

2016

Volume 1: Vegetation Mapping Report, Lake Macquarie Local Government Area

Stages 1 - 6



March 2016

Report to

Lake Macquarie City Council

Stephen Bell & Colin Driscoll

Eastcoast Flora Survey
PO Box 216
Kotara Fair NSW 2289



Report produced by:

Dr Stephen A.J. Bell
Eastcoast Flora Survey
PO Box 216 Kotara Fair NSW 2289 Australia

Telephone (02) 4953 6523
Email: sajbell@bigpond.com

ABN 38 325 015 471

Dr Colin Driscoll
Hunter Eco
PO Box 1047 Toronto NSW 2283 Australia

Telephone (02) 4959 8016
Email: cd_enviro@bigpond.com

This document should be cited as:

Bell, S.A.J. & Driscoll, C. (2016) *Volume 1: Vegetation Mapping Report, Lake Macquarie Local Government Area. Stages 1 - 6*. Unpublished Report to Lake Macquarie City Council. March 2016. Eastcoast Flora Survey.

Disclaimer:

While reasonable efforts have been made to ensure that the contents of this publication are factually correct, Lake Macquarie City Council does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this publication.

Cover image: Views of Snappy Gum Ridgetop Heathy Forest (top), