conservation plans

New South Wales has developed coastal regional conservation plans to guide councils in achieving biodiversity conservation outcomes, particularly through planning processes. These include:

- DECCW (2010a) *Far North Coast Regional Conservation Plan* - identified priority conservation areas that include swamp forest include the Cudgen Coast and Byron Bay–Broken Head. Available from: www.environment.nsw.gov.au/resources/biodiversity/10982fncrcp.pdf

- DECCW (2010b) Draft *Mid North Coast Regional Conservation Plan* recommends protection for all wetland areas in the Clarence, Macleay and Manning rivers due to their importance in ecosystem function and as threatened species habitat. Available from: www.environment.nsw.gov.au/resources/biodiversity/10999dmncrcp.pdf
- DECCW (2010c) *South Coast Regional Conservation Plan.* Available from: www.environment.nsw.gov.au/resources/biodiversity/101000scrcp.pdf

Plans of Management for national park estate with areas of swamp oak coastal forest

- The *Maroochy River Conservation Park Management Plan*. Available from: www.nprsr.qld.gov.au/managing/plans-strategies/pdf/maroochy-river-conservation-park-2000.pdf
- Office of Environment and Heritage (NPWS 1999) *Bongil Bongil National Park Draft Plan of Management.* Available from: www.environment.nsw.gov.au/publications/parks/bongil-bongil-national-park-draft-plan-of-management-170136.htm

Regional planning documents

For New South Wales, regional planning documents recognise that coastal growth and development places pressure on environmentally sensitive areas, including coastal lakes and estuaries and wetlands in the northern extent of the state.

- For example, the *Far North Coast Regional Strategy* (Department of Planning, 2006) notes that Swamp Oak Floodplain Forest is the ecological community that will be most impacted as a result of proposed urban development. Available from: www.planning.nsw.gov.au/~/media/Files/DPE/Strategy-documents/far-north-coast-regional-strategy-2006-to-2031-2006-12.ashx
- The *North Coast Regional Plan 2036* (DPE, 2017) highlights important planning principles to enhance the management the impacts of natural hazards and climate change on sensitive ecosystems, within the context of coastal development. Available from: www.planning.nsw.gov.au/~/media/Files/DPE/Plans-and-policies/north-coast-2036-regional-plan-2017.ashx

5.5. Recovery plan recommendation

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

The main threats to the ecological community and the priority actions required to address them are largely understood. The Conservation Advice sufficiently outlines the priority actions needed for this ecological community and many of the threats affecting the ecological community are best managed at a landscape scale, coordinated with management of other ecological communities. In addition, a number of existing documents are relevant to the management and/or recovery of this ecological community or the threats to it, outlined in section 5.3 above.

Taking into account the benefits of supplementing existing protection with national listing and implementing the priority research and conservation actions outlined in section 5.3 above, a separate recovery plan for the ecological community is not required at this time.

6. APPENDICES

6.1. Appendix A – Species Lists

6.1.1. Characteristic or common flora species of Coastal Swamp Oak Forest[9]

Scientific names are nationally accepted names as per the Australian Government 2016: *Australian Plant Census* as at May 2016 *and* NSW Flora Online (PlantNet, 2016) as at May 2017.

Other sources: NSW Scientific Committee (2004); Keith and Scott, (2005); Miles, (2006); Sheringham et al., (2008); DECC (2008) and Tozer et al., (2010).

Note: Due to the large latitudinal range of this community, some species will be only relevant in certain parts of the coast. Relevant species are noted if they are known to be limited to north (N) or south (S) of Sydney.

Table 3: Characteristic or common flora

Scientific name	**Common name/s**
Canopy / sub-canopy / emergent species	
Acmena smithii	lilly pilly
Alphitonia excelsa	red ash, soap tree, sarsaparilla tree
Casuarina glauca	swamp oak (swamp she-oak)
Cupaniopsis anacardioides (N)	tuckeroo
Elaeodendron australe	red olive-berry
Eucalyptus botryoides (S)	southern mahogany, bangalay
Eucalyptus longifolia (S)	woollybutt
Eucalyptus tereticornis	forest red gum
Ficus coronata	sandpaper fig
Glochidion ferdinandi	cheese tree
Glochidion sumatranum (N)	umbrella cheese tree
Lophostemon suaveolens (N)	swamp mahogany
Melaleuca alternifolia	narrow-leaved paperbark
Melaleuca ericifolia (S)	swamp paperbark
Melaleuca decora	white feather honey myrtle
Melaleuca quinquenervia	broad leaved paperbark
Melaleuca styphelioides	prickly leaved tea-tree
Melicytus dentatus	tree violet
Myoporum acuminatum	boobialla
Myrsine howittiana	muttonwood
Pittosporum undulatum	sweet pittosporum
Mid storey	
Breynia oblongifolia	breynia
Cladium procerum	leafy twigrush
Notelaea venosa	mock olive
Phragmites australis	common reed
Rhagodia spp.	rhagodia

[9] The total vascular plant species list of the ecological community is considerably larger than the species listed here

Scientific name	Common name/s
Climbing and epiphytic species	
Amyema cambagei	mistletoe
Cynanchum carnosum(N)	mangrove vine
Dendrobium teretifolium	pencil orchid
Flagellaria indica(N)	whip vine
Geitonoplesium cymosum	native asparagus
Glycine clandestina	twining glycine
Parsonsia straminea	common silkpod
Platycerium bifurcatum	elkhorn/staghorn ferns
Smilax australis	Austral sarsparilla
Stephania japonica var. discolour	snake vine
Ground layer	
Alternanthera denticulata	lesser joyweed
Atriplex australasica	native orache
Baumea juncea	bare twig rush
Blechnum indicum	swamp-water fern
Carex appressa	tall sedge
Centella asiatica	Indian pennywort
Commelina cyanea	scurvy weed
Cynodon dactylon	sand couch
Crinum pedunculatum	swamp lily
Dianella caerulea	blue flax lily
Enchylaena tomentosa var. *glabra*	ruby salt bush
Enydra spp.	an enydra
Entolasia spp.	panic grasses
Ficinia nodosa	knobby-club rush
Fimbristylis dichotoma	tall fringe rush
Gahnia clarkei	saw (sword) sedge
Goodenia ovata	hop goodenia
Hypolepis muelleri	harsh ground fern
Imperata cylindrica	blady grass
*Juncus kraussii (*including *subsp. Australiensis)*	sea rush
Lobelia anceps	angled lobelia
Lomandra longifolia	spiny-headed mat-rush
Microlaena stipoides	weeping grass
Oplismenus imbecillis, O. aemulus	creeping beard grass, basket grass
Persicaria eliator	tall knotweed, smart pinkweed
Persicaria spp.	slender knotweed
Phragmites australis	common reed
Poa poiformis	blue tussock grass
Pratia purpurascens	whiteroot
Samolus repens	creeping brook/bushweed
Sarcocornia quinqueflora	samphire
Selliera radicans	swamp weed
Sesuvium portulacastrum	sea purslane
Smilax australis	Austral sarsparilla
Sporobolus virginicus	sand or salt couch
Suaeda australis	Austral seablite
Tetragonia tetragonoides	warrigal greens, New Zealand spinach
Viola banksii	wild violet

6.1.2. Characteristic or common fauna species of Coastal Swamp Oak Forest.

Sources: Marchant and Higgins (1990, 1993); Higgins and Davies, 1996; Higgins, 1999; Higgins, Peter and Steele (2001); Higgins and Peter (2002); Meyer et al., (2006); Van Dyck and Strahan (2008); Watson (2011); Cogger, 2014; SPRAT Search (Australian Government 2016b); and, OEH (2016).

Table 4: Common or characteristic fauna

Scientific name	Common name
Mammals	
Antechinus agilis	agile antechinus
Antechinus flavipes	yellow-footed antechinus (northern)
Antechinus stuartii	brown antechinus
Cercartetus nanus	eastern pygmy possum
Chalinolobus dwyeri	large-eared pied bat
Chalinolobus nigrogriseus	hoary wattled bat
Dasyurus maculatus maculatus (S)	spotted-tailed quoll (se mainland)
Isoodon obesulus obesulus (S)	southern brown bandicoot
Falsistrellus tasmaniensis	eastern false pipistrelle
Isodon macrourus	northern brown bandicoot
Macropus giganteus	eastern grey kangaroo
Macropus rufogriseus	red-necked wallaby
Miniopterus australis	little bentwing bat
Myotis adversus	large-footed myotis
Miniopterus schreibersii oceanensis	eastern bentwing bat
Mormopterus norfolkensis	eastern free-tail bat
Myotis macropus	southern myotis
Petaurides volans	greater glider
Petaurus australis	yellow bellied glider
Petaurus norfolcensis	squirrel glider
Petaurus breviceps	sugar glider
Petrogale penicillata	brush-tailed rock wallaby
Peramales nasuta (population)	long-nosed bandicoot
Phascogale tapoatafa	brush-tailed phascogale
Phascolarctos cinereus	koala
Planigale maculata	common planigale
Potorous tridactylus	long-nosed potoroo
Pseudomys novaehollandiae	New Holland mouse, Pookila
Pteropus poliocephalus	grey-headed flying fox
Rattus lutreolus	swamp rat
Saccolaimus flaviventris	yellow-bellied sheathtail bat
Scoteanax rueppellii	greater broad-nosed bat
Sminthopus leucopus (S)	white-footed dunnart
Syconycteris australis (N)	eastern blossom-bat
Trichosaurus caninus SEQ	short eared (or mountain) brush tailed possum
Xeromys myoides.	water mouse (false water rat)

Scientific name	Common name
Reptiles	
Amphibolurus muricatus	jacky lizard
Bellatorias major	land mullet
Chelodina longicollis	eastern long-necked turtle
Cyclodomorphus gerradiii	pink-tongued lizard
Cyclodomorphus michaeli	mainland she-oak skink
Egernia mcpheei	tree skink
Elseya albagula	white throated snapping turtle – SEQ only
Elusor macrurus	Mary River turtle
Emydura macquarii	Murray River turtle
Hemiaspis signata	black-bellied swamp (or marsh) snake
Hoplocephalus bitorquatus (N)	pale-headed snake
Intellagama leseuruii	eastern water dragon
Myuchelys georgesi	Bellinger River turtle
Tiliquia nigrolutea	blotched blue tongue lizard
Tropidechis carinatus (N)	Clarence River or rough-scaled snake
Pseudonaja textilis	eastern brown snake
Pseudechis porphyriacus	red-bellied black snake
Amphibians	
Crinia tinnula	wallum froglet
Lechriodus fletcheri	Fletcher's frog
Limnodynastes dumerilii	eastern banjo frog (pobblebonk)
Limnodynastes peroni	brown-striped frog
Litoria aurea	green and golden bell frog
Litoria brevipalmata	green-thighed frog
Litoria caerulea	green tree frog
Litoria citropa	Blue Mountains tree frog
Litoria cooloolensis (N)	Cooloo segdgefrog
Litora fallax	dwarf green tree frog (all colour morphs)
Litoria freycinetti	wallum rocket frog
Litoria latopalmata	broad-palmed frog
Litoria olongburensis (N)	Olongburra frog/ wallum sedgefrog
Litoria revelata	revealed frog
Litoria wilcoxi	Wilcox's frog
Platyplectrum ornatum	ornate burrowing frog
Birds	
Accipiter novaehollandiae	grey goshawk
Acrocephalus australis	Australian reed warbler
Anseranas semipalmata	magpie goose
Anthochaera phrygia	regent honeyeater
Ardea alba	eastern great egret
Botaurus poiciloptilus	Australasian bittern
Bubulus ibis	cattle egret
Calidris tenuirostris	great knot
Calyptorhynchus funereus	yellow-tailed black cockatoo
Calyptorhynchus lathami lathami	glossy black cockatoo
Charadrius leschenaultia	the greater sand plover
Cracticus tibicen	Australian magpie
Coturnix ypsilophora	brown quail
Dasyornis brachypterus	eastern bristlebird
Dendro cygna arcuata	wandering whistling duck
Dromaius novaehollandiae (N)	emu
Egretta garzetta	little egret

