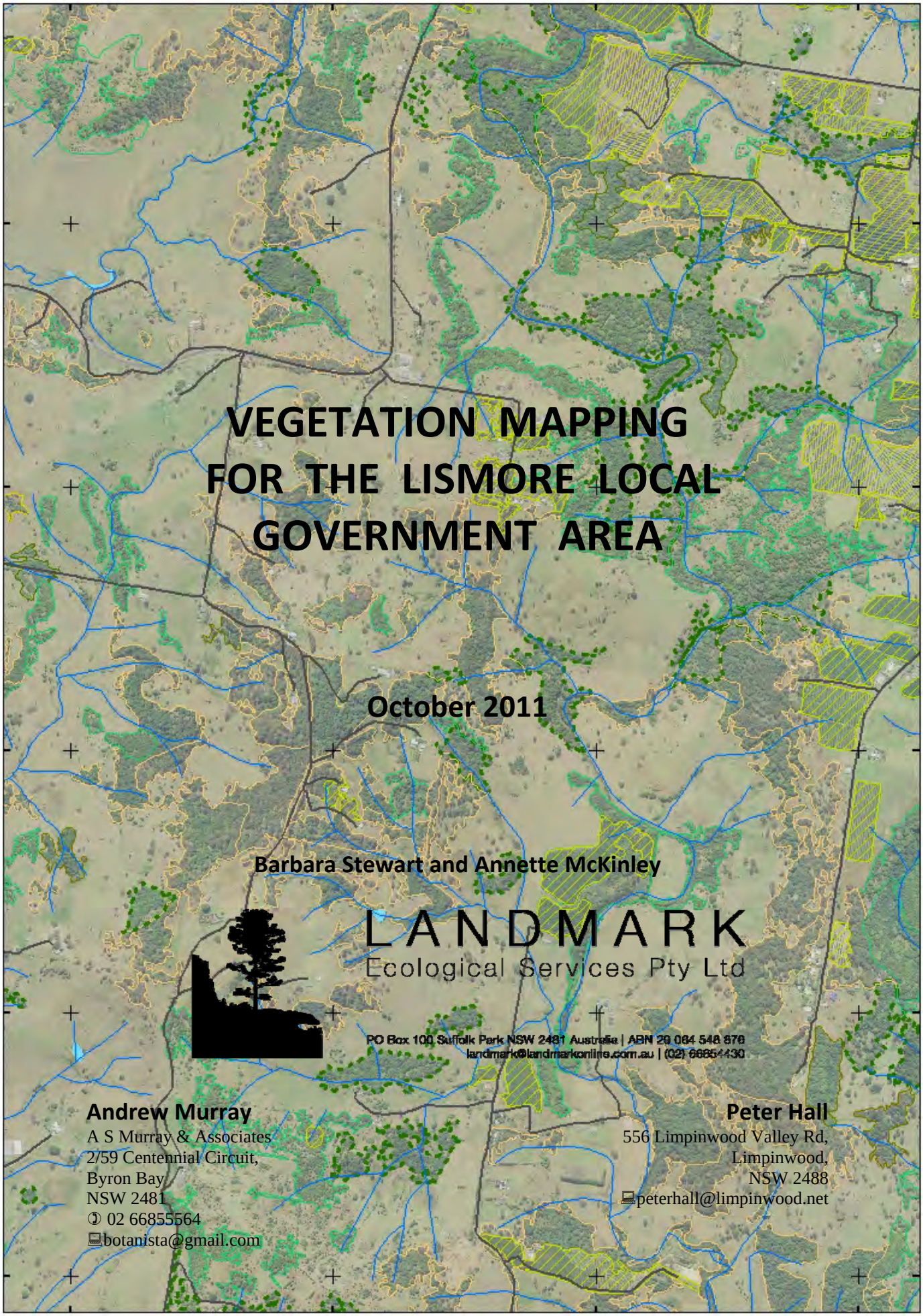

VEGETATION MAPPING FOR THE LISMORE LOCAL GOVERNMENT AREA

October 2011

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Vegetation Mapping for the Lismore Local Government Area

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Project Team

The project team comprised Barbara Stewart (Landmark), Annette McKinley (Landmark), Andrew Murray (A.S. Murray & Associates), Peter Hall (independent consultant) and Damian Licari (LCC). Roles were as follows:

Peter Hall – preparation of Bushland Layer
Barbara Stewart – project co-ordinator, reporting, fieldwork
Annette McKinley – API, fieldwork, reporting
Andrew Murray – GIS co-ordination, API, fieldwork
Damian Licari – fieldwork, Council liaison

Acknowledgements

The project was undertaken with project co-ordination and field assistance from Damian Licari (Environmental Strategy Officer – Ecology, LCC) and valuable input and field assistance from Nick Stephens (Environmental Strategies Co-ordinator, LCC). Other LCC staff contributions included Vanessa Tallon (field assistance), Russell Bell (GIS liaison) and Paula Newman (consultation re floodplain mapping). David Milledge (Landmark) assisted with fieldwork.

Council provided background information including GIS layers (details **Section 1.4**).

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1 Introduction

1.1 Background

Landmark Ecological Services Pty Ltd (Landmark) has been engaged by Lismore City Council (LCC) to conduct fine-scale mapping of vegetation, including Endangered Ecological Communities (EECs) and Koala habitat across the Local Government Area (LGA), (the study area). In a later stage of the project, mapping of key habitats and corridors will be conducted.

The mapping will fulfill a fundamental requirement for the development of a Biodiversity Management Strategy (BMS) by LCC. The purpose of this strategy is to maintain, manage and enhance the biodiversity and ecosystems of the LGA, as expressed in the Lismore Community Strategic Plan 2008-18.

1.2 The study area

The LGA was divided into three zones, designated by colour, reflecting differing levels of available background information, potential for landuse to conflict with biodiversity objectives and other threats (**Figure 1, Table 1**). National Parks estate, including National Parks (NPs), Nature Reserves (NRs) and State Conservation Areas (SCAs) as well as State Forests (SFs) are outside the scope of the mapping project, but are shown on maps and included in area statistics in **Table 1.**

Table 1 Details of zones within study area.

Zone	**Area (ha)**	
Green	56,274.83	The Green Zone is located north of the area bounded by the line that extends SSW from the intersection of the Whian Whian SCA and Rocky Creek to Dunoon Road. The boundary then follows Dunoon Road south to the corner of Cusack Road. It then extends westward approximately following the 50m contour along the floodplains of Leycester Creek (south), Booerie Creek, Terania Creek, Goolmangar Creek, Jiggi Creek, Leycester Creek (west) and Back Creek west to the boundary of the Lismore and Richmond Valley LGAs.
Grey	20,873.71	The Grey Zone lies in the southeast of the LGA. This zone is bounded by the Wilsons River in the north and west and the border with Ballina Shire in the east. In the south, the boundary follows Delelvin Lane, Paff Lane, Maxwell Lane, Tuckean Island Road, along the drainage canal to the south of Tuckean Island Road and then along the southern boundary of Tuckean Nature Reserve. The Grey Zone corresponds to the koala planning area defined in the Comprehensive Plan of Management for south-east Lismore.
Blue	51,582.02	The Blue Zone lies to the south of the southern boundary described for the Green Zone and occupies the remainder of the study area. The Blue Zone lies across the centre of the LGA, extends along its western boundary and occupies the far south of the LGA.
TOTAL	**128,730.55**	

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map originally produced in A3

TWEED SHIRE

KYOGLE SHIRE

BYRON SHIRE

RICHMOND VALLEY

BALLINA SHIRE

SAMS GULLY

TUNTABLE CREEK

BAT CAVE CREEK

Nightcap National Park

ROCKY CREEK

BRANCH CREEK

TOPSY CREEK

Whian Whian
State Conservation Area

BILLEN CREEK

JEFFRIES CREEK

JIGGI CREEK

BISHOPS CREEK

BOWEN GULLY

DANS CREEK

MICKS CREEK

YANKEY CREEK

Johnston Creek

EMERALD CREEK

Bungabbee
Nature Reserve

Bungabbee
State Forest

BACK CREEK

ONKEY CREEK

Muckleewee Mountain
Nature Reserve

BOOERIE CREEK

LAGOON CREEK

Boatharbour Nature Reserve

YAK YAK CREEK

PELICAN CREEK

Browns Creek

LISMORE

Wilson Nature Reserve

ALSTONVILLE

CASINO

BOGGY CREEK

MAROM CREEK

TUCKI TUCKI CREEK

Tucki Tucki
Nature Reserve

Tucki Tucki
Nature Reserve

Tuckean
Nature Reserve

Tuckean
Nature Reserve

STIBBARDS CREEK

RAINBOW CREEK

RICHMOND RIVER

510000 520000 530000 540000

6840000 6830000 6820000 6810000 6800000 6790000

N

0 2.5 5 Kilometers

co-ordinates Map Grid Australia

Legend

Lismore LGA

- Grey Zone
- Blue Zone
- Green Zone
- NPWS estate
- NSW State Forest
- town or village
- drainage line

Figure 1 Study Area

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1.3 Aims and objectives

The original aim of the project, as set out in the project brief, was to generate accurate 1:10,000 scale digital maps identifying the distribution of vegetation communities, across the LGA. This mapping was to include native vegetation remnants in urban areas, but exclude cleared areas. The aims and objectives of the vegetation mapping were refined in discussion between LCC and Landmark.

The agreed specific objectives of the first stage of the project were to (within resourcing and technical limitations stated throughout this report):

1. Delineate a Bushland Layer. The Bushland Layer was to comprise detailed linework that outlines the extent of patches and blocks of woody vegetation (and enclosed water bodies) as evident from air photos.
2. Within the Bushland Layer, identify and map land-use categories (plantations, non-plantation vegetation and open water).
3. Within the Bushland Layer, to identify and map vegetation and classify to the community[1] level.
4. Describe and map vegetation condition[2]
5. Identify and map vegetation of conservation value to include:
   - Vegetation preferred by Koalas.
   - Endangered Ecological Communities listed on Schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act)
   - Location of Grasses i.e. small patches of grassland and grassy open-forest in and around the Big Scrub, known locally as 'Grasses' (Stubbs 2001).

Resources did not permit mapping to the same level of detail for the whole LGA. Hence, the Bushland Layer was generated for the whole LGA while tasks within zones were identified as follows:

<u>Grey Zone</u>

- Refinement to existing vegetation mapping, including previous Koala habitat mapping (Ecograph 2004);
- reassignment of Koala habitat categories to reflect new definitions;
- intensive field checking to support a Koala Plan of Management (KPoM) for the zone;
- assignment of condition categories to mapped vegetation; and
- mapping of other high conservation value vegetation.

<u>Blue Zone</u>

New vegetation mapping;

- assignment of Koala habitat categories to mapped vegetation polygons;
- moderate levels of field checking;
- assignment of condition categories to mapped vegetation; and
- mapping of other high conservation value vegetation.

[1] Plant communities are repeating and recognisable assemblages of plant species occurring together in the landscape, usually with similar structural characteristics (Sivertsen 2009).

[2] See Section 2.2.3 for condition descriptions

Green Zone

- Further subdivide the Bushland Layer to delineate plantations and open water, and
- limited fieldwork to confirm the plantation layer.

A minimum polygon size of 0.5 ha was to be employed for purposes of delineating the Bushland Layer and for the vegetation community polygons within the Bushland Layer outline. Some variations to the minimum size for polygons were made in parts of the project area (**Section 2.1.1**).

The latest available Land and Property Information high resolution digital photography (ADS40, September 2009) was to be utilised.

1.4 Information sources

Existing vegetation mapping within the LGA included:

- Vegetation mapping conducted as part of larger regional assessments (e.g. Comprehensive Regional Assessment Aerial Photographic Interpretation (CRAFTI).
- 1:10,000 scale maps of distribution of vegetation within the LGA based on Keith (2004) classifications (GHD 2008).
- Koala habitat mapping for the south-eastern portion of the LGA (Ecograph 2004). The method used in 2004 to map Koala habitat involved SPOT/LANDSAT satellite image analysis and aerial photo interpretation with a limited amount of field verification. Resultant mapping identified patches of remnant vegetation with a patch size resolution of 0.02-0.05 ha. The accompanying report (Turnbull and Boulton 2000) included a detailed description of each mapped unit, a list of diagnostic/common species and an equivalency/lookup table, which shows the relationship between mapped vegetation units and vegetation communities identified in the literature.

Other sources included:

- Species lists and reports for example LCC lands and some private properties
- Scientific Committee Determinations for Endangered Ecological Communities
- Locations for Grasses (Stubbs 2001).

LCC also provided GIS layers with relevance for vegetation classification and evaluation of conservation status, including:

- Air photo imagery
- Drainage, cadastral and zoning layers
- Soils and geology
- Landform (based on mapping by Morand 1994)
- LCC 100-year flood level (refinement ongoing, version supplied dated August 2011).

Resources did not permit the full evaluation and incorporation of all available background data. Existing mapping and species lists were used for reference; however, for consistency it was judged advisable and most efficient to apply the image analysis, air photo interpretation and field checking methods of the current project in the same manner across all vegetation in the study area.

2 Methods

2.1 Mapping methods

2.1.1 Image analysis and air photo interpretation

The Bushland Layer was derived through digital interpretation of 2009 orthorectified aerial photography (orthographs), imported into a Geographic Information System (GIS) (TNT Mips and ArcInfo). The technical details of the image analysis process are provided in **Appendix 1**.

The image analysis process produced a detailed outline of the woody vegetation using an arbitrary canopy cover cut-off of >40%. The cut-off was considered appropriate for practical purposes since the delineation of vegetation boundaries became difficult for sparser vegetation.

Some variations were employed in parts of the project area as API and field work proceeded:

- in delineating plantations, an exception to the 40% canopy cover cutoff was employed to include areas of vegetation with plantation structure but canopy cover <40% where they were enclosed in, or adjacent to, mapped plantation.
- in the case of vegetation of high conservation value (EEC or Koala habitat), further exceptions were employed, guided by API and field checking. Polygons less than 0.5 ha in area and/or having less than 40% canopy cover were included where possible. As resources were limited, mapping of small or sparsely vegetated polygons was not consistent across the study area.

Water bodies were identified and mapped at the image analysis stage, as bodies wider than 10 meters and visible in the imagery at 1:10,000 (dams, lagoons, rivers etc.).

Stereoscopic inspection of overlapping pairs of air photos (2004) was used in conjunction with digital images of 2009 air photography to further refine the Bushland Layer outline and assign land-use categories (whole LGA), to subdivide large vegetation blocks into reasonably homogenous vegetation polygons and to assign vegetation type or plantation type, Koala habitat and condition attributes (Blue and Grey Zones only).

2.1.2 Field inspection

Field work was undertaken between November 2010 and June 2011. Ground truthing was undertaken to confirm (or modify) the mapped plantation and vegetation types, to document their structure and floristics in more detail, and to illustrate the range of variation within and between the polygons.

While the intensity of ground truthing required in the project varied within the study area (**Section 1.3**), ground truthing priorities were also determined by confidence in API, the desirability of checking a representative sample of each vegetation community and geographic spread of samples.

Field checking was undertaken by traverse, i.e. the vegetation was inspected by way of meandering transects within the polygon, or by remote inspection from roadsides or other vantage points, often using binoculars. Where inspection by traverse was undertaken, details of vegetation structure and floristics were recorded, including dominant species in each stratum and measures of weed abundance and severity. As most vegetation in the study area is in private ownership, access for purposes of ground truthing by traverse was only occasionally possible.

Remote inspection focused on identifying dominant canopy tree species, presence of Camphor Laurel etc. During field checking by remote inspection, vegetation polygons were viewed, wherever possible, from more than one vantage point in order to improve the accuracy of the field assessment of the API. However, in some cases only the edge or a small proportion of a vegetation polygon could be viewed.

2.1.3 Data collection and handling

A data sheet (**Appendix 2**) was developed to record data collected for each polygon from air photo interpretation and field inspection, as conducted in the Grey and Blue Zones. Codes and definitions are provided in **Appendix 3** or other sources listed in **Table 2.** Data was entered into a spreadsheet linked to a GIS (Arc Info) database.

Data was collected/compiled for some or all of the following fields, depending on the land-use category and the level, if any, of ground-truthing (**Table 2**). The table represents the ideal or maximum data set recorded for each circumstance – resources did not always permit full data collection.

Table 2 Details of data collection by land-use category.

		Landuse category			
GIS Database Field Name	**Short description**	**Non-plant-ation veget-ation**	**Plant-ation**	**Open Water**	**For codes and definitions refer to:**
POLYID	Polygon number	x	x	x	
HECTARES	Area (ha)	x	x	x	
SOIL	Layer supplied by LCC	x	x	x	
LANDSCAPE	Layer supplied by LCC	x	x	x	Morand (1994)
FLOOD	% polygon below 100 year flood level Layer supplied by LCC	x	x	x	
ZONE	Subdivision of LGA	x	x	x	Appendix 3
DATE	Date of field inspection	x	x	x	
RECORDER	Person conducting field inspection	x	x	x	Appendix 3
LOCATION	General geographic location	x	x	x	
LAND_USE	Land-use category	x	x	x	Appendix 3
PLANTN_TYP	Plantation type		x		s. 2.2.2
KEITH_FORMATION	Based on Keith	x			Keith (2004)
KEITH_CLASS	Based on Keith	x			Keith (2004)
COMM_SHORT_NAME	Abbreviation for community	x			Table 9
COMM_CODE	For mapping labels	x			Table 9
LM_VEG_UNIT	Vegetation unit	x			Table 9
CAN_HEIGHT	Canopy height (m)	x			
CAN_COVER	Canopy cover (%)	x			
WH-STRUCTU	Vegetation structure	x			Walker and Hopkins 1990
FP_EEC_PROB	Likelihood of Floodplain EEC	x	x		s. 2.2.4
FP_EEC_TYPE	Floodplain EEC type	x	x		s. 2.2.4
RF_PROB	Likelihood of Lowland subtropical rainforest EEC	x	x		s. 2.2.4
EMERGENT	Emergent species	x			

		Landuse category			
GIS Database Field Name	**Short description**	**Non-plant-ation veget-ation**	**Plant-ation**	**Open Water**	**For codes and definitions refer to:**
UPPERDOM1	Upper stratum dominant species	x			
UPPERDOM2	Upper stratum dominant species	x			
UPPERDOM3	Upper stratum dominant species	x			
MIDDOM1	Mid stratum dominant species	x			See note Appendix 3
MIDDOM2	Mid stratum dominant species	x			
MIDDOM3	Mid stratum dominant species	x			
LOWERDOM1	Lower stratum dominant species	x			See note Appendix 3
LOWERDOM2	Lower stratum dominant species	x			
LOWERDOM3	Lower stratum dominant species	x			
K_HAB_REL	Reliability of Koala habitat typing	x	x		s. 2.2.4
K_HAB_CAT	Koala habitat	x	x		s. 2.2.4
SUCC_STAGE	Site condition (field inspection)	x			s. 2.2.3
API_SUCC_S	Landscape condition (API)	x			s. 2.2.3
LANTANA	Lantana cover (API)	x			s. 2.2.3
CAMPHOR	Camphor cover (API)	x			s. 2.2.3
WEED_DENSI	Weed density (field inspection)	x			Appendix 3
WEED_SEVER	Weed severity (field inspection)	x			Appendix 3
RELIABILIT	Reliability	x	x	x	s. 2.3
NOTES	Notes	x	x	x	

2.2 Mapping categories and classification

2.2.1 Land-use categories

The Bushland Layer was subdivided into broad land-use categories as follows:

- Plantations
- Non-plantation vegetation
- Open water

The parts of the project area lying outside the Bushland Layer were termed Non-bushland Matrix.

