

**THE NATURAL VEGETATION  
IN THE  
MUNICIPALITY OF KIAMA  
NEW SOUTH WALES**

**FINAL REPORT**

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ECOLOGICAL AND ENVIRONMENTAL CONSULTANTS**

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a report prepared by

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# THE NATURAL VEGETATION IN THE MUNICIPALITY OF KIAMA NEW SOUTH WALES

## 1. INTRODUCTION

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This report was prepared for Kiama Municipal Council, to accompany a map of the natural vegetation in the Kiama Local Government Area (LGA), also prepared by Kevin Mills & Associates in 2005. The map is stored digitally in Council's Geographic Information System (GIS). Figure 1 shows the boundaries of Kiama Local Government Area.

The Kiama Municipality covers about 256 km<sup>2</sup> and abuts Shellharbour LGA to the north and Shoalhaven LGA to the south. Both of those areas have been previously mapped for their vegetation by Kevin Mills & Associates. The techniques employed in this study and the terminology used to denote the vegetation communities are consistent between these three local government areas.

The term "natural vegetation" refers, in this report, to areas of native vegetation that have retained most of their structural and floristic characteristics. The term also refers to regrowth that has achieved or has the potential to achieve a near natural structure. Very little vegetation in the Kiama LGA is in a completely natural condition; almost all areas have been logged or partially cleared at some time since European settlement, except for the sandstone communities of the plateaux. Artificial communities are included in the study, for completeness. These include stands of planted trees, patches of exotic trees and Lantana scrub.

The primary purposes for preparing the vegetation map for the Municipality and this report are:

- to provide Council with a map of the vegetation types that can be used to identify bushfire hazard and assist in bushfire planning throughout the municipality;
- to identify the endangered ecological communities and their distribution within the municipality, so that Council can meet its obligations under the *Threatened Species Conservation Act, 1995*;
- to document the known threatened plant species in the Municipality;
- to assist Council in the preparation of a biodiversity conservation strategy for the Municipality; and
- to provide a basis upon which Council can assess development applications that involve vegetation clearing or disturbance.

## **2. METHODOLOGY**

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### **2.1 PREPARATION OF THE VEGETATION MAP**

The vegetation map was prepared through field surveys undertaken in 2003, although the consultant had been studying the vegetation in the Kiama district for many years and some existing information on the vegetation of the area was available from various previous reports. Extensive use was made of the 1:8,000 colour aerial photographs taken in 1997. Reports containing vegetation maps and other information on the vegetation in the Kiama LGA were also sourced. Any appropriate information on the maps in those reports was incorporated into the vegetation map.

The boundaries of the vegetation communities were identified on the aerial photographs during the field surveys, and were then marked onto a set of maps prepared by Council at a scale of 1:8,000, showing rectified colour aerial photography (flown in 1999) roads and the boundary of the local government area. Council then digitised the boundaries directly into their Geographical Information System (GIS). A small version of the vegetation map is provided in Figure 2.

Although this study focuses on the natural vegetation in the Kiama LGA, a few non-natural communities were also included, in order to complete the vegetation map; introduced plants dominate most of these communities. A few natural communities cover small areas and were not mapped; these are mainly wetland communities and are discussed in this report.

### **2.2 SURVEY METHODOLOGY**

The survey methodology used during this study has been described in a paper on a survey methodology and vegetation classification system developed for the Shoalhaven LGA (Mills 1998). The methodology was developed because of the need for a uniform approach to vegetation surveys and vegetation classification in the Shoalhaven area. The same method was used in Shellharbour LGA and during this study, because it standardises the methods and terminology used in the three adjoining local government areas. Furthermore, with the development of Council's GIS system, there is a need to ensure that all future vegetation studies in the Kiama area conform to a benchmark standard. Eventually, vegetation maps from several local government areas in the region can be combined to produce a regional map.

The methodology involved the collection of floristic data and other ecological information at locations considered to be representative of the vegetation community being sampled. The vegetation on each site was surveyed at all levels present, including the canopy (trees), middle canopy (trees), understorey (shrubs) and ground cover (plants less than one metre in height). The aim of the surveys was to describe the general character of the vegetation community, and record information such as the geology and altitude, etc.

Extensive field investigation was used to identify community types and delineate vegetation boundaries instead of scattered vegetation survey plots and extrapolation to unsurveyed areas.

Using the data from these and previous surveys, the vegetation communities were then classified using the following two criteria: (i) the name(s) of the dominant species in the tallest stratum of the community, and (ii) the structure of the community. The vegetation communities in the Kiama LGA were therefore described using a binomial system; the first part refers to the

common name(s) of the dominant species, usually a tree species, and the second part refers to the structure of the community, indicating whether it is forest, woodland, shrubland or grassland, etc.

The community was then assigned a six-letter identification code. In order to achieve consistency throughout the Illawarra Region, the names of the communities and the identification codes used in the Shoalhaven LGA (Mills 1998) and Shellharbour LGA (Kevin Mills & Associates (2001) were applied to the Kiama LGA. Several additional vegetation communities were described and several new identification codes devised over and above those previously used in Shellharbour or Shoalhaven.

## **2.3 VEGETATION COMMUNITIES IN THE KIAMA LGA**

The vegetation communities mapped within the Municipality of Kiama are listed in Table 1. Forty (40) communities have been identified, grouped into eight broad categories ranging from rainforests, to eucalypt forests, shrublands, wetlands and grasslands. All of the communities are natural, with the exception of Wattle Forest (ACA-FOR), Miscellaneous/Mixed Forest (MIS-FOR), Lantana Shrubland (LAN-SHR) and Non-native Grassland (INT-GRL); these communities were included in the report for the sake of completeness. The vegetation map is provided in Figure 2. In total, 7,127 hectares of vegetation was mapped in this study; this is about 28% of the LGA.

The vegetation within Budderoo National Park and Barren Grounds Nature Reserve has been mapped by the NPWS. Their map is incorporated into Council's GIS, thus the total area of Kiama LGA has been mapped. The NPWS vegetation types are listed in Table 2. The vegetation map presented to Council converts the NPWS types to those used in this study; Table 2 shows the equivalent communities.

The vegetation communities identified during this study are described below, in terms of the following:

- i. a brief summary of the structure and floristic composition of the community;
- ii. notes on the distribution of each community in the Kiama LGA;
- iii. the total area (hectares) of the community mapped in the Kiama LGA; these areas do not include additional vegetation within Budderoo National Park and Barren Grounds Nature Reserve, mapped by NPWS.
- iv. a conservation priority rating, based on its ecological value, to indicate what priority should be given to conserving the community wherever it occurs in the Kiama LGA;
- v. information on which reserve(s) contain the vegetation community. It should be noted that "reservation" does not always imply "conservation". While some reserves have a nature conservation focus, others were established to provide areas for recreation, as well; they are not necessarily managed to conserve flora and fauna. The reserves in the area are discussed in Section 4.1.

**Table 1**  
**Vegetation Communities Identified within the Municipality of Kiama**

Vegetation Community <sup>1</sup>	Code	Key Species	Notes
<b>Group 1. Rainforests (7 types)</b>			
1.1 Complex Subtropical Rainforest	COM-SRF	<i>Ficus</i> spp., <i>Toona ciliata</i> , <i>Pouteria australe</i>	Occurs on lowland volcanic soils.
1.2 Complex Littoral Rainforest	COM-LRF	<i>Podocarpus elatus</i> , <i>Elaeodendron australe</i>	Occurs on sand on the coast and sometimes on headlands.
1.3 Coachwood Warm Temperate Rainforest	CER-WRF	<i>Ceratopetalum apetalum</i> , <i>Doryphora sassafras</i>	Common on the upper escarpment slopes.
1.4 Plumwood Cool Temperate Rainforest	EUC-CRF	<i>Eucryphia moorei</i> , <i>Ceratopetalum apetalum</i>	Occurs on the upper slopes of the escarpment, below the cliffs.
1.5 Ironwood Warm Temperate# Rainforest	BAC-WRF	<i>Backhousia myrtifolia</i>	Occurs in small stands along lower escarpment gullies and on dry site amongst moist rainforest.
1.6 Simple Littoral Rainforest	SIM-LRF	<i>Glochidion ferdinandi</i> , <i>Guioa semiglauca</i>	Occurs on sand, mostly on an understorey to Bangalay – Banksia forest south of Gerroa.
1.7 Sassafras Warm /Cool Temperate Rainforest	DOR-WRF	<i>Doryphora sassafras</i> , <i>Dicksonia antarctica</i>	On basalt soils in the Knights Hill area.
<b>Group 2. Eucalypt Forests (11 types)</b>			
2.1 White Box - Brown Barrel Tall Forest	QUD-FAS	<i>E. quadrangulata</i> , <i>E. fastigata</i> , <i>E. smithii</i>	The most common tall forest along the escarpment slopes, above about 300 metres in elevation.
2.2 White Box - Yellow Stringybark Tall Forest	QUD-MUL	<i>E. quadrangulata</i> , <i>E. muelleriana</i>	Occurs on rather exposed escarpment ridges.
2.3 Blackbutt Tall Forest	PIL- SYN	<i>Eucalyptus pilularis</i> , <i>Syncarpia glomulifera</i>	Occurs on volcanic sandstone and talus across the area, mostly in discrete stands from other forests.
2.4 Blackbutt – Banksia Tall Forest	PIL-BAN	<i>Eucalyptus pilularis</i> , <i>Banksia serrata</i>	Occurs on sand plains and low dunes inland of community 2.9.
2.5 Blue Gum – White Box Tall Forest	SAL-QUD	<i>E. saligna</i> / <i>E.botryoides</i> , <i>E. quadrangulata</i>	Occurs at the foot of the escarpment, in moister sites than community 2.8.
2.6 Blue Gum – Turpentine Forest	SAL-SYN	<i>E. saligna</i> / <i>E.botryoides</i> , <i>Syncarpia glomulifera</i>	
2.7 Red Gum - Blue Gum Forest	TER-SAL	<i>Eucalyptus tereticornis</i> , <i>E. saligna</i> / <i>E.botryoides</i>	
2.8 Red Gum - Stringybark Forest	TER-EUG	<i>Eucalyptus tereticornis</i> , <i>E. eugenioides</i> , <i>Angophora floribunda</i> , <i>Eucalyptus bosistoana</i>	



Vegetation Community <sup>1</sup>	Code	Key Species	Notes
<b>Group 2 cont...</b>			
2.9 Bangalay - Banksia Forest	BOT-BAN	<i>Eucalyptus botryoides</i> , <i>Banksia integrifolia</i>	Inland of the hind dunes along the coast, usually growing on sand plains.
2.10 Silvertop Ash – Peppermint Forest/Woodland	SIE-PIP	<i>Eucalyptus sieberi</i> , <i>Eucalyptus piperita</i> , <i>Eucalyptus gummifera</i>	Extensive across the Budderoo-Barren Grounds plateau; very variable community.
2.11 Brown Barrel Tall Forest	FAS-CYP	<i>Eucalyptus fastigata</i> , <i>Eucalyptus cypellocarpa</i> , <i>Eucalyptus smithii</i> , <i>Eucalyptus obliqua</i>	On basalt and shale soils in the Budderoo-Knights Hill area.
<b>Group 3. Miscellaneous Forests (1 natural type)</b>			
3.1 Coast Banksia Forest	BAN-FOR	<i>Banksia integrifolia</i>	Occurs on sand dunes inland of the foredunes.
3.2 Wattle Forest	ACA-FOR	<i>Acacia mearnsii</i>	Widespread artificial community, regrowth following clearing.
3.3 Miscellaneous Forest	MIS-FOR	Native and introduced trees	Used to denote planted trees, stands of weed trees and sometimes miscellaneous regrowth.
<b>Group 4. Floodplain Forests (2 types)</b>			
4.1 River Oak Tall Forest	CAS-CUN	<i>Casuarina cunninghamiana</i>	Occurs along the upper parts of the main streams in the area, such as Minnamurra River and Broughton Creek.
4.2 Swamp Oak Forest	CAS-GLA	<i>Casuarina glauca</i>	Occurs extensively on floodplains and near-estuary flats near the coast. Replaced by 4.1 higher up the stream.
<b>Group 5. Shrublands/Heathlands (5 types)</b>			
5.1 Paperbark Tall Shrubland	MEL-ARM	<i>Melaleuca armillaris</i>	Occurs on dry, rocky ridge crests and some slopes on volcanic rocks.
5.2 Coast Teatree Shrubland	LEP-LAV	<i>Leptospermum laevigatum</i> , <i>Banksia integrifolia</i>	Occurs just behind the foredunes along the coast.
5.3 Coast Wattle Shrubland	ACA-SPH	<i>Acacia longifolia sophorae</i>	Occurs on the foredunes along the coast.
5.4 Lantana Shrubland	LAN-SHR	<i>Lantana camara</i> *	Artificial community widespread in thickets in and near rainforest areas.
5.5 Sandstone Sedgeland/Heathland/Shrubland (Upland Swamp)	SST-SDG	Cyperaceae, Restioaceae, Myrtaceous shrubs	Extensive across the Budderoo-Barren Grounds plateau.
<b>Group 6. Fresh Wetlands (4 types)</b>			
6.1 Swamp Mahogany – Paperbark Forest	ROB-MEL	<i>Eucalyptus robusta</i> , <i>Melaleuca linariifolia</i>	On low-lying freshwater swamps near the coast.
6.2 Cumbungi Reedland#	TYP-RDL	<i>Typha orientalis</i>	Often an artificial community and occurring in stormwater ponds.

Vegetation Community <sup>1</sup>	Code	Key Species	Notes
<b>Group 6 cont...</b>			
6.3 Fresh Juncus Rushland#	JUN-FRH	<i>Juncus usitatus</i> , <i>Ludwigia peploides</i> *	Generally small stands around farm dams and other freshwater sites.
6.4 Spike-rush Sedgeland#	ELE-SDG	<i>Eleocharis sphacelata</i>	Common as small stands in dams and other freshwater depressions.
<b>Group 7. Saline Wetlands (5 types)</b>			
7.1 Mangrove Forest	AVI-FOR	<i>Avicennia marina</i>	Extensive along the estuary of the Minnamurra River.
7.2 Mangrove Shrubland	AVI-SHR	<i>Avicennia marina</i> , <i>Aegiceras corniculatum</i>	Extensive along the estuary of the Minnamurra River.
7.3 Phragmites Reedland	PHR-RDL	<i>Phragmites australis</i>	Generally small patches along estuaries and sometimes in floodplain depressions.
7.4 Saltmarsh	SAR-SUA	<i>Sarcocornia quinqueflora</i> , <i>Suaeda australis</i>	Quite extensive around the estuaries of the Minnamurra and Crooked Rivers.
7.5 Saltwater Juncus Rushland	JUN-SAL	<i>Juncus kraussii</i>	Generally small patches along estuaries, spreading onto the adjacent low-lying floodplains.
<b>Group 8. Grasslands (2 natural types)</b>			
8.1 Spinifex Grassland	SPN-GRL	<i>Spinifex sericeus</i> , <i>Carex pumila</i>	Occurs at the front of the foredunes along the coast.
8.2 Kangaroo Grass Grassland#	THM-GRL	<i>Themeda australis</i>	Occurs in small stands on headlands along the coast.
8.3 Non-native Grassland#	INT-GRL	<i>P. clandestinum</i> *, <i>S. secundatum</i> *	Most of the unmapped rural areas support pastures of non-native grassland.
1. Those communities too small to map, and not included on the vegetation community maps, are indicated by an "#".			
* Introduced plant species			

NPWS Type and Code Number <sup>1</sup>	This study	Notes
2. Lowland Dry Shrub Forest – <i>Corymbia gummifera</i> / <i>Syncarpia glomulifera</i>	na	Not present in the Kiama area.
18. Southern Coastal Hinterland Moist Shrub/Vine/Grass Forest – <i>E. cypellocarpa</i> / <i>E. muelleriana</i>	Part of 2.2 White Box – Yellow Stringybark Tall Forest	Moister variation of No. 19.
19. Coastal Escarpment and Hinterland Dry Shrub/Fern Forest – <i>E. muelleriana</i>	Part of 2.2 White Box – Yellow Stringybark Tall Forest	Drier variation of No. 18.
21. Northern Foothills Moist Shrub Forest – <i>C. maculata</i> – <i>E. pilularis</i>	na	Not present in the Kiama area.
56. Tableland and Escarpment Moist Herb/Fern Grass Forst – <i>E. radiata</i> / <i>E. viminalis</i> / <i>Viola</i> spp	na	Present to the northwest of The Kiama area.
57. Southern Escarpment Shrub/Fern/Herb Moist Forest <i>E. cypellocarpa</i> / <i>E. fastigata</i> / <i>E. obliqua</i>	2.11 Brown Barrel Tall Forest	Forest on basalts on the plateau.
58. Tableland and Escarpment Wet Layered Shrub Forest – <i>E. fastigata</i> / <i>Olearia argophylla</i> / <i>Dicksonia antarctica</i>	2.11 Brown Barrel Tall Forest	Forest on basalts on the plateau.
137. Coastal Escarpment Moist Shrub/Fern Forest <i>E. sieberi</i> – <i>E. piperita</i> – <i>Gleichenia dicarpa</i>	2.10 Silvertop Ash – Peppermint Forest/Woodland	Mostly on the shale-influenced edges of the sandstone on the plateau.
138. Northern Plateau and Escarpment Heath Shrub Dry Forest – <i>E. sieberi</i> / <i>E. consideniana</i>	2.10 Silvertop Ash – Peppermint Forest/Woodland	Very common across the sandstone plateau.
139. Northern Coastal Hinterland Heath Shrub Dry Forest <i>Corymbia gummifera</i> / <i>Eucalyptus sclerophylla</i>	Not present in Kiama	Not present in the Kiama area.
141. Northern Coast (and Escarpment) Wet Heath/Sedge	5.5 Sandstone Sedgeland/Heathland	Extensive across the sandstone plateau.
169. Coastal Hinterland Sub Tropical Temperate Rainforest	1.1 Complex Subtropical Rainforest 1.3 Coachwood	Includes several rainforest community types.
171. Coastal Shrub/Grass Forest <i>E. tereticornis</i>	na	
176. Morton Plateau Mallee Swamp Low Forest	5.5 Sandstone Sedgeland, etc. 2.10 Silvertop Ash – Peppermint Forest Woodland	Extensive on sandstone plateau.

NPWS Type and Code Number <sup>1</sup>	This study	Notes
178. Robertson Warm Temperate Rainforest	1.7 Sassafras Warm/Cool Temperate Rainforest	Grows on basalt on the plateau.
Tall Open Forest Type (a) – <i>E. obliqua</i> , <i>E. elata</i> , <i>E. fastigata</i> , ( <i>E. cypellocarpa</i> – <i>E. piperita</i> )	2.11 Brown Barrel tall Forest	Occurs on basalt, less often Wianamatta Group (high altitudes).
Tall Open Forest Type (b) – <i>E. elata</i> – <i>E. saligna</i> x <i>botryoides</i> – <i>E. piperata</i> ( <i>E. muelleriana</i> – <i>E. fastigata</i> – <i>E. quadrangulata</i> ) [ <i>Syncarpia</i> ]	2.1 White Box – Brown Barrel Tall Forest 2.2 White Box – Yellow Stringybark Tall Forest	Occurs on Illawarra Coal Measures and Berry Formation (low altitudes).
Tall Open Forest Type (c) – <i>E. fastigata</i> – <i>E. smithii</i> – <i>E. obliqua</i> ( <i>E. piperita</i> – <i>E. cypellocarpa</i> )	2.11 Brown Barrel Tall Forest	Occurs on Narrabeen Group and basalt (moderate altitudes).

1. Communities shown on vegetation map provided to Kiama Council by NPWS.

### 3. VEGETATION COMMUNITY DESCRIPTIONS

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The following section describes the vegetation communities identified in this study. A few have not been shown on the vegetation map, mainly because they cover such small areas. The communities were summarised in Table 1 in Section 2.3; there, those communities not shown on the maps were indicated.

#### GROUP 1: RAINFORESTS

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##### 1.1 COMPLEX SUBTROPICAL RAINFOREST

*Toona ciliata* - *Ficus* spp. - *Dendrocnide excelsa* – *Pouteria australe*  
COM-SRF

**Description:** Complex Subtropical Rainforest is the most diverse rainforest type in the region and in southern New South Wales. It occurs on Permian volcanic soils in areas with a relatively low to moderate rainfall. The rainforest is characterised by a diversity of tree species, multiple canopy layers and an abundance of vines. The ground cover is usually quite sparse and the ground is often very rocky. Emergent trees are common, including large old figs *Ficus* spp. The characteristic tree species include Red Cedar *Toona ciliata*, Giant Stinging Tree *Dendrocnide excelsa*, Brush Bloodwood *Baloghia inophylla*, Black Apple *Pouteria australe*, Whalebone Tree *Streblus brunonianus* and Illawarra Flame Tree *Brachychiton acerifolius*. A dry variation of this community occurs on some of the driest, north-facing slopes; species such as White Cedar *Melia azedarach*, Illawarra Flame Tree *Brachychiton acerifolius* and Koda *Ehretia acuminatum* are common in such locations.

**Distribution in Kiama LGA:** This rainforest community occurs throughout the area on the Permian volcanic rocks from low to moderate altitudes; most of the land south of Jamberoo Valley was once covered in this community (Mills 1988). Today, it is mostly restricted to rocky gorges and steep land. Area mapped in Kiama is 3,128 hectares; this is about 44% of all mapped vegetation.

**Conservation Priority:** VERY HIGH

Complex Subtropical Rainforest is an endangered ecological community under the NSW *Threatened Species Conservation Act, 1995*; therefore the vegetation has a very high conservation priority. The community has been severely depleted in the Illawarra Region since European settlement (Mills & Jakeman 1995). The rainforest provides habitat for many threatened and regionally significant flora and fauna species.

**Reserved Areas in Kiama LGA:** Few stands of this rainforest occur in reserves, most are on private rural holdings. Stands of Complex Subtropical Rainforest can be found in Budderoo National Park at Minnamurra Falls and in small Council reserves at Saddleback Mountain and Jerrara Dam.

##### 1.2 COMPLEX LITTORAL RAINFOREST

*Podocarpus elatus* - *Endiandra sieberi* - *Elaeodendron australe*  
COM-LRF

**Description:** Complex Littoral Rainforest is similar to Complex Subtropical Rainforest; the two communities contain many of the same species. Tree and vine species diversity is fairly high, and there are few ferns because of the dry conditions and well drained sandy soils. The main tree species include Plum Pine *Podocarpus elatus*, Red-fruited Olive-plum *Elaeodendron australe*,

Corkwood *Endiandra sieberi*, Native Olive *Notelaea longifolia*, Hairy Wilkiea *Wilkiea huegeliana* and various Figs *Ficus* spp. Burny Vine *Trophis scandens* and Water Vine *Cissus antarctica* are common.

**Distribution in Kiama LGA:** This community once covered a fairly large area immediately south of the Crooked River, behind Seven Mile Beach, where it grew on coastal sand dunes. Today, most of this is gone, although there is still some remaining in that area. Two stands are recognised under SEPP No. 26. Small stands on the headland above Gerroa are also recognised under this SEPP, although they are not on sand but volcanic soil.

**Conservation Priority:** VERY HIGH

Complex Littoral Rainforest is an endangered ecological community and is quite rare in southern New South Wales.

**Reserved Areas in Kiama LGA:** This community does not occur in any reserved area.

### 1.3 COACHWOOD WARM TEMPERATE RAINFOREST

*Ceratopetalum apetalum* - *Doryphora sassafras* - *Acmena smithii*

CER-WRF

**Description:** Coachwood Warm Temperate Rainforest is much simpler in structure and floristic composition than the subtropical rainforest types described above. The dominant tree species is usually Coachwood *Ceratopetalum apetalum*, which commonly occurs with Sassafras *Doryphora sassafras*, Lilly Pilly *Acmena smithii*, Featherwood *Polyosma cunninghamii* and Native Laurel *Cryptocarya glaucescens*. Pepper Bush *Tasmannia insipida*, a shrub species, is usually present. Ferns are common, including tree ferns.

**Distribution in Kiama LGA:** This rainforest community occurs on the upper slopes of the escarpment, mostly on the steep slopes below the sandstone and on talus; it occasionally occurs lower down the escarpment along watercourses. Area mapped in Kiama is 44 hectares.