Scientific name	Common name
Ephippiorhynchus asiaticus	black-necked stork
Epthianura albifrons	white-fronted chat
Erythrotriorchis radiates	red goshawk
Grantiella picta	painted honeyeater
Haliaeetus leucogaster	white-bellied sea-eagle
Haliastur indus	Brahminy kite
Irediparra gallinacea	comb-crested jacana
Ixobrychus flavicollis	black bittern
Lathamus discolor	swift parrot
Leucosarcia picata	Wonga pigeon
Limosa limosa	black-tailed godwit
Lophoictinia isura	square-tailed kite
Malurus cyanus	superb blue wren
Malurus lamberti	variegated wren
Malurus melanocephalus	red-backed fairy wren
Merops ornatus	rainbow bee-eater
Neochmia temporalis	red browed firetail
Ninox connivens	barking owl
Ninox strenua	powerful owl
Numenius madagascariensis	eastern curlew
Pandion cristatus	eastern osprey
Pachycephala rufiventris	rufous whistler
Parvipsitta pusilla	little lorikeet
Petroica phoenicea	flame robin
Pezoporus wallicus wallicus	eastern ground parrot
Pomatostomus temporalis temporalis	grey-crowned babbler
Rhipidura albiscapa	grey fantail
Rostratula australis	Australian painted snipe
Stictonetta naevosa	freckled duck
Stipiturus malachurus	Southern emu wren
Trichoglossus haematodus	rainbow lorikeets
Trichoglossus chlorolepidotus (N)	scaley breasted lorikeets
Threskiornis spinicollis	straw-necked ibis
Tringa nebularia	common greenshank
Tringa stagnatilis	marsh sandpiper
Tyto longimembris	eastern grass owl
Tyto novaehollandiae	masked owl
Xenus cinereus	Terek sandpiper
Invertebrates	
Argynnis hyperbius (N)	laced fritillary
Australothele Nambucca (N)	large curtain web spider
Delias aganippe	spotted jezebel
Hypochrysops delcicia	moonlight jewel
Megadolomedes australianus	giant water spider
Nephilla spp.	golden orb weaving spider
Ocybadistes knightorum (N)	black grass (Knights) dart butterfly
Petalura litorea (N)	coastal petaltail (dragonfly)
Psychonatis caelius taygetus	small green-banded blue (butterfly)
Tisiphone abeona	varied sword grass brown (butterfly)
Spodoptera picta	lily caterpillar (moth)
Tetragonula carbonaria	stingless native bees

6.2. Appendix B - Additional information on map units and regions

Relevant Map Units	**South-east Queensland** ***Regional Ecosystem Description Database*** (DSITIA 2017) RE 12.1.1 *Casuarina glauca* woodland on margins of marine clay plains (Swamp She Oak open forest). *Parts of* RE: 12.3.20 *Melaleuca quinquenervia, Casuarina glauca +/- Eucalyptus tereticornis, E. siderophloia* open forest (Vegetated swamp). (Only where dominated by *C. glauca*) **New South Wales** ***Vegetation of the coastal lowlands of Tweed shire, northern New South Wales, species and conservation*** Pressey and Griffith (1992) F10 - *Casuarina glauca* tall to very tall open to closed forest ***North-east NSW Forest Ecosystems*** (NPWS 1999b) 143 – Swamp oak ***NPWS NSW Coastal Vegetation*** (Griffith and Wilson 2007) (cited in Sheringham 2008) 5001/2 – *Casuarina glauca* forest and woodland 40991/2 – Mixed stands of *Melaleuca quinquinerva – Casuarina glauca* 40151 – *Casuarina glauca – Avicenna marina* ssp *australasica* ***Tweed Vegetation Management Strategy 2004*** (Kingston et al. 2004) 601 – Swamp She-oak Closed Forest to Woodland 602 – Mangrove Low Closed Forest to Woodland ***Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands*** (Tozer et al. 2010) FoW 105: Floodplain Swamp Forest; FoW 106: Estuarine Fringe Forest; FoW 107: Estuarine Creekflat Scrub. **NSW Plant Community Types (PCT) ID:** 1235 - Swamp oak swamp forest of the coastal lowlands of NSW NC Bioregion 1727 - Swamp-oak-Sea rush-Baumea juncea swamp forest 1728 - Swamp oak- Prickly paperbark tall sedge forest of the Central Coast Lower North Coast 1232 - Coastal Freshwater Swamp Forest 1234 - Swamp oak swamp forest fringing estuaries, Syd Basin and SEC 1236 - Swamp paperbark-Swamp oak 1800 - Swamp oak open forest on riverflats of the Cumberland Plain and Hunter Valley 1917- Milky Mangrove Woodland of tidal estuaries 1920 - Swamp Oak – Broad-leaved paperbark – Willow bottlebrush floodplain forested wetland 1924 - Broad-leaved Paperbark – Swamp Oak – Tall Sedge swamp forest on alluvial soils **From the NSW Vegetation Information Systems database** http://www.environment.nsw.gov.au/research/Visclassification.htm
Natural Resource Management (NRM) Regions	**South East Queensland** Fitzroy Burnett-Mary South East Queensland. **New South Wales** North-coast Hunter Greater Sydney South East NSW