A definition of “plantation" based on the *NSW Timber Plantations (Harvest Guarantee) Act* 1995 was adopted i.e. an area of land on which the predominant number (>50%) of trees or shrubs forming, or expected to form, the canopy are trees or shrubs that have been planted (whether by sowing seed or otherwise):

(a) for the purpose of timber production, or

(b) for the protection of the environment (including for the purpose of reducing the salinity of the land or otherwise repairing or improving the land, for the purpose of biodiversity conservation or for the purpose of acquiring or trading in carbon

sequestration rights), or
(c) for any other purpose, including for the purpose of the production of food or any other farm produce other than timber.

Plantations were recognized during API by their structure (usually planted in rows).

2.2.2 Vegetation typing and classification

Vegetation was classified by API mainly on the basis of spatial patterns, texture and colour calibrated by field observations. Non-plantation vegetation polygons were assigned to vegetation units on the basis of canopy dominant species (following Walker and Hopkins 1990).

Plantations were further subdivided into categories based on dominance, as follows:

1. Eucalyptus species
2. Exotic pine
3. Hoop Pine
4. Rainforest (mixed species)
5. Orchard
6. Mixed/other.

At the conclusion of API and field work, the units recognised within non-plantation vegetation were placed into groups of similar vegetation and assigned to vegetation communities from existing classifications used in locally relevant mapping.

The project brief required vegetation classification at the community level as defined by the Interim Vegetation Community List and reflected in the Interim Vegetation Classification (EcoLogical 2010) and accompanying spreadsheet Draft_North_Coast_Community_list_V1.4.xls". Communities that could not readily be placed in the existing Interim Vegetation communities were placed in Biometric (Ayers *et al.* 2004, 2008) communities, rainforest sub-alliances (Floyd 1990) or, as necessary, previously unrecognized communities recognized and described during this project.

In assigning a vegetation unit to a vegetation community, consideration was given to:

- Canopy dominants and structure (and other floristic data where available)
- Soils and landform
- Spatial relationship to known distribution of vegetation types (GIS map inspection)
- Understanding of vegetation types and distribution gleaned from field work and previous experience of the project team
- Vegetation descriptions were prepared for all vegetation communities. Where vegetation units appeared to be heterogeneous (e.g. units named Forest Red Gum included vegetation located on both the floodplain and higher ground), API and any available field data was assessed polygon by polygon and the unit was split into more than one vegetation community.

Vegetation communities were placed in Keith's (2004) formations and classes.

2.2.3 Vegetation condition

The project brief required that vegetation condition measures be incorporated into mapping. Options for measuring condition from API were limited, while other measures for use during

ground survey were possible but applicable only to a small proportion of sites. The measures selected included some that had been developed by review and, where relevant, adaptation of different available rapid survey approaches (i.e. Gibbons *et al*. 2005, 2009, NRCMA 2009) during data collection undertaken in adjoining LGAs during the Tweed Byron Bushland Audit (Bushland Restoration Services *et al.* 2010). In particular, the categories for landscape condition (from API), site condition (from ground survey), weed density (from ground survey) and weed severity (from ground survey) reflected the latter source. In addition, cover classes for Lantana *Lantana camara* and Camphor Laurel *Cinnamomum camphora* were assigned from API and the latter was validated or refined from ground-truthing when possible. The vegetation floristics and structural data collected in the field (**Section 2.1.2**) included some further data about the integrity of vegetation strata and weed occurrence.

Categories and codes were as follows:

Landscape condition (from API):

1. Old growth/excellent condition
Vegetation with negligible unnatural disturbance, as discerned from canopy cover relative to undisturbed state of vegetation type.
Evidence of senescent crowns in eucalypt forest >10%
2. Mature forest
Vegetation with small unnatural disturbance, as discerned from canopy cover relative to undisturbed state of vegetation type.
Evidence of senescent crowns in eucalypt forest <10%
3. Other

Lantana cover (from API)

1. >50%: **2.** 26 –50% ; **3.** 5 –25%; **4** Not detected

Camphor cover (from API)

1. >50%; **2.** <50% throughout; **3.** Occasional/patchy/edges; **4.** Not detected

Site condition (from ground survey)

1. Old growth - Mature forest or other vegetation with common age related features (fallen logs, senescent trees, stags, tree hollows, epiphytes, lithophytes, buttresses, large trees, emergents etc).
2. Mature vegetation – well developed vegetation; e.g. > 5 yrs old for non-woody vegetation; >8 yrs for shrublands; >40 yrs for forests.
3. Advanced regrowth – intermediate successional development e.g. 1 – 5 yrs old for non-woody vegetation; 3 – 8 yrs for shrublands; 10 – 40 yrs for forests.
4. Early successional development e.g. < 1 yr old for non-woody vegetation; < 3 yrs for shrublands; < 10 yrs for forests.

Weed density (from ground survey, includes Camphor and Lantana)

1 – Few or no weeds observed (no or light infestation)
2 – Weeds mainly around edges or very scattered (light to mod),
3 - Weeds common, but patchy or scattered (including canopy),
4 - Weeds throughout excluding canopy (heavy infestation),
5 - Weeds throughout the canopy (heavy infestation),

Weed severity (from ground survey, includes Camphor and Lantana)

1 –No problem weeds present:
2 –Infestation is mostly minor weeds,
3 –Infestation a mix of minor and moderate weeds, isolated major weeds
4 - Infestation mostly of moderate weeds +/- major weed present,
5 –2 or more major weeds present

(List of minor/moderate/major weeds see **Appendix 3**)

2.2.4 High conservation value vegetation

Koala habitat
Each vegetation polygon was assigned to a Koala habitat category (**Tables 3** and **4**) according to definitions provided by LCC and based on those derived during the development of a Comprehensive Koala Plan of Management for south-east Lismore.

The mapping did not consider fauna data nor observations of animals in assigning habitat (as set out in project brief). Therefore all Koala habitat assessments were based only on flora species present. Where Koalas were observed in the field, their presence was recorded in the "Notes" field of the GIS database and records were compiled for reference in later stages of the project.

Habitat categories were coded as follows:
1. Primary **2.** Secondary A **3.** Secondary B **4.** Other **5**. Unknown

Table 3 Koala habitat categories

Preferred Koala Habitat	Primary	Vegetation associations and/or communities wherein primary food tree species comprise the dominant or co-dominant (i.e. ≥ 50%) overstorey tree species.
	Secondary A	Vegetation associations and/or communities wherein "primary food tree species" are sub-dominant components of the overstory tree species and usually (but not always) growing in association with one or more "secondary food tree species".
	Secondary B	Vegetation associations and/or communities wherein "primary food tree species" are absent, habitat containing "secondary and/or supplementary food tree species" only.
Other Vegetation	Other	Native vegetation associations and/or communities within which "preferred koala food trees" are absent.
	Unknown	Vegetation mapping polygons for which there is insufficient data available to enable classification. This includes both individual trees and clumps of trees which are unmapped owing to the resolution of the mapping. These trees may be verified as *koala habitat* by a Koala Habitat Assessment.

Table 4 Preferred Koala food trees

	Scientific Name	Common Name
Primary food tree species	Orange Gum	*Eucalyptus bancroftii*
	Forest Red Gum*	*E. tereticornis*
	Tallowwood	*E. microcorys*
	Swamp Mahogany	*E. robusta*
Secondary and/or supplementary food tree species	Grey Gum	*E. punctata***
	Thin-leaved Stringybark	*E. eugenioides*
	White Stringybark	*E. globoidea*
	Small-fruited Grey Gum	*E. propinqua*
	Narrow-leaved Red Gum	*E. seeana*

* includes the naturally occurring *E. tereticornis* x *E. robusta* hybrid referred to as *E. patentinervis* (Bale, 2003). ** includes synonym *E. biturbinata*.

Polygons were assigned a Koala habitat reliability code to indicate the confidence in application of the definitions.

Codes**: 1.** Inferred from API, incomplete ground inspection or other sources
2. Assigned from comprehensive ground inspection

Many polygons were inspected on the ground prior to January 2011 when advice re habitat category definitions was received. These polygons were assigned a reliability code of 2 although confidence in assignment to habitat categories is slightly lower than for polygons inspected after January 2011.

In some cases professional judgment was employed in applying the Secondary A habitat definition. For some polygons made up of vegetation that included primary food trees as sub-dominants, assignment to Category 2 Secondary A habitat did not appear in keeping with the intent of the Secondary A habitat definition detailed in the DECC NSW's (2008) Recovery Plan for the Koala (Option 1 definition set) i.e. habitat capable of supporting a medium density of Koalas. Examples included polygons with low numbers of food trees, or where the food trees were localized (e.g. a small Tallowwood *E. microcorys* windbreak associated with a large plantation). Where mapping the polygon as secondary habitat seemed misleading, the polygon was designated "Category 4 Other" and the presence of food trees was documented in the "Notes" field of the GIS database.

Endangered Ecological Communities

A list of EECs reported or considered likely to occur in the LGA (**Table 5**), as shown in the project brief provided by LCC, was used to devise appropriate assessment methods.

The approach to assessing the status of EECs varied between communities, since the NSW Scientific Committee's determinations, which define the communities, are based on different combinations of floristic, structural, locational and edaphic (soils) criteria. The assessment aimed to produce indicative EEC mapping, which may require ground inspection in conjunction with the determinations for confirmation, especially in marginal cases.

Table 5 Endangered Ecological Communities in the Lismore LGA

Full name	Short name
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Freshwater wetlands on coastal floodplains
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	Lowland Rainforest on Floodplain
Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion	Sub-tropical Coastal Floodplain Forest
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp oak floodplain forest
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp sclerophyll forest on coastal floodplains
Lowland rainforest in the North Coast and Sydney Bioregions	Lowland rainforest

The EECs were treated in two stages. Firstly, the Coastal Floodplain group of EECs were delineated collectively and secondly, the Lowland Rainforest EEC was delineated on lands outside the floodplain. Wherever possible, vegetation types likely to constitute or include EECs were examined during ground survey to assess conformity with the community description in the Scientific Committee's determinations.

Coastal Floodplain EECs

Six of the EECs belong to the Coastal Floodplains group of EECs, which adjoin or intergrade with each other to collectively cover all remaining native vegetation on the coastal floodplains of New South Wales (as stated in the various determinations).

The intersection of the available 100 year flood level GIS layer (supplied by LCC August 2011) with native vegetation was used to delineate the group of EECs. The floodplain layer enclosed mangroves, which are classified as protected marine vegetation (NSW Fisheries Management Act 1994) and were excluded from consideration of EEC status. Vegetation polygons were designated as within (100%) or partly within (percentage assigned) the mapped floodplain.

All polygons partly or wholly within the floodplain were assigned a probability for EEC status as follows:

> **1.** Highly likely (vegetation such as Paperbark *Melaleuca quinquenervia*, Swamp Oak *Casuarina glauca*, Forest Red Gum *E. tereticornis* that fit well with EEC determinations and ecotones between these types)
> **2.** Probable or possible (e.g. exotic vegetation with some components of EEC types)
> **3.** Unlikely but possible (e.g. vegetation types not fitting well with EEC types, such as Blackbutt *E. pilularis* on the edge of floodplain and exotic vegetation with only small components of EEC types). Plantations were also placed in this category.

Where possible, the various floristic descriptors included in the determinations were employed to match mapped vegetation types to particular EECs within the floodplain communities. Some mapped vegetation types appeared to constitute depleted and degraded examples of communities or intergradations between communities and could not be

confidently assigned to a specific EEC though were identified as belonging to the Coastal Floodplain group. EECs were coded as follows:

1. Freshwater wetlands on coastal floodplains
2. Lowland Rainforest on Floodplain
3. Sub-tropical Coastal Floodplain Forest
4. Swamp oak floodplain forest
5. Swamp sclerophyll forest on coastal floodplains
6. Ecotonal types, not discernible due to disturbance and exotic vegetation components and plantations.

As background information indicated that Coastal Saltmarsh was not present in the LGA, no code was assigned.

Lowland Rainforest EEC

The determination for the Lowland Rainforest EEC relies on floristic and structural characteristics to define the community, which includes disturbed types. All rainforest and vegetation with rainforest components (outside the floodplain) were selected and coded for likelihood of EEC classification as follows:

1. Highly likely (vegetation types that fit well with EEC determination)
2. Probable or possible (e.g. exotic vegetation with some components of EEC types, dry rainforest types that are included only where grading into the subtropical types)
3. Unlikely (exotic vegetation with small components of EEC types, dry rainforest unlikely to be associated with subtropical types, plantations).

Polygons including rainforest and located on the edge of the floodplain have potential for inclusion in either or both of the EECs, Lowland Rainforest on Floodplain and Lowland Rainforest. The difficulty arises as polygons may be partially located on floodplain and/or the floodplain location may be uncertain since the resolution of the available floodplain mapping was coarser than that of the vegetation mapping. Such polygons were designated with probabilities for both EECs.

Grasses

Grasses were incorporated into a GIS layer in the form of point locations derived from Stubbs (2001).

2.3 Reliability

Due to differences in sampling effort and inspection methods, some areas are likely to be more reliably mapped than others. A reliability code was therefore allocated to each mapped polygon, according to the source of the data and/or the manner in which data was collected. Reliability codes are as follows:

1. On-site traverse and API
2. Limited on-site or remote inspection and API
3. Other information source and API
4. API only

2.4 Limitations

In any mapping project of this scale there are always limitations to the mapping process that relate to the inherent variability of natural vegetation and the scale of investigation.

Image analysis techniques have been used to accurately delineate vegetation boundaries for the bushland layer and vegetation communities have then been identified by API with ground-checking of a sample of the polygons (**Section 2.1**). Costs and other practicalities make it impossible to check every patch of vegetation. For this project, a high level of field checking was achieved. For the Grey and Blue Zones, on ground inspection was achieved for 28% of vegetation polygons and 38% of areas vegetated with woody vegetation (**Section 3.3**). Vegetation community descriptions have been prepared with the limited information collected for mid and ground strata.

Factors limiting confidence are:

- Mapping was based on aerial photography dated September 2009. Due to clearing and regrowth since this time, vegetation boundaries may have changed (not considered to be significant, except in cases of major clearing).

- Field inspection by traverse was undertaken only occasionally (access and resource constraints). Sometimes only the edge of vegetation was visible from a roadside or other vantage point (**Section 2.1.2**). The edge may not be typical of the whole vegetation polygon.

- Access limitations restricted sampling of some vegetation communities. For example, dry rainforest around Bentley and Caniaba was viewed only from a distance through binoculars.

- For the photo sets utilized, it was difficult to distinguish some canopy species. The exotic Large-leaved Privet *Ligustrum lucidum* can sometimes be confused with regrowth rainforest and dense patches of Cockspur *Maclura cochinchinensi*s on occasion appeared similar to Camphor Laurel.

- Lantana was difficult to detect using API, except where present as large homogenous patches. The usefulness of Lantana cover estimates as an indicator of condition (**Section 2.2.3**) is therefore limited.

- While woody vegetation has been detected readily from API, wetlands such as freshwater meadows, lagoons, swamps and marshes have not been comprehensively recorded. These were sometimes visible from air photos or added during field work. Wetlands may also be more or less visible depending on recent rainfall history.

- Heterogeneous vegetation units were grouped into communities where judged, following consideration of floristic, soil, topographic data and spatial relationships, to be variants of the community. The predominantly early successional and disturbed status of much vegetation contributed to variation within communities.

Ideally, the current vegetation mapping would have been conducted according to the NSW Native Vegetation Interim Type Standard (Sivertsen 2009) (the Standard). However, adoption

of the specifications of the Standard would require unlimited ground access to all parts of the project area, as well as additional budget and time for plot-based sampling.

3 Results and discussion

3.1 Bushland Layer and land use

National Parks, Nature Reserves, State Conservation Areas and State Forests were located in the study area, but were out of scope of mapping for the current project. Very small NRs (Boatharbour, Tucki Tucki and Wilson) and very small disjunct outliers of Tuckean NR and Whian Whian SCA were, however, included. For the purposes of statistics derived from the mapping, the Bushland Layer is considered to include only 151.48 ha of vegetation mapped in NRs and SCAs (**Table 6**).

Table 6 Areas of National Parks, Nature Reserves, State Conservation Areas and State Forests

	AREA (ha)		
	Mapped	**Not mapped**	**TOTAL**
GREY ZONE			
Tuckean NR	82.2	614.6	
Boatharbour NR	24.3		
Tucki Tucki NR	4.5		
Wilson NR	27.4		
TOTAL	**138.4**	**614.6**	**752.9**
BLUE ZONE			
Boatharbour NR	2.7		
Whian Whian SCA	10.5		
TOTAL	**13.1**	**0.00**	**13.1**
GREEN ZONE			
Bungabbee NR		169.1	
Bungabbee SF		1,091.6	
Muckleewee Mountain NR		351.7	
Nightcap NP		5,526.5	
Whian Whian SCA		2,247.4	
TOTAL	**0.0**	**9,386.3**	**9,386.3**
TOTAL for study area	**151.5**	**10,000.8**	**10,152.3**

The division of the LGA into vegetation and land-use categories is represented diagrammatically in **Appendix 4** and mapped in **Figure 2,** with the areal extents of each subdivision shown in **Table 7.**

Just over 50,000 ha, or almost 40% of the LGA is vegetated (assumes NPs, NRs, SCA and SFs are fully vegetated). The study area (portion of LGA outside NPs, NRs, SCA and SFs) is more sparsely vegetated.

The Bushland Layer occupied a total area of 40,256 ha and was further subdivided into land use categories.

Open water occupied a total of 473.8 ha. The area of open water present is likely to be underestimated since some of the areas mapped as woody vegetation along creek lines

could/will contain slivers of open water that are not visible where the banks are vegetated on both sides.

The mapped areas of vegetated lands in the Blue and Grey Zones occupied 16,316.4 ha, representing 22.5% of the area of the zones. A small, vegetated area of National Park is additional to the mapped vegetation, but the figures illustrate the overall low level of woody vegetation cover.

Table 7 Land-use categories - area

	Area (ha)				% area			
Land-use categories	**Grey Zone**	**Blue Zone**	**Green Zone**	**Total**	**Grey Zone**	**Blue Zone**	**Green Zone**	**Total**
NPs, NRs , SCA and SF (unmapped)	614.6	0.0	9,386.3	10,000.9	2.9	0.0	16.7	7.8
Non-bushland matrix	14,972.4	40,156.1	22,870.6	77,999.1	71.7	77.8	40.6	50.6
Bushland								
Non-plant-ation vegetation	3,653.2	7,946.9	22,695.1	34,295.1	17.5	15.4	40.3	26.6
Plantation	1,601.1	3,115.3	1,245.2	5,961.6	7.7	6.0	2.2	4.6
Total bushland	5,254.2	11,062.2	23,940.3	40,256.7	25.2	21.4	42.5	31.3
Open water	32.5	363.7	77.6	473.8	0.2	0.7	0.1	0.4
Total mapped polygons	5,286.7	11,425.9	24,017.9	40,730.5	25.3	22.2	42.7	31.6
Total for zone	20,873.7	51,582.0	56,274.8	128,730.5	100.0	100.0	100.0	100.0

A substantial proportion of the mapped vegetation consisted of plantation. For the Blue and Grey Zones, plantation vegetation was broken down into categories (**Table 8**). Most plantation vegetation consisted of orchards, most commonly noted as Macadamia, though the type of orchard was noted for only a small proportion of polygons. Eucalypt plantations included plantings for timber production, windbreaks around orchards and some for conservation purposes (e.g. Koala food trees). Cultural plantings and gardens were included in the mixed/other category. Though many plantings were of exotic or non-locally native species, some vegetation in the mixed/other category included mature trees contributing to habitat values and landscape connectivity. Exotic species with invasive characteristics were also common e.g. Jacaranda *Jacaranda mimosifolia*, Golden Rain Tree *Koelreuteria paniculata*.