**Conservation Priority:** HIGH

Coachwood Warm Temperate Rainforest is a regionally significant ecological community that should have a high conservation priority. The rainforest is naturally rare and supports regionally significant flora and fauna species.

**Reserved Areas in Kiama LGA:** This higher altitude rainforest occurs in Budderoo National Park and Barren Grounds Nature Reserve.

### 1.4 PLUMWOOD COOL TEMPERATE RAINFOREST

*Eucryphia moorei* – *Ceratopetalum apetalum*

EUC-CRF

**Description:** This rainforest is only found at high altitudes; its characteristic species are generally restricted to such high elevations. These include the co-dominant Plumwood *Eucryphia moorei*; Coachwood *Ceratopetalum apetalum* is usually the other dominant. Other species include Possumwood *Quintinia sieberi*, Featherwood *Polyosma cunninghamiana* and many species ferns. It usually merges with the Coachwood Warm Temperate Rainforest community lower down the slope.

**Distribution in Kiama LGA:** This community occurs on the higher altitude slopes below the sandstone cliffs around Barren Grounds and the Kangaroo River valley escarpment.

**Conservation Priority:** HIGH

Cool Temperate Rainforest is a regionally significant ecological community that should have a high conservation priority. The community reaches its northern limit in the Illawarra region where it only occurs as fairly small stands.

**Reserved Areas in Kiama LGA:** This community occurs in the upper sections of the escarpment in Budderoo National Park and Barren Grounds Nature Reserve.

### 1.5 IRONWOOD WARM TEMPERATE RAINFOREST

*Backhousia myrtifolia*

**BAC-WRF**

**Description:** Ironwood Warm Temperate Rainforest contains mainly hardy species, rainforest plants able to grow in very dry conditions. The dominant tree species is always Ironwood *Backhousia myrtifolia*. Other characteristic species include Native Olive *Notelaea venosa*, Sweet Pittosporum *Pittosporum undulatum*, Gristle Water Fern *Blechnum cartilagineum* and various vines such as Bearded Tylophora *Tylophora barbata* and Traveller's Joy *Clematis aristata*. There are often emergent eucalypts, the species varying from one location to another.

**Distribution in Kiama LGA:** This community generally occurs as small stands on the edges of moister rainforest and on dry and often rocky sites, sometimes along watercourses at the base of the escarpment.

**Conservation Priority:** MODERATELY HIGH

The conservation of Ironwood Warm Temperate Rainforest should have a moderately high priority; the stands are usually found in association with other rainforest.

**Reserved Areas in Kiama LGA:** There are small patches in Budderoo National Park and Barren Grounds Nature Reserve.

### 1.6 SIMPLE LITTORAL RAINFOREST

*Glochidion ferdinandi* - *Guioa semiglauc*

**SIM-LRF**

**Description:** This littoral rainforest is much simpler than the Complex Littoral Rainforest Community, in terms of the structure of the forest and the number of plant species present. The main species are generally hardy, common and widespread plants, such as Cheese Tree *Glochidion ferdinandi*, Guioa *Guioa semiglauc*, Native Olive *Notelaea longifolia*, Coffee Bush *Breynia oblongifolia*. Creepers such as Slender Grape *Cayratia clematidea*, Thornless Sarsaparilla *Smilax glyciphylla* and Snake Vine *Stephania japonica* are common, while ferns are generally absent.

**Distribution in Kiama LGA:** Common on sand dunes between the Crooked River southwards to the Municipal boundary, mapped as part of the Bangalay – Banksia Forest.

**Conservation Priority:** VERY HIGH

This community is part of the littoral rainforest endangered ecological community.

**Reserved Areas in Kiama LGA:** Seven Mile Beach National Park.

### 1.7 SASSAFRAS WARM/COOL TEMPERATE RAINFOREST

*Doryphora sassafras*

**DOR-WRF**



**Description:** This is a fairly simple rainforest community when compared to the subtropical rainforest at low altitudes near the coast. The main trees are Sassafras *Doryphora sassafras*, Lilly Pilly *Acmena smithii*, Native Laurel *Cryptocarya glaucescens*, Featherwood *Polyosma cunninghamii* and, along watercourses, Plumwood *Eucryphia moorei*.

**Distribution in Kiama LGA:** This type of rainforest occurs on basalt soils in the Knights Hill area. Area mapped in Kiama is 132 hectares.

**Conservation Priority:** VERY HIGH

This is an endangered ecological community, known as Robertson Rainforest. Most of this rainforest has been cleared and only small remnants remain (Mills & Jakeman 1995).

**Reserved Areas in Kiama LGA:** Small areas occur in Budderoo National Park on the southern flank of Knights Hill.

## GROUP 2: EUCALYPT FORESTS

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### 2.1 WHITE BOX - BROWN BARREL TALL FOREST

*Eucalyptus quadrangulata* - *Eucalyptus fastigata* - *Eucalyptus smithii*  
QUD-FAS

**Description:** This tall forest community is dominated by Coast White Box *Eucalyptus quadrangulata*, Brown Barrel *Eucalyptus fastigata* and Gully Gum *Eucalyptus smithii*, some of which are very large trees. The middle canopy often contains rainforest species. The understorey is often a dense tangle of shrubs and ferns and vines are common.

**Distribution in Kiama LGA:** This community occurs at the higher elevations along the escarpment, occasionally extending down to the escarpment foothills. It is the main eucalypt of the escarpment in the Kiama area. Area mapped in Kiama is 1,372 hectares; this is about 19% of all mapped vegetation.

**Conservation Priority:** HIGH

White Box - Brown Barrel Tall Forest is a regionally significant community, with a high priority for conservation. It is one of the best developed and least disturbed forest types in the region. It is contiguous with similar forest extending along the escarpment towards Wollongong and the Shoalhaven, and it provides habitat for a diverse range of forest fauna, including threatened owls.

**Reserved Areas in Kiama LGA:** Relatively small areas of this tall forest community occur in Budderoo National Park and Barren Grounds Nature Reserve.

### 2.2 WHITE BOX - YELLOW STRINGYBARK TALL FOREST

*Eucalyptus quadrangulata* - *Eucalyptus muelleriana*  
QUD-MUL

**Description:** This tall forest community is dominated by Coast White Box *Eucalyptus quadrangulata* and Yellow Stringybark *Eucalyptus muelleriana*. Trees from the adjoining communities are often present as well, such as Forest Red Gum *Eucalyptus tereticornis*. There is usually a strong rainforest component in the understorey, although it is usually grassy on dry slopes.



**Distribution in Kiama LGA:** This community occurs on somewhat drier sites than the above, such as the top of Currys Mountain; it is not extensive in Kiama, being more common to the north in Shellharbour. Area mapped in Kiama is 203 hectares or 3% of all mapped vegetation.

**Conservation Priority:** HIGH

The conservation of White Box - Yellow Stringybark Tall Forest should have a high priority, for this is a regionally significant ecological community. Its conservation values are similar to those of White Box - Brown Barrel Tall Forest.

**Reserved Areas in Kiama LGA:** Not reserved in Kiama.

## **2.3 BLACKBUTT TALL FOREST**

*Eucalyptus pilularis* - *Syncarpia glomulifera*

PIL- SYN

**Description:** This tall forest community is dominated by Blackbutt *Eucalyptus pilularis*; the most common associate is Turpentine *Syncarpia glomulifera*. The understorey is drier than in the forests higher on the escarpment. Common understorey species include Brush Daisy-bush *Olearia viscidula*, Two-veined Hickory *Acacia binervata* and Spiny-headed Mat-rush *Lomandra longifolia*.

**Distribution in Kiama LGA:** This community occurs in several places, particularly on the Budgong Sandstone in the Jamberoo valley and on sandstone talus to the north of Saddleback Mountain. Mapped area in Kiama 73 hectares.

**Conservation Priority:** MODERATELY HIGH

The conservation of Blackbutt Tall Forest should have a moderately high priority. Although it is quite common throughout the Illawarra Region, it is rather restricted in Kiama. Like the other tall forest communities, it probably provides habitat for several threatened and regionally significant fauna species.

**Reserved Areas in Kiama LGA:** Blackbutt Tall Forest does not occur in any conservation reserve in Kiama.

## **2.4 BLACKBUTT - BANKSIA FOREST**

*Eucalyptus pilularis* - *Banksia serrata*

PIL-BAN

**Description:** This forest community is dominated by Blackbutt *Eucalyptus pilularis*, some of which are very large trees. The other trees present include Bangalay *Eucalyptus botryoides*, Old Man Banksia *Banksia serrata*, Coast Banksia *Banksia integrifolia* and Rough-barked Apple *Angophora floribunda*. The understorey varies considerably, depending upon the time since the last fire. It ranges from very open and dominated by fire-tolerant species such as Blady Grass *Imperata cylindrica* and Common Bracken *Pteridium excultum*, to stands of simple littoral rainforest.

**Distribution in Kiama LGA:** This community occurs on the sand plain and low dunes behind the hind dunes along Seven Mile Beach; it is more common over the border in the Shoalhaven. Mapped area in Kiama 45 hectares.

**Conservation Priority:** MODERATELY HIGH

This community should have a moderately high conservation priority. In the region it is common, although north of the Shoalhaven River it is almost totally restricted to Seven Mile Beach National Park and contiguous areas.

**Reserved Areas in Kiama LGA:** Blackbutt - Banksia Forest occurs in Seven Mile Beach National Park.

## **2.5 BLUE GUM - WHITE BOX TALL FOREST**

*Eucalyptus saligna*/*E. botryoides* - *Eucalyptus quadrangulata*  
SAL-QUD

**Description:** This forest community is similar to the White Box - Brown Barrel Tall Forest that occurs higher up the escarpment, although there is less rainforest present and Brown Barrel does not occur this low on the escarpment. The main trees are Blue Gum *Eucalyptus saligna*/*E. botryoides* Coast White Box *Eucalyptus quadrangulata* and Turpentine *Syncarpia glomulifera*. The most common rainforest species are those that are somewhat hardier and grow in drier conditions.

**Distribution in Kiama LGA:** This forest is the dominant forest type on the foothills of the escarpment, up to around 300 metres elevation, where it is replaced by the White Box - Brown Barrel Tall Forest. Mapped area in Kiama 322 hectares, this is about 5% of all mapped vegetation.

**Conservation Priority:** HIGH

As a part of the tall forest complex of the escarpment, this forest type has a high conservation priority. This community contains habitat for threatened and regionally significant fauna species.

**Reserved Areas in Kiama LGA:** A small area is reserved in Budderoo National Park.

## **2.6 BLUE GUM - TURPENTINE FOREST**

*Eucalyptus saligna*/*E. botryoides* – *Syncarpia glomulifera*  
SAL-SYN

**Description:** This forest type is dominated by Blue Gum *Eucalyptus saligna*/*E. botryoides* and Turpentine *Syncarpia glomulifera*. Like the above forest, it generally has little to no rainforest component, although various hardy rainforest species occur there.

**Distribution in Kiama LGA:** This community occurs as remnants on the lowest foothills of the escarpment and across the Jamberoo valley to near the coast at Minnamurra. It is the main lowland eucalypt forest, occurring below the Blue Gum - White Box Tall Forest. Mapped area in Kiama 464 hectares or 7% of all mapped vegetation.

**Conservation Priority:** HIGH

Blue Gum - Turpentine Forest is a regionally significant community. It should have a high priority for conservation. The community probably provides habitat for threatened and regionally significant fauna species.

**Reserved Areas in Kiama LGA:** This forest is not reserved in Kiama.

## **2.7 RED GUM - BLUE GUM FOREST**

*Eucalyptus tereticornis* - *Eucalyptus saligna*/*E. botryoides*  
TER-SAL

**Description:** Most of the Red Gum - Blue Gum Forest in the Shellharbour LGA has been removed, and the remainder has been heavily disturbed. The main tree species are Forest Red Gum *Eucalyptus tereticornis*, Blue Gum *Eucalyptus saligna*/*E. botryoides*, Hickory *Acacia implexa*, Red Ash *Alphitonia excelsa* and Black She-oak *Allocasuarina littoralis*. Thin-leaved Stringybark *Eucalyptus eugenioides* and Rough-barked Apple *Angophora floribunda* are also present. Part of the area mapped has a rainforest understorey.

**Distribution in Kiama LGA:** This community occurs in small remnant stands on the floor of the northern part of the Jamberoo valley and on the adjacent low ridges. Mapped area in Kiama 16 hectares.

**Conservation Priority:** HIGH

Like the other Red Gum communities, Red Gum - Blue Gum Forest should have a high priority for conservation as it a part of the endangered ecological community known as Illawarra Lowlands Grassy Woodland.

**Reserved Areas in Kiama LGA:** Red Gum - Blue Gum Forest is not reserved in the Kiama area.

## **2.8 RED GUM - STRINGYBARK FOREST**

*Eucalyptus tereticornis* - *Eucalyptus eugenioides* - *Eucalyptus bosistoana*

**TER-EUG**

**Description:** This community, which varies from forest to woodland, contains Forest Red Gum *Eucalyptus tereticornis*, Thin-leaved Stringybark *Eucalyptus eugenioides* and Coast Grey Box *Eucalyptus bosistoana*. The understorey is rather open; it contains few shrubs. The ground cover is grassy; the characteristic species include Kangaroo Grass *Themeda australis*, Small-leaved Bramble *Rubus parvifolius*, Mulga Fern *Cheilanthes sieberi*, Barbwire Grass *Cymbopogon refractus*, Dwarf Blue Trumpet *Brunoniella pumilio* and Tick-trefoil *Desmodium rhytidophyllum*.

**Distribution in Kiama LGA:** This community occurs as small remnant stands mainly on dry ridges on the northern side of Jamberoo valley. Mapped area in Kiama 7 hectares.

**Conservation Priority:** VERY HIGH

Red Gum - Stringybark Forest is a regionally significant ecological community that should have a very high conservation priority. Referred to as Illawarra Lowlands Grassy Woodland by the NSW Scientific Committee in its Final Determination, the community has been listed as an endangered ecological community under the *Threatened Species Conservation Act, 1995*.

**Reserved Areas in Kiama LGA:** Red Gum - Stringybark Forest is not reserved in the Kiama area.

## **2.9 BANGALAY - BANKSIA FOREST**

*Eucalyptus botryoides* - *Banksia integrifolia*

**BOT-BAN**

**Description:** The forest is dominated by Bangalay *Eucalyptus botryoides*, with occasional Rough-barked Apple *Angophora floribunda*. The shrubby understorey contains coastal species such as Tree Broom-heath *Monotoca elliptica* and Coast Banksia *Banksia integrifolia*, as well as Golden Wattle *Acacia longifolia*, Cheesetree *Glochidion ferdinandi*, Maiden's Wattle *Acacia maidenii* and Corkwood *Duboisia myoporoides*. At Seven Mile Beach, this forest often has a littoral rainforest understorey.

**Distribution in Kiama LGA:** This community occurs inland of the hind dunes along the coast, particularly behind Seven Mile Beach. It is replaced further inland by Blackbutt - Banksia Forest. Mapped area in Kiama 118 hectares, this is 2% of all mapped vegetation.

**Conservation Priority:** VERY HIGH

Bangalay - Banksia Forest has largely been cleared form along this part of the coast; the stands that remain have a high conservation priority. This forest community has recently been listed as an endangered ecological community.

**Reserved Areas in Kiama LGA:** Bangalay – Banksia Forest occurs in Seven Mile Beach National Park.

## **2.10 SILVERTOP ASH – PEPPERMINT FOREST/WOODLAND**

*Eucalyptus sieberi* - *Eucalyptus piperita* - *Eucalyptus gummifera*  
**SIE-PIP**

**Description:** This community is very variable, ranging from an open woodland on the more exposed sandstone country to tall forest on the edges of the sandstone where there is probably some influence from the shale soil. The main trees are SilvertopAsh *Eucalyptus sieberi*, Sydney Peppermint *Eucalyptus piperita* and Red Bloodwood *Eucalyptus gummifera*. In some places, Old Man Banksia *Banksia serrata* is common. The understorey is rich in shrub species and the forest often has a ferny understorey of Coral Fern *Gleichenia dicarpa*. Common shrubs include Hairpin Banksia *Banksia spinulosa*, Swamp Banksia *Banksia paludosa*, Finger Hakea *Hakea dactyloides* and Yellow Teatree *Leptospermum polygalifolium*.

**Distribution in Kiama LGA:** The forest occurs in the Knights Hill area and the woodland is widespread across the plateau. Mapped area in Kiama 193 hectares, or 3% of all mapped vegetation.

**Conservation Priority:** MODERATELY HIGH

This community complex is very common on the plateaux in the western part of Kiama; most is contained within Budderoo National Park and Barren Grounds Nature Reserve.

**Reserved Areas in Kiama LGA:** Extensive areas occur in Budderoo National Park and Barren Grounds Nature Reserve.

## **2.11 BROWN BARREL TALL FOREST**

*Eucalyptus fastigata* - *Eucalyptus cypellocarpa* - *Eucalyptus smithii* - *Eucalyptus obliqua*  
**FAS-CYP**

**Description:** This is a tall forest, often containing very large, old trees. The dominant tree is usually Brown Barrel *Eucalyptus fastigata*, with the associated trees Monkey Gum *Eucalyptus cypellocarpa*, Gully Gum *Eucalyptus smithii* and/or Messmate *Eucalyptus obliqua*. The understorey is mostly rainforest, as described under community 2.7. River Peppermint *Eucalyptus elata* is occasional, such as in the forest around the Kangaroo River.

**Distribution in Kiama LGA:** This tall forest occurs on basalt soils around Knights Hill and in isolated patches of volcanic in the sandstone country on the Budderoo Plateau. Mapped area in Kiama 315 hectares, this is 4% of all mapped vegetation.

**Conservation Priority:** VERY HIGH

This forest is listed as an endangered ecological community; most has previously been cleared because of the value of the basalt soils or agriculture.

**Reserved Areas in Kiama LGA:** Small stands occur in Budderoo National Park, south of Knights Hill and on the Budderoo Plateau.

## GROUP 3: MISCELLANEOUS FOREST COMMUNITIES

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### 3.1 COAST BANKSIA FOREST

*Banksia integrifolia*

BAN-FOR

**Description:** This community, which ranges from forest to woodland, occurs mainly as regrowth in the Shellharbour LGA. The most characteristic species is Coast Banksia *Banksia integrifolia*, although many others are also present, such as Coast Teatree *Leptospermum laevigatum* and Lilly Pilly *Acmena smithii*. The species composition varies with the substrate on which the vegetation is growing, whether sand or volcanic rock.

**Distribution in Kiama LGA:** This community occurs as a narrow band behind Seven Mile Beach, on the hind dunes; it is mostly cleared from all other areas in Kiama. The mapped area in Kiama is 0.7 hectares.

**Conservation Priority:** MODERATELY HIGH

Coast Banksia Forest should have a moderately high priority for conservation. Most of this community has been cleared between Stanwell Park and Gerroa.

**Reserved Areas in Kiama LGA:** Coast Banksia Forest occurs in Killalea State Park, as well as at Bass Point and on the islands near the entrance of Lake Illawarra.

### 3.2 WATTLE FOREST

*Acacia mearnsii* - *Acacia maidenii*

ACA-FOR

**Description:** This community occurs as a forest or woodland of rather small wattle trees, mostly Black Wattle *Acacia mearnsii* and Maiden's Wattle *Acacia maidenii*. It is not a natural community, but grows on land that was previously cleared. It is often infested with thickets of Lantana.

**Distribution in Kiama LGA:** This community occurs throughout Kiama, particularly on the edges of forest and in forest clearings. Mapped area in Kiama is 1.7 hectares.

**Conservation Priority:** LOW

Most regrowth wattle has a low conservation priority. However, in some cases the regrowth is a precursor to a more stable and long-lived forest community. Wattle Forest occurring in corridors of bushland can improve the effectiveness of the corridor and assist in the regeneration of rainforest and eucalypt forest.

**Reserved Areas in Kiama LGA:** The community is not natural, so it is not important to conserve it as a community, although it clearly can have other values.

### 3.3 MISCELLANEOUS FOREST

\**Erythrina x sykesii* - \**Pinus* spp. - *Acacia* spp.

MIS-FOR

**Description:** This community is composed of stands of trees in plantations, windbreaks and thickets. The trees are native, introduced or a mixture of both.

**Distribution in Kiama LGA:** Throughout the Municipality, particularly around farm buildings. Total area mapped in Kiama is 105 hectares.

**Conservation Priority: LOW**

It is not usually important to conserve this community for its ecological values, which are mostly negligible. Farm plantings and miscellaneous stands of introduced trees have a low priority for nature conservation. However, individual fig trees occurring in the stands are important for some native fauna species, such as the Grey-headed Flying-Fox and some stands may be important for scenic reasons or as part of a tree corridor for fauna movement.

**Reserved Areas in Kiama LGA:** Some reserves contain Mixed/Miscellaneous Forest; for example, some small council reserves. The community is not natural, so it is usually not important to conserve it.

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**GROUP 4: FLOODPLAIN FORESTS**

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**4.1 RIVER OAK TALL FOREST***Casuarina cunninghamiana***CAS-CUN**

**Description:** This community usually contains large River Oaks *Casuarina cunninghamiana* and other native plants such as Spiny-headed Mat-rush *Lomandra longifolia*. Rainforest plants and Coral Trees *Erythrina x sykesii* are sometimes present too. Weeds are often prolific, forming a tangled mass along the banks of the streams.

**Distribution in Kiama LGA:** This community occurs along the main streams in the area, particularly the Minnamurra River and the streams at Foxground. Mapped area in Kiama totals 88 hectares.

**Conservation Priority: HIGH**

River Oak Tall Forest should have a high priority for conservation, because the community plays an important role in stabilising stream banks and providing local fauna corridors.

**Reserved Areas in Kiama LGA:** This community is not reserved in Kiama.

**4.2 SWAMP OAK FOREST***Casuarina glauca***CAS-GLA**

**Description:** This community usually occurs as a dense stand of Swamp Oak *Casuarina glauca*, with few other trees. It occurs upslope from mangroves and saltmarsh, but downslope from Bangalay - Banksia Forest.

**Distribution in Kiama LGA:** This community occurs extensively around the larger local estuarine areas, particularly the Minnamurra River and the Crooked River. Mapped area in Kiama is 118 hectares.

**Conservation Priority: VERY HIGH**

Swamp Oak Forest is an endangered ecological community; most has been cleared from the floodplains in the district. It is an integral part of the estuarine vegetation complex, together with saltmarsh and, in some places, mangrove communities. Where Swamp Oak Forest grows along streams and estuaries, and helps to stabilise the banks.

**Reserved Areas in Kiama LGA:** There are small areas of Swamp Oak Forest on Council land in various places, such as Crooked River and Minnamurra River.



## GROUP 5: SHRUBLANDS

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### 5.1 PAPERBARK TALL SHRUBLAND

*Melaleuca armillaris*

MEL-ARM

**Description:** This community is a dense, tall and dry shrubland dominated by the large shrub species, Bracelet Honey-myrtle *Melaleuca armillaris*. Other species in the shrubland include Giant Hop-bush *Dodonaea viscosa*, Mulga Fern *Cheilanthes sieberi* and Cockspur Flower *Plectranthus graveolens*.

**Distribution in Kiama LGA:** This community occurs on dry, open rocky sites around the Jamberoo valley. Usually above Complex Subtropical Rainforest growing in more favourable conditions in gullies and gorges. Area mapped in Kiama is 39 hectares.

**Conservation Priority:** VERY HIGH

Paperbark Tall Shrubland is a regionally significant ecological community that should have a very high conservation priority. Referred to as Illawarra Lowlands Grassy Woodland by the NSW Scientific Committee in its Final Determination, the community has been listed as an endangered ecological community under the *Threatened Species Conservation Act, 1995*.

**Reserved Areas in Kiama LGA:** Paperbark Tall Shrubland does not occur in any conservation reserve in Kiama.

### 5.2 COAST TEATREE SHRUBLAND

*Leptospermum laevigatum* - *Banksia integrifolia*

LEP-LAV

**Description:** The shrubland is dominated by Coast Teatree *Leptospermum laevigatum*. It contains other coastal species such as Tree Broom-heath *Monotoca elliptica*, Coast Banksia *Banksia integrifolia* and Coast Beard-heath *Leucopogon parvifolius*. Other common species include Spiny-headed Mat-rush *Lomandra longifolia*, Saloop *Einadia hastata* and Native Stork's-bill *Pelargonium australe*.