IBRA bioregions and subregions (IBRA v.7)	**South East Queensland (SEQ)** SEQ 1 Burnett-Curtis Hills and Ranges SEQ 3 Burringbar-Conondale Ranges SEQ 4 Sunshine Coast-Gold Coast Lowlands SEQ 8 Burnett-Curtis Coastal Lowlands SEQ 9 Great Sandy SEQ 13 Clarence Lowlands **NSW North Coast (NNC)** NNC 5 Yuraygir NNC 6 Coffs Coast and Escarpment NNC 7 Macleay Hastings NNC 17 Karuah Manning **Sydney Basin (SYB)** SYB 2 Hunter SYB 5 Yengo SYB 9 Burragorang SYB 12 Illawarra SYB 13 Ettrema SYB 14 Jervis **South East Corner (SEC)** SEC 3 Bateman SEC 2 South East Coastal Ranges (to Bega only)

6.3. Appendix C - Additional information to assist in identifying the ecological community

6.3.1. Identifying a patch

A patch is a discrete and mostly continuous area of the ecological community, as defined by the key diagnostics, but can include small-scale variations, gaps and disturbances.

Boundary of a patch

The edge of the patch extends to the outer edge of swamp oak tree canopy.

Breaks in a patch

When it comes to defining a patch of the ecological community allowances are made for "breaks" up to 30 metres between areas that meet the key diagnostics. Such breaks may be the result of watercourses or drainage lines, tracks, paths, roads, gaps made by exposed areas of soil, and areas of localised variations in vegetation that do not meet the key diagnostics. Such breaks do not significantly alter the overall functionality of the ecological community and form a part of the patch. They should be included in the calculation of the size of the patch, and taken into account when determining the overall condition of the patch.

For example, a single patch could include two areas of the ecological community that meet the **key diagnostics, but** are separated by < **30 m** mangroves lining a watercourse.

Where there is a break in the ecological community of 30 metres or more (e.g. due to permanent artificial structures, wide roads or other barriers, water bodies or other types of vegetation) then the gap indicates that separate patches are present.

Patch condition and variation within a patch

Patches of Coastal Swamp Oak Forest may contain areas that vary in structural or biological complexity. One part of a patch may have a larger number of mature species and more ecological diversity, whereas another part of the same patch may demonstrate fewer mature trees and less groundcover. Areas with soil exposed and/or leaf litter can be expected within this ecological community. Variation in quality or condition of vegetation across a patch should not be considered to be evidence of multiple patches.

Patches of the ecological community can be spatially variable and are often characterised by one or more areas within a patch that meet higher condition threshold criteria amongst areas of lower condition. Average quality across the largest area that meets the key diagnostics should be used in determining overall vegetation condition. All areas that meet the key diagnostics, regardless of their condition, are generally included in patch size calculations.

Where the average condition falls below the minimum condition thresholds for a vegetation patch as a whole, the largest area or areas that meet minimum condition thresholds should be specified as the patch or patches of the nationally listed ecological community. This may result in multiple patches of the ecological community being identified within the overall area first identified as meeting the key diagnostics.

6.3.2. Buffer zones

A buffer zone is a contiguous area adjacent to a patch that is important for protecting the integrity of the ecological community. As the risk of damage to an ecological community is usually greater where actions occur close to a patch, the purpose of the buffer zone is to minimise this risk by guiding land managers to be aware that the ecological community is nearby and take extra care. For instance, the buffer zone will help protect the root zone of edge trees and other components of the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land), weed invasion, polluted water runoff and other damage. The best buffer zones are typically comprised of other native vegetation.

The buffer zone is not part of the ecological community, so while having a buffer zone is strongly recommended, it is not formally protected as a Matter of National Environmental Significance and is not included in the calculation of the patch size. To avoid the need to refer an action for approval under the EPBC Act, changes in use of the land that falls within the buffer zone must not have a significant impact on the ecological community, but there are exemptions for continuing use (e.g. cropping, grazing or maintaining existing fire breaks). If the use of an area that directly adjoins a patch of the ecological community will be intensified, approval under the EPBC Act may be required. The buffer zone may also be a suitable focus for revegetation or other restoration initiatives.

The recommended minimum buffer zone is 30 m from the outer edge of the patch (as defined by the edge of the tree canopy) as this distance accounts for likely influences upon the root zone. A larger buffer zone should be applied, where practical, to protect patches that are of very high conservation value or if patches are located below drainage lines or a source of nutrient enrichment or groundwater drawdown.

6.3.3. Survey protocols

Patches of the ecological community can vary markedly in their shape, size, condition and features. Thorough and representative on-ground surveys are essential to accurately assess the extent and condition of the patch. The 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. The size, number and spatial distribution of plots or transects must be adequate to represent variation across the patch. 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. For instance, localised weed cover, drainage lines, burned or grazed areas, saline zones. Plots of 0.04 ha (quadrats of 20 x 20 m) may 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).

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