Table 8 Plantations (excluding Green Zone)

Plantation Type	Area (ha)		
	Grey Zone	**Blue Zone**	**Total**
Eucalypts	168.6	389.4	**557.9**
Slash Pine	7.0	12.0	**19.0**
Hoop/Bunya Pine	6.1	2.5	**8.6**
Rainforest	11.1	65.7	**76.9**
Orchard	1,228.1	2,378.2	**3,606.3**
Mixed/other	180.1	267.6	**447.7**
Total	**1,601.1**	**3,115.3**	**4,716.4**

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map originally produced in A3

Nightcap NP

Whian Whian SCA

Bungabee NR

Bungabee SF

Muckleewee Mountain NR

Clunes

Boatharbour NR

LISMORE

Wilson NR

Tucki Tucki NR

Tucki Tucki NR

Tuckean NR

Tuckean NR

Legend

bushland layer

Land Use

open water

plantation

Lismore LGA

Grey Zone

Blue Zone

Green Zone

NPWS estate

NSW State Forest

town or village

drainage line

N

0 2.5 5 Kilometers

Figure 2 Bushland Layer and land use

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3.2 Vegetation mapping

For the purposes of this section, the mapped sections of non-plantation vegetation of the Grey and Blue Zones collectively are referred to as the vegetation mapping area.

3.2.1 Classification

In the vegetation mapping area, 365 vegetation units were identified from API and limited field survey and were assigned to 29 vegetation communities for mapping and further assessment purposes. In allocating vegetation units into broader categories, it was often necessary to group quite heterogeneous vegetation, since much of the vegetation was early successional and varied with factors such as soil, aspect, and topographic position. Some professional judgement was applied, following consideration of all available floristic, soil and landform data and inspection of maps to confirm spatial relationships.

Table 9 illustrates the grouping of communities into Keith classes (mapped **Figures 3** and **4)** and formations. The detail of allocation of vegetation units to communities is shown in **Appendix 5**. Vegetation communities are described in **Appendix 6**. It is generally true that communities are named and described for their canopy dominants, but the detail of the vegetation descriptions for the communities reflects the occurrence of occasional or patchy additional canopy species. For instance, examination of **Appendix 5** demonstrates that vegetation units with Grey Ironbark *E. siderophloia* as the canopy dominant have been included in the vegetation community Forest Red Gum-Tallowwood.

Table 9 also demonstrates the relationships between the vegetation communities employed in the current vegetation classification and the Interim Vegetation Community List (EcoLogical 2010). Many communities, however, did not have analogues in the Interim Vegetation Community List. (The need for further survey, sampling and plot data has been recognised in evaluations of vegetation classification in the project area and surrounds.) Therefore, some vegetation was placed in Biometric (Ayers *et al.* 2004, 2008) communities or Floyd (1990) rainforest sub-alliances. Where necessary, additional communities were recognized and described during this project.

Additional issues in placing vegetation into communities used in the Interim Vegetation Community List arose as a result of the highly disturbed nature of much of the vegetation in the project area. The List was derived from principles set out in the NSW Vegetation Classification and Assessment (NSW VCA) (Benson 2006). The NSW VCA is "based on existing native and semi-native vegetation dominated by indigenous plant species that persist without regular human intervention or maintenance….. It concentrates on listing late successional stages of vegetation but post-disturbance, early successional stages can be described in the 'variation and natural disturbances' field in the database" (Benson 2006). In the project area, much vegetation consists of early successional vegetation, and includes small to large components of exotic species. Such vegetation is therefore excluded from Benson's classification and cannot, with the resources of the current project, be readily assigned as a disturbed variant of a specific, late successional type.

The difficulty of classifying exotic vegetation is apparently recognized in EcoLogical's (2010) use of a Rainforest (derived) community to encompass Camphor Laurel-dominated communities (the term has been adopted in the current project but as vegetation other than rainforest is also associated with Camphor Laurel, the Rainforest-derived category has not been placed in the classification hierarchy). It is noted that this usage of the "derived" descriptor does not fit completely with that recommended by Benson i.e. plant communities substantially altered since European settlement that are grossly modified in their structure and floristic composition. Benson's derived communities are restricted to native vegetation.

3.2.2 Distribution and abundance

Table 10 shows the areal extent of 24 native and five exotic vegetation communities, grouped into formations and classes in the vegetation mapping area.

About one quarter of the vegetation is classified in the rainforest formation. Much of the rainforest present is disturbed and in early to mid regrowth stages, but some excellent examples of Big Scrub rainforest remnants lying outside the NP estate are included. These remnants are in old growth condition or in advanced stages of regrowth. Rainforests generally have outstanding biodiversity, biogeographical and evolutionary significance (Adam 1987). Most rainforests in the vegetation mapping area are listed as threatened ecological communities (**Section 3.2.4**), reflecting both their values for biodiversity and ecosystem services and the threats to those values.

A further approximately one quarter of the vegetation is mapped as rainforest (derived) (Camphor Laurel). More information about the extent of Camphor infestation in the Camphor Laurel community is contained in details of canopy dominants of component vegetation units (**Appendix 5**) and Camphor cover codes used as a measure of vegetation condition (**Section 3.2.3**).

About 5% of the vegetation is wet sclerophyll forest, and just under 20% belongs to dry sclerophyll sub-formations. Sclerophyll forests are made up largely of species having fire tolerance or those reliant on fire for regeneration, though long intervals between fire can permit fire-intolerant mesic species to develop in lower strata of wet sclerophyll forests. Koalas depend on a sub-set of sclerophyll dominants for food resources.

Forested wetlands, including large components of Paperbark-dominated forest and woodlands, occupy about 13% of the vegetation, freshwater wetlands about 5% and a very small area of mangroves is present. Most wetlands in the vegetation mapping area are listed as threatened ecological communities (**Section 3.2.4**) reflecting their values for biodiversity and ecosystem services and threats to those values. Freshwater meadows, lagoons, swamps and marshes were mapped where possible but mapped areas are likely to represent only a small proportion of the actual extent (**Section 2.4**). It is likely that some of the wetlands detected and mapped should better be classed as coastal floodplain sedgelands, rushlands and forblands – the distinction would require comprehensive field survey. Mangroves are limited in extent in the LGA as near-coastal potential habitat is restricted to the lower reaches of the Richmond River around Broadwater.

Naturalised exotic vegetation is widespread, usually as small components of otherwise native vegetation but sometimes dominant in the canopy and therefore detected with the mapping methods employed in the current project. Small areas dominated by exotics including Indian Coral Tree *Erythrina crista-galli*, Lantana and Privet *Ligustrum* spp. were mapped as well as the large areas of Camphor-dominated vegetation.

Table 9 Vegetation classification and description. Sources: Biometric (Ayers *et al*, 2004, 2008); Interim Veg = Interim Vegetation Classification v 1.4 (Ecological 2010); and Rainforest Sub-alliances (Floyd 1990). Nomenclature, formatting and capitalisation are as copied from external sources. Some communities had no analogues in the listed sources. Blank entries in the 'Source' column indicate communities described and recognized during this project.

Keith Form-ation	Keith Class	Community	Community short name	Community code	Source	Description (from external source)
Rainforest formation						
	Dry Rainforest	Dry Rainforest complex	Dry Rainforest	DR	Rainforest Sub-alliance 21	
	Dry Rainforest	Riparian rainforest-lower reaches	Riparian rainforest-lower reaches	Rr-l	Rainforest Sub-alliances 3 and 6	
	Dry Rainforest	Riparian rainforest-mid reaches	Riparian rainforest-mid reaches	Rr-m	Rainforest Sub-alliance 3	
	Subtropical Rainforest	Subtropical Rainforest complex	Subtropical Rainforest	SR	Rainforest Sub-alliances 1,5 and 21	
Rainforest (derived)						
	Closed Forest	Derived Camphor Laurel Rainforest Wet Sclerophyll Forest	Camphor Laurel	CL	Interim Veg (Community ID Rf58)	An open forest in which the exotic Camphor Laurel *(Cinnamomum camphora)* dominates and is occasionally associated with Forest Red Gum *(Eucalyptus tereticornis),* Brush Box *(Lophostemon confertus)* and Pink Bloodwood *(Corymbia intermedia). C*amphor laurel co-occurs with other rainforest species such as Guioa *Guioa semiglauca* and Foambark Tree *(Jagera pseudorhus var. pseudorhus forma pseudorhus.* The middle stratum is also dominated by weeds: Large-leaved Privet *(Ligustrum lucidum)* and Small-leaved Privet *(Ligustrum sinense).* Some natives are also present including Red Kamala *(Mallotus philippensis), Pittosporum undulatum and* Scrub Turpentine *(Rhodamnia rubescens). T*he lower stratum comprises Privet seedlings, Blue Couch *(Cynodon dactylon), Ottochloa gracillima, Paspalum wettsteinii, Ochna serrulata,* Fishbone Fern *(Nephrolepis cordifolia)* and *Ardisia crenata.*
Wet Sclerophyll Forest Shrub grass formation						
	North Coast	Blackbutt -	Blackbutt-	B-TW	Biometric	Blackbutt (*Eucalyptus pilularis*), Tallowwood (*Eucalyptus microcorys*);

Keith Form-ation	Keith Class	Community	Community short name	Comm unity code	Source	Description (from external source)
	Wet Sclerophyll Forest	Tallowwood tall moist forest of the far north east of the North Coast	Tallowwood			Narrow-leaved White Mahogany (*Eucalyptus acmenoides*)
	North Coast Wet Sclerophyll Forest	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Flooded Gum-Tallowwood-Brush Box	FG-TW	Biometric	Dominant: Flooded Gum (*Eucalyptus grandis*), Tallowwood (*Eucalyptus microcorys*), Brush Box (*Lophostemon confertus*); Associate species: Turpentine (*Syncarpia glomulifera*), Pink Bloodwood (*Corymbia intermedia*)
	Northern Hinterland Wet Sclerophyll forest	Brush Box tall moist forest of the northern ranges of the North Coast	Brush Box tall moist forest	BB	Biometric	Brush Box dominant with *Cryptocarya microneura*, *Alpinia caerulea*, *Synoum glandulosum*, *Eupomatia laurina*, *Cordyline petiolaris*, *Rhodamnia rubescens*, *Citriobatus pauciflorus*, *Polyscias elegans, Neolitsea dealbata, Croton verreauxii, Cissus antarctica, Dioscorea transversa, Adiantum formosum, Smilax australis,* Gristle Fern (*Blechnum cartilagineum*), *Geitonoplesium cymosum, Dianella caerulea, Pseuderanthemum variabile, Parsonsia straminea*.
Dry Sclerophyll Forest shrubby sub formation						
	North Coast Dry Sclerophyll forest	Coast Banksia on volcanic soils	Coast Banksia	CB		
	North Coast Dry Sclerophyll forest	Forest Red Gum-Tallowwood moist open forest	Forest Red Gum-Tallowwood	FRG-TW		Forest Red Gum (*Eucalyptus tereticornis*), Pink Bloodwood (*Corymbia intermedia*), Rough-barked Apple (*Angophora floribunda*)
	North Coast Dry Sclerophyll forest	Scribbly Gum-Black She Oak-Slender Tea tree Woodlands on acid volcanics of the Tweed and Focal Peak Shields	Scribbly Gum	SG	Interim Veg (Community ID Dsf84) (variant)	*Eucalyptus signata, Allocasuarina littoralis, Leptospermum trinervium*
Dry Sclerophyll Forest grassy sub formation						
	North Coast Dry Sclerophyll forest	Forest Red Gum grassy open forest of the	Forest Red Gum grassy open forest	FRGg	Biometric	Dominant: Forest Red Gum (*Eucalyptus tereticornis*) Associate species: Broad-leaved Apple (*Angophora subvelutina*), Grey Ironbark (*Eucalyptus siderophloia*), Pink Bloodwood (*Corymbia intermedia*)

Keith Form-ation	Keith Class	Community	Community short name	Comm unity code	Source	Description (from external source)
		coastal ranges of the North Coast				
Forested wetlands formation						
	Coastal Floodplain Wetlands	Swamp Oak swamp forest of the coastal lowlands of the North Coast	Swamp Oak	SO	Biometric	Dominant: Swamp Oak (*Casuarina glauca*); Associated species: Broad-leaved Paperbark (*Melaleuca quinquenervia*), Forest Red Gum (*Eucalyptus tereticornis*)
	Coastal Swamp forest	Broad-leaved Paperbark (*Melaleuca quinquenervia*), Willow Bottlebrush (*Callistemon salignus*) Swamp Oak (*Casuarina glauca*) Floodplain Swamp Sclerophyll Forest	Paperbark-Swamp Oak	PB-SO	Interim Veg (Community ID 14)	A swamp sclerophyll forest of Broad-leaved Paperbark *(Melaleuca quinquenervia),* Willow Bottlebrush *(Callistemon salignus),* with Swamp Oak *(Casuarina glauca)* and occasionally Swamp Mahogany *(Eucalyptus robusta)* and Swamp Turpentine *(Lophostemon suaveolens).*
	Coastal Swamp forest	Forest Red Gum+/-Swamp Box	Forest Red Gum-Swamp Box	FRG-SB		
	Coastal Swamp forest	Paperbark swamp forest of the coastal lowlands of the North Coast	Paperbark	P	Interim veg (Community ID W3)	Broad-leaved Paperbark, Snow-in-Summer *Melaleuca linariifolia*, *Melaleuca sieberi*, *Melaleuca alternifolia*, Prickly-leaved Paperbark, *Melaleuca nodosa, Melastoma affine*, *Leptospermum* spp., *Parsonsia straminea, Gahnia* spp., *Hypolepis muelleri*, *Blechnum indicum*. Swamp sclerophyll shrubland, woodland and forest dominated by paperbarks. Main associates: Swamp Mahogany *Eucalyptus robusta*, Forest Red Gum, Swamp Oak. On poorly drained sites that may remain waterlogged for considerable periods, and along creek banks (Biometric description).
	Coastal Swamp forest	Prickly-leaved Tea-tree	Prickly-leaved Tea-tree	Pl-Tt		

Keith Form-ation	Keith Class	Community	Community short name	Comm unity code	Source	Description (from external source)
	Coastal Swamp forest	Swamp Box swamp forest of the coastal lowlands of the North Coast	Swamp Box	SB	Biometric	Dominant: Swamp Box (*Lophostemon suaveolens*); Associated species: Broad-leaved Apple (*Angophora subvelutina*), Swamp Mahogany (*Eucalyptus robusta*), Cabbage Gum (*Eucalyptus amplifolia*)
	Coastal Swamp forest	Willow Bottlebrush	Willow Bottlebrush	WB		
Freshwater wetlands formation						
	Coastal Freshwater Lagoons	Coastal freshwater meadows and forblands of lagoons and wetlands	Freshwater Meadows	FM	Biometric	Lakes, swamps and lagoons on floodplain alluvium Characteristic mid storey species - *Eleocharis equisetina*, Characteristic ground storey species - *Triglochin procerum* sens. lat., Water Couch (*Paspalum distichum*), *Carex pumila*, *Phyla nodiflora*
	Eastern Riverine forest	Forest Red Gum-River Oak forest	Forest Red Gum-River Oak	FRG-RO		
	Eastern Riverine forest	*Melaleuca bracteata* riparian forest	Black Tea-tree	BTt	Interim Veg (Community ID W19)	
	Eastern Riverine forest	River Oak riparian woodland of the North Coast	River Oak	RO	Biometric	River Oak dominant. Also Silky Oak (*Grevillea robusta*), Weeping Lilly Pilly (*Waterhousea floribunda*), Rough-barked Apple (*Angophora floribunda*), Broad-leaved Apple (*Angophora subvelutina*)
	Eastern Riverine forest	Swamp Oak-River Oak forest	Swamp Oak-River Oak	SO-RO		
Saline wetlands formation						
	Mangrove Swamp	Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions	Mangrove	M	Biometric	*Aegiceras corniculata, Avicennia marina*
Miscellaneous						
	Exotic	Indian Coral Tree	Indian Coral Tree	IC		
	Exotic	Lantana	Lantana	L		

Keith Form-ation	Keith Class	Community	Community short name	Community code	Source	Description (from external source)
		shrubland				
	Exotic	Privet forest to woodland	Privet	Pr		
	Exotic	Various exotic	Various exotic	Ve		

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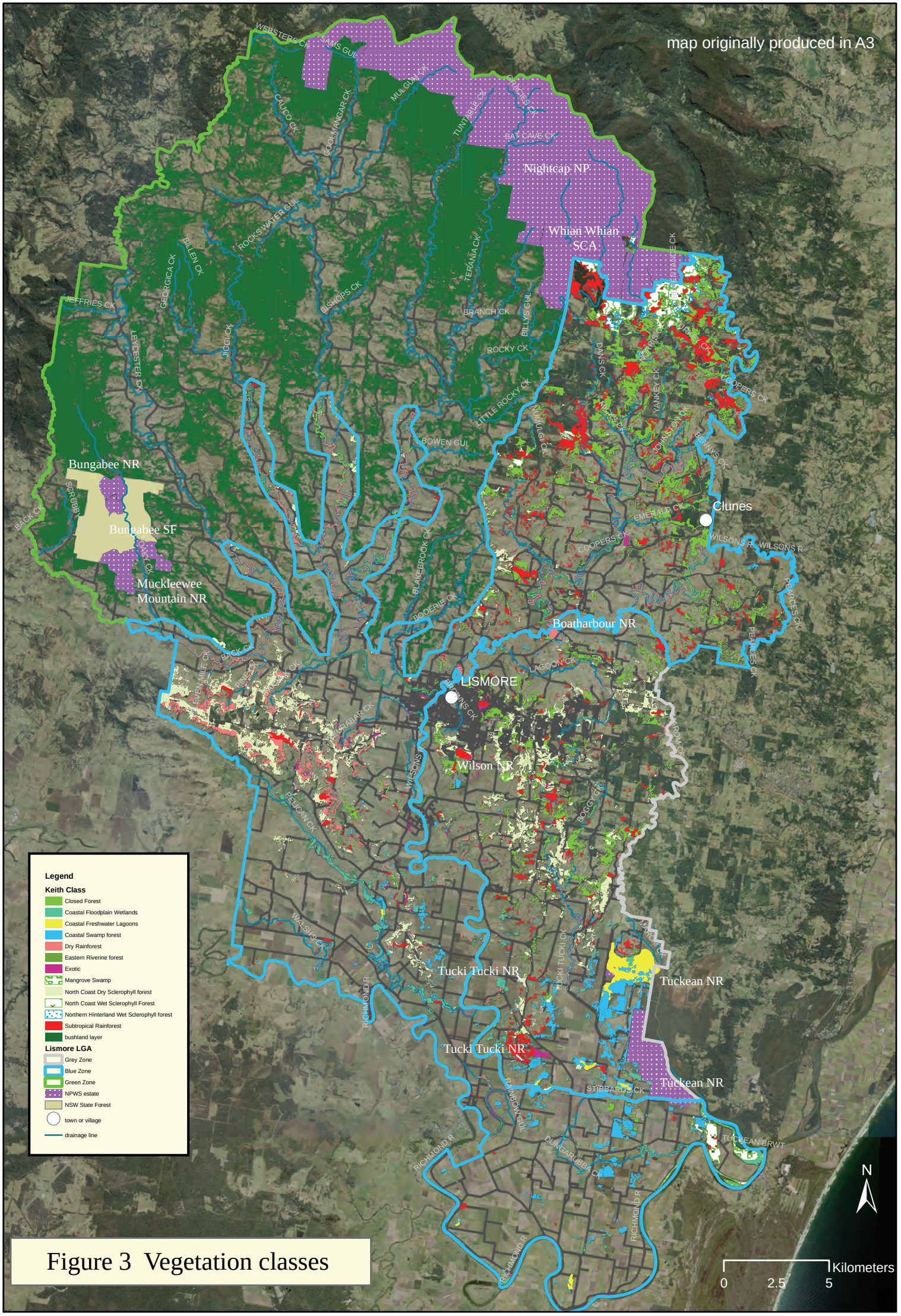

Figure 3 Vegetation classes

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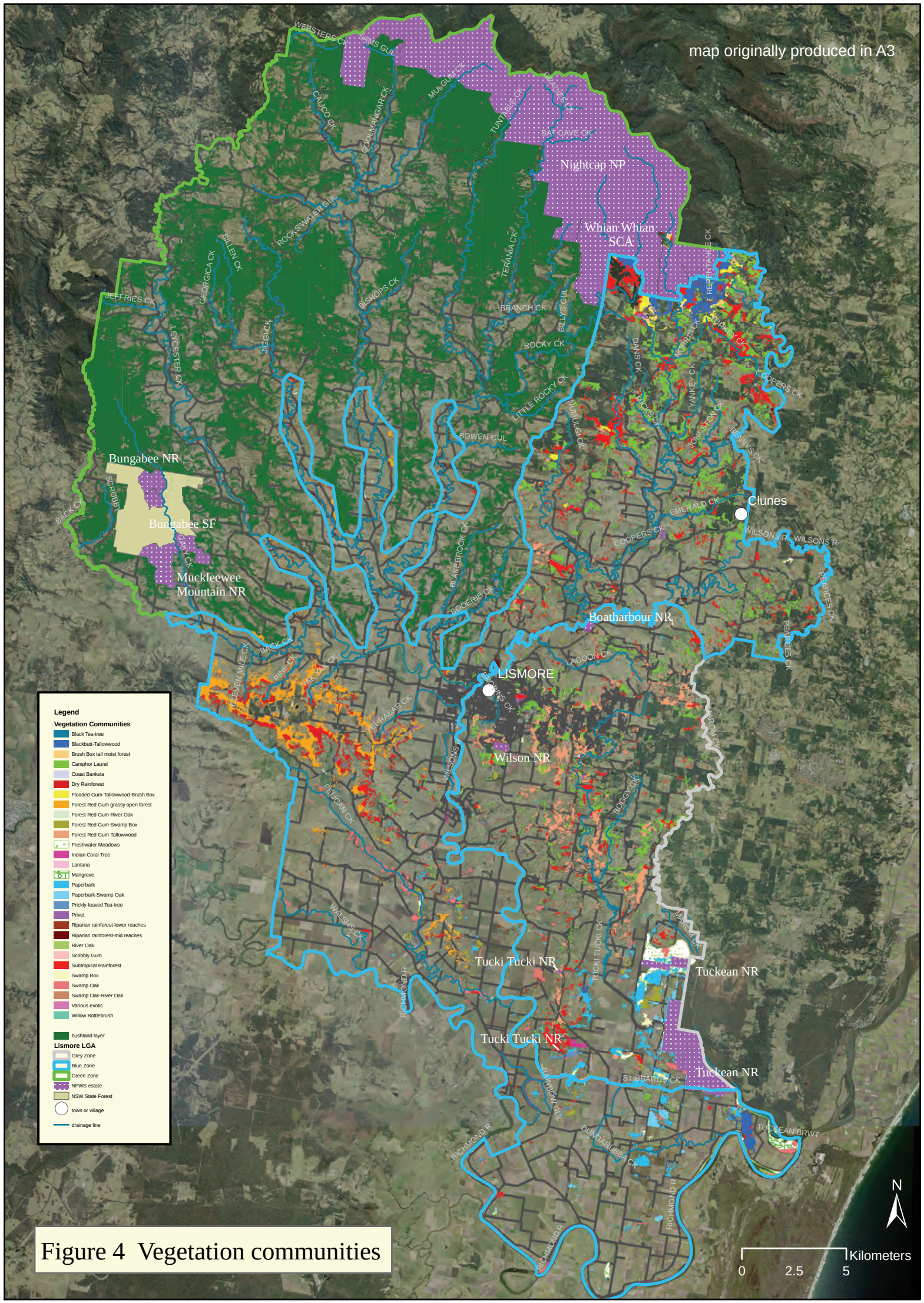

Figure 4 Vegetation communities

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Table 10 Vegetation community classification and extent of non-plantation vegetation (formations and classes based on Keith 2004).

			Area (ha)			% total non-plantation vegetation		
	Class	**Community (short name)**	**Grey Zone**	**Blue Zone**	**Total**	**Grey Zone**	**Blue Zone**	**Total**
Rainforest formation								
	Dry Rainforest	Dry Rainforest	36.3	461.7	**497.98**	1.0	5.8	**4.3**
		Riparian rainforest-lower reaches	20.4	16.8	**37.2**	0.6	0.2	**0.3**
		Riparian rainforest-mid reaches	68.5	481.8	**550.3**	1.9	6.1	**4.7**
	Subtropical Rainforest	Subtropical Rainforest	497.6	1,530.3	**2,027.9**	13.6	19.3	**17.5**
	TOTAL Rainforest		**622.8**	**2,490.5**	**3,113.4**	**17.0**	**31.3**	**26.8**
Rainforest (derived) sub formation								
	Closed Forest	Camphor Laurel	957.5	2,352.0	**3,309.6**	26.2	29.6	**28.5**
	TOTAL Rainforest (derived)		**957.5**	**2,352.0**	**3,309.6**	**26.2**	**29.6**	**28.5**
Wet Sclerophyll forest shrub grass formation								
	North Coast Wet Sclerophyll Forest	Blackbutt-Tallowwood	8.5	409.7	**418.2**	0.2	5.1	**3.6**
		Flooded Gum-Tallowwood-Brush Box		132.0	**132.0**	0.0	1.7	**1.1**
	Northern Hinterland Wet Sclerophyll forest	Brush Box tall moist forest		83.1	**83.1**	0.0	1.0	**0.7**
	TOTAL Wet Sclerophyll forest shrub grass		**8.5**	**624.9**	**633.4**	**0.2**	**7.9**	**5.5**
Dry Sclerophyll forest shrubby sub formation								
	North Coast Dry Sclerophyll forest	Coast Banksia	2.6		**2.6**	0.1	0.0	**0.0**
		Forest Red Gum-Tallowwood	938.4	111.2	**1,049.6**	25.7	1.4	**9.0**
		Scribbly Gum		4.6	**4.6**	0.0	0.1	**0.0**
	TOTAL Dry Sclerophyll Forest shrubby sub formation		**941.0**	**115.7**	**1,056.7**	**25.8**	**1.5**	**9.1**
Dry Sclerophyll forest grassy sub formation								
	North Coast Dry Sclerophyll forest	Forest Red Gum grassy open forest	1.0	1,120.9	**1,121.8**	0.0	14.1	**9.7**
	TOTAL Dry Sclerophyll forest grassy sub formation		**1.0**	**1,120.9**	**1,121.8**	**0.0**	**14.1**	**9.7**
Forested wetlands formation								
	Coastal Floodplain Wetlands	Swamp Oak	91.2	307.8	**398.9**	2.5	3.9	**3.4**
	Coastal Swamp forest	Forest Red Gum-Swamp Box	98.0	133.8	**231.8**	2.7	1.7	**2.0**
		Paperbark	416.9	214.3	**631.2**	11.4	2.7	**5.4**
		Paperbark-Swamp Oak	45.3	90.6	**136.0**	1.2	1.1	**1.2**

			Area (ha)			% total non-plantation vegetation		
	Class	**Community (short name)**	**Grey Zone**	**Blue Zone**	**Total**	**Grey Zone**	**Blue Zone**	**Total**
		Prickly-leaved Tea-tree	21.5	26.6	**48.1**	0.6	0.3	**0.4**
		Swamp Box	28.9	14.7	**43.6**	0.8	0.2	**0.4**
		Willow Bottlebrush	5.9	0.9	**6.8**	0.2	0.0	**0.1**
	TOTAL Forested wetlands		**707.6**	**788.8**	**1,496.4**	**19.4**	**9.9**	**12.9**
Freshwater Wetlands formation								
	Coastal Freshwater Lagoons	Freshwater Meadows	291.7	23.4	315.0	8.0	0.3	2.7
	Eastern Riverine forest	Black Tea-tree		12.8	12.8	0.0	0.2	0.1
		Forest Red Gum-River Oak	5.6	66.9	72.5	0.2	0.8	0.6
		River Oak	49.1	149.2	198.2	1.3	1.9	1.7
		Swamp Oak-River Oak	15.2		15.2	0.4	0.0	0.1
	TOTAL Freshwater Wetlands		**361.5**	**252.3**	**613.8**	**9.9**	**3.2**	**5.3**
Saline Wetlands formation								
	Mangrove Swamp	Mangrove		102.4	102.4	0.0	1.3	0.9
	TOTAL Saline Wetlands			**102.4**	**102.4**	**0.0**	**1.3**	**0.9**
Miscellaneous								
	Exotic	Indian Coral Tree	26.4	44.2	70.6	0.7	0.6	0.6
		Lantana	1.3	4.4	5.7	0.0	0.1	0.0
		Privet	19.3	48.3	67.6	0.5	0.6	0.6
		Various exotic	6.2	2.5	8.7	0.2	0.0	0.1
	TOTAL Miscellaneous		**53.3**	**99.4**	**152.6**	**1.5**	**1.3**	**1.3**
TOTAL non-plantation vegetation			**3,653.2**	**7,946.9**	**11,600.0**	**100.0**	**100.0**	**100.0**

3.2.3 Vegetation condition

Landscape condition (from API)

Some aspects of vegetation structure visible in air photos and correlated with maturity and disturbance were utilised to broadly categorise landscape condition of non-plantation vegetation (**Table 11**). Less than 1% of the vegetation was classed as old-growth/excellent condition. The difficulty in assigning a classification from API is reflected in the large percentage of vegetation that remained undetermined.

Table 11 Landscape condition (full definitions of codes see **Section 2.2.3).**

Landscape condition (code and short definitions)	Area (ha)			%		
	Grey zone	Blue zone	Total	Grey zone	Blue zone	Total
1 Old growth/excellent	71.6	24.6	96.2	2.0	0.3	0.8
2 Mature	2,285.2	7,017.2	9,302.3	62.6	88.3	80.2
3 Not determined	1,296.4	905.1	2,201.5	35.5	11.4	19.0
Total	3,653.2	7,946.9	11,600.0	100.0	100.0	100.0

Site condition (from ground-survey)

To complement the landscape condition assessment from API, a related but different measure of condition was applied during field inspections of non-plantation vegetation (not all polygons inspected). The results showed similar small proportions of old-growth. Most very early regrowth is likely to have been omitted from API mapping (vegetation with small components of woody vegetation is not visible on air photos), accounting for the very small proportion recorded. Advanced regrowth was the predominant condition class (**Table 12**).

Table 12 Site condition (full definitions of codes see **Section 2.2.4)**

Site condition (code and short definitions)	Area (ha)			%		
	Grey zone	Blue zone	Total	Grey zone	Blue zone	Total
1 Old growth	16.0	79.99	96.00	0.4	1.0	0.8
2 Mature vegetation	466.3	553.37	1,019.7	12.8	7.0	8.8
3 Advanced regrowth	1,246.0	1,971.7	3,217.6	34.1	24.8	27.7
4 Early successional	17.5	22.8	40.3	0.5	0.3	0.3
Total	1,907.4	5,319.1	7,226.5	52.2	66.9	62.3

Camphor cover (from API with some field checking)

The level of Camphor Laurel of non-plantation vegetation infestation is shown in **Table 13** and mapped **(Figure 5).** Camphor Laurel was detected in about 3/4 of vegetation in the Grey and Blue Zones, though often only as sparse occurrences. Camphor is dominant in about ¼ of total vegetation and is concentrated in the east of the Grey and Blue Zones.

Table 13 Camphor cover

Camphor cover (code and definitions)	Area (ha)			%		
	Grey zone	Blue zone	Total	Grey zone	Blue zone	Total
1 >50% cover						
2 <50% throughout	865.3	2,277.1	3,142.4	23.7	28.7	27.1
3	733.7	1,555.5	2,289.3	20.1	19.6	19.7
Occasional/patchy/edges	1,426.8	1,694.3	3,121.1	39.1	21.3	26.9
4 not detected	627.2	2,420.0	3,047.3	17.2	30.3	26.3
Total	3,653.2	7,946.9	11,600.0	100.0	100.0	100.0

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map originally produced in A3

Nightcap NP

Whian Whian SCA

Bungabee NR

Bungabee SF

Muckleewee Mountain NR

Boatharbour NR

Wilson NR

Tucki Tucki NR

Tuckean NR

Clunes

LISMORE

Legend

Camphor Laurel

1 >50%

2 <50% throughout

3 Occasional, patchy/edges

Lismore LGA

Grey Zone

Blue Zone

Green Zone

NPWS estate

NSW State Forest

town or village

drainage line

N

0 2.5 5 Kilometers

Figure 5 Camphor Laurel cover

Note: Green Zone not mapped for Camphor Laurel

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Measures of Camphor cover reported in this section differ from, though are related to, the mapped Camphor Laurel community identified in **Section 3.2.1**, having been derived by different methods. The Camphor Laurel community includes a range of vegetation units (**Appendix 5**). The vegetation unit Camphor Laurel consists of polygons with Camphor cover code of 1, while other vegetation units include polygons with mixtures of Camphor cover codes.

Lantana cover (from API)

The level of Lantana infestation in non-plantation vegetation is shown in **Table 14.** Lantana was present in the higher cover classes in only small proportions of the vegetation in the Blue and Grey Zones (**Section 2.4**).

Table 14 Lantana cover

Lantana cover (code and definitions)	Area (ha)			%		
	Grey zone	Blue zone	Total	Grey zone	Blue zone	Total
1. >50%:	3.7	4.5	8.3	0.1	0.1	0.1
2. 26 –50%	137.8	538.8	676.5	3.8	6.8	5.8
3. 5 –25%;	1,342.3	2,595.7	3,938.0	36.7	32.7	33.9
4 Not detected	2,169.3	4,807.9	6,977.2	59.4	60.5	60.1
Total	3,653.2	7,946.9	11,600.0	100.0	100.0	100.0

3.2.4 High conservation value vegetation

Koala habitat

Primary and Secondary A habitat makes up about 20% of the total mapped vegetation in the Grey and Blue Zones (**Table 15**). Koala habitat mapping (**Figure 6**) shows habitat concentrated on the mildly leached chocolate soils and krasnozems in the central section of the Blue and Grey Zones, extending from Goonellabah south towards Wyrallah and west towards Pelican Creek, Parrots Nest and Bentley. Koala habitat was also mapped on alluvium on the floodplain and along the Wilson and Richmond Rivers, extending along the mid-reaches of Jiggi, Leycester and Terania Creeks. To the north of Lismore, areas of habitat were mapped around Modanville and Dunoon and as smaller areas around Dorroughby, Rosebank and Upper Coopers Creek. (Note that small areas of Secondary B habitat, vegetation with very small components of food tree species, some scattered paddock trees and some components of the "Unknown" category are additional to the Koala habitat mapped in **Figure 6.**)

The main primary food tree species recorded in the Blue and Grey Zones were Forest Red Gum *E. tereticornis* and Tallowwood *E. microcorys*. Large areas of Forest Red Gum-Tallowwood were mapped around Goonellabah and south towards Tregeagle and Wyrallah. Forest Red Gum grassy open forest was common around Bentley, Pelican Creek and Parrots Nest. On the floodplain, substantial areas of Forest Red Gum-Swamp Box were mapped, often comprising grazed open woodland and isolated trees. The primary food tree Swamp Mahogany *E. robusta* was occasionally recorded (often planted) and Grey Gum *E. siderophloia* (secondary and/or supplementary food tree species) was sometimes recorded as a component of Forest Red Gum-Tallowwood forest.

Tallowwood *E. microcorys* is commonly planted as windbreaks around plantations and these windbreaks were generally mapped as Koala habitat depending on size and context (**Section 2.2.4**).

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map originally produced in A3

Nightcap NP

Whian Whian SCA

Bungabee NR

Muckleewee Mountain NR

Boatharbour NR

Wilson NR

Tucki Tucki NR

Tuckean NR

LISMORE

ALSTONVILLE

Legend

Koala Habitat

- 1 Primary
- 2 Secondary A
- bushland layer

Lismore LGA

- Grey Zone
- Blue Zone
- Green Zone
- NPWS estate
- NSW State Forest
- town or village
- drainage line

N

0 2.5 5 Kilometers

Figure 6 Koala habitat

Note: Koala habitat not mapped in Green Zone

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Table 15 Koala habitat categories (full definitions **Section 2.2.4**)

Koala habitat (codes and short descriptions)	Area (ha)			% mapped vegetation		
	Grey Zone	Blue Zone	Total	Grey Zone	Blue Zone	Total
1 Primary habitat	856.0	1,226.1	2,082.1	16.3	11.1	12.8
2 Secondary A	612.2	705.4	1,317.6	11.7	6.4	8.1
3 Secondary B	3.2	0.6	3.8	0.1	0.0	0.0
4 Other	3,566.8	8,657.6	12,224.4	67.9	78.3	74.9
5 Unknown	216.0	472.6	688.6	4.1	4.3	4.2
Total	5,254.2	11,062.2	16,316.4	100.0	100.0	100.0

Very high levels of field survey support the assignment of Koala habitat categories – about one third of the mapped vegetation was inspected (**Table 16**).

Table 16 Koala habitat reliability (full definitions **Section 2.2.4**)

Koala habitat reliability (codes and short descriptions)	Area (ha)			% mapped vegetation		
	Grey Zone	Blue Zone	Total	Grey Zone	Blue Zone	Total
1 API, incomplete survey	2,601.94	8,172.90	10,774.84	49.52	73.88	66.04
2 ground survey	2,652.26	2,889.32	5,541.58	50.48	26.12	33.96
Total	5,254.20	11,062.21	16,316.41	100.00	100.00	100.00

Endangered Ecological Communities

Of the seven EECs listed in **Table 5**, six were recorded during the vegetation mapping process. The EEC Coastal Saltmarsh was not found to be present in the Blue or Grey Zones and possible habitat is very limited in the LGA. Although saltmarsh was not detected during the current project it is difficult to recognise through API, and could be present but undetected and undocumented.

Coastal Floodplain EECs

Five of the recognised EECs belong to the Coastal Floodplain group. Only about 10% of original vegetation remains on the floodplain and most is considered highly likely to be classed as an EEC (**Table 17, Figure 7**). (Note that Categories 1 and 2 only are mapped in **Figure 7** – other mapped and unmapped vegetation on the floodplain may also be classified as an EEC.) The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices. The NSW Scientific Committee determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats and the determinations make clear the intention to include all remaining (native) vegetation on the coastal floodplains as EECs.

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map originally produced in A3

Nightcap NP

Whian Whian SCA

Bungabee NR

Bungabee SF

Muckleewee Mountain NR

Boatharbour NR

Wilson NR

Tucki Tucki NR

Tuckean NR

Clunes

LISMORE

CABBAGE TREE CK
CALICO CK
GOOLMANGAR CK
MULGRAM CK
TUNTABLE CK
BAT CAVE CK
BRANDY CK
JEFFRIES CK
GEORGICA CK
BILLEN CK
BISHOPS CK
ROCKY CK
TOPSY CK
BILLYS GUL
BULLFROG GUL
COOPERS CK
TURKEY CK
NORRIS CK
DAVIS CK
KOONORIGAN CK
TERANIA CK
LITTLE ROCKY CK
NUMULGI CK
MICKS CK
YANKEY CK
JOHNSTON CK
BENNYS CK
JIGGI CK
BACK CK
SCRUBBY CK
DORRY CK
COOPERS CK
EMERALD CK
WILSONS R
BOOBERIE CK
BLAKEBROOK CK
HEYCESTER CK
PEARCES CK
ELEVEN MILE CK
PINE CK
YAK YAK CK
LAGOON CK
BROWNS CK
YEURABAR CK
LOFTVILLE CK
MAROM CK
BOGGY CK
PELICAN CK
WALSHS CK
TUCKI TUCKI CK
RICHMOND R
RAINBOW GUL
STIBBARUS CK
TUCKEAN BRWT
DUNGARUBBA CK

Note: Green Zone is not mapped for EECs

Categories 1 and 2 only are mapped (see Table 2)
Other vegetation on the floodplain may also be classified as the EEC. Decisions as to whether ay particular area of vegetation constitutes an EEC should be based on field inspection in conjunction with the NSW Scientific Committee Final Determinations.

Legend

Floodplain EEC probability
- 1 Highly Likely
- 2 Probable or Possible

Lismore LGA
- Grey Zone
- Blue Zone
- Green Zone
- NPWS estate
- NSW State Forest
- town or village
- drainage line

N

0 2.5 5 Kilometers

Figure 7 Floodplain EEC probability

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The methods used to delineate the coastal floodplain EECs in the current project have relied on the intersection of the 100 year flood level line with the mapped vegetation layer, as an approximation of the distribution of the EECs. The 100 year flood level GIS layer is indicative of the habitat of the communities described in the determinations as "periodically inundated alluvial flats, drainage lines and river terraces 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)." The determinations also specify the soil types of the habitats as alluvium. The 100 year flood line encompasses, however, small areas of other soil types besides alluvium. As mapping of alluvium and other soil types with sufficient accuracy to delineate communities on alluvium is not available, verification of Coastal Floodplain EEC status may require on ground checking of soil type among other considerations that also apply to the Lowland Rainforest EEC (below).

Table 18 shows division of the floodplain vegetation into specific EECs. The most abundant is Lowland Rainforest on Floodplain, which has been mapped to include Hoop Pine *Araucaria cunninghamii*-dominated forests and much riparian vegetation. River Oak *Casuarina cunninghamiana*-dominated vegetation, which does not clearly fit community descriptions in any of the determinations, has mostly been classed with Lowland Rainforest. River Oak dominated vegetation usually included rainforest components. Swamp Sclerophyll Forest EEC, largely in the form of Paperbark *Melaleuca quinquenervia* forest, is the second most abundant.

Table 17 Floodplain EEC probability

Floodplain EEC Probability (Codes and short descriptions)	**Area (ha)**			**% total floodplain area**
	Grey Zone	**Blue Zone**	**Total**	
1.Highly likely	1,181.2	1,497.9	2,679.1	7.7
2. Possible or probable	131.4	390.4	521.8	1.5
3. Unlikely but possible	117.7	275.3	393.0	1.1
(Mangroves)		102.4	102.4	0.3
Total	1,430.3	2,266.0	3,696.3	10.7

Table 18 Floodplain EEC types

Floodplain EEC types (codes and short descriptions)	**Area (ha)**		
	Grey Zone	**Blue Zone**	**Total**
1.Freshwater wetlands	283.6	23.4	306.9
2.Lowland Rainforest	198.8	838.4	1,037.1
3.Sub-tropical Forest	132.9	271.3	404.3
4.Swamp oak	50.9	177.3	228.2
5.Swamp sclerophyll	473.4	238.2	711.6
6.Ecotonal, not discernible and plantations	290.7	615.1	905.8
(Mangroves)		102.4	102.4
Total	1,430.3	2,266.0	3,696.3

Lowland rainforest EEC

The remaining EEC, Lowland rainforest (**Table 19, Figure 8**), is defined in terms of canopy structure and floristics, while noting modification resulting from disturbance. (Note that Categories 1 and 2 only are mapped in **Figure 8** – other mapped and unmapped vegetation with rainforest components may also be classified as an EEC.) The EEC includes subtropical rainforests on high nutrient substrates and excludes most warm temperate rainforest on acid volcanics and much dry rainforest. The determination notes that scattered eucalypt emergents (e.g. Flooded Gum *Eucalyptus grandis,* Sydney Blue Gum *E. saligna*) may occasionally be present and Brush Box *Lophostemon confertus* is listed as a characteristic species, leaving open the possibility that some wet sclerophyll vegetation types might be considered to be part of the Lowland rainforest EEC.

Table 19 Lowland rainforest EEC probability

Lowland rainforest EEC probability (codes and short descriptions)	Area (ha)		
	Grey Zone	Blue Zone	Total
1. Highly likely	528.9	1,576.3	2,105.2
2. Possible or probable	373.5	1,439.9	1,813.3
3. Unlikely but possible	743.1	1,571.6	2,314.7
Total	1,645.5	4,587.8	6,233.3

As some rainforest polygons located on the edge of the floodplain have been assigned probabilities for two EECs (**Section 2.2.4)**, the total area of possible EECs may be slightly overestimated in the statistics presented.

Verifying EECs

Other issues influencing classification of EECs include:

- Patch size Minimum patch sizes are not specified in the determinations, hence EECs outside the mapped vegetation (small polygons, sparse vegetation) may be present.
- Depleted and degraded vegetation - EEC descriptions all extend to depleted and degraded examples of the communities. Vegetation that has been modified to the extent that e.g. canopy species characteristic of an EEC are no longer present, may sometimes be considered to constitute examples of EECs.
- Exotic species In all determinations, the presence of weeds in many occurrences of the EECs is acknowledged. The Scientific Committee determinations do not provide guidance as to levels of weed dominance acceptable, hence much disturbed vegetation with exotic species components must be considered as potentially classed as an EEC.
- Plantations determinations do not preclude classification of plantations as EECs.

In conclusion, mapping of EECs is indicative only. Legal definitions of EECs are provided in the Scientific Committee's determinations. Decisions as to whether any particular area of vegetation constitutes an EEC may require ground inspection, in conjunction with the determination, especially in marginal cases.

map originally produced in A3

Nightcap NP

Whian Whian SCA

Bungabee NR

Bungabee SF

Muckleewee Mountain NR

Boatharbour NR

Wilson NR

Tucki Tucki NR

Tuckean NR

Clunes

LISMORE

CABBAGE TREE CK
CALICO CK
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MULGRAM CK
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BAT CAVE CK
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JEFFRIES CK
GEORGICA CK
BILLEN CK
BISHOPS CK
TOPSY CK
BILLYS GUL
ROCKY CK
BULLFROG GUL
WEIGALL CK
NORRIS CK
DAVIS CK
COOPERS CK
TERANIA CK
LITTLE ROCKY CK
NUMULGI CK
BENNYS CK
EMERALD CK
WILSONS R
PEARCES CK
KOONORIGAN CK
IGGIL CK
SCRUBBY CK
BACK CK
BOOBERIE CK
BLAKEBROOK CK
HEYCESTER CK
ELEVEN MILE CK
PINE CK
YABBAI CK
YURUBAR CK
BROWNS CK
LOFTVILLE CK
PELICAN CK
MAROM CK
BOGGY CK
WALSHS CK
RICHMOND R
TUCKI TUCKI CK
THOMAS CK
RAINBOW GUL
STIBBARDS CK
TUCKEAN BRWT
DUNGARUBBA CK
LAGOON CK

Legend

Lowland Rainforest EEC probability

- 1 Highly Likely
- 2 Probable or Possible

Lismore LGA

- Grey Zone
- Blue Zone
- Green Zone
- NPWS estate
- NSW State Forest
- town or village
- drainage line

Note: Green Zone is not mapped for EECs

Categories 1 and 2 only are mapped (see Table 2)
Other vegetation on the floodplain may also be classified as the EEC. Decisions as to whether ay particular area of vegetation constitutes an EEC should be based on field inspection in conjunction with the NSW Scientific Committee Final Determinations.

N

0 2.5 5 Kilometers

Figure 8 Lowland Rainforest EEC probability

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Grasses

Twenty-nine Grasses had been identified in the Lismore LCC by point locations (Stubbs 2001). Several locations were inspected during field work. Further investigation was not practical using the mapping methods employed in the current project, particularly since Grasses could not be discerned from API in cases where trees and shrubs had grown over the grassy layer.

3.3 Reliability

A total of 84 person-days were dedicated to ground-truthing. In addition, a further 18.5 person-days were employed on another project conducted concurrently, in which a component of the field time was dedicated to ground truthing of vegetation mapping.

A high level of field checking was achieved. For the Grey and Blue Zones, on ground inspection (reliability codes 1 and 2 combined) was achieved for 28% of polygons and 38% of area (**Table 20, Figure 9**). Data is reported for plantation and non-plantation vegetation i.e. excludes open water polygons.

Table 20 Reliability **a)** no of polygons

	No of polygons			% no of polygons		
Reliability	**Grey Zone**	**Blue Zone**	**Total**	**Grey Zone**	**Blue Zone**	**Total**
1 On-site traverse and API	21	33	54	0.9	0.6	0.7
2 Limited on-site or remote inspection and API	990	1,149	2139	41.2	21.8	27.8
4 API only	1,392	4.090	5482	57.9	77.6	71.4
Total	2.403	5,272	7675	100.0	100.0	100.0

Table 20 Reliability **b)** area

	Area (ha)			% mapped vegetation		
Reliability	**Grey Zone**	**Blue Zone**	**Total**	**Grey Zone**	**Blue Zone**	**Total**
1 On-site traverse and API	143.5	174.3	317.8	2.7	1.6	2.0
2 Limited on-site or remote inspection and API	2,776.4	3,138.34	5,914.8	52.8	28.4	36.3
4 API only	2,334.3	7,749.6	10,083.8	44.4	70.1	61.8
Total	5,254.2	11,062.2	16,316.4	100.0	100.0	100.0

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map originally produced in A3

Nightcap NP
Whian Whian SCA
Bungabee NR
Bungabee SF
Muckleewee Mountain NR
Boatharbour NR
Wilson NR
Tucki Tucki NR
Tucki Tucki NR
Tuckean NR
Tuckean NR
Clunes
LISMORE

Legend

- ground-truthed polygons
- bushland layer

Lismore LGA

- Grey Zone
- Blue Zone
- Green Zone
- NPWS estate
- NSW State Forest
- town or village
- drainage line

N

0 2.5 5 Kilometers

Figure 9 Ground-truthed polygons

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Recommendations

It is recommended that future mapping endeavours be resourced to produce mapping approaching the Native Vegetation Interim Standard (Sivertsen 2009. In particular, plot-based sampling (structure and floristics) should be conducted to provide a sound basis for further developing a system of classification and for assignment of vegetation to recognised communities. Plot data could be used locally to refine the subjective classification developed during the current project, and/or incorporated into databases used for regional Interim Vegetation Classification (EcoLogical 2010).

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APPENDICES

Appendix 1 Steps in the image analysis process

- 2009 orthophotos were mosaic-ed into a single (24 bit) shire wide image.
- The mosaic was split into individual (8 bit) Red, Green and Blue raster components.
- Individual RGB component images were contrast enhanced.
- A Principal Components raster was constructed based on the RGB images.
- The processing area was established by combining the LGA boundary and exclusion areas (National Parks, waterways etc) within GIS framework.
- The 3 RGB rasters, the Principal Components raster and processing area mask were loaded into TNT Mips and highly supervised classification of the raster layers at 1:10000 scale was conducted to identify candidate bushland pixels.
- The resulting classification raster was filtered to eliminate isolated groups of pixels (total area less than 0.5 h) and other unwanted artefacts of the classification process.
- The classification output (raster) was converted to vector format for reality checking and refinement by ‘heads up’ examination against the 2009 orthophotos.
- The refined vector data was filtered to remove discreet polygons less than half a hectare.
- Splining and smoothing algorithms were run on the vector linework to reduce the vertex count and remove 'steps and stairs' appearance resulting from raster lineage. (This process also provided a smaller file size to facilitate data delivery across Council's computer network.)

Appendix 2 Field data sheet

Polygon ID		**Date**		**Recorder:**	
Location					
Plantation/horticulture	No/Yes **1.** Eucalyptus species **2.** Exotic pine **3.** Hoop Pine **4.** Rainforest (mixed species) **5.** Orchard **6.** Other/mixed.				
Landmark Vegetation Mapping Unit				Vegetation Code (nn)	
Canopy Height (m)		Canopy Cover (%)			
Walker & Hopkins (1990) Structure					
Emergents					
Upper Dominant 1					
Upper Dominant 2					
Upper Dominant 3					
Mid Dominant 1					
Mid Dominant 2					
Mid Dominant 3					
Lower Dominant 1					
Lower Dominant 2					
Lower Dominant 3					
Koala habitat reliability		**1.** Inferred from API, incomplete ground inspection or other sources **2.** Assignment from comprehensive ground inspection			
Koala habitat category		**1.** Primary **2.** Secondary A **3**. Secondary B **4**. Other **5**. Unknown			
Landscape Condition (from API)		**1.** Old growth/excellent condition ; **2.** Mature forest ; **3.** Other			
Site Condition (from ground survey)		**1.** – Old growth/excellent condition **2.**- Mature vegetation **3** - Advanced regrowth; **4** – Early successional development			
Lantana (from API)		**1.** >50%: **2.** 26 –50% ; **3.** 5 –25%; **4** Not detected			
Camphor (from API)		**1.** >50%; **2.** <50% throughout; **3.** Occasional/patchy/edges; **4.** Not detected			
Weed Density (from ground survey, includes Camphor and Lantana)		**1** – Few or no weeds observed (no or light infestation) **2** – Weeds mainly around edges or very scattered (light to mod), **3** - Weeds common, but patchy or scattered (including canopy), **4** - Weeds throughout excluding canopy (heavy infestation), **5** - Weeds throughout the canopy (heavy infestation),			
Weed Severity (from ground survey, includes Camphor and Lantana)		**1** –No problem weeds present: **2** –Infestation is mostly minor weeds, **3** –Infestation a mix of minor and moderate weeds, isolated major weeds **4** - Infestation mostly of moderate weeds +/- major weed present, **5** –2 or more major weeds present			
Reliability		**1** On-site traverse and API **2** Limited on-site or remote inspection and API **3.** Other information source and API **4** API only **5** Not determined			
Notes					

Appendix 3 Definitions for mapping data fields

ZONE Subdivision of LGA
1. Grey Zone 2. Blue Zone 3. Green Zone

RECORDER Person conducting field inspection
ALM Annette McKinley ASM Andrew Murray BS Barbara Stewart DL Damian Licari

LAND_USE Land-use category
np non-plantation vegetation
p plantation
ow open water

MIDDOM1 Mid stratum dominant species
Note: If no species name entered, noted as either nd = not determined or absent

LOWERDOM1 Lower stratum dominant species
Note: If no species name entered, noted as either nd = not determined or absent

WEED DENSITY
1 – Few or no weeds observed (no or light infestation)
2 – Weeds mainly around edges or very scattered (light to mod),
3 - Weeds common, but patchy or scattered (including canopy),
4 - Weeds throughout excluding canopy (heavy infestation),
5 - Weeds throughout the canopy (heavy infestation),

WEED SEVERITY
1 –No problem weeds present:
2 –Infestation is mostly minor weeds,
3 –Infestation a mix of minor and moderate weeds, isolated major weeds
4 - Infestation mostly of moderate weeds +/- major weed present,
5 –2 or more major weeds present

Weed Severity Categories

Weed Severity was assessed as follows. A list of 94 weed species was each assigned a severity rating based on the known ecology of the weed, its ability to colonise and degrade native vegetation and difficulty of control. Using these criteria weeds were assigned a severity rating of Major, Moderate or Minor.

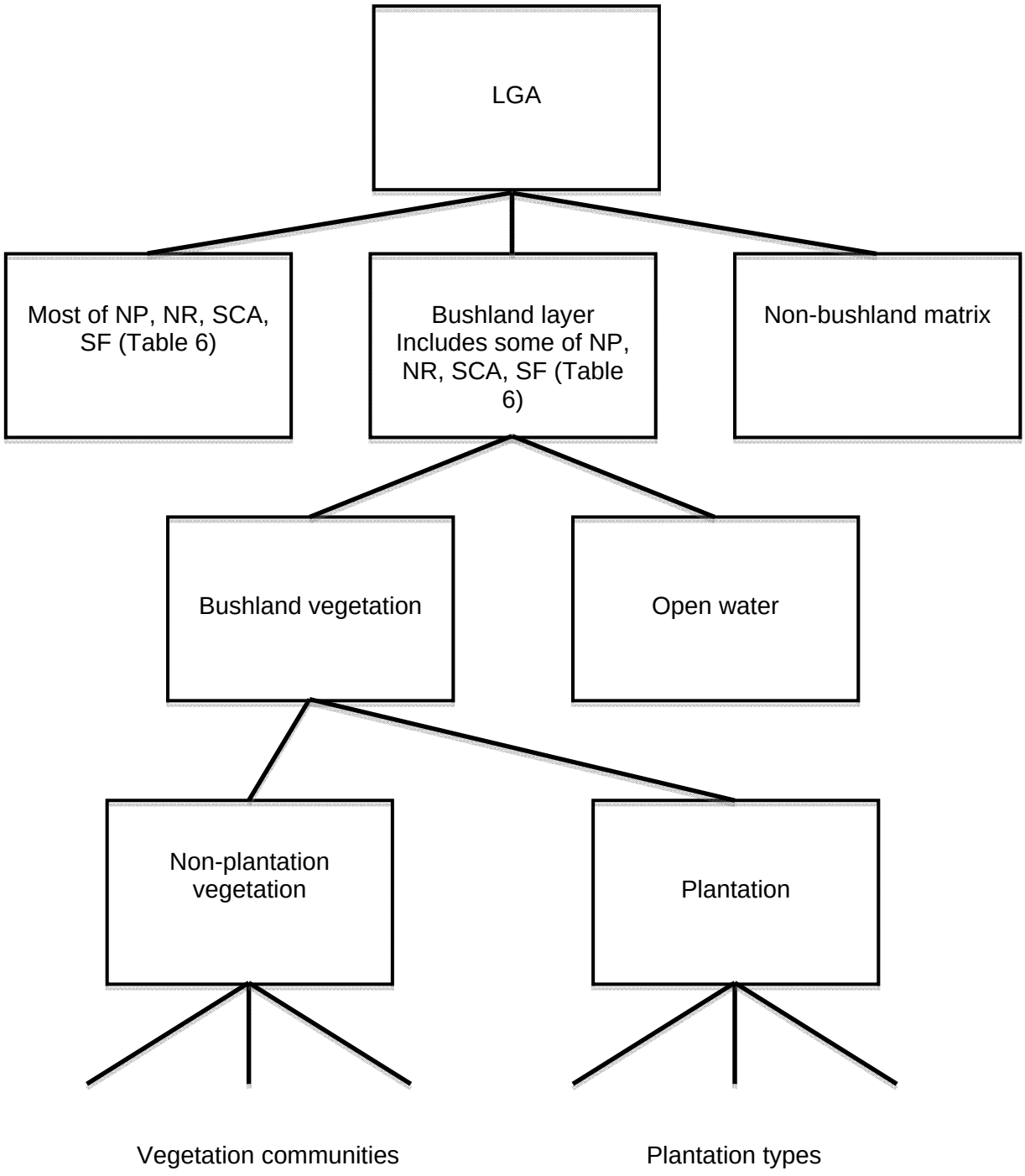
ComName	ScName	Category	Form
Asparagus Fern(s)	*Asparagus spp.*	1	Groundcover/Vine
Balloon Vine	*Cardiospermum grandifolium*	1	Vine
Cats Claw Climber	*Macfadyena unguis-cati*	1	Vine
Glory Lily	*Gloriosa superba*	1	Groundcover
Madeira Vine	*Anredera cordifolia*	1	Vine
Morning Glory	*Ipomoea spp.*	1	Vine
Moth Vine	*Araujia sericifolia*	1	Vine
Privet(s)	*Ligustrum spp.*	1	Tree
Salvinia	*Salvinia molesta*	1	water weed
Camphor Laurel	*Cinnamomum camphora*	2	Tree
Broad Leaf Pepper Tree	*Schinus terebinthifolia*	2	Tree
Cape Ivy	*Delairea odorata*	2	Vine
Chinese Celtis	*Celtis sinensis*	2	Tree
Dutchman's Pipe	*Aristolochia elegans*	2	Vine
Firethorn	*Pyracantha spp*	2	Shrub / Tree
Fishbone Fern	*Nephrolepis spp.*	2	Groundcover
Green-leaved desmodium	*Desmodium intortum*	2	Vine
Hairy Commelina	*Commelina benghalensis*	2	Groundcover
Hawthorn	*Crataegus monogyna*	2	Shrub
Honeysuckle	*Lonicera japonica*	2	Vine
Monbretia	*Crocosmia X crocosmiiflora?*	2	Groundcover
Mother of Millions	*Bryophyllum spp.*	2	Groundcover
Ochna	*Ochna serrulata*	2	Shrub
Silver-leaf Desmodium	*Desmodium uncinatum*	2	Vine
Siratro	*Macroptilium atropurpureum*	2	Vine
Smooth Senna	*Senna X floribunda*	2	Shrub
Thorny Poinciana	*Caesalpinia decapetala*	2	Vine
Turkey Rhubarb	*Acetosa sagittata*	2	Vine
Umbrella Tree	*Schefflera actinophylla*	2	Tree
Watsonia	*Watsonia meriana cv. Bulbillifera*	2	Groundcover
Ardisia	*Ardisia crenulata*	2	Shrub
Winter Senna	*Senna pendula var glabrata*	2	Shrub
Brazilian Cherry	*Eugenia uniflora*	2	Shrub / Tree
Coffee	*Coffea arabica*	2	Shrub
Coral Tree	*Erythrina spp*	2	Shrub / Tree
Freckle Plant	*Hypoestes phyllostachya*	2	Groundcover
Ginger Lily	*Hedychium gardnerianum*	2	Shrub
Guavas	*Psidium spp*	2	Shrub / Tree
Mother-in-law's Tongue	*Sansevieria trifasciata*	2	Groundcover
Passionfruit	*Passiflora spp.*	2	Vine
Singapore Daisy	*Wedelia trilobata*	2	Groundcover