**Distribution in Kiama LGA:** This community occurs behind Seven Mile Beach, mainly on the hind dunes. Mapped area in Kiama is 15 hectares.

**Conservation Priority:** MODERATELY HIGH

Coast Teatree Shrubland should have a moderately high conservation priority, mainly because it is now so uncommon in the region north of the Shoalhaven River. The shrubland is important for dune stabilisation.

**Reserved Areas in Kiama LGA:** Most of the Coast Teatree Shrubland in the Kiama LGA occurs in Seven Mile Beach National Park, south of the Crooked River.

### 5.3 COAST WATTLE SHRUBLAND

*Acacia longifolia* var. *sophorae*

ACA-SPH

**Description:** This shrubland community is usually dominated by Coast Wattle *Acacia longifolia* var. *sophorae*. It contains various other coastal dune species, such as Knobby Club-rush *Isolepis nodosa*, Coast Beard-heath *Leucopogon parvifolius*, Sea Bindweed *Calystegia soldanella*, Coast Teatree

*Leptospermum laevigatum* and Coast Banksia *Banksia integrifolia*. Hairy Spinifex *Spinifex sericeus* occurs on the seaward side.

**Distribution in Kiama LGA:** This community occurs at the back of many of the local beaches, in some places it has been planted during dune stabilisation works. It is the most extensive and natural on Seven Mile Beach. Mapped area in Kiama is 16 hectares.

**Conservation Priority: HIGH**

Coast Wattle Shrubland is not a regionally significant ecological community, but it should have a high conservation priority because it helps to stabilise sand dunes.

**Reserved Areas in Kiama LGA:** Coast Wattle Shrubland occurs in Seven Mile Beach National Park.

## **5.4 LANTANA SHRUBLAND**

*Lantana camara*\* - *Acacia* spp.

LAN-SHR

**Description:** Lantana *Lantana camara*, which a rampant introduced shrub, forms dense thickets in areas that have been disturbed or previously cleared. There are large stands at Dunmore, where rainforest once occurred, and along the base of the escarpment. It also occurs on abandoned farmland along the escarpment and has invaded some areas of dry eucalypt forest. Black Wattle *Acacia mearnsii* is common in and around Lantana thickets. Rainforest plants often occur among the Lantana.

**Distribution in Kiama LGA:** This community occurs throughout the area and is particularly extensive on the high nutrient volcanic soils under high rainfall. Total area mapped in Kiama is 137 hectares.

**Conservation Priority: LOW**

The conservation priority for Lantana Shrubland is generally low, because it is not a natural community. However, Lantana thickets sometimes contain significant plant species, including threatened species such as *Zieria granulata* and *Cynanchum elegans*.

**Reserved Areas in Kiama LGA:** Lantana Shrubland occurs in several reserves. It is usually not important to conserve it in terms of the community.

## **5.5 SANDSTONE SEDGELAND/HEATHLAND/SHRUBLAND (UPLAND SWAMP)**

Cyperaceae, Restioaceae, Myrtaceous and Proteaceous shrubs

SST-SDG

**Description:** This is a community complex ranging from swamps dominated by sedgeland to treeless shrubland; these communities are influenced by very wet soils. Plant species diversity is very high, typical of the Sydney Basin sandstone communities. This community complex is composed of very wet sedge swamps, moist heathlands and closed shrublands.

**Distribution in Kiama LGA:** Very extensive across the sandstone plateau. Mapped area in Kiama is 44 hectares.

**Conservation Priority: HIGH**



These swamps supply the water for many of the local streams, providing flow even in very dry conditions. Plant species diversity is very high and many significant plant species are found in this complex of communities.

**Reserved Areas in Kiama LGA:** Most of the swampland is within Budderoo National Park and Barren Ground Nature Reserve.

## GROUP 6: FRESH WETLANDS

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### 6.1 SWAMP MAHOGANY – PAPERBARK FOREST

*Eucalyptus robusta* – *Melaleuca linariifolia*

ROB-MEL

**Description:** This is a “wetland forest”; the species dominating the community are characteristic wetland plants and there is usually standing water on the ground or at least a very wet soil. The main trees are Swamp Mahogany *Eucalyptus robusta*, Narrow-leaved Paperbark *Melaleuca linariifolia*, Swamp Oak *Casuarina glauca*, Bangalay *Eucalyptus botryoides* and Cabbage Palm *Livistona australis*. Other wetland plants present include Common Reed *Phragmites australis*, Tall Sedge *Carex appressa*, Swamp Paperbark *Melaleuca ericifolia* and Harsh Ground Fern *Hypolepis muelleri*.

**Distribution in Kiama LGA:** The forest grows on sand close to estuaries or other near-coastal wetlands. This community occurs on low-lying land to the south of the Crooked River, in the vicinity of Blue Angle Creek. Mapped area in Kiama is 33 hectares.

**Conservation Priority:** VERY HIGH

This forest is part of the endangered ecological community known as Swamp Sclerophyll Forest on Coastal Floodplains. The forest is also an important fauna habitat as it contains a winter flowering eucalypt, *E. robusta*.

**Reserved Areas in Kiama LGA:** This community is not reserved in the Kiama LGA.

### 6.2 CUMBUNGI REEDLAND

*Typha orientalis* - *Persicaria* spp.

TYP-RDL

**Description:** Originally, Cumbungi Reedland probably occurred only as small isolated patches on freshwater wetlands. As it occurs in most places today, however, it is usually not a natural community. A dense growth of Cumbungi *Typha orientalis* is now typical, sometimes mixed with Common Reed *Phragmites australis* and other wetland plants, both native and introduced. The community often occurs in association with Phragmites Reedland (PHR-RDL).

**Distribution in Kiama LGA:** This community occurs on many farm dams and can become extensive in constructed water quality control ponds.

**Conservation Priority:** LOW TO HIGH

Conservation value is variable; in most places it has a low priority for conservation. However, at least two threatened animal species inhabit Cumbungi Reedland, the Australasian Bittern and the Green and Golden Bell Frog. Some stands therefore have a potentially high conservation value. Some areas may be included in the Freshwater Wetlands on Coastal Floodplains endangered ecological community.

**Reserved Areas in Kiama LGA:** Cumbungi Reedland does not occur in any reserves. The community is not natural, so it is not particularly important to conserve it. Some sites may be important for fauna.

### 6.3 FRESH JUNCUS RUSHLAND

*Juncus* spp. - *Carex appressa* - *Persicaria* spp.

JUN-FRH

**Description:** The floristic composition of Juncus Rushland is a variable. Many wetland species are associated with this community, the most common being Common Rush *Juncus usitatus* and Tall Sedge *Carex appressa*. Water Primrose *Ludwigia peploides*, Knotweeds *Persicaria* spp. and Cumbungi *Typha orientalis* are also common. The community expands during wet periods and contracts during the dry.

**Distribution in Kiama LGA:** This community occurs as small stands around farm dams and sometimes across low-lying floodplains.

**Conservation Priority:** LOW TO HIGH

The priority for conserving Juncus Rushland is variable, ranging from low to high. The larger areas are important as wetland habitat after heavy rainfall, and are part of the Freshwater Wetlands on Coastal Floodplains endangered ecological community.

**Reserved Areas in Kiama LGA:** Juncus Rushland is not reserved in Kiama.

### 6.4 SPIKE-RUSH SEDGELAND

*Eleocharis sphacelata* - *Schoenoplectus validus*

ELE-SDG

**Description:** Tall Spike-rush *Eleocharis sphacelata* is the most common reed species in this community, but other species are also usually present, particularly in shallow water and on the edge of the water. Other sedge species occasionally dominate.

**Distribution in Kiama LGA:** This community occurs as small stands in farm dams and sometimes in depressions in low-lying floodplains.

**Conservation Priority:** LOW TO HIGH

Spike-rush Sedgeland can be important as wetland habitat, but mostly stands are small and of local value. Spike-rush Sedgeland can provide habitat for several waterbird species and other wetland fauna, including the Green and Golden Bell Frog. Some stands would be a part of the Freshwater Wetlands on Coastal Floodplains endangered ecological community.

**Reserved Areas in Kiama LGA:** Spike-rush Sedgeland does not occur in any conservation reserve in Kiama.

## GROUP 7: SALINE WETLANDS

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### 7.1 MANGROVE FOREST

*Avicennia marina*

AVI-FOR

**Description:** This community is usually a mono-specific stand of the tree, Grey Mangrove *Avicennia marina*. Other species are occasionally present, mainly saltmarsh species and River

Mangrove *Aegiceras corniculatum*. Usually, however, no other plants grow on the tidally inundated river flats on which this community occurs.

**Distribution in Kiama LGA:** This community is fairly extensive on the Minnamurra River. Mapped area in Kiama is 33 hectares.

**Conservation Priority:** HIGH

Mangrove Forest should have a high conservation priority. It is a regionally significant ecological community. Mangroves are an important part of estuarine ecosystems. They provide breeding grounds for fish and habitat for several rare bird species. The Black Bittern, a threatened species, inhabits mangroves.

**Reserved Areas in Kiama LGA:** The complex of estuarine communities in the Minnamurra wetlands is not reserved. However, most of the wetlands along the Minnamurra River are protected under SEPP No.14 - Coastal Wetlands.

## 7.2 MANGROVE SHRUBLAND

*Avicennia marina* - *Aegiceras corniculatum* - *Sarcocornia quinqueflora*

### AVI-SHR

**Description:** Mangrove Shrubland is dominated by the shrub River Mangrove *Aegiceras corniculatum* and the herb Beaded Glasswort *Sarcocornia quinqueflora*. Other species include Sea Rush *Juncus kraussii* and Salt Couch *Sporobolus virginicus*.

**Distribution in Kiama LGA:** This community is fairly extensive on the Minnamurra River. Area mapped in Kiama is 15 hectares.

**Conservation Priority:** HIGH

Mangrove Shrubland is a regionally significant ecological community. It should have a priority for conservation, because it is an important part of the estuarine ecosystem. It provides breeding areas for fish, stabilises the channel and provides habitat for several rare bird species. The Black Bittern, a threatened species, inhabits mangroves.

**Reserved Areas in Kiama LGA:** The complex of communities in the Minnamurra wetlands is not reserved. However, the estuarine wetlands along the Minnamurra River are protected under SEPP No. 14 - Coastal Wetlands.

## 7.3 PHRAGMITES REEDLAND

*Phragmites australis*

### PHR-RDL

**Description:** Phragmites Reedland usually occurs in a mosaic with associated communities such as Swamp Oak Forest (CAS-GLA), Saltwater Juncus Rushland (JUN-SAL) and/or Paperbark Shrubland (MEL-ERI). The dominant species is Common Reed *Phragmites australis*, but many other wetland species are also present.

**Distribution in Kiama LGA:** This community occurs as small stands near estuaries and occasionally on low-lying floodplains. Here is an extensive stand just to the north of Gerringong. Three hectares was mapped in Kiama, although small areas occur throughout the LGA.

**Conservation Priority:** LOW TO HIGH

Conservation value variable; most stands are small. Phragmites Reedland provides habitat for at least one threatened species, the Australasian Bittern, so the larger stands, in particular, are

potentially significant. Some stands would be a part of the Freshwater Wetlands on Coastal Floodplains endangered ecological community.

**Reserved Areas in Kiama LGA:** This community is not reserved in the Kiama area.

#### 7.4 SALTMARSH

*Sarcocornia quinqueflora* - *Suaeda australis* - *Sporobolus virginicus* - *Juncus kraussii*  
SAR-SUA

**Description:** The Saltmarsh in the Shellharbour LGA is very variable. It is a complex of communities encompassing low growing shrubland, herbland and grassland vegetation growing on tidally inundated flats. The most common species is Beaded Glasswort *Sarcocornia quinqueflora*, which often dominates broad areas of the lower saltmarsh. The upper saltmarsh is usually dominated by *Juncus kraussii* (Saltwater Juncus Rushland JUN-SAL). The saltmarsh species in the community include Austral Seablite *Suaeda australis*, Salt Couch *Sporobolus virginicus* and Streaked Arrowgrass *Triglochin striatum*.

**Distribution in Kiama LGA:** This community occurs mainly in the estuarine wetland of the lower Minnamurra River, with some smaller areas at the crooked River and elsewhere. Mapped area in Kiama is 27 hectares.

**Conservation Priority:** VERY HIGH

Saltmarsh is listed as an endangered ecological community. It provides areas for fish to breed, stabilises foreshores and provides habitat for several rare bird species.

**Reserved Areas in Kiama LGA:** The complex of communities in the Minnamurra wetlands is not reserved. However, the estuarine wetlands along the Minnamurra River are protected under SEPP No.14 - Coastal Wetlands.

#### 7.5 SALTWATER JUNCUS RUSHLAND

*Juncus kraussii* - *Suaeda australis* - *Samolus repens*  
JUN-SAL

**Description:** Saltwater Juncus Rushland occurs along the edge of tidally inundated estuaries and lakes, as well as around lakes and lagoons that are seldom open to the sea. It sometimes extends across floodplains. The community is characterised by dense stands of Sea Rush *Juncus kraussii* and a few other saltmarsh species. This community usually occurs above Saltmarsh (SAR-SUA) and below Swamp Oak Forest (CAS-GLA).

**Distribution in Kiama LGA:** This community occurs around the edges of estuaries and sometimes across adjacent floodplains, where it is probably unnatural and growing on land previously covered in Swamp Oak forest (e.g. north of Gerringong). Mapped area in Kiama is 17 hectares.

**Conservation Priority:** LOW TO HIGH

The priority for conserving Saltwater Juncus Rushland varies from low to high, depending upon its locality, extent and interspersed with other estuarine communities. It is a part of the saltmarsh endangered ecological community.

**Reserved Areas in Kiama LGA:** The complex of communities in the Minnamurra wetlands is not reserved. However, the main areas of estuarine wetland along the Minnamurra River are protected under SEPP No. 14 - Coastal Wetlands.

## GROUP 8: GRASSLANDS

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### 8.1 SPINIFEX GRASSLAND

*Spinifex sericeus* - *Carex pumila* - *Isolepis nodosa*

SPN-GRL

**Description:** Spinifex Grassland dominated by *Spinifex sericeus* is always the closest vegetation to the ocean and is often destroyed during heavy seas. The associated species, most of which are restricted to this community, include Dune Thistle *Actites megalocarpa*, Strand Sedge *Carex pumila* and Knobby Club-rush *Isolepis nodosa*. The introduced Sea Rockets *Cakile* spp. and Pennywort *Hydrocotyle bonariensis* are also common in the community.

**Distribution in Kiama LGA:** This community occurs along the back of beaches, just above high water mark. It is most extensive along Seven Mile Beach. Area mapped in Kiama totals two hectares.

**Conservation Priority:** MODERATE

The community has little habitat value, but is important in stabilising frontal dune systems.

**Reserved Areas in Kiama LGA:** This community is reserved in Seven Mile Beach National Park.

### 8.2 KANGAROO GRASS GRASSLAND

*Themeda australis*

THM-GRL

**Description:** This native grassland is dominated by Kangaroo Grass *Themeda australis*, with various other grassland species. These species include Tall Bluebell *Wahlenbergia stricta*, Wandering Sailor *Commelina cyanea*, Kidney-weed *Dichondra repens*, Native Sarsaparilla *Hardenbergia violacea* and Spiny-headed Mat-rush *Lomandra longifolia*.

**Distribution in Kiama LGA:** This community occurs on a few headlands along the coast, e.g. Minnamurra Head. Generally, it covers only small areas.

**Conservation Priority:** VERY HIGH

This community is rather rare in the region so all areas are of botanical interest. The threatened species Spike Rice-flower *Pimelea spicata* occurs in this community in some locations. This grassland has recently been listed as an endangered ecological community.

**Reserved Areas in Kiama LGA:** This community occurs in a few Council headland reserves.

### 8.3 NON-NATIVE GRASSLAND

*Pennisetum clandestinum* - *Stenotaphrum secundatum* - *Axonopus affinis*

INT-GRL

**Description:** This community is dominated by introduced grasses and other herbs; many of the species were introduced as pasture species. Many species are present, but the most common grasses are Kikuyu Grass *Pennisetum clandestinum*, Buffalo Grass *Stenotaphrum secundatum* and Carpet Grass *Axonopus affinis*.

**Distribution in Kiama LGA:** Non-native Grassland occurs where the natural vegetation has been removed, and where grazing or other agricultural activities have prevented the native vegetation from regenerating. This community was not mapped and no area was determined.

**Conservation Priority:** Not relevant.

## 4. CONSERVATION OF THE VEGETATION

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The natural vegetation of the Illawarra region, of which the Kiama LGA is a part, represents a unique assemblage of communities that do not occur anywhere else. The uniqueness of the vegetation is the result of several key environmental factors: a relatively high rainfall, the presence of volcanic soils and a broad altitudinal range (sea level to over 600 metres). The protection and enhancement of this vegetation resource is a major component of conserving the biological diversity within the LGA.

The natural vegetation identified in the Local Government Area in this study is composed of 40 vegetation communities. As with the adjoining LGAs, the remaining natural vegetation is largely associated with the escarpment area; much more vegetation has been cleared from the lowlands, to the east. It is not surprising that several of the lowland communities are now listed as endangered ecological communities in New South Wales under the *Threatened Species Conservation Act, 1995*.

### 4.1 CONSERVATION RESERVES

Several areas reserved in the Kiama LGA have strong nature conservation objectives; these are mainly managed by the National Parks and Wildlife Service. Council controls several areas, that, although they may be small, are of considerable conservation value. The importance of the small reserves should not be under-estimated, as in total they account for a large area and individually contain rare communities and species.

#### *Reserves Managed by the National Parks and Wildlife Service*

Seven Mile Beach National Park (part only)

Budderoo National Park (part only)

Barren Grounds Nature Reserve

#### *Main Reserves Managed by Kiama Municipal Council*

Jerrara Dam Reserve

Saddleback Mountain Reserve

Spring Creek Wetland Reserve

Minnamurra Point Reserve

### 4.2 ENDANGERED ECOLOGICAL COMMUNITIES

Endangered ecological communities in New South Wales are listed in Part 3 of Schedule 1 of the NSW *Threatened Species Conservation Act, 1995*. The inclusion of these communities on Schedule 1 is determined by the NSW Scientific Committee, as established by the Act. From time to time, the Scientific Committee make determinations to add communities to the list of endangered communities on Schedule 1.

Several endangered ecological communities are found in the Kiama LGA; these are summarised in Table 3; their distribution is shown on Figure 3. The equivalent mapped vegetation communities in this study are provided in the table.



**Table 3**

**Endangered Ecological Communities - Municipality of Kiama**

<b>Name</b>	<b>KMA Equivalent</b>	<b>Site Example in Kiama</b>
<b><u>Rainforests</u></b>		
Robertson Rainforest (June 2001)	1.7 Sassafras Warm/Cool Temperate Rainforest (DOR-WRF)	Knights Hill area.
Illawarra Subtropical Rainforest (November 2002)	1.1 Complex Subtropical Rainforest (COM-SRF)	Extensive on escarpment slopes.
Littoral Rainforest (June 2004)	1.2 Complex Littoral Rainforest (COM-LRF) 1.6 Simple Littoral Rainforest (SIM-LRF)	Seven Mile Beach Area
<b><u>Eucalypt Forests/Woodlands</u></b>		
Illawarra Lowlands Grassy Woodland (December 1999)	2.7 Red Gum – Blue Gum Forest (TER-SAC) 2.8 Red Gum – Stringybark Forest (TER-EUG)	Hills northeast Jamberoo.
Robertson Basalt Tall Open Forest (June 2001)	2.11 Brown Barrel Tall Forest (FAS-CYP)	Knights Hill area.
Bangalay Sand Forest (October 2005)	2.9 Bangalay – Banksia Forest (BOT-BAN)	Seven Mile Beach, Minnamurra River area
<b><u>Shrublands</u></b>		
<i>Melaleuca armillaris</i> Tall Shrubland (August 2002)	5.1 Paperbark Tall Shrubland (MEL-ARM)	Hill tops around Jamberoo.
<b><u>Wetlands (Fresh and Saline)</u></b>		
Freshwater Wetlands on Coastal Floodplains (December 2004)	6.4 Spike-rush Sedgeland (ELE-SOG) 7.3 Phragmites Reedland (PHR-RDL)	North of Gerringong, Spring Creek.
Coastal Saltmarsh (June 2004)	7.4 Saltmarsh (SAR-SUA) 7.5 Saltwater Juncus Rushland (JUN-SAL)	Around Minnamurra River, Crooked River, Werri Lagoon.
Swamp Sclerophyll Forest on Coastal Floodplains (December 2004)	2.9 Bangalay – Banksia Forest (BOT-BAN) (possibly in part) 6.1 Swamp Mahogany – Paperbark Forest (ROB-MEL)	Crooked River Area
Swamp Oak Floodplain Forest (December 2004)	4.2 Swamp Oak Forest (CAS-GLA)	Minnamurra River, Crooked River, Werri Lagoon.
<b><u>Grasslands</u></b>		
Themeda Grassland on Seacliffs and Coastal Headlands (October 2005)	8.2 Kangaroo Grass Grassland (THM-GRL)	Minnamurra Point and Black Head (Gerroa)

### 4.3 THREATENED PLANT SPECIES

The threatened plant species known to occur within the Kiama LGA are listed in Table 4. The table lists the species, by family, provides the common and scientific names of each species and identifies the mapped vegetation communities where the species are most likely to be found.

**Table 4**  
**Threatened Plant Species within the Municipality of Kiama**

Family /Species	Distribution	Recovery Plan <sup>1</sup>
Asclepiadaceae <i>Cynanchum elegans</i>	Dry rainforest and lantana thickets on the lowlands.	No
Monimiaceae <i>Daphnandra</i> sp. C (Illawarra)	Occasional in moist lowland escarpment and subtropical rainforest.	Yes
Brassicaceae <i>Irenepharsus trypherus</i>	Escarpment, upper Minnamurra River Valley.	Yes
Proteaceae <i>Grevillea rivularis</i>	Near Kangaroo River around Carrington Falls.	No
Thymelaeaceae <i>Pimelea spicata</i>	Occasional on coastal headlands.	Draft
Orchidaceae <i>Pterostylis pulchella</i>	Escarpment, upper Minnamurra River Valley.	No
Rutaceae <i>Zieria granulata</i>	Moderately common on rocky land on the coastal ridges.	Yes
1. See Section 4.7 for discussion.		

### 4.4 SEPP NO. 26 – LITTORAL RAINFORESTS

*State Environmental Planning Policy No. 26 – Littoral Rainforests* identifies and makes provision for the protection of littoral (coastal) rainforest in New South Wales. A copy of SEPP No. 26 is provided in Appendix 2.

Patches of littoral rainforest identified in the SEPP occur near the Crooked River, in the far south of the Municipality. Two stands, nos. 175J and 175K, occur between the Seven Mile Beach Road and Blue Angle Creek. Three small adjacent stands, no. 175A, are identified on the headland above Shelly Beach, north of Gerroa. The locations of the patches identified under the SEPP are shown on Figure 4. Littoral rainforest is an endangered ecological community; see Appendix 6. The endangered community behind Seven Mile Beach is much more extensive than the areas delineated in SEP No. 26.



#### 4.5 SEPP NO. 14 – COASTAL WETLANDS

*State Environmental Planning Policy No. 14 - Coastal Wetlands* identifies and makes provision for the protection of coastal wetlands in New South Wales. A copy of SEPP No. 14 is provided in Appendix 3.

All wetlands in the Policy in Kiama are listed in Table 5; their location is shown on Figure 4. These wetlands occur on three watercourses in the LGA, note that none are identified on the Crooked River, even though that river contains wetlands. The major wetlands in the Municipality are along the Minnamurra River; these are contiguous with similar estuarine wetlands within the adjoining City of Shellharbour area.

**Table 5**  
**SEPP No. 14 Wetlands in the Municipality of Kiama**

No. in Policy	Name of Location	Mapped Vegetation Communities
374	Minnamurra River	CAS-GLA: Swamp Oak Forest AVI-FOR: Mangrove Forest AVI-SHR: Mangrove Shrubland SAR-SUA: Saltmarsh
373	Minnamurra River	AVI-FOR: Mangrove Forest AVI-SHR: Mangrove Shrubland
372	Minnamurra River	CAS-GLA: Swamp Oak Forest AVI-FOR: Mangrove Forest AVI-SHR: Mangrove Shrubland SAR-SUA: Saltmarsh
371	Spring Creek	None mapped. Includes reedbeds and some saltmarsh plants.
371a	Ooaree Creek (Werri Beach)	CAS-GLA: Swamp Oak Forest

#### 4.6 BUSHFIRE MANAGEMENT

One of the aims of this vegetation study was to assist Kiama Council to prepare a Bushfire Prone Land Map under the Bushfire Prone Land Mapping exercise required by the NSW Rural Fire Service (NSW Rural Fire Service 2002). To further assist council in this exercise, we have tabulated in Table 6 the vegetation communities recognised in this study along with the “Bushfire Vegetation Category” as defined by the above document from the Rural Fire Service.

<b>Table 6</b>		
<b>Vegetation Communities and Bushfire Categories</b>		
<b>Vegetation Community<sup>1</sup></b>	<b>Code</b>	<b>Bushfire Vegetation Category<sup>2</sup></b>
<b>Group 1. Rainforests</b>		
1.1 Complex Subtropical Rainforest	COM-SRF	Vegetation Group 3 (Moist Rainforests)
1.2 Complex Littoral Rainforest#	COM-LRF	Vegetation Group 3 (Moist Rainforests)
1.3 Coachwood Warm Temperate Rainforest	CER-WRF	Vegetation Group 3 (Moist Rainforests)
1.4 Plumwood Cool Temperate Rainforest#	EUC-CRF	Vegetation Group 3 (Moist Rainforests)
1.5 Ironwood Warm Temperate Rainforest#	BAC-WRF	Vegetation Group 1 (Forest) (sometimes Group 3 (Moist Rainforests))
1.6 Simple Littoral Rainforest#	SIM-LRF	Vegetation Group 1 (Forest)
1.7 Sassafras Warm/Cool Temperate Rainforest	DOR-WRF	Vegetation Group 3 (Moist Rainforests)
<b>Group 2. Eucalypt Forests</b>		
2.1 White Box - Brown Barrel Tall Forest	QUD-FAS	Vegetation Group 1 (Forest)
2.2 White Box - Yellow Stringybark Tall Forest	QUD-MUL	Vegetation Group 1 (Forest)
2.3 Blackbutt Tall Forest	PIL- SYN	Vegetation Group 1 (Forest)
2.4 Blackbutt - Banksia Tall Forest	PIL-BAN	Vegetation Group 1 (Forest)
2.5 Blue Gum - White Box Tall Forest	SAL-QUD	Vegetation Group 1 (Forest)
2.6 Blue Gum - Turpentine Forest	SAL-SYN	Vegetation Group 1 (Forest)
2.7 Red Gum - Blue Gum Forest	TER-SAL	Vegetation Group 1 (Forest) - Group 2 (Woodland)
2.8 Red Gum - Stringybark Forest	TER-EUG	Vegetation Group 1 (Forest) - Group 2 (Woodland)
2.9 Bangalay - Banksia Forest	BOT-BAN	Vegetation Group 1 (Forest)
2.10 Silvertop Ash – Peppermint Forest	SIE-PIP	Vegetation Group 1 (Forest) - Group 2 (Woodland)
2.11 Brown Barrel Tall Forest	FAS-CYP	Vegetation Group 1 (Forest)
<b>Group 3. Miscellaneous Forests</b>		
3.1 Coast Banksia Forest	BAN-FOR	Vegetation Group 1 (Forest)
3.2 Wattle Forest	ACA-FOR	Mostly Vegetation Group 1 (Forest)
3.3 Miscellaneous Forest	MIS-FOR	Mostly excluded (small areas in cleared land)
<b>Group 4. Floodplain Forests</b>		
4.1 River Oak Tall Forest	CAS-CUN	Vegetation Group 1 (Forest)
4.2 Swamp Oak Forest	CAS-GLA	Vegetation Group 1 (Forest) - Group 2 (Wetlands)
<b>Group 5. Shrublands/Heathlands</b>		
5.1 Paperbark Tall Shrubland	MEL-ARM	Vegetation Group 3 (Shrubland)
5.2 Coast Teatree Shrubland	LEP-LAV	Vegetation Group 3 (Shrubland)
5.3 Coast Wattle Shrubland	ACA-SPH	Vegetation Group 3 (Shrubland)
5.4 Lantana Shrubland	LAN-SHR	Vegetation Group 3 (Shrubland)
5.5 Sandstone Sedgeland/Heathland/ Shrubland (Upland Swamp)	SST-SDG	Vegetation Group 2 (Heath/Wetlands) - Group 3 (Shrubland)
<b>Group 6. Fresh Wetlands</b>		
6.1 Swamp Mahogany – Paperbark Forest	ROB-MEL	Vegetation Group 1 (Forest) - Group 2 (Wetlands)
6.2 Cumbungi Reedland#	TYP-RDL	Vegetation Group 2 (Wetlands)
6.3 Fresh Juncus Rushland#	JUN-FRH	Vegetation Group 2 (Wetlands)
6.4 Spike-rush Sedgeland#	ELE-SDG	Vegetation Group 2 (Wetlands)

Vegetation Community <sup>1</sup>	Code	Bushfire Vegetation Category <sup>2</sup>
<b>Group 7. Saline Wetlands</b>		
7.1 Mangrove Forest	AVI-FOR	Excluded (Mangroves)
7.2 Mangrove Shrubland	AVI-SHR	Excluded (Mangroves)
7.3 Phragmites Reedland	PHR-RDL	Vegetation Group 2 (Wetlands)
7.4 Saltmarsh	SAR-SUA	Vegetation Group 2 (Wetlands)
7.5 Saltwater Juncus Rushland	JUN-SAL	Vegetation Group 2 (Wetlands)
<b>Group 8. Grasslands</b>		
8.1 Spinifex Grassland#	SPN-GRL	Vegetation Group 3 (Grasslands)
8.2 Kangaroo Grass Grassland#	THM-GRL	Vegetation Group 3 (Grasslands)
8.3 Non-native Grassland#	INT-GRL	Mostly Excluded (Managed Grazing Land)
1. Communities not mapped are indicated by an "#".		
2. Bushfire category after NSW Rural Fire Service (2002).		

#### 4.7 RECOVERY PLANS

Recovery Plans must be prepared for all endangered and vulnerable species of plant listed under the *Threatened Species Conservation Act, 1995*. Section 56 of the Act states:

"The Director-General is required to prepare a recovery plan for each endangered species (other than a species presumed extinct), population and ecological community, as soon as practicable after it is listed in Schedule 1, to promote the recovery of the species, population or ecological community to a position of viability in nature."

Section 57, guidelines for recovery plans, states:

- "(1) The Director-General must, in preparing a recovery plan and in deciding which measures to include in it, have regard to the following:
- (a) the objects of this Act,
  - (b) the likely social and economic consequences of the making of the plan,
  - (c) the most efficient and effective use of available resources for the conservation of threatened species, populations and ecological communities,
  - (d) the minimising of any significant adverse social and economic consequences.
- (2) The Director-General is to consider, when preparing a recovery plan, any measures by which the public may co-operate in the conservation of a threatened species, population or ecological community."

The following Recovery Plans have been prepared to date for endangered plant species found in Kiama; these plans are available from the Department of Environment and Conservation or from their website, where they can be downloaded.

<i>Daphnandra</i> sp. 'C' (Illawarra)	Illawarra Socketwood
<i>Irenepharsus trypherus</i>	Illawarra Irene
<i>Pimelea spicata</i>	Rice-flower (Draft only)
<i>Zieria granulata</i>	Illawarra Zieria

There is a considerable backlog of recovery plans to be prepared. It may be some time before plans dealing with the other threatened species and the endangered communities are prepared.

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## APPENDIX 1

### FINAL DETERMINATION: ILLAWARRA LOWLANDS GRASSY WOODLAND

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule I of the Act. The listing of Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. The Illawarra Lowlands Grassy Woodland is the name given to the plant community from the local government areas of Wollongong City, Shellharbour City, and Kiama Municipality (within the Sydney Basin Bioregion) that is characterised by the following assemblage of species:

<i>Acacia falcata</i>	<i>Dianella revoluta</i>	<i>Hypoxis hygrometrica</i>
<i>Acacia implexa</i>	<i>Dichondra repens</i>	<i>Jacksonia scoparia</i>
<i>Acacia maidenii</i>	<i>Dodonaea viscosa var</i>	<i>Kennedia rubicunda</i>
<i>Acacia mearnsii</i>	<i>angustifolia</i>	<i>Lepidosperma laterale</i>
<i>Acacia stricta</i>	<i>Echinopogon caespitosus</i>	<i>Leucopogon juniperinum</i>
<i>Allocasuarina littoralis</i>	<i>Echinopogon ovatus</i>	<i>Lomandra filiformis</i>
<i>Angophora floribunda</i>	<i>Entolasia stricta</i>	<i>Lomandra multiflora</i>
<i>Aristida ramosa</i>	<i>Eragrostis sp.</i>	<i>Melaleuca decora</i>
<i>Aristida vagans</i>	<i>Eucalyptus amplifolia</i>	<i>Melaleuca styphelioides</i>
<i>Athropodium milleflorum</i>	<i>Eucalyptus bosistoana</i>	<i>Microlaena stipoides</i>
<i>Boronia polygalifolia</i>	<i>Eucalyptus botryoides</i>	<i>Oplismenus aemulus</i>
<i>Bothriochloa macra</i>	<i>Eucalyptus botryoides/saligna</i>	<i>Oplismenus imbecillis</i>
<i>Brachychiton populneus</i>	<i>Eucalyptus eugenioides</i>	<i>Panicum sp.</i>
<i>Brunoniella pumilio</i>	<i>Eucalyptus longifolia</i>	<i>Parsonsia straminea</i>
<i>Bursaria spinosa</i>	<i>Eucalyptus pilularis</i>	<i>Plectranthus parviflorus</i>
<i>Callistemon salignus</i>	<i>Eucalyptus tereticornis</i>	<i>Poa labillardieri</i>
<i>Carex longibrachiata</i>	<i>Gahnia radula</i>	<i>Pratia purpurascens</i>
<i>Cheilanthes sieberi</i>	<i>Geitonoplesium cymosum</i>	<i>Pultenaea retusa</i>
<i>Citriobatus pauciflorus</i>	<i>Geranium solanderi</i>	<i>Pultenaea villosa</i>
<i>Commelina cyanea</i>	<i>Glycine sp.</i>	<i>Rubus parvifolius</i>
<i>Cymbopogon refractus</i>	<i>Goodenia hederacea</i>	<i>Stellaria flaccida</i>
<i>Daviesia genistifolia</i>	subsp. <i>hederacea</i>	<i>Themeda australis</i>
<i>Daviesia ulicifolia</i>	<i>Hardenbergia violacea</i>	<i>Tricoryne elatior</i>
<i>Desmodium rhytidophyllum</i>	<i>Hibbertia aspera</i>	<i>Veronica calycina</i>
<i>Desmodium varians</i>	<i>Hypericum gramineum</i>	<i>Wahlenbergia sp.</i>

2. The total species list of the community is considerably larger than that given in 1 (above), with many species present in only one or two sites or in very small quantity. In any particular site not all of the assemblage listed in 1 may be present. At any one time, seeds of some species may only be present in the soil seed bank with no above-ground individuals present. The species composition of the site will be influenced by the size of the site and by its recent disturbance history. The number of species and the above-ground composition of species will change with time since fire, and may also change in response to changes in fire frequency.



3. Illawarra Lowlands Grassy Woodland has been recorded from the local government areas of Wollongong City, Shellharbour City and Kiama Municipality (within the Sydney Basin Bioregion).
4. Illawarra Lowlands Grassy Woodland includes the Yallah Woodland and Mills' (1997) communities of the Floodplains, communities of the Ridges and Slopes (Dry communities) and communities of the lower escarpment (Moist communities), but does not include Floodplain Communities dominated by *Casuarina* species or rainforest on latite soils.
5. Characteristic tree species in the Illawarra Lowlands Grassy Woodland are *Eucalyptus tereticornis*, *Eucalyptus eugenioides*, *Eucalyptus longifolia*, *Eucalyptus bosistoana* and *Melaleuca decora*.
6. Illawarra Lowlands Grassy Woodland occurs on relatively gently sloping to undulating lands less than about 200m elevation on Berry Siltstone, Budgong Sandstone and Quaternary alluvium.
7. Illawarra Lowlands Grassy Woodland provides habitat for the endangered orchid *Pterostylis gibbosa*.
8. No areas of Illawarra Lowlands Grassy Woodland are presently included in formal conservation reserves though some occur in small council reserves including Blackbutt Reserve and Croome Road Reserve in Shellharbour.
9. Large areas of Illawarra Lowlands Grassy Woodland have been cleared. Most remnants are small and fragmented and their long term viability is threatened. Some remnants consist of regrowth after clearing or other disturbances. Identified threats include further clearing, grazing, weed invasion, selective logging, rubbish dumping, housing and hobby farm developments and physical damage from recreational activities.
10. In view of the small size of existing remnants, the threat of further clearing and other threatening processes, the Scientific Committee is of the opinion that Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion is likely to become extinct in nature unless factors threatening its survival or evolutionary development cease to operate and that listing as an endangered ecological community is warranted.

Dr Chris Dickman  
Chairperson  
Scientific Committee

Gazetted: 24/12/99  
Exhibition period: 24/12/99 – 4/2/00

Reference: Kevin Mills & Associates (1997) *Ecological Study Figtree Estate and Forest Red Gum Communities of the Illawarra Coastal Plain*. (prepared for Stockland Trust Group Ltd Sydney).

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## APPENDIX 2

### FINAL DETERMINATION: ILLAWARRA SUBTROPICAL RAINFOREST

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Illawarra Subtropical Rainforest in the Sydney Basin Bioregion as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act. The listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Illawarra Subtropical Rainforest is the name given to the ecological community on high nutrient soils in the Illawarra area within the Sydney Basin Bioregion and is characterised by the following assemblage of species.

<i>Adiantum formosum</i>	<i>Alectryon subcinereus</i>
<i>Alphitonia excelsa</i>	<i>Baloghia inophylla</i>
<i>Brachychiton acerifolius</i>	<i>Cassine australis</i>
<i>Cayratia clematidea</i>	<i>Celastrus australis</i>
<i>Cissus antarctica</i>	<i>Citriobatus pauciflorus</i>
<i>Dendrocnide excelsa</i>	<i>Diospyros pentamera</i>
<i>Diploglottis australis</i>	<i>Doodia aspera</i>
<i>Ehretia acuminata</i>	<i>Ficus</i> spp.
<i>Guioa semiglauca</i>	<i>Hibiscus heterophyllus</i>
<i>Legnephora moorei</i>	<i>Maclura cochinchinensis</i>
<i>Malaisia scandens</i>	<i>Pennantia cunninghamii</i>
<i>Piper novaehollandiae</i>	<i>Planchonella australis</i>
<i>Podocarpus elatus</i>	<i>Scolopia braunii</i>
<i>Streblus brunonianus</i>	<i>Toona ciliata</i>
<i>Wilkiea huegliana</i>	

2. The total species list of the community is considerably larger than that given above, with many species present in only one or two sites or in very small quantity. The species composition of a site will be influenced by the size of the site, recent rainfall or drought condition and by its disturbance (including fire) history. The number of species, and the above ground relative abundance of species will change with time since fire, and may also change in response to changes in fire regime (including changes in fire frequency). At any one time, above ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs,

corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. Illawarra Subtropical Rainforest has been recorded from the local government areas of Wollongong City, Shellharbour City, Shoalhaven City and Kiama Municipality (within the Sydney Basin Bioregion) and may occur elsewhere in the Bioregion.
4. Illawarra Subtropical Rainforest includes Subtropical Rainforest (Type 1), Moist Subtropical Rainforest (Type 2) and Dry Subtropical Rainforest (Type 3) of Mills, K & Jakeman, J. (1995) *Rainforests of the Illawarra District* (Coachwood Publishing, Jamberoo). (The classification of Mills & Jakeman was developed specifically for the Illawarra - in a broader context much of the community recognised here would fall within dry forest (suballiance 23) in Floyd, A. G. (1990). *Australian rainforests in New South Wales* (Vols 1 and 2, Surrey Beatty and Sons, Chipping Norton). Although rainforest canopies are generally closed, in highly disturbed stands the canopy may be irregular and open. Canopy height varies considerably, and structurally some stands are scrub.
5. Characteristic tree species in the Illawarra Subtropical Rainforest are *Baloghia inophylla*, *Brachychiton acerifolius*, *Dendrocnide excelsa*, *Diploglottis australis*, *Ficus* spp., *Pennantia cunninghamii* and *Toona ciliata*. Stands may have species of *Eucalyptus*, *Syncarpia* and *Acacia* as emergents or incorporated into the dense canopy.
6. Illawarra Subtropical Rainforest occurred mainly on the coastal Permian volcanics, but can occur on a range of geological substrates, mainly between Albion Park and Gerringong (termed the Illawarra Brush by Mills and Jakeman 1995) and north of Lake Illawarra on the Berkeley Hills (termed the Berkeley Brush by Mills & Jakeman 1995). The Illawarra Brush and Berkeley Brush originally covered about 13 600 ha and made up about 60% of the rainforest of the Illawarra area. Outlying occurrences of Illawarra Subtropical Rainforest also occur south to the Shoalhaven River and westwards into Kangaroo Valley, where areas of Permian volcanic soils occur. The community generally occurs on the coastal plain and escarpment foothills, rarely extending onto the upper escarpment slopes.
7. Illawarra Subtropical Rainforest provides habitat for the tree *Daphnandra* sp. C Illawarra, and in some drier stands the endangered vine *Cynanchum elegans*. The shrub *Zieria granulata* may grow near stands of Illawarra Subtropical Rainforest and in regrowth stands (K. Mills pers. comm.).
8. Small areas of Illawarra Subtropical Rainforest occur in Budderoo National Park, Macquarie Pass National Park, Morton National Park, Cambewarra Range Nature Reserve, Devils Glen Nature Reserve and Rodway Nature Reserve.
9. Large areas of Illawarra Subtropical Rainforest have been cleared for agriculture. Only about 3400 ha remains with about 13% of this (440 ha) in reserved areas (Mills & Jakeman 1995, L. Mitchell pers. comm). Illawarra Subtropical Rainforest occurs mainly on private land and is inadequately protected. Compared with warm temperate rainforest it is under-represented in conservation reserves.
10. Remnants are small and fragmented and their long term viability is threatened. Weed invasion is a major threat and invasive exotic species include *Lantana camara*, *Araujia*

*sericiflora*, *Ageratina riparia*, *Ageratina adenophora*, *Delairea odorata*, *Senna pendula* var *glabra*, *Senna septemtrionalis*, *Tradescantia fluminensis*, *Cinnamomum camphora*, *Olea europea* subsp. *africana*, *Hedychium gardnerianum*, *Ligustrum lucidum*, *Ligustrum sinense*, *Passiflora subpeltata* and *Solanum mauritianum*. Other threats include further clearing, quarrying, grazing, inappropriate fire regimes, rubbish dumping and hobby farm developments.

11. In view of the above the Scientific Committee is of the opinion that Illawarra Subtropical Rainforest in the Sydney Basin Bioregion is likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Proposed Gazettal date: 01/11/02  
Exhibition period: 01/11/02 – 05/12/02

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## APPENDIX 3

### FINAL DETERMINATION: *MELALEUCA ARMILLARIS* TALL SHRUBLAND

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list *Melaleuca armillaris* Tall Shrubland in the Sydney Basin Bioregion as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act. The listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. *Melaleuca armillaris* Tall Shrubland is the name given to the ecological community found on outcrops of volcanic soils on dry rocky ridges in the Illawarra area (within the Sydney Basin Bioregion) and is characterised by the following assemblage of species:

<i>Acacia mearnsii</i>	<i>Alphitonia excelsa</i>
<i>Bracteantha bracteata</i>	<i>Calandrinia pickeringii</i>
<i>Cheilanthes distans</i>	<i>Cheilanthes sieberi</i>
<i>Commelina cyanea</i>	<i>Commersonia fraseri</i>
<i>Crassula sieberiana</i>	<i>Dodonaea viscosa</i> subsp. <i>angustifolia</i>
<i>Hibiscus heterophyllus</i>	<i>Melaleuca armillaris</i>
<i>Plectranthus graveolens</i>	<i>Prostanthera linearis</i>
<i>Zieria granulata</i>	

2. The total species list of the community is considerably larger than that given in 1 (above), with many species present in only one or two sites or in very small quantity. In any particular site not all of the assemblage listed in 1 may be present. At any one time, some species may only be present as seeds in the soil seed bank with no above-ground individuals present. The species composition of the site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance history. The number of species and the above-ground composition of species will change with time since fire, and may also change in response to changes in fire frequency. The community includes a diverse fauna, both vertebrate and invertebrate, but it is poorly known. The threatened species *Zieria granulata* is closely associated with *Melaleuca armillaris* Tall Shrubland (Mills & Assoc 2000).

3. *Melaleuca armillaris* Tall Shrubland may be up to about 5 m tall and is dominated by the large Paperbark shrub *Melaleuca armillaris*. It occurs in sites away from the coast on very dry rocky ridges, at Dunmore and in Jamberoo Valley on volcanic soils overlying latite, and in small patches near Killalea. Rock outcrops are common within the Community. Because the soils on which it grows are shallow and are unable to retain enough moisture, the shrubs may die back during drought. (Dense stands of *M. armillaris* on coastal headlands are not included within this ecological community).

4. *Melaleuca armillaris* Tall Shrubland has been recorded from the local government areas of Shellharbour City, and Kiama Municipality (within the Sydney Basin Bioregion) and may occur elsewhere in the Bioregion.

5. Small stands of *Melaleuca armillaris* Tall Shrubland occur in Killalea State Park.

6. Many areas of *Melaleuca armillaris* Tall Shrubland have been cleared. Most remnants are small and fragmented and their longterm viability is threatened. Threats include further clearing, grazing, including by rabbits, quarrying, inappropriate fire regimes, weed invasion, rubbish dumping, housing and hobby farm developments.

7. In view of the above the Scientific Committee is of the opinion that *Melaleuca armillaris* Tall Shrubland in the Sydney Basin Bioregion is likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Proposed Gazettal date: 23/08/02

Exhibition period: 23/08/02 – 27/09/02

#### **Reference**

Kevin Mills & Associates (2000) Nature Conservation Study, Rural Lands Study Area, City of Shellharbour. Prepared for Shellharbour City Council.

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## APPENDIX 4

### FINAL DETERMINATION: FRESHWATER WETLANDS ON COASTAL FLOODPLAINS

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Freshwater Wetlands on Coastal Floodplains generally occur below 20 m elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community may vary from sedgeland and reedlands to herbfields, and woody species of plants are generally scarce. Typically these wetlands form mosaics with other floodplain communities, and often they include or are associated with ephemeral or semi-permanent standing water (e.g. Goodrick 1970).