ComName	ScName	Category	Form
Tradescantia (Wandering Dew)	*Tradescantia fluminensis*	2	Groundcover
White Butterfly	*Syngonium podophyllum*	2	Vine
White Trumpet Flower, Monkey's Comb	*Pithecoctenium crucigerum*	2	Vine
Green Cestrum	*Cestrum parqui*	2	shrub
Creeping Inch Plant	*Callisia repens*	2	ground cover
Orange Trumpet Vine	*Pyrostegia venusta*	2	vine
Yucca	*Yucca elephantides*	2	shrub
Fucreae	*Fucreae sp*	2	shrub
Bana Grass	*Pennisetum purpurea*	2	grass
Para grass	*Brachiaria mutica*	2	grass
Bitou Bush	*Chrysanthemoides monilifera*	3	Shrub
Aerial Yam	*Dioscorea bulbifera*	3	Vine
African Olive	*Olea europaea ssp. africana*	3	Tree
Black-eyed Susan	*Thunbergia alata*	3	Vine
Blackberry	*Rubus fruticosus agg. Spp*	3	Vine
Blue Skyflower	*Thunbergia grandiflora*	3	Vine
Bush Lemon	*Citrus lemonia*	3	Shrub / Tree
Busy Lizzie	*Impatiens walleriana*	3	Groundcover
Butterfly Bush	*Buddleja madagascariensis*	3	Vine
Cadagi	*Eucalyptus torelliana*	3	Tree
Callisia	*Callisia fragrans*	3	Groundcover
Canna Lily	*Canna indica*	3	Shrub
Cape Honeysuckle	*Tecoma capensis*	3	Vine
Caster Oil Tree	*Ricinus communis*	3	Shrub / Tree
Century plant	*Agave spp.*	3	Shrub
Coast TeaTree	*Leptospermum laevigatum*	3	Shrub / Tree
Cocos Palm	*Syagrus romanzoffianum*	3	Tree
Coral Berry	*Rivina humilus*	3	Shrub
Duranta	*Duranta repens*	3	Shrub
Evening Primrose	*Oenothera spp*	3	Groundcover
Golden Rain Tree	*Koelreuteria paniculata*	3	Tree
Jacaranda	*Jacaranda mimosifolia*	3	Tree
Japanese Daisy	*Tithonia diversifolia*	3	Shrub
Lantana	*Lantana camara*	3	Shrub
Large-leaf Abutilon	*Abutilon grandiflorum*	3	Shrub
Loquat	*Eriobotrya japonica*	3	Tree
Mistflower	*Ageratina riparia*	3	Groundcover
Mulberry	*Morus sp*	3	Tree
Nightshades	*Solanum spp*	3	Shrub
Orange Jessamine	*Murraya paniculata*	3	Shrub
Pellaea viridis	*Pellaea viridis*	3	Groundcover
Periwinkle	*Vinca major*	3	Groundcover
Prickly Pear	*Opuntia spp*	3	Shrub
Tecoma	*Tecoma stans*	3	Shrub / Tree
Variegated Ribbon Grass	*Chlorophytum comosum cv. Variegatum*	3	Groundcover

ComName	ScName	Category	Form
Devil's Fig	*Solanum chrysotrichum*	3	Tree
Broad-leaved Paspalum	*Paspalum wettsteinii*	3	Grass
Pigeon Grass	*Setaria spp.*	3	Grass
Callisia	*Callisia repens*	3	Groundcover
Whisky Grass	*Andropogon virginicus*	3	grass
Trumpet Flower	*Campsis radicans*	3	shrub
Introduced grasses (other than those on list)	*Introduced grasses*	3	
Slash Pine	*Pinus elliottii*	3	Tree
Tabebuia	*Tabebuia chrysotricha*	3	tree
Icecream Bean	*Inga*	3	tree

1. Major Weed
2. Moderate Weed
3. Minor Weed

Appendix 4 Vegetation and Land-use Categories



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Appendix 5 Allocation of Vegetation Units to Communities

Note: Some LM Vegetation Units are split between communities (**Section 2.2.)**

COMMUNITY	LM VEGETATION UNIT
Black Tea-tree	
	Black Tea-tree
	Black Tea-tree- Hoop Pine
	Black Tea-tree-Indian Coral Tree
	Black Tea-tree-Rainforest
Blackbutt-Tallowwood	
	Blackbutt
	Blackbutt-Brush Box
	Blackbutt-Brush Box-Rainforest
	Blackbutt-Camphor Laurel
	Blackbutt-Pink Bloodwood
	Blackbutt-Scribbly Gum
	Blackbutt-Tallowwood-Brush Box
	Blackbutt-Turpentine
	Brush Box
	Brush Box-Blackbutt
	Brush Box-Eucalypt
	Brush Box-Flooded Gum
	Brush Box-Pink Bloodwood
	Eucalypt
	Eucalypt-Camphor Laurel
	Grey Ironbark
	Pink Bloodwood-Brush Box-Blackbutt
	Rainforest-Eucalypt
	Turpentine
Brush Box tall moist forest	
	Brush Box
	Brush Box-Camphor Laurel
	Brush Box-Camphor Laurel-Rainforest
	Brush Box-Nightcap Wattle-Rainforest
	Brush Box-Rainforest
Camphor Laurel	
	Camphor Laurel
	Camphor Laurel-Black Tea-tree
	Camphor Laurel-Blackbutt
	Camphor Laurel-Brush Box
	Camphor Laurel-Brush Box-Rainforest
	Camphor Laurel-Coral Tree
	Camphor Laurel-Eucalypt
	Camphor Laurel-Eucalypt-Rainforest
	Camphor Laurel-Forest Red Gum
	Camphor Laurel-Forest Red Gum-Brush Box
	Camphor Laurel-Forest Red Gum-Pink Bloodwood

COMMUNITY	LM VEGETATION UNIT
	Camphor Laurel-Forest Red Gum-Tallowwood
	Camphor Laurel-Hoop Pine
	Camphor Laurel-Lantana
	Camphor Laurel-Paperbark
	Camphor Laurel-Paperbark-Indian Coral Tree
	Camphor Laurel-Privet
	Camphor Laurel-Rainforest
	Camphor Laurel-Rainforest-Chinese Elm
	Camphor Laurel-Rainforest-Eucalypt
	Camphor Laurel-Rainforest-Privet
	Camphor Laurel-River Oak
	Camphor Laurel-River Oak-Rainforest
	Camphor Laurel-Sally Wattle
	Camphor Laurel-Silky Oak
	Camphor Laurel-Slash Pine
	Camphor Laurel-Tallowwood
	Camphor Laurel-Tallowwood-Brush Box
	Camphor Laurel-Tallowwood-Pink Bloodwood
	Camphor Laurel-Tallowwood-Rainforest
	Camphor Laurel-Umbrella Tree-Small-leaved Privet
	Camphor Laurel-Wattle
	Camphor Laurel-Wattle-Rainforest
	Camphor Laurel-Wattle-Slash Pine
	Grey Ironbark-Camphor Laurel
	Grey Ironbark-Forest Red Gum-Camphor Laurel
Coast Banksia	
	Coast Banksia
	Coast Banksia-Rainforest
Dry Rainforest	
	Dry Rainforest
	Hoop Pine
	Hoop Pine-Brush Box
	Hoop Pine-Camphor Laurel
	Hoop Pine-Forest Red Gum
	Hoop Pine-Rainforest
	Hoop Pine-Silky Oak-Coral Tree
	Rainforest
	Rainforest regrowth
	Rainforest-Camphor Laurel

COMMUNITY	LM VEGETATION UNIT
	Rainforest-Camphor Laurel-Privet
	Rainforest-Eucalypt
	Rainforest-Forest Red Gum
	Rainforest-Hoop Pine
	Rainforest-Hoop Pine-Brush Box
	Rainforest-Pink Bloodwood
	Rainforest-Privet
	Silky Oak
	Silky Oak-Grey Ironbark
Flooded Gum-Tallowwood-Brush Box	
	Brush Box
	Brush Box-Flooded Gum
	Brush Box-Tallowwood
	Eucalypt
	Eucalypt-Brush Box
	Eucalypt-Camphor Laurel
	Eucalypt-Rainforest
	Flooded Gum
	Flooded Gum-Brush Box
	Flooded Gum-Brush Box-Rainforest
	Flooded Gum-Tallowwood
	Flooded Gum-Tallowwood-Pink Bloodwood
	Hoop Pine-Eucalypt
	Pink Bloodwood-Flooded Gum
	Tallowwood
	Tallowwood-Brush Box
	Tallowwood-Flooded Gum
	Tallowwood-Flooded Gum-Brush Box
	Tallowwood-Pink Bloodwood-Brush Box
Forest Red Gum grassy open forest	
	Broad-leaved Apple
	Broad-leaved Apple-Forest Red Gum
	Brush Box
	Brush Box-Broad-leaved Apple-Forest Red Gum
	Brush Box-Eucalypt
	Brush Box-Forest Red Gum
	Brush Box-Pink Bloodwood
	Brush Box-Rainforest
	Eucalypt
	Eucalypt-Camphor Laurel
	Eucalypt-Camphor Laurel-Rainforest
	Eucalypt-Rainforest
	Forest Red Gum
	Forest Red Gum-Broad-leaved Apple
	Forest Red Gum-Brush Box
	Forest Red Gum-Brush Box-Pink Bloodwood

COMMUNITY	LM VEGETATION UNIT
	Forest Red Gum-Brush Box-Rainforest
	Forest Red Gum-Camphor Laurel
	Forest Red Gum-Eucalypt
	Forest Red Gum-Grey Gum-Pink Bloodwood
	Forest Red Gum-Grey Ironbark
	Forest Red Gum-Grey Ironbark-Broad-leaved Apple
	Forest Red Gum-Grey Ironbark-Brush Box
	Forest Red Gum-Grey Ironbark-Pink Bloodwood
	Forest Red Gum-Grey Ironbark-Rainforest
	Forest Red Gum-Grey Ironbark-Swamp Box
	Forest Red Gum-Hoop Pine-Brush Box
	Forest Red Gum-Pink Bloodwood
	Forest Red Gum-Pink Bloodwood-Broad-leaved Apple
	Forest Red Gum-Privet
	Forest Red Gum-Rainforest
	Forest Red Gum-Rainforest-Camphor Laurel
	Forest Red Gum-Rainforest-Privet
	Forest Red Gum-Tallowwood
	Forest Red Gum/Grey Ironbark+/-Pink Bloodwood+/-Broad-leaved Apple
	Forest Red Gum/Tallowwood +/- Pink Bloodwood
	Grey Ironbark
	Grey Ironbark-Broad-leaved Apple
	Grey Ironbark-Brush Box
	Grey Ironbark-Brush Box-Rainforest
	Grey Ironbark-Forest Red Gum
	Grey Ironbark-Pink Bloodwood
	Grey Ironbark-Pink Bloodwood-Forest Red Gum
	Grey Ironbark-Rainforest
	Grey Ironbark-Tallowwood-Pink Bloodwood
	Hoop Pine-Eucalypt-Brush Box
	Pink Bloodwood
	Pink Bloodwood-Brush Box-Forest Red Gum
	Pink Bloodwood-Forest Red Gum
	Pink Bloodwood-Forest Red Gum-Broad-leaved Apple
	Pink Bloodwood-Grey Ironbark
	Tallowwood
	Tallowwood-Brush Box

COMMUNITY	LM VEGETATION UNIT
	Tallowwood-Grey Ironbark-Pink Bloodwood
Forest Red Gum-River Oak	
	Forest Red Gum
	Forest Red Gum-Black Tea Tree
	Forest Red Gum-Camphor Laurel
	Forest Red Gum-Hoop Pine
	Forest Red Gum-Indian Coral Tree
	Forest Red Gum-Rainforest
	Forest Red Gum-Rainforest-River Oak
	Forest Red Gum-River Oak
	Forest Red Gum-Swamp Oak
	River Oak-Forest Red Gum
Forest Red Gum-Swamp Box	
	Brush Box
	Camphor Laurel-Eucalypt
	Eucalypt
	Forest Red Gum
	Forest Red Gum-Black Tea Tree
	Forest Red Gum-Camphor Laurel
	Forest Red Gum-Hoop Pine
	Forest Red Gum-Indian Coral Tree
	Forest Red Gum-Paperbark
	Forest Red Gum-Paperbark-Camphor Laurel
	Forest Red Gum-Paperbark-Prickly Tea-tree
	Forest Red Gum-Prickly Tea-tree-Swamp Box
	Forest Red Gum-Prickly Tea-tree-Swamp Oak
	Forest Red Gum-Rainforest
	Forest Red Gum-Swamp Box
	Forest Red Gum-Swamp Box-Paperbark
	Forest Red Gum-Swamp Oak
	Forest Red Gum-Swamp Oak-Paperbark
	Forest Red Gum-Swamp Oak-Prickly Tea-tree
	Paperbark-Forest Red Gum
	Paperbark-Prickly Tea-tree-Forest Red Gum
	Pink Bloodwood-Swamp Box
	Regrowth
	Swamp Box
Forest Red Gum-Tallowwood	
	Brush Box
	Brush Box-Camphor Laurel
	Brush Box-Eucalypt
	Brush Box-Flooded Gum
	Brush Box-Forest Red Gum

COMMUNITY	LM VEGETATION UNIT
	Brush Box-Pink Bloodwood
	Brush Box-Pink Bloodwood-Camphor Laurel
	Brush Box-Pink Bloodwood-Tallowwood
	Brush Box-Rainforest
	Brush Box-Rainforest-Tallowwood
	Brush Box-Tallowwood
	Brush Box-Tallowwood-Camphor Laurel
	Brush Box-Tallowwood-Pink Bloodwood
	Brush Box-Tallowwood-Rainforest
	Eucalypt
	Eucalypt-Brush Box
	Eucalypt-Camphor Laurel
	Eucalypt-Rainforest
	Eucalypt-Rainforest-Camphor Laurel
	Flooded Gum-Hoop Pine
	Flooded Gum-Pink Bloodwood
	Flooded Gum-Tallowwood
	Forest Red Gum
	Forest Red Gum -Rainforest
	Forest Red Gum-Brush Box
	Forest Red Gum-Brush Box-Camphor Laurel
	Forest Red Gum-Brush Box-Pink Bloodwood
	Forest Red Gum-Brush Box-Rainforest
	Forest Red Gum-Brush Box-Tallowwood
	Forest Red Gum-Camphor Laurel
	Forest Red Gum-Camphor Laurel-Brush Box
	Forest Red Gum-Coast Banksia
	Forest Red Gum-Eucalypt
	Forest Red Gum-Grey Ironbark
	Forest Red Gum-Hoop Pine
	Forest Red Gum-Ironbark-Camphor Laurel
	Forest Red Gum-Ironbark-Pink Bloodwood
	Forest Red Gum-Ironbark-Rainforest
	Forest Red Gum-Pink Bloodwood
	Forest Red Gum-Pink Bloodwood-Brush Box
	Forest Red Gum-Pink Bloodwood-Camphor Laurel
	Forest Red Gum-Pink Bloodwood-Sally Wattle
	Forest Red Gum-Rainforest

COMMUNITY	LM VEGETATION UNIT
	Forest Red Gum-Rainforest-Camphor Laurel
	Forest Red Gum-Sally Wattle-Privet
	Forest Red Gum-Slash Pine
	Forest Red Gum-Tallowwood
	Forest Red Gum-Tallowwood-Broad-leaved Apple
	Forest Red Gum-Tallowwood-Brush Box
	Forest Red Gum-Tallowwood-Camphor Laurel
	Forest Red Gum-Tallowwood-Grey Ironbark
	Forest Red Gum-Tallowwood-Pink Bloodwood
	Forest Red Gum/Tallowwood +/- Pink Bloodwood
	Grey Ironbark
	Grey Ironbark-Brush Box
	Grey Ironbark-Brush Box-Rainforest
	Grey Ironbark-Tallowwood-Wattle
	mixed Eucalypts
	Pink Bloodwood
	Pink Bloodwood-Brush Box
	Pink Bloodwood-Brush Box-Wattle
	Pink Bloodwood-Camphor Laurel
	Pink Bloodwood-Forest Red Gum
	Pink Bloodwood-Rainforest
	Pink Bloodwood-Rainforest-Camphor Laurel
	Pink Bloodwood-Tallowwood-Brush Box
	Pink Bloodwood-Tallowwood-Forest Red Gum
	Rainforest-Eucalypt
	Tallowwood
	Tallowwood-Brush Box
	Tallowwood-Brush Box-Camphor Laurel
	Tallowwood-Brush Box-Flooded Gum
	Tallowwood-Brush Box-Forest Red Gum
	Tallowwood-Brush Box-Pink Bloodwood
	Tallowwood-Brush Box-Pink Bloodwood-Camphor Laurel
	Tallowwood-Brush Box-Rainforest
	Tallowwood-Brush Box-Wattle
	Tallowwood-Camphor Laurel
	Tallowwood-Camphor Laurel-Privet
	Tallowwood-Flooded Gum

COMMUNITY	LM VEGETATION UNIT
	Tallowwood-Flooded Gum-Brush Box
	Tallowwood-Flooded Gum-Eucalypt
	Tallowwood-Forest Red Gum
	Tallowwood-Forest Red Gum-Camphor Laurel
	Tallowwood-Forest Red Gum-Pink Bloodwood
	Tallowwood-Pink Bloodwood
	Tallowwood-Pink Bloodwood-Camphor Laurel
	Tallowwood-Pink Bloodwood-Flooded Gum
	Tallowwood-Pink Bloodwood-Forest Red Gum
	Tallowwood-Rainforest
	Tallowwood-Rainforest-Camphor Laurel
	Wattle-Camphor Laurel-Rainforest
	White Mahogany-Pink Bloodwood-Brush Box
Freshwater Meadows	
	Sedgeland
	Sedgeland/Grassland
	Swamp Foxtail grassland
	Tall Saw Sedge sedgeland
	Water Couch-Smartweed meadow
	Wet Meadow
	Wet Meadow-Paperbark
	Wet Meadow/Sedgeland
Indian Coral Tree	
	Indian Coral Tree
	Indian Coral Tree-Camphor Laurel
	Indian Coral Tree-River Oak
	Indian Coral Tree-Swamp Oak
	Indian Coral Tree-Willow
Lantana	
	Lantana
	Lantana-Camphor Laurel
Mangrove	
	Grey Mangrove
	Mangrove
Paperbark	
	Paperbark
	Paperbark-Black Tea Tree
	Paperbark-Brush Box
	Paperbark-Cabbage Palm
	Paperbark-Camphor Laurel
	Paperbark-Camphor Laurel-Brush Box
	Paperbark-Camphor Laurel-Indian Coral Tree
	Paperbark-Camphor Laurel-Rainforest

COMMUNITY	LM VEGETATION UNIT
	Paperbark-Eucalypt
	Paperbark-Forest Red Gum
	Paperbark-Indian Coral Tree
	Paperbark-Pink Bloodwood-Red Ash
	Paperbark-Prickly Tea-tree
	Paperbark-Rainforest
	Paperbark-Rainforest-Camphor Laurel
	Paperbark-Swamp Box
	Paperbark-Swamp Box-Camphor Laurel
	Paperbark-Swamp Box-Pink Bloodwood
	Paperbark-Swamp Box-Prickly Tea-tree
	Paperbark-Swamp Box-Rainforest
	Paperbark-Swamp Box-Swamp Oak
	Paperbark-Tea-tree-Indian Coral Tree
	Paperbark-Weeping Lilly Pilly
	Paperbark-Wet Meadow
	Pink Bloodwood
	Rainforest-Paperbark
	Wattle
	Wattle-Eucalypt-Paperbark
Paperbark-Swamp Oak	
	Paperbark-Swamp Oak
	Paperbark-Swamp Oak-Camphor Laurel
	Paperbark-Swamp Oak-Forest Red Gum
	Paperbark-Swamp Oak-Rainforest
	Paperbark-Swamp Oak-Swamp Box
Prickly-leaved Tea-tree	
	Prickly-leaved Tea Tree
	Prickly-leaved Tea-tree-Forest Red Gum
	Prickly-leaved Tea-tree-Paperbak
	Prickly-leaved Tea-tree-Paperbark-Swamp Oak
	Prickly-leaved Tea-tree-Rainforest
	Prickly-leaved Tea-tree-Swamp Box
	Prickly-leaved Tea-tree-Swamp Oak
	Prickly-leaved Tea-tree-Willow Bottlebrush
	Tea-tree-Willow Bottlebrush
Privet	
	Large-leaved Privet-Camphor Laurel-Rainforest
	Privet

COMMUNITY	LM VEGETATION UNIT
	Privet-Camphor Laurel
	Privet-Rainforest
	Privet-Wattle
Riparian rainforest-lower reaches	
	Floodplain Rainforest
	Forest Red Gum-Hoop Pine
	Forest Red Gum-Rainforest
	Rainforest-Black Tea Tree
	Rainforest-Camphor Laurel
	Rainforest-Camphor Laurel-Swamp Oak
	Rainforest-Forest Red Gum
	Rainforest-Prickly Tea-tree
	Riparian Rainforest
Riparian rainforest-mid reaches	
	Black Bean-Maidens Blush-Brown Tamarind
	Brush Box-Rainforest
	Floodplain Rainforest
	Forest Red Gum-Rainforest
	Hoop Pine
	Hoop Pine-Rainforest
	Hoop Pine-Rainforest-Forest Red Gum
	Rainforest
	Rainforest regrowth
	Rainforest-Brush Box-Camphor Laurel
	Rainforest-Camphor Laurel
	Rainforest-Eucalypt
	Rainforest-Forest Red Gum
	Rainforest-Indian Coral Tree
	Rainforest-River Oak
	Riparian Rainforest
River Oak	
	Eucalypt
	Eucalypt-Camphor Laurel
	Forest Red Gum-Camphor Laurel
	Red Bottlebrush
	Red Bottlebrush-River Oak
	River Oak
	River Oak +/- Forest Red Gum
	River Oak-Camphor Laurel
	River Oak-Camphor Laurel-Indian Coral Tree
	River Oak-Indian Coral Tree
	River Oak-Rainforest
	River Oak-Rainforest-Camphor Laurel
	River Oak-vine
Scribbly Gum	
	Scribbly Gum
	Scribbly Gum-Blackbutt
	Scribbly Gum-Brush Box

COMMUNITY	LM VEGETATION UNIT
	Scribbly Gum-Sally Wattle-Camphor Laurel
Subtropical Rainforest	
	Black Bean-Pepperberry Tree-Cudgerie
	Brush Box
	Brush Box-Rainforest
	Cabbage Palm
	Eucalypt-Rainforest-Camphor Laurel
	Fig
	Fig-Eucalypt
	Fig-Forest Red Gum
	Fig-Rainforest
	Floodplain Rainforest
	Forest Red Gum-Rainforest
	Hoop Pine-Brush Box
	Hoop Pine-Rainforest-Forest Red Gum
	Rainforest
	Rainforest regrowth
	Rainforest regrowth-Camphor Laurel
	Rainforest-Brush Box
	Rainforest-Camphor Laurel
	Rainforest-Camphor Laurel-Privet
	Rainforest-Eucalypt
	Rainforest-Flooded Gum
	Rainforest-Forest Red Gum
	Rainforest-Forest Red Gum-Camphor Laurel
	Rainforest-Paperbark
	Rainforest-Prickly Tea-tree-Forest Red Gum
	Rainforest-Tallowwood-Brush Box
	Subtropical Rainforest
	Wattle
	Wattle-Camphor Laurel
	Wattle-Camphor Laurel-Tallowwood
	Wattle-Eucalypt
	Wattle-Rainforest
Swamp Box	
	Swamp Box
	Swamp Box-Paperbark
	Swamp Box-Paperbark-Camphor Laurel
	Swamp Box-Prickly Tea-tree
	Swamp Box-Rainforest

COMMUNITY	LM VEGETATION UNIT
	Swamp Box-Rainforest-Coast Banksia
	Swamp Box-Swamp Mahogany
	Swamp Box-Swamp Oak
	Swamp Box-Willow Bottlebrush
	Swamp Oak
	Swamp Oak-Black Tea Tree
	Swamp Oak-Camphor Laurel
	Swamp Oak-Forest Red Gum
	Swamp Oak-Forest Red Gum-Paperbark
	Swamp Oak-Forest Red Gum-Rainforest
	Swamp Oak-Indian Coral Tree
	Swamp Oak-Milky Mangrove
	Swamp Oak-Paperbark
	Swamp Oak-Prickly Tea-tree
	Swamp Oak-Prickly Tea-tree-Indian Coral Tree
	Swamp Oak-Prickly Tea-tree-Rainforest
	Swamp Oak-Rainforest
	Swamp Oak-sedgeland
	Swamp Oak-Swamp Box
Swamp Oak-River Oak	
	Swamp Oak-River Oak
	Swamp Oak-River Oak-Rainforest
Various exotic	
	Chinese Elm-Camphor Laurel
	Chinese Elm-Coral Tree-Camphor Laurel
	Jacaranda-Camphor Laurel
	Mulberry-Pencil Willow
	Pencil Willow-Rainforest
	Pine regrowth
	Poplar
	Poplar-Japanese Sunflower
	Slash Pine
	Slash Pine-Camphor Laurel
	Small-leaved Privet-Chinese Elm
	Various exotic
	Willow
Willow Bottlebrush	
	Willow Bottlebrush
	Willow Bottlebrush-Brush Box-Wattle-Camphor Laurel
	Willow Bottlebrush-Paperbark
	Willow Bottlebrush-Rainforest

Appendix 6 Vegetation descriptions

This appendix refers to the mapped sections of non-plantation vegetation of the Grey and Blue Zones collectively.

Vegetation communities are identified by short name and code – full names, sources and equivalent communities are shown in **Table 9.**

Plant names follow Plantnet - http://plantnet.rbgsyd.nsw.gov.au. Within this appendix the common name and scientific name are given when the species is first mentioned, thereafter only the common name is used.

Rainforest formation

Dry Rainforest complex

Dry Rainforest (DR)

Dry rainforest with Forest Red Gum emergents near Tuncester. Forest Red Gum forest can also be seen on the upper hill slope in background.

Low to tall closed to open forest

Dry rainforest occurs within areas that have a relatively low rainfall (for rainforest development) and/or that have a marked spring drought. It commonly occurs on fertile, shallow, well-drained soils that experience periods of low soil moisture (Turnbull and Boulton 2000). The dry rainforest community corresponds with Rainforest Suballiance No. 21 *Araucaria* (Floyd 1990).

Regrowth dry rainforest was mapped largely in the west of the Blue Zone, particularly around Bentley, Caniaba and Leycester Creek. It was generally dominated by Red Kamala *Mallotus philippensis*, Native Elm *Aphananthe philippinensis*, Cockspur Vine *Maclura cochinchinensis*, Macaranga *Macaranga tanarius*, Whalebone Tree *Streblus brunonianus*, Small-leaved Tuckeroo *Cupaniopsis parvifolia* and White Cedar *Melia azedarach*. Forest Red Gum *Eucalyptus tereticornis* and/or Hoop Pine *Araucaria cunninghamii* were often present as emergents. Dry rainforest also occurred as patches in other parts of the Blue and Grey Zones (see **Subtropical Rainforest** below).

Weeds: Large-leaved Privet *Ligustrum lucidum* and Small-leaved Privet *L. sinense* were common, dominating the vegetation in many areas.

Riparian rainforest - lower reaches (Rr-l)

Hoop Pine emergent with Swamp Oak, rainforest species and introduced vines as a narrow riparian strip between the road and the lower Richmond.

Tall to very tall closed forest to woodland along the lower reaches of the Wilson and Richmond Rivers and their tributaries.

The upper stratum typically included Hoop Pine, Forest Red Gum, large Figs *Ficus* spp, Swamp Oak *Casuarina glauca* and River Oak *Casuarina cunninghamiana.* Forest Red Gum and Hoop Pine were also emergent.

The mid stratum was dominated by rainforest species including including Tuckeroo *Cupaniopsis anacardioides*, Silky Oak *Grevillea robusta*, Cabbage Palm *Livistona australis*, Bangalow Palm *Archontophoenix cunninghamiana*, Common Silkpod *Parsonsia straminea*, Whip Vine *Flagellaria indica* and Cottonwood *Hibiscus tiliaceous.*

The ground layer was often sparse and/or dominated by introduced grasses, particularly on the edges. Crinum Lily *Crinum pedunculatum* and Mangrove Fern *Acrostichum speciosum* were common in the ground stratum downstream in more saline environments. Common Reed *Phragmites australis* occurred in wetter areas.

This community includes Sub-alliance No. 3 *Cryptocarya obovata-Dendrocnide excelsa-Ficus* spp. *–Araucaria* (Floyd 1990) and in areas with impeded drainage Sub-alliance No. 6 *Archontophoenix-Livistona*.

Weeds: Lantana *Lantana camara* was common in the mid stratum and often dominant and Indian Coral Tree *Erythrina crista-galli* was common throughout. Five-leaf Morning Glory *Ipomoea cairica*, Balloon Vine *Cardiospermum grandiflorum*, Wild Tobacco *Solanum mauritianum*, Camphor Laurel *Cinnamomum camphora* and introduced grasses including Windmill Grass *Chloris gayana* were common in this community.

Riparian rainforest - mid reaches (Rr-m)

Riparian rainforest on the mid reaches of Back Creek near Tuncester. Forest Red Gum and Figs were common emergents.

Tall to very tall closed forest to woodland along the mid reaches of the Wilson and Richmond Rivers, Leycester Creek and tributaries. The community typically includes a greater diversity of rainforest species in the canopy than does the Riparian rainforest- lower reaches community.

The upper stratum typically included Hoop Pine, Figs *Ficus* spp, Forest Red Gum, River Oak, Black Bean *Castanospermum australe*, Pepperberry *Cryptocarya obovata*, Red Kamala, Silky Oak, Native Elm, Whalebone Tree and Giant Water Gum *Syzygium francisii*. Forest Red Gum, Hoop Pine, Strangling Fig *Ficus watkinsiana* and Moreton Bay Fig *Ficus macrophylla* were often emergent. This community most closely fits Sub-alliance No. 3 *Cryptocarya obovata-Dendrocnide excelsa- Ficus* spp. *–Araucaria* (Floyd 1990).

Rainforest species dominated the mid stratum including Creek Sandpaper Fig *Ficus coronata*, Common Lilly Pilly *Syzygium smithii*, Red Kamala, Water Gum *Tristaniopsis laurina* with Red Bottlebrush *Callistemon viminalis* often fringing the creek.

The ground stratum was variable and sometimes grazed. It was often sparse, with rainforest grasses and sedges. Spiny-headed Mat-rush *Lomandra hystrix* was common on the water's edge.

Weeds: Camphor Laurel, Castor Oil *Ricinus communis*, Willow *Salix* sp., Indian Coral Tree, Balloon Vine *Cardiospermum grandiflorum*, Mulberry *Morus* sp., Common Morning Glory *Ipomoea purpurea*, Moonflower *Ipomoea alba*, Trad *Tradescantia albiflora*, Mexican Sunflower *Tithonia diversifolia*, Small-leaved and Large-leaved Privet.

Subtropical Rainforest

Subtropical Rainforest (SR)

A patch of Subtropical Rainforest at Ridgewood Rd, Rosebank.

Midhigh to very tall closed to open forest although sometimes occurring as woodland where the midstorey has been disturbed (e.g. grazed).

Subtropical Rainforest was mapped on volcanic soils in the hilly eastern parts of the Blue and Grey Zones and on alluvium on the floodplain. Subtropical Rainforest was found primarily in the area formerly known as the Big Scrub, which historically formed a mosaic of subtropical and dry rainforest, representing at least four of Floyd's sub-alliances (Floyd 1990) and reflecting minor changes in drainage and soils. This community also graded into Brush Box *Lophostemon confertus* in some locations.

Within the Blue and Grey Zones the rainforest sub-alliances that occur are as follows.

Sub-alliance 1 – *Heritiera trifoliolata.* The upper stratum includes Strangling Fig *Ficus watkinsiana*, Giant Stinging Tree *Dendrocnide excelsa* and Yellow Carabeen *Sloanea woollsii*, White Booyong *Heritiera trifoliolata*, Red Carabeen *Geissois benthamii*, Yellowwood *Flindersia xanthoxyla*, Cudgerie *F. schottiana* and Rose Marara *Pseudoweinmannia lachnocarpa*. Woody vines and epiphytes are common.

Sub-alliance 5 – *Castanospermum australe-Dysoxylum muelleri.* The main emergent in this suballiance is Moreton Bay Fig. The upper stratum may comprise Black Bean, Red Bean *Dysoxylum mollisimum*, Purple Cherry *Syzygium crebrinerve*, White Booyong, Yellowwood, Cudgerie and Red Cedar *Toona ciliata*. Woody vines and epiphytes are common.

Sub-alliance 21 – *Araucaria*. Hoop Pine is typically emergent. The upper stratum includes Croton *Croton verreauxii*, Yellow Tulip *Drypetes australasica*, Python Tree *Austromyrtus bidwillii*, Celerywood *Polyscias elegans*, Ribbonwood *Euroschinus falcata*, Guioa *Guioa semiglauca*, Beetroot *Elattostachys nervosa*, Red Cedar, Black Plum *Diospyros australis* and Myrtle Ebony *D. pentamera*. The shrub layer is composed of small-leaved, prickly species, including Capparis *Capparis arborea* and Orange Thorny Pea (Threatened) *Citriobatus pauciflorus* with Broad-leaved Palm-lily *Cordyline petiolaris* in the moister gullies. The herb layer is very sparse with ferns such as Rasp Fern *Doodia aspera*. Vines are particularly well-developed. (Floyd 1990).

Weeds: Camphor Laurel, Privet, Ochna, Madeira Vine *Anredera cordifolia*, Yellow Guava *Psidium guajava*, Balloon Vine, *Ipomoea* spp.

Rainforest (derived)

(not placed in formation)

Closed Forest

Camphor Laurel (CL)

Camphor Laurel forest near Dunoon.

Midhigh to very tall closed forest to woodland

In the Blue and Grey Zones Camphor Laurel broadly conforms to the Interim Vegetation Type description for Derived Camphor Laurel Rainforest Wet Sclerophyll Forest (**Table 9**). The community often occurred as pure, even-aged stands with or without rainforest species in the understorey. Camphor Laurel has invaded eucalypt forest on high fertility soils (particularly volcanic soils) and, in the absence of fire, often forms a dense mid stratum below Forest Red Gum or other forest types. Camphor Laurel was recorded as co-dominant with Privet, River Oak, Rainforest and Swamp Sclerophyll forest. Rainforest species often dominate the mid stratum of Camphor Laurel forest to the exclusion of Camphor.

Camphor Laurel was particularly common in the eastern part of the Blue and Grey Zones and rare in the drier areas around Bentley and Pelican Creek in the western extent of the Blue Zone.

Wet Sclerophyll Forest Shrub grass Formation

North Coast Wet Sclerophyll Forest

Blackbutt-Tallowwood (B-TW)

Blackbutt-Tallowwood forest on Nightcap Range Road near Dorroughby.

Tall to extremely tall open forest sometimes with a dense understorey of rainforest species.

In the Blue and Grey Zones Blackbutt-Tallowwood broadly conforms to the Biometric Vegetation Type description for Blackbutt-Tallowwood tall moist forest of the far north east of the North Coast (**Table 9**). This community was found mainly in the north-east of the Blue Zone on krasnozems and on red and yellow podsolic soils – from Dorroughby and Rosebank to the Nightcap NP boundary in the north-east of the study area but also on hill slopes around Broadwater in the far south-east of the Blue Zone.

Blackbutt *Eucalyptus pilularis* was generally dominant and associated with Pink Bloodwood *Corymbia intermedia*, Brush Box, Tallowwood *Eucalyptus microcorys*, Turpentine *Syncarpia glomulifera*, White Mahogany *Eucalyptus acmenoides* and Grey Ironbark *E. siderophloia*.

The mid layer included Sally Wattle *Acacia melanoxylon*, Forest Oak *Allocasuarina torulosa*, Red Ash, Scentless Rosewood *Synoum glandulosum* (in the north-east of the study area) and Native Guava *Rhodomyrtus psidioides*, Sweet Bursaria *Bursaria spinosa* and Brush Ironbark Wattle *Acacia disparrima* (around Broadwater).

The ground stratum typically included Gristle Fern *Blechnum cartilagineum*, Lantana, Large Spiny-headed Mat-rush *Lomandra longifolia*, Blady Grass *Imperata cylindrica* and Bracken Fern *Pteridium esculentum*.