The composition of Freshwater Wetlands on Coastal Floodplains is primarily determined by the frequency, duration and depth of waterlogging and may be influenced by the level of nutrients and salinity in the water and substrate. The community is characterised by the following assemblage of species:

<i>Alisma plantago-aquatica</i>	<i>Azolla filiculoides</i> var. <i>rubra</i>
<i>Azolla pinnata</i>	<i>Baumea articulata</i>
<i>Baumea rubiginosa</i>	<i>Bolboschoenus caldwellii</i>
<i>Bolboschoenus fluviatilis</i>	<i>Brasenia schreiberi</i>
<i>Carex appressa</i>	<i>Centipeda minima</i>
<i>Ceratophyllum demersum</i>	<i>Cyperus lucidus</i>
<i>Eclipta platyglossa</i>	<i>Eclipta prostrata</i>
<i>Eleocharis acuta</i>	<i>Eleocharis equisetina</i>
<i>Eleocharis minuta</i>	<i>Eleocharis sphacelata</i>
<i>Fimbristylis dichotoma</i>	<i>Gratiola pedunculata</i>
<i>Hemarthria uncinata</i>	<i>Hydrilla verticillata</i>
<i>Hydrocharis dubia</i>	<i>Juncus polyanthemus</i>
<i>Juncus usitatus</i>	<i>Leersia hexandra</i>
<i>Lemna</i> spp.	<i>Lepironia articulata</i>
<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	<i>Marsilea mutica</i>
<i>Maundia triglochinoides</i>	<i>Myriophyllum crispatum</i>
<i>Myriophyllum latifolium</i>	<i>Myriophyllum propinquum</i>

<i>Myriophyllum variifolium</i>	<i>Najas marina</i>
<i>Najas tenuifolia</i>	<i>Nymphaea gigantea</i>
<i>Nymphoides geminata</i>	<i>Nymphoides indica</i>
<i>Ottelia ovalifolia</i>	<i>Panicum obseptum</i>
<i>Panicum vaginatum</i>	<i>Paspalum distichum</i>
<i>Persicaria attenuata</i>	<i>Persicaria decipiens</i>
<i>Persicaria hydropiper</i>	<i>Persicaria lapathifolia</i>
<i>Persicaria strigosa</i>	<i>Philydrum lanuginosum</i>
<i>Phragmites australis</i>	<i>Potamogeton crispus</i>
<i>Potamogeton ochreatus</i>	<i>Potamogeton perfoliatus</i>
<i>Potamogeton tricarinatus</i>	<i>Pseudoraphis spinescens</i>
<i>Ranunculus inundatus</i>	<i>Schoenoplectus litoralis</i>
<i>Schoenoplectus mucronatus</i>	<i>Schoenoplectus validus</i>
<i>Spirodella</i> spp.	<i>Triglochin procera</i> sensu lato
<i>Typha orientalis</i>	<i>Utricularia australis</i>
<i>Vallisneria</i> spp.	<i>Wolffia</i> spp.

2. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance history (including grazing, flooding, land clearing and pollution in the catchment). The number and relative abundance of species will change with time since flooding or significant rainfall, and may also change in response to changes in grazing regimes and land use in the catchment. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Penrith, Fairfield, Liverpool, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Examples include Swan Bay, Gundurimba wetland, Bungawalbin Swamp, Dyraaba Creek and Tuckean Swamp on the Richmond floodplain; Southgate wetlands and Trenayr Swamp on the Clarence floodplain; Seven Oaks Swamp, Swan Pool, Kinchela Creek and Upper Belmore Swamp on the Macleay floodplain; Great Swamp on the Manning floodplain; Wentworth Swamp, Hexham Swamp, Wallis Creek and Ellalong Lagoon on the Hunter floodplain; Bushells, Pitt Town, Long Neck and Broadwater Lagoons on the Hawkesbury floodplain; Coomonderry Swamp on the Shoalhaven floodplain; Pedro and Old Man Bed Swamps on the Moruya floodplain; and Jellat Jellat Swamp on the Bega floodplain (Goodrick 1970).

4. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime (Yen and Myerscough 1989, Boulton and Brock 1999). Wetlands or parts of



wetlands that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum* (water couch), *Leersia hexandra* (swamp rice-grass), *Pseudoraphis spinescens* (mud grass) and *Carex appressa* (tussock sedge). Wetlands or parts of wetlands subject to regular inundation and drying may include large emergent sedges over 1 metre tall, such as *Baumea articulata*, *Eleocharis equisetina* and *Lepironia articulata*, as well as emergent or floating herbs such as *Hydrocharis dubia* (frogbit), *Philydrum lanuginosum* (frogsmouth), *Ludwigia peploides* subsp. *montevidensis* (water primrose), *Marsilea mutica* (nardoo) and *Myriophyllum* spp. (milfoils). As standing water becomes deeper or more permanent, amphibious and emergent plants become less abundant, while floating and submerged aquatic herbs become more abundant. These latter species include *Azolla filiculoides* var. *rubra*, *Ceratophyllum demersum* (hornwort), *Hydrilla verticillata* (water thyme), *Lemna* spp. (duckweeds), *Nymphaea gigantea* (giant waterlily), *Nymphoides indica* (water snowflake), *Ottelia ovalifolia* (swamp lily) and *Potamogeton* spp. (pondweeds). The threatened aquatic plants, *Aldrovanda vesiculosa* and *Najas marina*, also occur within this community. The composition and structure of the vegetation is also influenced by grazing history, changes to hydrology and soil salinity, catchment runoff and disturbance, and may have a substantial component of exotic grasses and forbs. Artificial wetlands created on previously dry land specifically for purposes such as sewerage treatment, stormwater management and farm production, are not regarded as part of this community, although they may provide habitat for threatened species.

5. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has a distinctive fauna that includes frogs, fish, freshwater tortoises, waterbirds and a diversity of micro- and macro-invertebrates. The frog families represented are Myobatrachidae (southern frogs) and Hylidae (tree frogs), including the threatened Green and Golden Bell Frog (*Litoria aurea*). Waterbirds include Black Swan (*Cygnus atratus*), Pacific Black Duck (*Anas superciliosa*), Australian Grey Teal (*Anas gracilis*), Pacific Heron (*Ardea pacifica*), White-faced Heron (*Ardea novaehollandiae*), Great Egret (*Ardea alba*), Intermediate Egret (*Ardea intermedia*), Little Egret (*Ardea garzetta*), Straw-necked Ibis (*Threskiornis spinicollis*), Sacred Ibis (*Threskiornis aethiopica*), Black-necked Stork (*Ephippiorhynchus asiaticus*), Royal Spoonbill (*Platalea regia*), Yellow-billed Spoonbill (*Platalea flavipes*), Japanese Snipe (*Gallinago hardwickii*), Black-winged Stilt (*Himantopus himantopus*), Dusky Moorhen (*Gallinula tenebrosa*), Comb-crested jacana (*Jacana gallinacea*) and Purple swamphen (*Porphyrio porphyrio*).

6. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested wetland and treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified several types of forested wetlands that are distinct from this treeless wetland community (Keith and Scott 2005). The combination of features that distinguish Freshwater Wetlands on Coastal Floodplains from other endangered ecological communities on the coastal floodplains include its scarcity or complete absence of woody plant species and the presence of amphibious, emergent, floating or submerged aquatic forbs, grasses or sedges. It generally occupies low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes; habitats where flooding is periodic and standing fresh water persists for at least part of the year in most years. The community also occurs in backbarrier landforms where floodplains adjoin coastal sandplains (e.g. Pressey and Griffith 1992). However, it is distinct from Sydney Freshwater Wetlands, which may include a component of woody plant species and are associated with sandplains in the Sydney Basin bioregion.

7. Freshwater Wetlands on Coastal Floodplains may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on

the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, Subtropical Floodplain Forest of the NSW North Coast bioregion, River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal River-flat Forest in the Sydney Basin bioregion), Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal Estuary Swamp Forest Complex in the Sydney Basin bioregion) and Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. For example, Freshwater Wetlands on Coastal Floodplains are sometimes fringed by trees, such as *Casuarina glauca* (swamp oak) and *Melaleuca quinquenervia* (paperbark), indicating transitional zones to forested communities of the floodplains. The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston *et al.* 2003, Stevenson 2003). In addition, Freshwater Wetlands on Coastal Floodplains may adjoin or intergrade with Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner bioregions and Sydney Freshwater Wetlands of the Sydney Basin bioregion. The Determinations for these communities collectively encompass the full range of intermediate assemblages.

8. A number of vegetation surveys and mapping studies have been conducted across the range of Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. This community includes 'Fresh meadows', 'Seasonal fresh swamps', 'Semi-permanent fresh swamps', and 'Open fresh waters' in the general coastal wetlands classification of Goodrick (1970). In the Tweed valley lowlands, this community includes '*Eleocharis equisetina* tall closed sedgeland' (E2) and '*Triglochin procera* tall forbland to tall open forbland' (E3) of Pressey and Griffith (1992) and parts of the 'Floodplain Wetland Complex' (FL) that are dominated by herbaceous plants (Pressey and Griffith 1992). In the lower Hunter valley, 'Freshwater Wetland Complex' (map unit 46) of NPWS (2000) falls within this community. In the Sydney region, this community includes 'Freshwater wetlands on the floodplains' of Benson and Howell (1990); 'Freshwater reed swamps' (map unit 28a) of Benson (1992) and Ryan *et al.* (1996) in the Penrith-St Albans district; '*Lepironia* freshwater swamp' (map unit 75 and part of map unit 79) of NPWS (2002a) in the Warragamba area; and 'Freshwater wetlands' (map unit 36) of Tozer (2003) on the Cumberland Plain. On the Illawarra plain, this community includes 'Floodplain Wetland' (map unit 54) of NPWS (2002b). In the Comprehensive Regional Assessment of southern New South Wales (Thomas *et al.* 2000), this community includes 'Coastal alluvial valley floor wetlands' (map unit 189). This community also includes those parts of 'Coastal freshwater lagoon' (map unit 313) of Tindall *et al.* (2004), on the south coast of NSW, and parts of 'Floodplain Wetlands' (map unit 60) of Keith and Bedward (1999), in the Eden region, that are dominated by herbaceous aquatic plants. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is included within the 'Coastal Freshwater Lagoons' vegetation class of Keith (2002, 2004). There may be additional or unmapped occurrences of Freshwater Wetlands on Coastal Floodplains within and beyond these surveyed areas.

9. The extent of the Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. Estimates of wetland area also vary, depending on the scale of mapping (coarse scale maps may exclude many small wetlands), wetland definition and the occurrence of recent flooding. Mapping carried out by Kingsford *et al.* (2004), for example, focused on areas of open water and thus excluded many wetlands attributable to this community. One estimate based on a compilation of regional vegetation maps suggests that Coastal Freshwater Lagoons, which include Freshwater Wetlands on Coastal Floodplains, currently cover 90-160 km<sup>2</sup>, representing less than 60-90% of the original extent of this broadly defined vegetation class (Keith 2004). However, the

remaining area of Freshwater Wetlands on Coastal Floodplains is likely to represent much less than 60-90% of its original range, because this combined estimate for the Coastal Freshwater Wetlands class (Keith 2004) is likely to include a considerable area of freshwater wetlands on coastal sandplains, which are excluded from this Determination. Goodrick (1970) estimated that approximately 21 700 ha of 'Fresh meadows', 'Seasonal fresh swamps', 'Semi-permanent fresh swamps', and 'Open fresh waters' remained on NSW coastal floodplains in 1969, representing less than 39% of their original area. Continued clearing and drainage works in the 35 years since Goodrick's (1970) survey are likely to have resulted in a substantial diminution of Freshwater Wetlands on Coastal Floodplains. More detailed surveys have identified the following areas attributable to Freshwater Wetlands on Coastal Floodplains: less than 150 ha on the Tweed lowlands in 1985 (Pressey and Griffith 1992); about 10 600 ha on the lower Clarence floodplain in 1982 (Pressey 1989a); about 11 200 ha on the lower Macleay floodplain in 1983 (Pressey 1989b); about 3500 ha in the lower Hunter – central Hunter region in 1990s (NPWS 2000); less than 2700 ha on the NSW south coast from Sydney to Moruya in the mid 1990s (Tindall *et al.* 2004), including about 660 ha on the Cumberland Plain in 1998 (Tozer 2003) and about 100 ha on the Illawarra Plain in 2001 (NPWS 2002); and less than 1000 ha in the Eden region in 1990 (Keith and Bedward 1999). The wetlands included in these estimates exist in various states of modification.

10. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, poplars, etc.) and, on the far north coast, canefields. On the Tweed lowlands, Pressey and Griffith (1992) estimated that less than 3% of the original Floodplain Wetlands remained in 1985. Similar estimates are likely to apply to Freshwater Wetlands on Coastal Floodplains in other parts of the NSW North Coast bioregion (Pressey 1989a, 1989b). In the lower Hunter – central coast region, about two-thirds was estimated to have remained during the 1990s (NPWS 2000), while approximately 40% remained on the Cumberland Plain in 1998 (Tozer 2003). In the Sydney – South Coast region, about 70% was estimated to remain in the mid 1990s (Tindall *et al.* 2004), in the Eden region about 30% was estimated to remain during the 1990s (Keith and Bedward 1999).

11. Land clearing continues to threaten Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Pressey 1989a, b; Pressey and Griffith 1992), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and are further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, filling associated with urban and industrial development, pollution and eutrophication from urban and agricultural runoff, weed invasion, overgrazing, trampling by livestock, soil disturbance by pigs, activation of 'acid sulfate soils' and rubbish dumping (e.g. Goodrick 1970; Pressey 1989a, b; Pressey and Griffith 1992; Boulton and Brock 1999, Johnston *et al.* 2003). The native fauna of Freshwater Wetlands on Coastal Floodplains is threatened by predation, particularly by mosquito fish and cane toads. Anthropogenic climate change may also threaten Freshwater Wetlands on Coastal Floodplains if sea levels rise and future flooding regimes change as predicted (IPCC 2001; Hughes 2003). Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; and Anthropogenic climate change are listed as Key Threatening Processes under the Threatened Species Conservation Act (1995).

12. Large areas of habitat formerly occupied by Freshwater Wetlands on Coastal Floodplains have been directly drained by construction of artificial channels (e.g. Pressey 1989a, 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 former 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). On the north coast of NSW, expansion of *Melaleuca quinquenervia* and *Casuarina glauca* into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (Johnston *et al.* 2003, Stevenson 2003). These changes appear to be closely associated with enhanced acidity, altered ionic ratios, increased dissolved organic carbon and sulfide oxidation in the soil profile (Johnston *et al.* 2003). Conversely, alteration of tidal flows may have led to decreased soil salinity and localised expansion of Freshwater Wetland into areas that previously supported Coastal Saltmarsh or mangroves (Stevenson 2003). Re-instatement of tidal flows and other natural hydrological processes may therefore lead to contraction of Freshwater Wetlands. In addition, sedimentation and eutrophication of wetlands is associated with development of their catchments for intensive agriculture or urban or industrial infrastructure. Harmful runoff from developed catchments may include herbicides, pesticides, fertilisers, sewerage, industrial waste and polluted stormwater. The widespread degradation of Freshwater Wetlands on Coastal Floodplains has led to regional declines in their dependent fauna including Magpie Geese (*Anseranas semipalmata*), Cotton Pygmy Geese (*Nettapus coromandelianus*), Hardhead (*Aythya australis*), Black-necked Stork (*Ephippiorhynchus asiaticus*), and Wandering Whistling Duck (*Dendrocygna arcuata*).

13. Very few examples of Freshwater Wetlands on Coastal Floodplains remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community; the dumping of landfill, rubbish and garden refuse; eutrophication and polluted runoff from urban and agricultural areas; construction of roads and other utilities; soil disturbance by feral pigs and grazing by domestic livestock. In addition, mechanical and chemical methods of controlling aquatic weeds may threaten native components of the flora. The principal weed species affecting Freshwater Wetlands on Coastal Floodplains include *Alternanthera philoxeroides* (alligatorweed), *Baccharis halimifolia* (groundsel bush), *Echinochloa crus-galli* (barnyard grass), *Eichhornia crassipes* (water hyacinth), *Hygrophila costata* (glush weed), *Ludwigia longifolia*, *L. peruviana*, *Nymphaea capensis* (Cape waterlily), *Panicum repens* (torpedo grass), *Pennisetum clandestinum* (kikuyu) and *Salvinia molesta*, (Sainty and Jacobs 1981).

14. Small areas of Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Ukerebagh, Tuckean, Tabbimoble Swamp, Hexham Swamp, Pambalong and Pitt Town Nature Reserves and Bungawalbin, Scheyville and Seven Mile Beach National Parks, although these are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that were, and continue to be initiated outside their boundaries. Some Freshwater Wetlands on Coastal Floodplains are protected by State Environmental Planning Policy 14, although this has not always precluded impacts on wetlands from the development of major infrastructure.

15. Given the dynamic hydrological relationship between Freshwater Wetlands on Coastal Floodplains, Coastal Saltmarsh and other endangered ecological communities on coastal floodplains, future management of water and tidal flows may result in the expansion of some communities at the expense of others. Proposals for the restoration of natural hydrological regimes and for the rehabilitation of acid sulfate soils may also result in changes to the distribution and composition of floodplain communities. Co-ordinated planning and management approaches across whole catchments will be required to address and resolve priorities between different management objectives.



16. In view of the above the Scientific Committee is of the opinion that Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam  
Chairperson  
Scientific Committee

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## APPENDIX 5

### FINAL DETERMINATION: SWAMP SCLEROPHYLL FOREST ON COASTAL FLOODPLAINS

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act, and as a consequence to omit reference to Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion from Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act. The Scientific Committee has found that:

1. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

The composition of Swamp Sclerophyll Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil. Composition also varies with latitude. The community is characterised by the following assemblage of species:

<i>Acacia irrorata</i>	<i>Acacia longifolia</i>
<i>Acmena smithii</i>	<i>Adiantum aethiopicum</i>
<i>Allocasuarina littoralis</i>	<i>Banksia oblongifolia</i>
<i>Banksia spinulosa</i>	<i>Baumea articulata</i>
<i>Baumea juncea</i>	<i>Blechnum camfieldii</i>
<i>Blechnum indicum</i>	<i>Breynia oblongifolia</i>
<i>Callistemon salignus</i>	<i>Calochlaena dubia</i>
<i>Carex appressa</i>	<i>Casuarina glauca</i>
<i>Centella asiatica</i>	<i>Dianella caerulea</i>
<i>Dodonaea triquetra</i>	<i>Elaeocarpus reticulatus</i>
<i>Entolasia marginata</i>	<i>Entolasia stricta</i>
<i>Eucalyptus botryoides</i>	<i>Eucalyptus longifolia</i>
<i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i>	<i>Eucalyptus robusta</i>
<i>Ficus coronata</i>	<i>Gahnia clarkei</i>



<i>Gahnia sieberiana</i>	<i>Glochidion ferdinandi</i>
<i>Glycine clandestina</i>	<i>Gonocarpus tetragynus</i>
<i>Hydrocotyle peduncularis</i>	<i>Hypolepis muelleri</i>
<i>Imperata cylindrica</i> var. <i>major</i>	<i>Isachne globosa</i>
<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	<i>Livistona australis</i>
<i>Lomandra longifolia</i>	<i>Lophostemon suaveolens</i>
<i>Melaleuca ericifolia</i>	<i>Melaleuca linariifolia</i>
<i>Melaleuca quinquenervia</i>	<i>Melaleuca sieberi</i>
<i>Melaleuca styphelioides</i>	<i>Morinda jasminoides</i>
<i>Omalthanthus populifolius</i>	<i>Oplismenus aemulus</i>
<i>Oplismenus imbecillis</i>	<i>Parsonsia straminea</i>
<i>Phragmites australis</i>	<i>Polyscias sambucifolia</i>
<i>Pratia purpurascens</i>	<i>Pteridium esculentum</i>
<i>Stephania japonica</i> var. <i>discolor</i>	<i>Themeda australis</i>
<i>Villarsia exaltata</i>	<i>Viola banksii</i>
<i>Viola hederacea</i>	

2. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire, grazing, flooding and land clearing) history. The number and relative abundance of species will change with time since fire, flooding or significant rainfall, and may also change in response to changes in grazing regimes. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

4. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has an open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. For example, stands dominated by *Melaleuca ericifolia* typically do not exceed 8 m in height. The most widespread and abundant dominant trees include *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (paperbark) and, south from Sydney, *Eucalyptus botryoides* (bangalay) and *Eucalyptus longifolia* (woollybut). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including *Callistemon salignus* (sweet willow bottlebrush), *Casuarina glauca* (swamp oak) and *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), *Livistona australis* (cabbage palm) and *Lophostemon suaveolens* (swamp

turpentine). A layer of small trees may be present, including *Acacia irrorata* (green wattle), *Acmena smithii* (lilly pilly), *Elaeocarpus reticulatus* (blueberry ash), *Glochidion ferdinandi* (cheese tree), *Melaleuca linariifolia* and *M. styphelioides* (paperbarks). Shrubs include *Acacia longifolia* (Sydney golden wattle), *Dodonaea triquetra* (a hopbush), *Ficus coronata* (sandpaper fig), *Leptospermum polygalifolium* subsp. *polygalifolium* (lemon-scented tea tree) and *Melaleuca* spp. (paperbarks). Occasional vines include *Parsonsia straminea* (common silkpod), *Morinda jasminoides* and *Stephania japonica* var. *discolor* (snake vine). The groundcover is composed of abundant sedges, ferns, forbs, and grasses including *Gahnia clarkei*, *Pteridium esculentum* (bracken), *Hypolepis muelleri* (batswing fern), *Calochlaena dubia* (false bracken), *Dianella caerulea* (blue flax lily), *Viola hederacea*, *Lomandra longifolia* (spiny-headed mat-rush) and *Entolasia marginata* (bordered panic) and *Imperata cylindrica* var. *major* (blady grass). The endangered swamp orchids *Phaius australis* and *P. tankervillei* are found in this community. On sites downslope of lithic substrates or with soils of clay-loam texture, species such as *Allocasuarina littoralis* (black she-oak), *Banksia oblongifolia*, *B. spinulosa* (var. *collina* or var. *spinulosa*) (hairpin banksia), *Ptilothrix deusta* and *Themeda australis* (kangaroo grass), may also be present in the understorey. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.

5. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting (Law *et al.* 2000). The blossoms of *Eucalyptus robusta* and *Melaleuca quinquenervia* are also an important food source for the Grey-headed Flying Fox (*Pteropus poliocephalus*) and Common Blossom Bat (*Sycoonycteris australis*) (Law 1994), as well as the Yellow-bellied Glider (*Petaurus australis*), Sugar Glider (*Petaurus breviceps*), Regent Honeyeater (*Xanthomyza phrygia*) and Swift Parrot (*Lathamus discolor*). Other animals found in this community include the Osprey (*Pandion haliaetus*), Australasian Bittern (*Botaurus poiciloptilus*), Large-footed myotis (*Myotis adversus*), *Litoria olongburensis* and Wallum Froglet (*Crinia tinnula*).

6. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested and treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish Swamp Sclerophyll Forest on Coastal Floodplains from other endangered ecological communities on the coastal floodplains include: its relatively dense tree canopy dominated by *Eucalyptus robusta*, *Melaleuca quinquenervia* or *E. botryoides*, the relatively infrequent occurrence of other eucalypts, *Casuarina glauca* or *Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover. It generally occupies small alluvial flats and peripheral parts of floodplains where they adjoin lithic substrates or coastal sandplains. The soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water.

7. Swamp Sclerophyll Forest on Coastal Floodplains includes and replaces Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion. It may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal River-Flat Forest in the Sydney Basin bioregion), Subtropical Floodplain Forest, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney

Basin and South East Corner bioregions. For example, as soils become less waterlogged, Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions may adjoin or intergrade with River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. As soil salinity increases Swamp Sclerophyll Forest on Coastal Floodplains may intergrade with, and be replaced by, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston *et al.* 2003, Stevenson 2003). The Determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats.

8. A number of vegetation surveys and mapping studies have been conducted across the range of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. This community includes the *Eucalyptus robusta* (Swamp Mahogany) community identified on coastal alluvium by Douglas and Anderson (2002) and the Coastal Alluvium Swamp Forest complex defined by Anderson and Asquith (2002). In the Comprehensive Regional Assessment of the north-eastern NSW (NPWS 1999), those areas on floodplains mapped as 'Forest Ecosystem 112, Paperbark', and those areas on floodplains mapped as 'Forest Ecosystem 142, Swamp Mahogany' are included within this community. On the Tweed lowlands, this community includes 'Eucalyptus robusta mid-high to very tall closed forest' (F7), 'Archontophoenix cunninghamiana-Melaleuca quinquenervia very tall feather palm swamp forest' (F9), those parts of *Melaleuca quinquenervia* tall to very tall open to closed forest' (F8) on alluvial soils and parts of 'Floodplain Wetland Complex' (FL) dominated by *Eucalyptus robusta* or *Melaleuca quinquenervia* (Pressey and Griffith 1992). In the lower Hunter district, this community includes 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian *Melaleuca* Swamp Woodland (map unit 42) and *Melaleuca* Scrub (map unit 42a) of NPWS (2000). In the Sydney-Gosford region, this community includes those parts of 'Freshwater Swamp complex' (map unit 27a) dominated by *Eucalyptus robusta* or *E. botryoides* (Benson 1986, Benson and Howell 1994) and parts of the 'Freshwater wetlands – on the floodplains' of Benson and Howell (1990) and Benson *et al.* (1996). In the Illawarra, this community includes 'Alluvial swamp mahogany forest' (map unit 35) of NPWS (2002). On the south coast, this community includes 'Northern Coastal Lowlands Swamp Forest' (forest ecosystem 175) of Thomas *et al.* (2000) and 'Coastal Sand Swamp Forest' (map unit 45) of Tindall *et al.* (2004). Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is included within the 'Coastal Floodplain Wetlands' and 'Coastal Swamp Forest' vegetation classes of Keith (2002, 2004). There may be additional or unmapped occurrences of Swamp Sclerophyll Forest on Coastal Floodplains within and beyond these surveyed areas.