Weeds: Camphor Laurel and Lantana were the main weed species.

Flooded Gum-Tallowwood (FG-TW)

Flooded Gum forest near Numulgi.

Tall to extremely tall open forest to woodland.

In the study area Flooded Gum-Tallowwood broadly conforms to the Biometric Vegetation Type description for Flooded Gum-Tallowwood-Brush Box moist open forest of the coastal ranges of the North Coast (**Table 9**). This community was found mainly in the north-east of the Blue Zone around Rosebank and Upper Coopers Creek.

The community is a tall to extremely tall moist open forest, often with an understorey of rainforest trees and shrubs.

Flooded Gum, Brush Box and Tallowwood dominated the upper stratum.

The mid stratum often includes Nightcap Wattle *Acacia orites*, Forest Oak and rainforest species.

Large Spiny-headed Mat-rush, native ferns and rainforest seedlings were abundant in the ground layer.

Weeds: Camphor Laurel and Lantana were the main weed species.

Northern Hinterland Wet Sclerophyll forest

Brush Box tall moist forest (BB)

Brush Box forest near Nightcap Range Road, Dorroughby.

Midhigh to very tall open forest to woodland

In the study area Brush Box tall moist forest broadly conforms to the Biometric Vegetation Type description for Brush Box tall moist forest of the northern ranges of the North Coast (**Table 9**). The community was found mainly on 'mildly leached chocolate soils' and 'red and yellow podsolic soils' on the ranges around Rosebank, Dorroughby and Upper Coopers Creek. Brush Box also occurred as a common component of other forest associations such as Blackbutt, Forest Red Gum-Tallowwood and Forest Red Gum grassy open forest.

In the Blue and Grey Zones Brush Box dominated the community. The upper stratum sometimes included Turpentine, Pink Bloodwood or Forest Red Gum. The mid stratum was variable. In moister sheltered areas the mid stratum included rainforest species such as Red Ash, Red Kamala, Guioa, Bangalow Palm and Creek Sandpaper Fig and the ground stratum was dominated by Rasp Fern and rainforest seedlings. In more open areas the mid typically included Tree Heath *Trochocarpa laurina* and Water Vine *Cissus hypoglauca* and the ground was often dominated by Gristle Fern, Large-headed Spiny Mat-rush and Shiny Fan Fern *Sticherus flabellatus*.

On moist soils rainforest species were often present in the canopy and in the absence of fire and other disturbance it is likely the community would eventually develop into rainforest.

Eucalypt species were often present as emergents.

Weeds: Camphor Laurel, Lantana

Dry Sclerophyll Forest shrubby sub formation

North Coast Dry Sclerophyll forest

Coast Banksia (CB)

Midhigh to tall open forest to open woodland

Coast Banksia *Banksia integrifolia* was dominant. Forest Red Gum was often present, and sometimes co-dominant. The community had an open mid stratum and grassy understorey. The ground stratum was dominated by exotic grasses when regularly grazed and by Kangaroo Grass *Themeda australis* and other native grasses when less disturbed. Rainforest was developed in the understorey in the absence of fire or other disturbance. This community also occurred as small unmapped patches within the Forest Red Gum-Tallowwood association.

Weeds: Introduced grasses, Lantana, Camphor Laurel.

Forest Red Gum-Tallowwood (FRG-TW)

Forest Red Gum-Tallowwood near Connor Road, Tregeagle.

Tall to very tall open forest to woodland

Forest Red Gum and/or Tallowwood were usually present and often co-dominant. Pink Bloodwood was common and White Mahogany *Eucalyptus acmenoides*, Grey Ironbark and/or Broad-leaved Apple *Angophora subvelutina* were sometimes present. Near Tullera Hall (south of Modanville), Tallowwood was co-dominant with White Mahogany. Flooded Gum was occasionally recorded. Grey Gum was also recorded, but rarely.

The mid stratum was variable, often sparse, particularly in grazed areas. Sally Wattle was common. In undisturbed areas (absence of grazing and/or fire) rainforest and/or Brush Box may dominate the understorey.

Ferns such as Rasp Fern and rainforest seedlings were common where rainforest dominated the mid stratum. Blady Grass, Kangaroo Grass and Bracken Fern were often present in ungrazed open areas, otherwise the ground stratum was dominated by introduced grasses.

This community has been included in the dry sclerophyll forest shrubby sub-formation but often includes characteristics such as a rainforest or moist understorey that would suggest Forest Red Gum-Tallowwood could equally be classed as a wet sclerophyll forest community.

Weeds: Camphor Laurel and/or Large-leaved Privet dominating mid in many areas. Winter Senna and introduced grasses e.g. Carpet Grass *Axonopus fissifolius*, *Digitaria* sp.

Scribbly Gum (SG) (variant)

Scribbly Gum along Minyon Falls Road near Whian Whian State Conservation Area.

In the study area Scribbly Gum on acid volcanics differed from the Interim Vegetation Type description for this community (**Table 9**). Scribbly Gum *Eucalyptus signata* on Nimbin rhyolite was recorded on the edge of the Nightcap National Park. The mesic understorey was dominated by Tree Daviesia *Daviesia arborea*. Forest Oak, Brush Box and Turpentine were also present. Kangaroo Grass was common in the ground stratum with Blady Grass and Bracken Fern. This community graded into Blackbutt forest.

Sally Wattle and Camphor Laurel were common in disturbed areas.

Weeds: Camphor Laurel, Lantana.

Dry Sclerophyll Forest grassy sub formation

North Coast Dry Sclerophyll forest

Forest Red Gum grassy open forest (FRGg)

Forest Red Gum, Grey Ironbark and Broad-leaved Apple near Caniaba west of Lismore.

Midhigh to very tall open forest to open woodland and isolated trees

In the Blue and Grey Zones, Forest Red Gum grassy open forest broadly conforms to the Biometric Vegetation Type description for this community (**Table 9**). This community was largely restricted to the drier western part of the Blue Zone, on the ranges around Bentley, Caniaba, Parrots Nest and Pelican Creek. It included large expanses of grazed open forest, woodland and open woodland.

The upper stratum included Forest Red Gum, Grey Ironbark and Broad-leaved Apple. Pink Bloodwood and Tallowwood were often present. Brush Box was also recorded in this community. In the absence of fire/grazing or other disturbance the mid stratum was often dominated by dry rainforest species including Red Kamala, Cockspur Vine, Whalebone Tree and Native Elm. Hoop Pine was sometimes present as an emergent.

Weeds: Privet has invaded large areas of Forest Red Gum grassy open forest.

Forested wetlands formation

Coastal Floodplain Wetlands

Swamp Oak (SO)

Midhigh to very tall open forest to open woodland

In the Blue and Grey Zones, Swamp Oak broadly conformed to the Biometric Vegetation Type description for this community (**Table 9**). Paperbark, Forest Red Gum and Willow Bottlebrush were common associates. Prickly-leaved Teatree was often present and Black Tea Tree an occasional.

The mid stratum was variable but generally included Common Silkpod and rainforest species such as Red Ash and Umbrella Cheese Tree *Glochidion sumatranum*.

The ground stratum also varied with Harsh Ground Fern *Hypolepis muelleri* and Bracken Fern in drier areas and *Carex* sp, Smart Weed *Persicaria* spp. and Swamp Water Fern *Blechnum indicum* in wetter locations.

Where Swamp Oak graded into the mangrove community the mid stratum included Tuckeroo and Milky Mangrove *Exoecaria agallocha* and the ground stratum Mangrove Fern and Crinum Lily.

Weeds: Indian Coral Tree, Camphor Laurel, *Ipomoea* spp.

Coastal Swamp Forest

Paperbark-Swamp Oak (PB-SO)

Paperbark-Swamp Oak forest near Stibbards Lane near Tuckean Swamp Nature Reserve.

Midhigh to very tall open forest to woodland

In the Blue and Grey Zones, Paperbark-Swamp Oak was broadly consistent with the Interim Vegetation Type description for Broad-leaved Paperbark, Willow Bottlebrush, Swamp Oak Floodplain Swamp Sclerophyll Forest (**Table 9**). The vegetation community has less Willow Bottlebrush component than the Interim Vegetation Type description and generally represents an intergrade between Paperbark and Swamp Oak.

Paperbark and Swamp Oak dominated the upper stratum. Swamp Box was often present.

The mid stratum typically included Common Silkpod, Paperbark, Red Ash and Sally Wattle. Rainforest species as Foambark *Jagera pseudorhus,* Hard Quandong *Elaeocarpus obovatus* and Poison Peach *Trema aspera* were often present.

The ground stratum generally included Bracken Fern, Harsh Ground Fern, Tall Sedge *Carex appressa* and rainforest grasses.

Weeds: Lantana

Forest Red Gum-Swamp Box (FRG-SB)

Forest Red Gum on the Lismore floodplain.

Midhigh to very tall open forest to woodland and isolated trees.

Forest Red Gum was usually dominant with Swamp Box *Lophostemon suaveolens* a common associate and occasionally dominant. Swamp Oak and Paperbark often graded in. Brush Box was occasionally present. This community was generally found on the alluvial floodplain but sometimes extended upslope.

Willow Bottlebrush was common in the mid stratum in undisturbed areas. Red Ash was sometimes present.

The ground stratum varied but in undisturbed areas typically included Blady Grass, a rainforest grass *Oplismenus imbecillis*, Blue Commelina *Commelina cyanea* and Swamp Water Fern.

Large areas of this vegetation community are grazed with little understorey and limited natural regeneration.

Weeds: Camphor Laurel, Indian Coral Tree

Paperbark (P)

Paperbark woodland to open woodland on Tuckean Island Road near Tuckean Swamp Nature Reserve. Freshwater wetland in background.

Midhigh to very tall open forest to open woodland and isolated trees.

In the Blue and Grey Zones, Paperbark was consistent with the Biometric Vegetation Type description for Paperbark swamp forest of the coastal lowlands of the North Coast (**Table 9**). The Paperbark community was dominated by *Melaleuca quinquenervia* and commonly associated with Swamp Oak, Swamp Box and Forest Red Gum. Prickly-leaved Tea-tree *Melaleuca styphelioides*, Willow Bottlebrush *Callistemon salignus* and Forest Red Gum were often present.

The mid stratum was variable. Where grazed the understorey was typically sparse to absent with scattered Cockspur Vine. Undisturbed areas often included well-developed rainforest including Cockspur Vine, Common Silkpod, Muttonwood *Myrsine variabilis*, Cheese Tree *Glochidion ferdinandi*, Red Ash, Pink-flowered Doughwood *Melicope elleryana*, Bangalow Palm and Cabbage Palm.

The ground varied according to disturbance and moisture level but generally included sedges such as Tall Sedge, *Juncus usitatus* and Tall Saw Sedge *Gahnia clarkei*, ferns *(*Binung *Christella dentata*, Swamp Water Fern, Harsh Ground Fern), herbs *Viola hederacea*, Blue Commelina, Smartweed *Persicaria* sp. and grasses such as Water Couch *Paspalum distichum* and Carpet Grass *Axonopus compressus*.

Weeds: Camphor Laurel, Privet

Prickly-leaved Tea-tree (Pl-Tt)

Prickly-leaved Tea-tree near Baxters Lane at Tucki Tucki.

Midhigh to tall forest to open woodland

This community was mapped on the Lismore floodplain south of Lismore.

Prickly Tea-tree dominated the upper stratum. Forest Red Gum and Swamp Oak were also common and Swamp Box occasionally recorded. The understorey frequently included rainforest species (such as Red Ash), Willow Bottlebrush, Brush Ironbark Wattle and Cockspur Vine. Prickly-leaved Tea-tree often intergraded with Paperbark.

The ground stratum was typically dominated by sedges such as Tall Sedge. The Prickly-leaved Tea-tree community was often grazed with little or no understorey.

Weeds: None documented although *Cuphea carthagenensis* is likely to be present.

Swamp Box (SB)

Swamp Box forest near Tucki Tucki.

Mid-high to tall open forest to open woodland and isolated trees

In the Blue and Grey Zones, Swamp Box was broadly consistent with the Biometric Vegetation Type description for Swamp Box swamp forest of the coastal lowlands of the North Coast (**Table 9**). Swamp Box was widely distributed, primarily on alluvial soils, throughout the study area and sometimes extending upslope. Swamp Box dominated the upper stratum with Paperbark and Swamp Oak common associates. Swamp Mahogany was occasionally present. Cabbage Gum was not recorded although present in the Biometric description. The mid stratum variously included rainforest species, Paperbark, Swamp Box and Sally Wattle.

The ground stratum was typically dominated by introduced pasture grass in grazed areas and sedges and rushes such as Large Spiny-headed Mat-rush in less disturbed sites.

Weeds: Camphor Laurel

Willow Bottlebrush (WB)

Mid-high to tall open forest to open woodland and isolated trees

Willow Bottlebrush dominated the upper stratum. Paperbark, Swamp Box and Sally Wattle were often present. The mid stratum was variable but frequently included Sally Wattle and rainforest species. The ground stratum was generally dominated by sedges and grasses (including introduced pasture grass). Most areas mapped were located in grazing land and represented regrowth of the Paperbark-Swamp Oak and/or Forest Red Gum - Swamp Box vegetation types where Willow Bottlebrush is commonly a minor canopy or understorey component.

Weeds: Camphor Laurel

Freshwater wetlands formation

Coastal Freshwater Lagoons

Freshwater Meadows (FM)

Freshwater Meadow with Paperbark emergents near Paff Lane at Tucki Tucki.

In the Blue and Grey Zones, Freshwater Meadows are broadly consistent with the NRCMA revised Vegetation Type description for Coastal freshwater meadows and forblands of lagoons and wetlands (**Table 9**).

Freshwater Meadows occurred on alluvium on the floodplain and comprised a diversity of communities variously dominated by sedges, grasses, rushes and herbs including Tall Saw Sedge, Tall Sedge, Swamp Foxtail Grass *Pennisetum alopecuroides*, Water Couch, Smartweed, Water Ribbons *Triglochin* sp, Frogmouth *Philydrum lanuginosum*, Common Reed and Broad-leaf Cumbungi *Typha orientalis.* Paperbark was often emergent and freshwater meadows often occurred within Paperbark open woodland.

Weeds: *Cuphea carthagenensis*

Eastern Riverine Forest

Forest Red Gum-River Oak forest (FRG-RO)

Forest Red Gum with River Oak and rainforest on the mid reaches of the Wilson River.

Tall to very tall open forest to open woodland

Along the Wilson and Richmond river and their tributaries – lower and mid reaches

Forest Red Gum and River Oak were often co-dominant or River Oak dominated the canopy with Forest Red Gum emergent. In some areas Forest Red Gum was dominant. Hoop Pine and Swamp Oak were often present. The mid stratum included Black Tea-tree *Melaleuca bracteata* and Prickly-leaved Teatree with Red Bottlebrush fringing the river or creek bank. This community merged into riparian rainforest and River Oak.

Weeds: Indian Coral Tree, Camphor Laurel, Mulberry, *Ipomoea* spp., Balloon Vine

Black Tea-tree (BTt)

Black Tea-tree near Pelican Creek.

Midhigh to tall open forest to woodland

In the Blue and Grey Zones Black Tea-tree may be comparable to the Interim Vegetation Type *Melaleuca bracteata* riparian forest (**Table 9**). The community was found on or associated with drainage lines on the floodplain around Pelican Creek and Parrots Nest. Black Tea-tree was also located along the lower reaches of the Wilson River.

Around Pelican Creek and Parrots Nest the upper stratum was dominated by Black Tea-tree. Hoop Pine and Forest Red Gum were often present in the upper stratum or emergent. Large clumps of Cockspur were frequently present around the margins and openings and sometimes Black Tea-tree occurred as mono-specific stands with a grazed open understorey.

Along the Wilson River this community typically included River Oak and Swamp Oak in the upper stratum.

Weeds: Indian Coral Tree was common in the understorey along the Wilson River.

River Oak (RO)

Tall to very tall open forest to open woodland

In the Blue and Grey Zones, River Oak may be comparable to the Biometric Vegetation Type River Oak riparian woodland of the North Coast (**Table 9**).

River Oak dominated long sections of the Wilson and Richmond Rivers. The upper stratum was dominated by River Oak. Hoop Pine and Forest Red Gum were often emergent. The mid stratum was variable but typically included rainforest species including Native Elm, Red Kamala and Giant Water Gum. Indian Coral Tree frequently dominated the mid stratum. Red Bottlebrush fringed the creekline. The ground stratum was variable but was generally dominated by introduced species such as Elephant Grass and Castor Oil Plant.

Weeds: Balloon Vine, Moonflower, *Senna* spp., Indian Coral Tree and Camphor Laurel

Swamp Oak-River Oak forest (SO-RO)

Tall to very tall open forest to open woodland

This community was mapped along the lower reaches of the Wilson River. Swamp Oak and River Oak were co-dominant. Forest Red Gum was present in the upper stratum and as an emergent. Indian Coral Tree dominated the understorey and rainforest was also present. Red Bottlebrush lined the river edge. The ground stratum was variable but was generally dominated by introduced vines.

Weeds: Balloon Vine, Moonflower, Coast Morning Glory, Mulberry *Morus alba.*

Saline wetlands formation

Mangrove Swamp

Mangrove (M)

Mangrove forest on the lower reaches of the Richmond River. Rainforest and vines in the foreground.

Low closed forest

In the Blue Zone, Mangrove is consistent with the Biometric vegetation type Grey Mangrove low closed forest of the NSW Coastal Bioregions (**Table 9**). This community was located on the lower reaches of the Richmond River near Broadwater. The upper stratum was dominated by Grey Mangrove *Avicenna marina*. River Mangrove *Aegiceras corniculatum* dominated the mid stratum. Cottonwood was sometimes present at the landward margins. The ground layer was often dominated by Mangrove Fern.

Weeds: Camphor Laurel, Five-leaf Morning Glory, Lantana and Indian Coral Tree on edges.

Miscellaneous

Exotic

Indian Coral Tree (IC)

Low to midhigh shrubland to open shrubland

This community's distribution extended from the lower reaches of the Wilson River near Coraki to the mid reaches of Terania Creek. It was primarily associated with riparian areas and drainage lines but was also mapped on the floodplain and on hill slopes. Indian Coral Tree dominated the upper stratum. Swamp Oak and Black Tea-tree were sometimes present. Forest Red Gum and River Oak were often emergent. The mid stratum was often dominated by Balloon Vine, Moonflower and Cockspur Vine.

Lantana shrubland (L)

Low to midhigh shrubland to open shrubland dominated by Lantana. Recorded throughout the study area mainly as an understorey within other vegetation but also mapped where Lantana formed large areas of shrubland. Often developed as mono-specific stands and/or associated with sparse Wattle and rainforest regrowth.

Privet (Pr)

Low to tall closed to open forest

The community was extensive on the volcanic soils west of Lismore around Caniaba and Pelican Creek.

The upper stratum was dominated by Large-leaved Privet. In the eastern part of the study area where there is higher rainfall the upper stratum often included Camphor Laurel but in the drier western areas around Caniaba and Pelican Creek dry rainforest regrowth (Macaranga, Red Kamala, Cockspur Vine) were common associates.

Large-leaved Privet was also common as an understorey component of rainforest regrowth and wet sclerophyll forest.

Small-leaved Privet was more common in the eastern part of the study area, generally as an understorey or edge species with rainforest.

Various exotic (Ve)

Low to tall open forest to woodland

This community describes exotic vegetation dominated by species other than Camphor Laurel, Privet or Indian Coral Tree. It includes Slash Pine *Pinus elliottii* regrowth, Willow, Chinese Elm *Celtis sinense* and Jacaranda *Jacaranda mimosifolia*.

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