9. The extent of the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. However, one estimate based on a compilation of regional vegetation maps suggests that Coastal Floodplain Wetlands, which include Swamp Sclerophyll Forest on Floodplains, currently cover 800-1400 km<sup>2</sup>, representing less than 30% of the original extent of this broadly defined vegetation class (Keith 2004). Compared to this combined estimate, the remaining area of Swamp Sclerophyll Forest on Coastal Floodplains is likely to be considerably smaller and is likely to represent much less than 30% of its original range. For example, there were less than 350 ha of native vegetation attributable to this community on the Tweed lowlands in 1985 (Pressey and Griffith 1992), less than 2500 ha on the Clarence floodplain in 1982 (Pressey 1989a), less than 700 ha on the Macleay floodplain in 1983 (Pressey 1989b), up to 7000 ha in the lower Hunter – central coast district during the 1990s (NPWS 2000), and less than 1000 ha in the Sydney – South Coast region in the mid 1990s (Tindall *et al.* 2004), including less

than 40 ha on the Illawarra plain in 2001 (NPWS 2002) and about 450 ha on the South Coast in the 1990s (Thomas *et al.* 2000).

10. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, poplars, etc.) and, on the far north coast, canefields. On the Tweed lowlands, Pressey and Griffith (1992) estimated that less than 3% of the original Floodplain Wetlands and Floodplain Forest remained in 1985. Similar estimates are likely to apply to Swamp Sclerophyll Forest on Coastal Floodplains in other parts of the NSW North Coast bioregion (Goodrick 1970, Pressey 1989a, 1989b). In the lower Hunter – central coast district, about 30 % of the original area of Swamp mahogany – paperbark forest was estimated to remain in the 1990s (NPWS 2000).

11. Land clearing continues to threaten Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Pressey and Griffith 1992, NPWS 2000), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping (e.g. Pressey 1989a, b; Pressey and Griffith 1992, Boulton and Brock 1999, Johnston *et al.* 2003). Anthropogenic climate change may also threaten Swamp Sclerophyll Forest on Coastal Floodplains if future flooding regimes are affected (IPCC 2001, Hughes 2003). Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species. Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change; High frequency fire and Removal of dead wood and dead trees are listed as Key Threatening Processes under the Threatened Species Act (1995).

12. Large areas of habitat formerly occupied by Swamp Sclerophyll Forest on Coastal Floodplains have been directly drained by construction of artificial channels (e.g. Pressey 1989a, Boulton and Brock 1999). While much of the early drainage works were associated with agricultural development, more recently they are associated with urban expansion. 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). On the north coast of NSW, expansion of *Melaleuca quinquenervia* into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (Johnston *et al.* 2003, Stevenson 2003). These changes appear to be closely associated with enhanced acidity, altered ionic ratios, increased dissolved organic carbon and sulfide oxidation in the soil profile (Johnston *et al.* 2003).

13. Relatively few examples of Swamp Sclerophyll Forest on Coastal Floodplains remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community, dumping of landfill rubbish and garden refuse, polluted runoff from urban and agricultural areas, construction of roads and other utilities, and grazing by domestic livestock. The principal weed species affecting Swamp Sclerophyll Forest on Coastal Floodplains include *Andropogon virginicus* (whiskey grass), *Anredera cordifolia* (Madeira vine), *Ageratina*



*adenophora* (crofton weed), *Baccharis halimifolia* (groundsel bush), *Cinnamomum camphora* (camphor laurel), *Lantana camara* (lantana), *Ligustrum sinense* (small-leaved privet), *Lonicera japonica* (Japanese honeysuckle) and *Ludwigia peruviana* (Keith and Scott 2005).

14. Small areas of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Bungawalbin, Tuckean and Moonee Beach Nature Reserves, and Hat Head, Crowdy Bay, Wallingat, Myall Lakes and Garigal National Parks. These occurrences are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that were, and continue to be initiated outside their boundaries. Some areas of Swamp Oak Floodplain Forest are protected by State Environmental Planning Policy 14, although this has not always precluded impacts on wetlands from the development of major infrastructure.

15. Given the dynamic hydrological relationship between Swamp Sclerophyll Forest on Coastal Floodplains, Coastal Saltmarsh and other endangered ecological communities on coastal floodplains, future management of water and tidal flows may result in the expansion of some communities at the expense of others. Proposals for the restoration of natural hydrological regimes and for the rehabilitation of acid sulfate soils may also result in changes to the distribution and composition of floodplain communities. Co-ordinated planning and management approaches across whole catchments will be required to address and resolve priorities between different management objectives.

16. In view of the above the Scientific Committee is of the opinion that Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam  
Chairperson  
Scientific Committee

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## APPENDIX 6

### FINAL DETERMINATION - LITTORAL RAINFOREST

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act, and as a consequence, to omit reference to the Sutherland Shire Littoral Rainforest from Part 3 of Schedule 1 (Endangered Ecological Community) of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions is generally a closed forest, the structure and composition of which is strongly influenced by proximity to the ocean. The plant species in this ecological community are predominantly rainforest species with evergreen mesic or coriaceous leaves. Several species have compound leaves, and vines may be a major component of the canopy. These features differentiate littoral rainforest from sclerophyll forest or scrub, but while the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *E. tereticornis* occur in many stands. Littoral Rainforest in NSW is found at locations along the entire NSW Coast in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion. The areas mapped for inclusion in State Environmental Planning Policy 26 Littoral Rainforest are examples of the Littoral Rainforest ecological communities, but the mapping for SEPP 26 is not exhaustive and stands of the Littoral Rainforest ecological community occur at locations not mapped under SEPP 26. Some stands may be regrowth or in the process of regenerating. The Sutherland Shire Littoral Rainforest Endangered Ecological Community which was previously listed as an endangered ecological community is included within this Community.

2. Littoral rainforest occurs on both sand dunes and on soils derived from underlying rocks (McKinley *et al.* 1999). Stands on headlands exposed to strong wind action may take the form of dense windpruned thickets (for example the Bunga Head Rainforest illustrated by Keith & Bedward 1999, or MU5 Littoral Windshear Thicket in NPWS 2002). In more sheltered sites, and in hind dunes, the community is generally taller, although still with wind pruning on the windward side of stands. Floristically there is a high degree of similarity between stands on different substrates. Most stands of Littoral Rainforest occur within 2 km of the sea, but may occasionally be found further inland, but within reach of maritime influence.

3. Littoral Rainforest comprises the *Cupaniopsis anacardioides* – *Acmena* spp. alliance of Floyd (1990). This alliance as described by Floyd includes five sub-alliances – *Syzygium leuhmannii* – *Acmena hemilampra*, *Cupaniopsis anacardioides*, *Lophostemon confertus*, *Drypetes* – *Sarcomelicope* – *Cassine* – *Podocarpus* and *Acmena smithii* – *Ficus* – *Livistona* – *Podocarpus*. The distribution of some of these sub-alliances is geographically restricted – the *Syzygium leuhmannii* – *Acmena hemilampra* sub-alliance is restricted to the north coast, while the most widespread sub-alliance *Acmena smithii* – *Ficus* – *Livistona* – *Podocarpus* is the only one present on the coast south of Sydney. The *Lophostemon confertus* suballiance, synonymous with Forest Type 25 Headland Brush Box (Forestry



Commission of NSW 1989) is restricted to exposed headlands in the North Coast Bioregion. There is considerable floristic variation between stands and in particular areas localised variants may be recognised (for example on the south coast a number of variants within the *Acmena smithii* – *Ficus* – *Livistona* – *Podocarpus* sub-alliance have been described, see Mills 1996, Mills & Jakeman 1995; Keith & Bedward 1999, NCC 1999, NPWS 2002). Small, depauperate stands may be difficult to assign to sub alliances. A number of species characteristic of Littoral Rainforest in NSW reach their southern limits at various places along the coast (for example *Cupaniopsis anacardioides* reaches its southern limit between Sydney and the Illawarra) but a number of temperate species are restricted to the south coast, and the total Littoral Rainforest flora declines from north to south. Characteristic species of littoral rainforest include:

<i>Acacia binervata</i>	<i>Acmena hemilampra</i>
<i>Acmena smithii</i>	+ <i>Acronychia imperforata</i>
<i>Acronychia oblongifolia</i>	+ <i>Alpinia caerulea</i>
<i>Alectryon coriaceus</i>	<i>Alyxia ruscifolia</i>
+ <i>Aphananthe philippinensis</i>	+ <i>Archontophoenix cunninghamiana</i>
<i>Arthropteris tenella</i>	+ <i>Arytera divaricata</i>
<i>Asplenium australasicum</i>	+ <i>Baloghia marmorata</i>
<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	+ <i>Beilschmiedia obtusifolia</i>
<i>Breynia oblongifolia</i>	+ <i>Bridelia exaltata</i>
+ <i>Calamus muelleri</i>	<i>Canthium coprosmoides</i>
+ <i>Capparis arborea</i>	<i>Cayratia clematidea</i>
<i>Celtis paniculata</i>	<i>Cissus antarctica</i>
<i>Cissus hypoglaucia</i>	<i>Cissus sterculiifolia</i>
<i>Claoxylon australe</i>	+ <i>Cordyline congesta</i>
+ <i>Cordyline stricta</i>	<i>Cryptocarya glaucescens</i>
<i>Cryptocarya microneura</i>	+ <i>Cryptocarya triplinervis</i>
<i>Cupaniopsis anacardioides</i>	<i>Cynanchum elegans</i>
<i>Dendrocnide excelsa</i>	+ <i>Dendrocnide photinophylla</i>
<i>Dioscorea transversa</i>	<i>Diospyros australis</i>
<i>Diospyros pentamera</i>	<i>Doodia aspera</i>
<i>Duboisia myoporoides</i>	+ <i>Dysoxylum fraserianum</i>
<i>Ehretia acuminata</i>	+ <i>Elaeocarpus obovatus</i>
+ <i>Elattostachys nervosa</i>	<i>Endiandra discolor</i>
<i>Endiandra sieberi</i>	<i>Eucalyptus botryoides</i>
<i>Eucalyptus tereticornis</i>	<i>Eupomatia laurina</i>
<i>Eustrephus latifolius</i>	<i>Ficus coronata</i>
<i>Ficus obliqua</i>	<i>Ficus rubiginosa</i>
+ <i>Ficus watkinsiana</i>	<i>Flagellaria indica</i>
<i>Geitonoplesium cymosum</i>	<i>Glochidion ferdinandi</i>
<i>Glycine clandestina</i>	+ <i>Gossia bidwillii</i>
<i>Guioa semiglaucia</i>	+ <i>Ixora beckleri</i>
+ <i>Jagera pseudorhus</i>	+ <i>Lepidozamia peroffskyana</i>
<i>Litsea reticulata</i>	<i>Livistona australis</i>
<i>Lomandra longifolia</i>	+ <i>Lophostemon confertus</i>
<i>Maclura cochinchinensis</i>	+ <i>Mallotus philippensis</i>
<i>Melaleuca quinquenervia</i>	<i>Melicope micrococca</i>
+ <i>Melicope vitiflora</i>	+ <i>Mischocarpus pyriformis</i>
+ <i>Monococcus echinophorus</i>	+ <i>Morinda jasminoides</i>
+ <i>Mucuna gigantea</i>	<i>Myoporum acuminatum</i>
<i>Notelaea longifolia</i>	+ <i>Olea paniculata</i>
<i>Oplismenus imbecillis</i>	+ <i>Pandanus pedunculatus</i>

<i>Pandorea pandorana</i>		<i>Pararchidendron pruinsum</i> var. <i>pruinsum</i>
<i>Parsonsia straminea</i>	+	<i>Pentaceras australis</i>
<i>Piper novae-hollandiae</i>	+	<i>Pisonia umbellifera</i>
<i>Pittosporum multiflorum</i>		<i>Pittosporum undulatum</i>
<i>Platynerium bifurcatum</i>		<i>Podocarpus elatus</i>
<i>Pollia crispata</i>		<i>Polyscias elegans</i>
<i>Pouteria australis</i>		<i>Pouteria cotinifolia</i> var. <i>cotinifolia</i>
+		<i>Rapanea variabilis</i>
<i>Rhodamnia rubescens</i>	+	<i>Rhodomyrtus psidioides</i>
<i>Ripogonum album</i>		<i>Ripogonum discolor</i>
<i>Sarcomelicope simplicifolia</i>		<i>Scolopia braunii</i>
<i>Smilax australis</i>		<i>Smilax glycyphylla</i>
+		<i>Stephania japonica</i> var. <i>discolor</i>
<i>Sophora tomentosa</i> subsp. <i>australis</i>		<i>Syzygium australe</i>
<i>Synoum glandulosum</i>		<i>Syzygium oleosum</i>
+		<i>Tetrastigma nitens</i>
<i>Syzygium luehmannii</i>		<i>Viola banksii</i>
<i>Syzygium paniculatum</i>		
<i>Trophis scandens</i> subsp. <i>scandens</i>		
<i>Wilkiea huegeliana</i>		

Those species marked '+' are found in littoral rainforest north of Sydney, with some restricted to the north coast or in only a few sites south of the North Coast Bioregion. The other species are geographically more widespread.

Given the small size of many stands and the history of fragmentation, the number of characteristic species in any stand is likely to be smaller than this list. In addition, the total richness of stands declines with increasing latitude and a number of the species listed above are absent or rare in the south.

4. The total species list of the community is considerably larger than that given above, with many species present in only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought condition and by its disturbance (including fire) history. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented but the assemblage in individual stands will depend on geographic location, size of stand, degree of exposure, history of disturbance and, if previously disturbed, stage of regeneration.

5. Threatened species and populations for which Littoral Rainforest is known or likely habitat include:

<i>Acronychia littoralis</i>	<i>Cryptocarya foetida</i>
<i>Archidendron hendersonii</i>	<i>Macadamia tetraphylla</i>
<i>Cynanchum elegans</i>	<i>Hicksbeachia pinnatifolia</i>
<i>Fontainea oraria</i>	<i>Syzygium moorei</i>
<i>Senna acclinis</i>	<i>Xylosma terrae-reginae</i>
<i>Syzygium paniculatum</i>	
<i>Amaurornis olivaceus</i>	Bush-hen
<i>Coracina lineata</i>	Barred Cuckoo-shrike
<i>Lichenostomus facioangularis</i>	Mangrove Honeyeater
<i>Monarchia leucotis</i>	White-eared Monarch
<i>Ninox strenua</i>	Powerful Owl
<i>Pandion haliaetus</i>	Osprey

<i>Ptilinopus magnificus</i>	Wompoo Fruit-dove
<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove
<i>Ptilinopus superbus</i>	Superb Fruit-dove
<i>Tyto tenebricosa</i>	Sooty Owl
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll
<i>Kerivoula papuensis</i>	Golden-tipped Bat
<i>Mormopterus beccarii</i>	Beccari's Freetail-bat
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat
<i>Myotis adversus</i>	Large-footed Myotis
<i>Nyctimene robinsoni</i>	Eastern Tube-nosed Bat
<i>Potorous tridactylus</i>	Long-nosed Potoroo
<i>Pteropus alecto</i>	Black Flying Fox
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox
<i>Syconycteris australis</i>	Eastern Blossom Bat
<i>Thylogale stigmatica</i>	Red-legged Pademelon
<i>Coeranoscincus reticulatus</i>	Three-toed Snake-tooth Skink
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake
<i>Thersites mitchellae</i>	Mitchell's Rainforest Snail
Emu, <i>Dromaius novaehollandiae</i> , population in the NSW North Coast Bioregion and Port Stephens Local Government Area	
<i>Menippus fugitivus</i> (Lea), a beetle population in the Sutherland Shire	

Most of the species included in this list are found at only some sites, or vary in occurrence and abundance. As such they are not regarded as part of the characterisation of the community. Nevertheless, they are of conservation significance and need to be considered in recovery planning.

6. Littoral Rainforest occurs in numerous, small stands and in total comprises less than 1% of the total area of rainforest in NSW. The largest known stand occurs in Iluka Nature Reserve, which is approximately 136 ha. Many, but not all, stands of Littoral Rainforest have been included in mapping for State Environmental Planning Policy 26 Littoral Rainforest, but degradation of the ecological community is still occurring.

7. Weed species that threaten the integrity of particular stands include *Ambrosia artemisifolia*, *Anredera cordifolia*, *Arecastrum romanzoffianum*, *Asparagus* spp., *Cardiospermum grandiflorum*, *Chrysanthemoides monilifera*, *Coprosma repens*, *Ehrharta* spp., *Gloriosa superba*, *Ipomoea* spp; *Impatiens walleriana*, *Lantana camara*, *Macfadyena unguis-cati*, *Rivina humilis*, *Pennisetum clandestinum*, *Schefflera actinophylla*, *Senna septemtrionalis*, *Solanum mauritianum* *Thunbergia alata* and *Tradescantia fluminensis*.

8. Other threats include loss of canopy integrity arising from salt and wind damage as a result of clearing or damage to stand margins; clearing of understorey (including for firewood collection); grazing and physical disturbance of understorey including by feral deer; inappropriate collection of a range of plant species (including, but not restricted to, epiphytes); fire, particularly fire incursion along boundaries: visitor disturbance including soil compaction, soil disturbance, erosion from foot, cycle, trail bike and 4 wheel drive tracks, introduction of pathogens, and disturbance from creation of new planned and unplanned tracks; increased visitation and resulting increased demand for and use of, visitor facilities such as walking tracks, viewing platforms, toilet blocks, picnic areas etc; dumping of garden waste causing weed infestation; car and other rubbish dumping. Loss of fauna due to predation by feral animals, road kill, loss of habitat and feeding resources, disturbance from human visitation (faunal elements are essential to the ecological functioning of littoral rainforest and loss, or reduction, in pollinators and seed dispersal agents will adversely affect long term vegetation health); fragmentation resulting in loss

of connectivity and possibly reduced genetic exchange between populations. For stands not protected by State Environmental Planning Policy 26, clearing and development remains a possibility. (Adam 1987, 1992; Floyd 1990; Mills 1996).

9. In view of the above the Scientific Committee is of the opinion that Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam, Chairperson, Scientific Committee

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## APPENDIX 7

### FINAL DETERMINATION: SWAMP OAK FLOODPLAIN FOREST

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions, as an **ENDANGERED ECOLOGICAL COMMUNITY** in Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Oak Floodplain Forest generally occurs below 20 m (rarely above 10 m) elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. Typically these forests, woodlands, scrubs and reedlands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

The composition of Swamp Oak Floodplain Forest is primarily determined by the frequency and duration of waterlogging and the level of salinity in the groundwater. Composition also varies with latitude. The community is characterised by the following assemblage of species:

<i>Acmena smithii</i>	<i>Alphitonia excelsa</i>
<i>Alternanthera denticulata</i>	<i>Baumea juncea</i>
<i>Blechnum indicum</i>	<i>Callistemon salignus</i>
<i>Carex appressa</i>	<i>Casuarina glauca</i>
<i>Centella asiatica</i>	<i>Commelina cyanea</i>
<i>Crinum pedunculatum</i>	<i>Cupaniopsis anacardioides</i>
<i>Cynodon dactylon</i>	<i>Dianella caerulea</i>
<i>Entolasia marginata</i>	<i>Enydra fluctuans</i>
<i>Flagellaria indica</i>	<i>Gahnia clarkei</i>
<i>Geitonoplesium cymosum</i>	<i>Glochidion ferdinandi</i>
<i>Glochidion sumatranum</i>	<i>Hypolepis muelleri</i>
<i>Imperata cylindrica</i> var. <i>major</i>	<i>Isolepis inundata</i>
<i>Juncus kraussii</i> subsp. <i>australiensis</i>	<i>Juncus planifolius</i>
<i>Juncus usitatus</i>	<i>Lobelia alata</i>
<i>Lomandra longifolia</i>	<i>Lophostemon suaveolens</i>
<i>Maundia triglochinos</i>	<i>Melaleuca alternifolia</i>
<i>Melaleuca ericifolia</i>	<i>Melaleuca quinquenervia</i>
<i>Melaleuca styphelioides</i>	<i>Myoporum acuminatum</i>
<i>Oplismenus imbecillis</i>	<i>Parsonsia straminea</i>



*Persicaria decipiens*  
*Phragmites australis*  
*Smilax australis*  
*Viola banksii*

*Persicaria strigosa*  
*Selliera radicans*  
*Stephania japonica* var. *discolor*

2. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire, grazing, flooding and land clearing) history. The number and relative abundance of species will change with time since fire, flooding or significant rainfall, and may also change in response to changes in grazing regimes. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers.

4. Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui (Keith and Bedward 1999). The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea* (common silkpod), *Geitonoplesium cymosum* (scrambling lily) and *Stephania japonica* var. *discolor* (snake vine), a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter. The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such *Centella asiatica* (pennywort), *Commelina cyanea*, *Persicaria decipiens* (slender knotweed) and *Viola banksii*; graminoids such as *Carex appressa* (tussock sedge), *Gahnia clarkei* (a saw-sedge), *Lomandra longifolia* (spiny-headed mat-rush), *Oplismenus imbecillis*; and the fern *Hypolepis muelleri* (batwing fern). On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, *Alexfloydia repens*, as well as *Baumea juncea*, *Juncus kraussii* subsp. *australiensis* (sea rush), *Phragmites australis* (common reed), *Selliera radicans* and other saltmarsh species. The composition and structure of the understorey is also influenced by grazing history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.

5. Unlike most other coastal floodplain communities, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions are not a significant habitat for waterbirds (Goodrick 1970). However, they do sometimes provide food resources for the Glossy

Black Cockatoo (*Calyptorhynchus lathami lathami*), and Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*) (Marchant and Higgins 1990 ). The fauna of Swamp Oak Floodplain Forest also includes the Squirrel Glider (*Petaurus norfolcensis*) and several species of frogs in the families Myobatrachidae (southern frogs) and Hylidae (tree frogs).

6. Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested wetland and treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish Swamp Oak Floodplain Forest from other endangered ecological communities on the coastal floodplains include: its dominance by a tree canopy of either *Casuarina glauca* or, more rarely, *Melaleuca ericifolia* with or without subordinate tree species; the relatively low abundance of *Eucalyptus* species; and the prominent groundcover of forbs and graminoids. It generally occupies low-lying parts of floodplains, alluvial flats, drainage lines, lake margins and fringes of estuaries; habitats where flooding is periodic and soils show some influence of saline ground water. This latter habitat feature sets it apart from other floodplain communities.

7. Swamp Oak Floodplain Forest may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, Subtropical Floodplain Forest of the NSW North Coast bioregion, River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal River-Flat Forest in the Sydney Basin bioregion), Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion) and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. For example, in less saline habitats, Swamp Oak Floodplain Forest may adjoin or intergrade with several other endangered ecological communities including River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions and Subtropical Floodplain Forest of the NSW North Coast bioregion. The most saline forms of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions may adjoin or intergrade with Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner bioregions. The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston *et al.* 2003). The Determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats.

8. A number of vegetation surveys and mapping studies have been conducted across the range of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. This community includes 'Sheoak Swamps' in the general coastal wetlands classification of Goodrick (1970). In the Tweed valley lowlands, this community includes 'Casuarina glauca tall to very tall open to closed forest' (F10) of Pressey and Griffith (1992) and parts of the 'Floodplain Wetland Complex' (FL) that include *Casuarina glauca* with *Melaleuca* spp. (Pressey and Griffith 1992). In the Comprehensive Regional Assessment of the north-eastern NSW (NPWS 1999), areas mapped as 'Forest Ecosystem 143, Swamp Oak', fall within this community. In the lower Hunter valley, 'Swamp Oak – Rushland Forest' (map unit 40) and 'Swamp Oak Sedge Forest' (map unit 41) of NPWS (2000) fall within this community. On the Cumberland Plain, 'Riparian Woodland' (map unit 5) of Tozer (2003) and parts of 'Alluvial Woodland' (map unit 11) dominated by *Casuarina glauca* (Tozer 2003) are included within this community, while those parts



of Benson's (1992) 'River Flat Forest' (map unit 9f) dominated by *C. glauca* also fall within this community, as do parts of the 'River-flat forests' of Benson and Howell (1990) and Benson et al. (1996) that are dominated by *C. glauca*. On the Illawarra Plain, 'Coastal Swamp Oak Forest' (map unit 36) of NPWS (2002) occurs within this community. In the Comprehensive Regional Assessment of southern New South Wales (Thomas *et al.* 2000), this community includes 'Coastal Wet Heath Swamp Forest' (forest ecosystem 24), 'South Coast Swamp Forest' complex (forest ecosystem 25) and those parts of 'Ecotonal Coastal Swamp Forest' (forest ecosystem 27) dominated by *Casuarina glauca*. In the Sydney - South Coast region, this community includes parts of 'Floodplain Swamp Forest' (map unit 105) dominated by *Casuarina glauca*, 'Estuarine Fringe Forest' (map unit 106) and 'Estuarine Creek Flat Scrub' (map unit 107) of Tindall *et al.* (2004). In the Eden region, this community includes 'Estuarine Wetland Scrub' (map unit 63) of Keith and Bedward (1999) and parts of 'Floodplain Wetlands' (map unit 60) that include *Casuarina glauca* or *Melaleuca ericifolia* (Keith and Bedward 1999). Swamp Oak Floodplain Forest South East Corner is included within the 'Coastal Floodplain Wetlands' vegetation class of Keith (2002, 2004). There may be additional or unmapped occurrences of Swamp Oak Floodplain Forest within and beyond these surveyed areas.

9. The extent of the Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. However, one estimate based on a compilation of regional vegetation maps suggests that Coastal Floodplain Wetlands, which include Swamp Oak Floodplain Forest, currently cover 800-1400 km<sup>2</sup>, representing less than 30% of the original extent of this broadly defined vegetation class (Keith 2004). Compared to this combined estimate, the remaining area of Swamp Oak Floodplain Forest is likely to be considerably smaller and is likely to represent much less than 30% of its original range. Major occurrences include: less than 350 ha on the Tweed lowlands in 1985 (Pressey and Griffith 1992); less than 650 ha on the lower Clarence floodplain in 1982 (Pressey 1989a); less than 400 ha on the lower Macleay floodplain in 1983 (Pressey 1989b); less than 3200 ha in the lower Hunter – central Hunter region in the 1990s (NPWS 2000); less than 5200 ha in the Sydney - South Coast region in the mid 1990s (Tindall *et al.* 2004), including up to 4700 ha on the Cumberland Plain in 1998 (Tozer 2003) and less than 250 ha on the Illawarra Plain in 2001 (NPWS 2002); and less than 1000 ha in the Eden region in 1990 (Keith and Bedward 1999).

10. Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, poplars, etc.) and, on the far north coast, canefields. On the Tweed lowlands, Pressey and Griffith (1992) estimated that less than 3% of the original Floodplain Wetlands and Floodplain Forest remained in 1985. Similar estimates are likely to apply to Swamp Oak Floodplain Forests in other parts of the NSW North Coast bioregion (Pressey 1989a, 1989b, NPWS 1999). In the lower Hunter – central coast region, less than 30-40% was estimated to have remained during the 1990s (NPWS 2000), while approximately 13% remained on the Cumberland Plain in 1998 (Tozer 2003). In the Sydney – South Coast region, less than 20% was estimated to remain in the mid 1990s (Tindall *et al.* 2004), in the Eden region about 30% was estimated to remain during the 1990s (Keith and Bedward 1999).

11. Land clearing continues to threaten Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Pressey 1989a, b; Pressey and Griffith 1992), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and

industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils' and rubbish dumping (e.g. Pressey 1989a, b; Pressey and Griffith 1992, Boulton and Brock 1999, Johnson *et al.* 2003). Anthropogenic climate change may also threaten Swamp Oak Floodplain Forest if sea levels rise as predicted or if future flooding regimes are affected (IPCC 2001, Hughes 2003). Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species. Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change and High frequency fire are listed as Key Threatening Processes under the Threatened Species Conservation Act (1995).

12. Large areas of habitat formerly occupied by Swamp Oak Floodplain Forest have been directly drained by construction of artificial channels (e.g. Pressey 1989a, 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). On the north coast of NSW, expansion of *Melaleuca quinquenervia* and *Casuarina glauca* into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (Johnston *et al.* 2003, Stevenson 2003). There have also been anecdotal reports of recruitment by *Casuarina glauca* in pastures during extended dry periods, though not necessarily by other components of the community. These changes appear to be closely associated with enhanced acidity, altered ionic ratios, increased dissolved organic carbon and sulfide oxidation in the soil profile (Johnston *et al.* 2003). Alteration of tidal flows may have lead to decreased soil salinity and localised expansion of *Casuarina glauca* into areas that previously supported Coastal Saltmarsh or mangroves (Stevenson 2003).

13. Very few examples of Swamp Oak Floodplain Forest remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community, dumping of landfill rubbish and garden refuse, polluted runoff from urban and agricultural areas, construction of roads and other utilities, and grazing by domestic livestock. The principal weed species affecting Swamp Oak Floodplain Forest include *Araujia sericiflora* (moth plant), *Asparagus asparagoides* (bridal creeper), *Baccharis halimifolia* (groundsel bush), *Cyperus eragrostis* (umbrella sedge), *Cinnamomum camphora* (camphor laurel), *Conyza* spp. (fleabanes), *Hydrocotyle bonariensis* (American pennywort), *Ipomoea cairica*, *I. purpurea* and *I. indica* (morning glories), *Lantana camara*, *Paspalum dilatatum* (paspalum), *Pennisetum clandestinum* (kikuyu) *Rubus fruticosus* agg. (blackberries), *Solanum pseudocapsicum* (Madeira winter cherry), *S. nigrum* (black-berry nightshade), *Tradescantia fluminensis* (wandering jew) and *Verbena bonariensis* (purpletop), (Tozer 2003, Keith and Scott 2005). In general, remaining examples of Swamp Oak Floodplain Forest from the most saline environments are in better condition, while those from less saline habitats are generally more degraded.

14. Small areas of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Stotts Island, Ukerebagh, Tuckean, Pambalong, Wamberal, Towra Point and Cullendulla Creek Nature Reserves and Bongil Bongil, Myall Lakes and Conjola National Parks. These occurrences are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that

were, and continue to be initiated outside their boundaries. Some areas of Swamp Oak Floodplain Forest are protected by State Environmental Planning Policy 14, although this has not always precluded impacts on wetlands from the development of major infrastructure.

15. Given the dynamic hydrological relationship between Swamp Oak Floodplain Forest, Coastal Saltmarsh and other endangered ecological communities on coastal floodplains, future management of water and tidal flows may result in the expansion of some communities at the expense of others. Proposals for the restoration of natural hydrological regimes and for the rehabilitation of acid sulfate soils may also result in changes to the distribution and composition of floodplain communities. Co-ordinated planning and management approaches across whole catchments will be required to address and resolve priorities between different management objectives.

16. In view of the above the Scientific Committee is of the opinion that Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam  
Chairperson  
Scientific Committee

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## APPENDIX 8

### FINAL DETERMINATION: COASTAL SALTMARSH

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#### NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions, as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is the name given to the ecological community occurring in the intertidal zone on the shores of estuaries and lagoons including when they are intermittently closed along the NSW coast. Coastal saltmarsh has been recorded from sites along the NSW coast. (NSW North Coast, Sydney Basin and South East Corner Bioregions).

2. Characteristic vascular plant species of Coastal Saltmarsh are:

<i>Baumea juncea</i>	<i>Isolepis nodosa</i>
<i>Juncus kraussii</i>	<i>Samolus repens</i>
<i>Sarcocornia quinqueflora</i>	<i>Selliera radicans</i>
<i>Sporobolus virginicus</i>	<i>Suaeda australis</i>
<i>Triglochin striata</i>	<i>Zoysia macrantha</i>

The total list of species is larger, with many species present in low abundance or at few sites. A more extensive list of species is provided by Adam *et al.* (1988). The sediment surface may support a diversity of both micro-algae and macro-algae.

3. Communities with similar floristic composition, but with a different fauna, are found supratidally on exposed headlands (Adam *et al.* 1988). These headland communities and those of inland saline areas are not included within this Determination of the Coastal Saltmarsh Ecological Community.

4. Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions provide habitat for a diverse invertebrate fauna, which includes both marine (crabs and molluscs) and terrestrial (insects and spiders) elements. During tidal flooding a number of fish species utilise saltmarsh habitats. Grazing by macropods may occur between tidal events. Some coastal saltmarshes provide important high tide roosts for migratory wading birds, and a range of other birds also utilise coastal saltmarsh as habitat. Diversity of macrofauna in mangrove forests adjacent to saltmarsh has been found to be greater than in mangroves that do not border saltmarsh (Yerman & Ross 2004)

5. Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is frequently found as a zone landward of mangrove stands. Occasional scattered mature *Avicennia marina* trees occur through saltmarsh at some sites, and *Avicennia* (and less frequently *Aegiceras corniculatum*) seedlings may occur throughout saltmarsh. In brackish areas dense stands of tall reeds (*Phragmites australis*, *Bulboschoenus* spp., *Schoenoplectus* spp., *Typha* spp.) may occur as part of the community.



6. West *et al.* (1985) estimated the total area of coastal saltmarsh in NSW was approximately 5700 hectares distributed in fragmented patches mostly less than 100 hectares. Since this estimate, further reduction and fragmentation have occurred.
7. Species composition within Coastal Saltmarsh varies with elevation. *Sarcocornia quinqueflora* dominates at lower, and hence more frequently flooded, levels than *Sporobolus virginicus* which dominates the mid saltmarsh, while *Juncus kraussii* and *Baumea juncea* are upper saltmarsh species. There is also geographic variation, with much more extensive stands of *Sporobolus virginicus* being found in northern NSW, and conversely more extensive *Sarcocornia quinqueflora* stands in the south. Coastal Saltmarsh in southern NSW is generally more species rich than further north, with *Austrostipa stipoides*, *Gahnia filum*, *Limonium australe* and *Sclerostegia arbuscula* forming a characteristic southern suite of species. A number of other species with restricted distribution in Coastal Saltmarsh include *Distichlis distichophylla* (endangered), *Halosarcia pergranulata* subsp. *pergranulata*, *Wilsonia backhousei* (vulnerable) and *Wilsonia rotundifolia* (endangered).
8. Saltmarshes are globally threatened, and many of the threatening processes identified by Adam (2002) operate in NSW including infilling, modified tidal flow, weed invasion, damage by domestic and feral animals, human disturbance, altered fire regimes and climate change.
9. Historically, substantial areas of saltmarsh have been infilled for roads and aerodromes and for residential, recreational, waste disposal, industrial and agricultural purposes. With increased recognition of the ecological value of saltmarshes, the threat of further large-scale reclamation is less, but smaller scale infilling still occurs (Harty and Cheng 2003).
10. Patterns of tidal flow have been restricted by artificial structures in many NSW saltmarshes (Williams and Watford 1997), while discharge of stormwater alters salinity regimes, increases nutrient levels and facilitates the spread of *Phragmites* and weeds.
11. In recent decades there has been widespread invasion of saltmarsh in southeast Australia by mangroves (Mitchell and Adam 1989, Saintilan and Williams 1999, 2000). The factors driving mangrove invasion are still unclear. The mangrove invasion limits the use of saltmarshes by birds that would normally make use of this habitat and has been a factor in their decline (Saintilan 2003, Straw 1999, 2000).
12. A large number of weed species occur in NSW saltmarshes (Adam 1981, Adam *et al.* 1988). In terms of change to the community structure and function, the most serious weed is *Juncus acutus*; other major weeds include *Baccharis halimifolia*, *Cortaderia selloana* and *Hydrocotyle bonariensis*. The upper saltmarsh zone may be dominated by introduced annuals or shortlived perennials, including *Parapholis incurva*, *Plantago coronopus* and *Polypogon monspeliensis*.
13. Damage to saltmarshes by recreational vehicles, including four wheel drives, is widespread, and deep wheel ruts persist for many years even after exclusion of vehicles. Use of BMX and mountain bikes is increasing, and even saltmarshes within conservation reserves have been seriously damaged (Adam 2002).
14. Grazing and trampling by domestic stock and feral herbivores occurs at a number of sites. Stock grazing has been shown to substantially change the vegetation composition and structure (Adam 1990), while on muddy substrates trampling can cause loss of plant cover and modify drainage patterns.
15. Saltmarshes have frequently been used for casual rubbish dumping and are at risk from waterborne pollution – including oil and chemical spills, both from shipping and road accidents, and catchment runoff of nutrients and agricultural chemicals.

16. Upper saltmarsh stands dominated by *Juncus kraussii* and *Baumea juncea* have high flammable fuel loads. While the natural incidence of fire in saltmarshes is likely to have been low, a number of saltmarshes have been burnt in recent years. The recovery of these sites is relatively slow and the long-term impacts of burning are uncertain.

17. Global warming and increased relative sea level are likely to pose an increasing threat to the survival of many areas of Coastal Saltmarsh (Adam 2002, Hughes 2003).

18. Coastal Saltmarsh occurs in a number of conservation reserves including the Ramsar listed sites at Towra Point and Kooragang Island Nature Reserves. Reserve status, however, does not confer protection from mangrove and weed invasion, recreational vehicles, pollution, fire or sea level rise without active management.

19. In view of the above the Scientific Committee is of the opinion that the Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival cease to operate.

Dr Lesley Hughes, Deputy Chairperson Proposed                      Gazettal                      date:                      04/06/04

Scientific Committee    Exhibition period: 04/06/04 – 16/07/04

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## APPENDIX 9

### FINAL DETERMINATION FOR ROBERTSON RAINFOREST IN THE SYDNEY BASIN BIOREGION

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#### NSW Scientific Committee

#### Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Robertson Rainforest in the Sydney Basin Bioregion, as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule 1 of the Act. Listing of Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Robertson Rainforest in the Sydney Basin Bioregion is the name given to the ecological community characterised by the species assemblage listed in 2 below. The community occurs on high nutrient soils in high rainfall areas of the Southern Highlands. All sites are within the Sydney Basin Bioregion.
2. Robertson Rainforest is characterised by the following assemblage:

*Acacia melanoxylon*  
*Acronychia oblongifolia*  
*Alphitonia excelsa*  
*Arthropteris tenella*  
*Asplenium australasicum*  
*Asplenium flaccidum*  
*Austrocynoglossum latifolium*  
*Blechnum patersonii*  
*Carex appressa*  
*Celastrus australis*  
*Cissus hypoglauca*  
*Clematis aristata*  
*Coprosma quadrifida*  
*Cyathea australis*  
*Dendrobium pugioniforme*  
*Dicksonia antarctica*  
*Diplazium australe*  
*Doryphora sassafras*  
*Elaeocarpus kirtonii*  
*Elatostema reticulatum*  
*Eucryphia moorei*  
*Ficus coronata*  
*Galium propinquum*  
*Geranium homeanum*  
*Guioa semiglauca*  
*Hedycarya angustifolia*  
*Hibbertia scandens*  
*Hydrocotyle laxiflora*  
*Hymenophyllum cupressiforme*  
*Lastreopsis acuminata*  
*Lastreopsis microsora*  
*Lomandra longifolia*

*Acmena smithii*  
*Alectryon subcinereus*  
*Aphanopetalum resinosum*  
*Asplenium attenuatum*  
*Asplenium flabellifolium*  
*Australina pusilla*  
*Blechnum nudum*  
*Blechnum wattsii*  
*Cassinia trinervia*  
*Ceratopetalum apetalum*  
*Citriobatus pauciflorus*  
*Clematis glycinoides*  
*Cryptocarya glaucescens*  
*Cyathea leichhardtiana*  
*Dennstaedtia davallioides*  
*Diospyros australis*  
*Doodia aspera*  
*Elaeocarpus holopetalus*  
*Elaeocarpus reticulatus*  
*Eucalyptus fastigata*  
*Eustrephus latifolius*  
*Fieldia australis*  
*Geitonoplesium cymosum*  
*Grammitis billardieri*  
*Gymnostachys anceps*  
*Helicia glabrifolia*  
*Histiopteris incisa*  
*Hymenanthera dentata*  
*Hymenophyllum flabellatum*  
*Lastreopsis decomposita*  
*Livistona australis*  
*Marsdenia rostrata*

*Microsorium pustulatum* subsp. *pustulatum*  
*Morinda jasminoides*  
*Notelaea venosa*  
*Ozothamnus diosmifolius*  
*Palmeria scandens*  
*Parsonsia brownii*  
*Pellaea falcata*  
*Pimelea ligustrina*  
*Pittosporum undulatum*  
*Plectorrhiza tridentata*  
*Polyphlebium venosa*  
*Polyscias sambucifolia*  
*Prostanthera lasianthos*  
*Pyrrosia rupestris*  
*Ranunculus lappaceus*  
*Rapanea howittiana*  
*Rubus moluccanus* var. *trilobus*  
*Rubus rosifolius*  
*Sarcochilus falcatus*  
*Schizomeria ovata*  
*Solanum aviculare*  
*Stellaria flaccida*  
*Sticherus lobatus*  
*Synoum glandulosum*  
*Tristaniopsis collina*  
*Urtica incisa*  
*Viola hederacea*

*Microsorium scandens*  
*Muellerina eucalyptoides*  
*Olearia argophylla*  
*Ozothamnus ferrugineus*  
*Pandorea pandorana*  
*Parsonsia straminea*  
*Pennantia cunninghamii*  
*Pittosporum revolutum*  
*Plantago debilis*  
*Polyosma cunninghamii*  
*Polyscias murrayi*  
*Polystichum proliferum*  
*Pteris umbrosa*  
*Quintinia sieberi*  
*Ranunculus plebeius*  
*Ripogonum album*  
*Rubus nebulosus*  
*Sambucus australasica*  
*Sarcopetalum harveyanum*  
*Smilax australis*  
*Solanum pungetium*  
*Stenocarpus salignus*  
*Symplocos thwaitesii*  
*Tasmannia insipida*  
*Tylophora barbata*  
*Veronica plebeia*

3. The total species list of the flora and fauna of the community is considerably larger than that given in 2 (above), with many species present in only one or two sites or in very small quantity. The community includes vertebrates and invertebrates, many of which are poorly known. Invertebrate species may be restricted to soils or canopy trees and shrubs. In any particular site not all of the assemblage listed above may be present. At any one time, seeds of some species may only be present in the soil seed bank with no above-ground individuals present. The species composition of the site will be influenced by the size of the site and by its recent disturbance history. The number of species and the above-ground composition of species will change with time since fire, and may also change in response to changes in fire frequency.

4. Robertson Rainforest is a warm temperate/cool temperate rainforest type characterised by *Quintinia sieberi*, *Polyosma cunninghamia* and *Doryphora sassafras* (Mills & Jakeman 1995). *Eucryphia moorei* was probably common along streams. Tree and shrub species typically associated with this rainforest type are *Acmena smithii*, *Acacia melanoxylon*, *Quintinia sieberi*, *Hymenanthera dentata*, *Coprosma quadrifida*, *Tasmannia insipida* and occasionally *Ceratopetalum apetalum*. Cool temperate components include *Olearia argophylla*, *Hedycarya angustifolia*, *Eucryphia moorei*, *Dicksonia antarctica* and *Parsonsia brownii*. Ground cover is a dense fern cover including *Lastreopsis microsora* and *Microsorium pustulatum* subsp. *pustulatum*.

5. Robertson Rainforest is found on high fertility soils derived generally from Tertiary basalts (mainly the Robertson Basalt and Kangaroo Valley Basanite), at high altitudes (500-750 m) and under high rainfalls (1000-1600 mm per annum) (Mills & Jakeman 1995).

6. Robertson Rainforest is or has been known to occur in the Wingecarribee and Shoalhaven Local Government Area, but may occur elsewhere in the Sydney Basin Bioregion. It has been reported from the Robertson plateau and Cambewarra Range (Mills & Jakeman 1995).
7. Disturbed Robertson Rainforest remnants are considered to form part of the community including areas where the vegetation would respond to assisted natural regeneration, such as where the natural soil and associated seedbank is still at least partially intact.
8. Robertson Rainforest has been extensively cleared for agriculture and rural development. About 400-600 ha or about 20% of its original extent is estimated to survive though mostly as fragmented remnants (Mills 1988). Remnants are often dominated by *Acmena smithii*, *Doryphora sassafras* and *Acacia melanoxylon*.
9. A remnant of Robertson Rainforest is conserved in Robertson Nature Reserve at Robertson.
10. Much of the remaining area of Robertson Rainforest is highly fragmented with much of it occurring on private land. Threatening processes include invasion of exotic weed species including *Ligustrum sinense*, *Hedera helix*, *Lonicera japonica*, *Ilex aquifolium* and clearing, grazing, trampling and further fragmentation.
11. In view of the originally restricted distribution of this community, its inadequate representation within conservation reserves, and threats from fragmentation and weed invasion, the Scientific Committee is of the opinion that Robertson Rainforest in the Sydney Basin Bioregion is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate and that the community is eligible for listing as an endangered ecological community.

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## APPENDIX 10

### FINAL DETERMINATION FOR ROBERTSON BASALT TALL OPEN FOREST

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#### NSW Scientific Committee - Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion, as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule 1 of the Act. Listing of Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion is the name given to the ecological community characterised by the species assemblage listed in 2 below. The community occurs on high nutrient soils in high rainfall areas of the Southern Highlands. All sites are within the Sydney Basin Bioregion.

2. Robertson Basalt Tall Open-forest is characterised by the following assemblage:

- |                                  |                                 |
|----------------------------------|---------------------------------|
| • <i>Acacia mearnsii</i>         | • <i>Hymenanthera dentata</i>   |
| • <i>Acacia melanoxylon</i>      | • <i>Lomandra longifolia</i>    |
| • <i>Acronychia oblongifolia</i> | • <i>Marsdenia rostrata</i>     |
| • <i>Aphanopetalum resinosum</i> | • <i>Microlaena stipoides</i>   |
| • <i>Australina pusilla</i>      | • <i>Notelaea venosa</i>        |
| • <i>Citriobatus pauciflorus</i> | • <i>Pandorea pandorana</i>     |
| • <i>Clematis aristata</i>       | • <i>Parsonsia straminea</i>    |
| • <i>Coprosma quadrifida</i>     | • <i>Pellaea falcata</i>        |
| • <i>Desmodium varians</i>       | • <i>Pimelea ligustrina</i>     |
| • <i>Doryphora sassafras</i>     | • <i>Pittosporum undulatum</i>  |
| • <i>Eucalyptus elata</i>        | • <i>Plantago debilis</i>       |
| • <i>Eucalyptus fastigata</i>    | • <i>Poa labillardieri</i>      |
| • <i>Eucalyptus radiata</i>      | • <i>Polyscias sambucifolia</i> |
| • <i>Eucalyptus tereticornis</i> | • <i>Pteridium esculentum</i>   |
| • <i>Eucalyptus viminalis</i>    | • <i>Rubus parvifolius</i>      |
| • <i>Eustrephus latifolius</i>   | • <i>Rubus rosifolius</i>       |
| • <i>Galium propinquum</i>       | • <i>Senecio linearifolius</i>  |
| • <i>Geitonoplesium cymosum</i>  | • <i>Smilax australis</i>       |
| • <i>Geranium homeanum</i>       | • <i>Solanum aviculare</i>      |
| • <i>Hedycarya angustifolia</i>  | • <i>Stellaria flaccida</i>     |

- *Themeda australis*
- *Tylophora barbata*
- *Urtica incisa*
- *Veronica plebeia*
- *Viola hederacea*
- 

3. The total species list of the flora and fauna of the community is considerably larger than that given in 2 (above), with many species present in only one or two sites or in very small quantity. The community includes vertebrates and invertebrates, many of which are poorly known. Invertebrate species may be restricted to soils or canopy trees and shrubs. In any particular site not all of the assemblage listed above may be present. At any one time, seeds of some species may only be present in the soil seed bank with no above-ground individuals present. Invertebrate species may be restricted to soils or canopy trees and shrubs, for example. The species composition of the site will be influenced by the size of the site and by its recent disturbance history. The number of species and the above-ground composition of species will change with time since fire, and may also change in response to changes in fire frequency.

4. Robertson Basalt Tall Open-forest was predominantly of tall open-forest structure, though remnants may now be of open forest or woodland structure due to clearing and disturbance. Typical trees include *Eucalyptus fastigata*, *Eucalyptus viminalis*, *Eucalyptus elata* and *Eucalyptus radiata*.

5. Robertson Basalt Tall Open-forest is found on high fertility soils derived generally from Tertiary basalts (mainly the Robertson Basalt and Kangaroo Valley Basanite), on areas of high rainfall (1000-1600 mm per annum). It is referred to in Fisher, Ryan & Lembit (1995) and Kodela (1990).

6. Robertson Basalt Tall Open-forest is or has been known to occur in the Wingecarribee and Shoalhaven Local Government areas, but may occur elsewhere in the Sydney Basin Bioregion. It has been reported from the Southern Highlands on the Robertson plateau and Cambewarra Range (Kodela, 1990, Kevin Mills pers. comm.).

7. Disturbed Robertson Basalt Tall Open-forest remnants are considered to form part of the community including where the vegetation would respond to assisted natural regeneration, such as where the natural soil and associated seedbank is still at least partially intact.

8. Robertson Basalt Tall Open-forest has been extensively cleared for agriculture and rural development. About 400ha or less than 15% of its original occurrence has been estimated to remain though this is mostly as small and isolated pockets.

9. Robertson Basalt Tall Open-forest has not been reported from any NPWS national parks or nature reserves.

10. Much of the remaining area of Robertson Basalt Tall Open-forest is highly fragmented with much of it occurring on private land. Threatening processes include clearing, logging, burning, introduced species and grazing.

11. In view of the originally restricted distribution of this community, its inadequate representation within conservation reserves, the extensive disturbance and weed invasion that has occurred, and the threats from ongoing development, the Scientific Committee is of the opinion



that Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate and that the community is eligible for listing as an endangered ecological community.

Proposed Gazettal date: 15/06/01

Exhibition period: 15/06/01 – 20/07/01

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## NSW Scientific Committee

## Preliminary Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Preliminary Determination to support a proposal to list Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions is the name given to the plant community associated with coastal sand plains of marine or aeolian origin. It occurs on deep, freely draining to damp sandy soils on flat to moderate slopes within a few kilometres of the sea and at altitudes below 100 m. Bangalay Sand Forest is characterised by the assemblage of species listed in paragraph 2 and typically comprises a relatively dense or open tree canopy, an understorey of mesophyllous or sclerophyllous small trees and shrubs, and a variable groundcover dominated by sedges, grasses or ferns.

2. Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions is characterised by the following assemblage of species:

<i>Acacia longifolia</i>	<i>Acacia sophorae</i>
<i>Acmena smithii</i>	<i>Allocasuarina littoralis</i>
<i>Astroloma pinifolium</i>	<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>
<i>Banksia serrata</i>	<i>Billardiera scandens</i>
<i>Breynia oblongifolia</i>	<i>Carex longebrachiata</i>
<i>Cassytha pubescens</i>	<i>Casuarina glauca</i>
<i>Commelina cyanea</i>	<i>Desmodium gunnii</i>
<i>Dianella caerulea</i> var. <i>caerulea</i>	<i>Dianella crinoides</i>
<i>Dichondra repens</i>	<i>Echinopogon ovatus</i>
<i>Entolasia marginata</i>	<i>Eucalyptus botryoides</i>
<i>Eucalyptus pilularis</i>	<i>Geranium potentilloides</i>
<i>Glycine clandestina</i>	<i>Gonocarpus teucrioides</i>
<i>Hardenberia violacea</i>	<i>Hibbertia scandens</i>
<i>Imperata cylindrica</i> var. <i>major</i>	<i>Isolepis nodosa</i>
<i>Kennedia rubicunda</i>	<i>Lagenifera stipitata</i>
<i>Lepidosperma concavum</i>	<i>Leptospermum laevigatum</i>
<i>Lomandra longifolia</i>	<i>Marsdenia rostrata</i>
<i>Microlaena stipoides</i> var. <i>stipoides</i>	<i>Monotoca elliptica</i>
<i>Notelaea longifolia</i>	<i>Oplismenus imbecillus</i>
<i>Parsonsia straminea</i>	<i>Pittosporum revolutum</i>
<i>Pittosporum undulatum</i>	<i>Pratia purpurascens</i>
<i>Pteridium esculentum</i>	<i>Ricinocarpus pinifolius</i>
<i>Rubus parvifolius</i>	<i>Solanum pungentium</i>
<i>Stellaria flaccida</i>	<i>Stephania japonica</i> var. <i>discolor</i>

3. The total species list of the community is larger than that given above, with many species present only in one or two sites, or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including grazing, land clearing and fire) history. The number and relative abundance of species will change with time since fire, and may also change in response to changes in fire frequency or grazing regime. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is mainly of vascular plant species, however the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

4. Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions typically has a dense to open tree canopy, approximately 5 – 20 m tall, depending on exposure and disturbance history. The most common tree species include *Eucalyptus botryoides* (Bangalay) and *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), while *Eucalyptus pilularis* (Blackbutt) and *Acmena smithii* (Lilly Pilly) may occur in more sheltered situations, and *Casuarina glauca* (Swamp Oak) may occur on dunes exposed to salt-bearing sea breezes or where Bangalay Sand Forest adjoins Swamp Oak Floodplain Forest. The open shrub stratum may be dominated by sclerophyllous species, such as *Banksia serrata* (Old Man Banksia), *Leptospermum laevigatum* (Coast Teatree) and *Monotoca elliptica*, or mesophyllous, species, such as *Breynia oblongifolia* (Coffee Bush) and *Pittosporum undulatum* (Sweet Pittosporum), or a combination of both. Shrubs may vary in height from one to ten metres tall. The groundcover varies from open to dense, and may be sparse where the tree canopy is dense or where there is a thick litter of leaves and branches. Dominant species include *Dianella* spp. (Blue Flax Lilies), *Lepidosperma concavum*, *Lomandra longifolia* (Spiny-headed Matrush), *Pteridium esculentum* (Bracken), and the grasses *Imperata cylindrica* var. *major* (Blady Grass), *Microlaena stipoides* var. *stipoides* (Weeping Grass) and *Themeda australis* (Kangaroo Grass), while herbs, such as *Desmodium gunnii*, *Dichondra repens* (Kidney Weed), *Pratia purpurascens* (Whiteroot) and *Viola hederacea* (Ivy-leaved Violet), are scattered amongst the larger plants. Vines of *Glycine clandestina*, *Hardenbergia violacea* (False Sarsparilla), *Kennedia rubicunda* (Running Postman), *Marsdenia rostrata* (Common Milk Vine) and *Stephania japonica* var. *discolor* (Snake Vine) scramble through the groundcover and occasionally over shrubs or tree trunks.

5. Bangalay Sand Forest of the Sydney Basin and South East bioregions is currently known from parts of the Local Government Areas of Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995).

6. A number of vegetation surveys and mapping studies have been carried out across the range of Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions. In the Sydney-South Coast region, this community includes 'Ecotonal Coastal Hind Dune Swamp Oak-Bangalay Shrub Forest' (ecosystem 27) and 'Coastal Sands Shrub/Fern Forest' (ecosystem 28) of Thomas *et al.* (2000); 'Littoral Thicket' (map unit 63) and part of 'Coastal Sand Forest' (map unit 64) of Tindall *et al.* (2004); 'Coastal sand Bangalay-blackbutt forest' (map unit 25) of NPWS (2002); and 'Dry Dune Shrub Forest' of Keith and Bedward (1999). Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions is included within the 'South Coast Sands Dry Sclerophyll Forests' vegetation class of Keith (2002, 2004). There may be additional or unmapped occurrences of Bangalay Sand Forest within and beyond these surveyed areas.

7. Near its northern limit in the Bundeena area, Bangalay Sand Forest co-occurs with Kurnell Dune Forest in the Sutherland Shire and City of Rockdale, which is listed as an Endangered Ecological

Community in Part 3 of Schedule 1 of the Act. In this area, Bangalay Sand Forest is generally restricted to foredunes and hind dunes of beaches, while Kurnell Dune Forest generally occurs on sheltered sand flats further from the immediate influence of the sea. Characteristic species of Kurnell Dune Forest, such as *Angophora costata*, *Banksia ericifolia*, *Cupaniopsis anacardioides*, *Endiandra sieberi*, *Eucalyptus robusta* and *Maclura cochinchinensis*, are not common components of Bangalay Sand Forest. However, the two communities may intergrade where they co-occur. This Determination and the Determination of Kurnell Dune Forest collectively encompass all intermediate stands of vegetation between the two communities.

8. Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions is threatened by land clearing; degradation and disturbance associated with heavy recreational use; frequent burning; rubbish dumping; and weed invasion. These threats are generally associated with existing and proposed urban development along the coast. However, areas of Bangalay Sand Forest within conservation reserves, including Royal, Seven Mile Beach, Conjola, Meroo, Murramarang, Eurobodalla and Biamanga National Parks, are exposed to degradation by visitor overuse due to their proximity to popular beaches and camping areas.

9. Available vegetation mapping indicates that Bangalay Sand Forest has suffered substantial levels of clearing. The coastline between Gerroa and Bermagui includes an estimated area of about 3450 ha, representing one-quarter of the estimated pre-1750 distribution of the community (ecosystems 27 and 28 of Thomas *et al.* 2000). Similarly, Tindall *et al.* (2004) map about 2200 ha of Littoral Thicket, representing about one-third of its estimated pre-European distribution between Sydney and Moruya. South of Bermagui, Keith and Bedward (1999) mapped a further 650 ha, representing less than two-fifths of the estimated pre-1750 distribution. However, recent reconnaissance suggests that these studies may have over-estimated the remaining area of Bangalay Sand Forest (J. Miles, pers. comm.). North of Gerroa, only small fragments of the community persist, for example, on Minnamurra Spit (Mills 2000), around Primbee and Windang (NPWS 2002), Bundeena and Taren Point. Clearing of native vegetation is listed as a Key Threatening Process under the Threatened Species Conservation Act (1995).

10. Some areas of Bangalay Sand Forest are exposed to frequent burning, particularly around camping areas, towns and other sources of ignition. High frequency fire alters species composition by favouring fire-tolerant rhizomatous grasses, sedges and ferns at the expense of woody plants that are slow to regenerate after fire (Keith 1996). Elimination of woody species by frequent burning is likely to be accelerated by grazing. High frequency fire is listed as a Key Threatening Process under the Threatened Species Conservation Act (1995).

11. Weed invasion occurs where Bangalay Sand Forest is exposed to disturbance and degradation. Common weed species include *Asparagus* spp., *Chrysanthemoides monilifera* subsp. *rotundata* (bitou bush), *Cynodon dactylon* (couch), *Cirsium vulgare* (spear thistle), *Conyza bonariensis* (fleabane), *Hypochaeris radicata* (cats ear), *Ipomea* spp. (morning glories), *Lantana camara*, *Pennisetum clandestinum* (kikuyu). Invasion of native plant communities by exotic perennial grasses is listed as a Key Threatening Process under the Threatened Species Conservation Act (1995).

12. In view of the above, the Scientific Committee is of the opinion that Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions it is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival cease to operate.

Dr Lesley Hughes, Chairperson, Scientific Committee

Proposed Gazettal date: 22/04/05

Exhibition period: 22/04/05 – 17/06/05

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## APPENDIX 12

### PRELIMINARY DETERMINATION: THEMEDA GRASSLAND ON SEACLIFFS AND COASTAL HEADLANDS

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#### NSW Scientific Committee

#### Preliminary Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Preliminary Determination to support a proposal to list *Themeda* grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. *Themeda* grassland on seacliffs and coastal headlands in NSW is an ecological community described by Adam *et al.* (1989). The community is found in the NSW North Coast, Sydney Basin and South East Corner Bioregions, on seacliffs and coastal headlands. The structure of the community is typically grassland, but may be open shrubland or heath. The community belongs to the Maritime Grasslands vegetation class of Keith (2004).

2. The community is characterised by the following assemblage of species.

<i>Acacia sophorae</i>	<i>Commelina cyanea</i>
<i>Glycine clandestina</i>	<i>Glycine microphylla</i>
<i>Hibbertia scandens</i>	<i>Isolepis nodosa</i>
<i>Kennedia rubicunda</i>	<i>Lepidosperma</i> spp.
<i>Leptospermum laevigatum</i>	<i>Lomandra longifolia</i>
<i>Monotoca elliptica</i>	<i>Opercularia aspera</i>
<i>Pimelea linifolia</i>	<i>Poranthera microphylla</i>
<i>Sporobolus virginicus</i>	<i>Themeda australis</i>
<i>Viola banksii</i>	<i>Westringia fruticosa</i>

3. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites, or in low abundance. The species composition of the site will be influenced by the size of the site, recent rainfall and drought conditions and by its disturbance history (including fire, grazing and land clearing). At any one time, above ground individuals of some species may be absent, but the species may be represented below ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of the vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse flora. These components of the community are poorly documented.

4. *Themeda australis* is the dominant species in the community. *Themeda australis* is an extremely widespread species, but in this community has a distinctive appearance, being prostrate and having glaucous leaves. These features are retained in cultivation and the form is believed to be genetically distinct (S Jacobs pers. comm.). Scattered dwarf shrubs occur in many stands, most frequently *Pimelea linifolia*, *Banksia integrifolia* and *Westringia fruticosa*. Tussocks of *Poa poiformis* may be found in some stands of the community, but *Poa poiformis*-dominated tussock grassland is generally found lower on cliffs (closer to the sea and more exposed to spray) and on steeper slopes.



5. A number of threatened species occur in some stands of the community, including *Diuris* sp. aff. *chrysantha*, *Pultenaea maritima*, *Thesium australe* (Cohn 2004) and *Zieria prostrata* (Hogbin 2001). The endangered population of the low growing form of *Zieria smithii* at Diggers Head is found in this community. The community is the major habitat for a number of other species, including *Chamaecrista maritima*, *Plectranthus cremnus* and *Stackhousia spathulata*. The presence of threatened species is a matter which will need to be addressed, on a stand by stand basis in management plans, but the presence of threatened species is not required for definition of the community.
6. Individual stands of the community are often small, a few square metres, but at some sites larger stands of up to several hectares occur.
7. The community is found on a range of substrates, although stands on sandstone are infrequent and small. Large stands are found on old sand dunes above cliffs as for example at Cape Banks and Henry Head in Botany Bay National Park (Adam *et al.* 1989). Occurrences of the community in northern NSW are discussed by Griffith *et al.* (2003).
8. The major threat to the community is invasion by shrubs, both introduced species such as *Chrysanthemoides monilifera* and *Lantana camara*, and native species including *Acacia sophorae*, *Banksia integrifolia* and *Westringia fruticosa*. Although native shrubs are a feature of the community, invasion and conversion to shrubland has occurred at a number of sites in recent years. This may reflect changed fire regimes and reduced grazing pressure (including by rabbits). A further major threat is provided by recreational use, with erosion occurring adjacent to footpaths and from use of off-road vehicles.
9. In view of the restricted distribution, small patch size and ongoing threats to the community, the Scientific Committee is of the opinion that *Themeda* grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival cease to operate.

Dr Lesley Hughes, Chairperson, Scientific Committee

Proposed Gazettal date: 22/04/05

Exhibition period: 22/04/05 – 17/06/05

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## **APPENDIX 13**

### **SEPP NO. 26 - LITTORAL RAINFORESTS**

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#### **Citation**

1. This State Environmental Planning Policy may be cited as "State Environmental Planning Policy No. 26 – Littoral Rainforests".

#### **Aims, objectives, etc.**

2. The aim of this Policy is to provide a mechanism for the consideration of applications for development that is likely to damage or destroy littoral rainforest areas with a view to the preservation of those areas in their natural state.

#### **Interpretation**

3. (1) In this Policy –  
"damage", in relation to flora, includes lopping, topping and felling;  
"flora" includes trees, shrubs and vegetation;  
"residential land" means land which is within a zone designated "Residential", "Village" or "Township" on the day on which this Policy takes effect in any environmental planning instrument;  
"the Act" means the Environmental Planning and Assessment Act 1979.

(2) Rocks, rock formations and earth are elements of the landscape for the purposes of this Policy.

#### **Application of Policy**

4. (1) This Policy applies to-
  - (a) land enclosed by the outer edge of the heavy black line on the series of maps held in the Department and marked "State Environmental Planning Policy No. 26 – Littoral Rainforests"; and
  - (b) land not so enclosed but within a distance of 100 metres from the outer edge of that heavy black line except residential land and land to which State Environmental Planning Policy No. 14 – Coastal Wetlands applies.(2) This Policy does not apply to land dedicated or reserved under the National Parks and Wildlife Act 1974 as an Aboriginal area, historic site, national park, nature reserve, state game reserve or state recreation area or land dedicated or set apart under section 25A of the Forestry Act 1916 as a flora reserve.

#### **Relationship between instruments**

5. In the event of an inconsistency between this Policy and a regional environmental plan or a local environmental plan whether made before, on or after the day on which this Policy takes effect, this Policy shall prevail to the extent of the inconsistency.

#### **Designated development**

6. An act which requires the consent of the Council by virtue of clause 7(1) is designated development for the purposes of the Act.

#### **Development – consent and concurrence**

- 7.(1) A person shall not, without the consent of the Council, on land described in clause 4(1)(a), erect a building, carry out work, use land for any purpose, or subdivide it, disturb, change or alter any landform or disturb, remove, damage or destroy and native flora or other element of the landscape or dispose of or dump any liquid, gaseous or solid matter.

(2) A person shall not, without the consent of the Council, on land described in clause 4(1)(b), erect a building, disturb or change or alter any landform or disturb, remove, damage or destroy and native flora, or dispose of or dump any liquid, gaseous or solid matter.

(3) Subject to subclause (4), the Council shall not determine an application under subclause (1) or (2) by granting consent under the Act except with the concurrence of the Director.

(4) The Council shall not determine an application described in section 91A of the Act by granting consent under the Act except with the concurrence of the Minister.

(5) Nothing in subclause (1) or (2) requires the consent of the Council to be obtained for –

- (a) any act which is carried out in the ordinary course of residential occupation of the land concerned;
- (b) eradication of native flora declared noxious by proclamation under section 467 of the Local Government Act 1919, by means not significantly detrimental to the native ecosystem;
- (c) unavoidable destruction or removal during eradication of native flora adjacent to any flora declared noxious by such a proclamation; or
- (d) removal of leaf litter, shed bark or cured grasses for the purpose of reducing the risk of bushfire.

(6) The Council shall not consent to an application made under subclause (1) or (2) unless it is satisfied, if the application is to erect a building, carry out a work, use land for any purpose or dispose of or dump any liquid, gaseous or solid matter, that there is no place outside the area to which this Policy applies on which the development might suitably be located or occur.

#### **Matters for consideration – concurrence**

7. (1) The Minister and Director shall, for the purpose of deciding whether concurrence should be granted, consider-

- (a) any representation made by or on behalf of the Director of National Parks and Wildlife about the likely impact of the proposal on the environment;
- (b) the objectives and major goals of A National Conservation Strategy for Australia published by the Australian Government Publishing Service, Canberra. In 1984; and
- (c) if the carrying out of the proposal and the use (if any) thereafter of the land concerned for the purpose for which it will be used may cause destruction or disturbance of the natural environment, the public interest (if any) in the carrying out of the proposal in relation to the public interest in the preservation of littoral rainforest in its natural state.

(2) A proposal may be in the public interest for the purposes of subclause (1) notwithstanding that it benefits persons (by means including financial or other advantage) who are not public authorities or benefits those persons exclusively.

#### **Forwarding of copies of applications to Director of National Parks and Wildlife**

8. If a Council receives an application under clause 7(1) or (2) of this Policy the Council shall within 7 days of its receipt of the application forward a copy of it to the Director of National Parks and Wildlife.

#### **Amendment of other State Environmental Planning Policies**

9. (1) State Environmental Planning Policy No. 4 – Development Without Consent, is amended by inserting in clause 4(1) after the word “State” the words “but does not apply to land to which State Environmental Planning Policy No. 26 – Littoral Rainforests applies”.

(2) State Environmental Planning Policy No. 8 – Surplus Public Land is amended by inserting at the end of Schedule 1 the following words:

6. Land to which State Environmental Planning Policy No. 26 – Littoral Rainforests applies.

(3) State Environmental Planning Policy No. 9 – Group Homes is amended by inserting in clause 4 after the word “State” the words “but does not apply to land to which State Environmental Planning Policy No. 26 – Littoral Rainforests applies”.

(4) State Environmental Planning Policy No. 14 – Coastal Wetlands, is amended by inserting after clause 4(3) the following subclause:

(5) This Policy does not apply to land to which State Environmental Planning Policy No. 26 – Littoral Rainforests applies.

(6) State Environmental Planning Policy No. 21 – Movable Dwellings is amended by inserting after clause 7(4) the following clause:

(7) Subclause (1) does not apply to land to which State Environmental Planning Policy No. 26 – Littoral Rainforests applies.

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## **APPENDIX 14**

### **SEPP NO. 14 - COASTAL WETLANDS**

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#### **Citation**

1. This State Environmental Planning Policy may be cited as “State Environmental Planning Policy No. 14 – Coastal Wetlands”.

#### **Aims, objectives etc.**

2. The aim of this policy is to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State.

#### **Interpretation**

3. In this policy, except in so far as the context or subject-matter otherwise indicates or requires-  
“the Act” means the Environmental Planning and Assessment Act 1979;  
“the map” means the series of maps marked “State Environmental Planning Policy No. 14 – Coastal Wetlands” deposited in the office of the Department.

#### **Application of policy**

4. (1) Subject to subclause (2), this policy applies to the land outlined by heavy black edging on the map.

(2) This policy does not apply to land dedicated or reserved under the National Parks and Wildlife Act 1974 as an Aboriginal area, historic site, national park, nature reserve, state game reserve or state recreation area.

#### **Inconsistency between instruments**

5. Subject to section 74(1) of the Act, in the event of an inconsistency between this policy and another environmental planning instrument, whether made before, on, or after the date on which this policy is made, this policy shall prevail to the extent of the inconsistency.

#### **Consent Authority**

6. The council of the local government area in which development described in clause 7(1)(a), (b), (c) or (d) is proposed to be carried out shall be the consent authority having the function to determine a development application relating to that development.

#### **Restriction on development of certain land**

7. (1) In respect of land to which this policy applies, a person shall not –

- (a) clear that land;
- (b) construct a levee on that land;
- (c) drain that land; or
- (d) fill that land,

except with the consent of the council and the concurrence of the Director.

(2) In considering whether to grant concurrence under subclause (1), the Director shall take into consideration –

- (a) the environmental effects of the proposed development, including the effect of the proposed development on –
  - (i) the growth of native plant communities;
  - (ii) the survival of native wildlife populations;
  - (iii) the provision and quality of habitats for both indigenous and migratory species;
  - (iv) the surface and groundwater characteristics of the site on which the

development is proposed to be carried out and of the surrounding area, including salinity and water quality;

- (b) whether adequate safeguards and rehabilitation measures have been, or will be, made to protect the environment;
- (c) whether carrying out the development would be consistent with the aim of this policy;
- (d) the objectives and major goals of the “National Conservation Strategy for Australia” (as set forth in the second edition of a paper prepared by the Commonwealth Department of Home Affairs and Environment for comment at the National Conference on Conservation held in June, 1983, and published in 1984 by the Australian Government Publishing Service) in so far as they relate to wetlands and the conservation of “living resources” generally, copies of which are deposited in the office of the Department;
- (e) whether consideration has been given to establish whether any feasible alternatives exist to the carrying out of the proposed development (either on other land or by other methods) and if so, the reasons given for choosing the proposed development; and
- (f) any representations made by the Director of National Parks and Wildlife in relation to the development application.

(3) Pursuant to section 29 of the Act, development for which consent is required by subclause (1) is declared to be designated development for the purposes of the Act.

#### **Copy of application to be sent to Director of National Parks and Wildlife**

8. Where a council receives an application for consent to carry out development referred to in clause 7(1), the council shall, within 7 days of its receipt of that application, forward a copy of the application to the Director of National Parks and Wildlife.

#### **Amendment of State Environmental Planning Policy No. 4 – Development Without Consent**

9. State Environmental Planning Policy No. 4 – Development Without Consent is amended by inserting in clause 10(1) after the matter “clause 9” the words “or to land to which State Environmental Planning Policy No. 14 – Coastal Wetlands applies”.

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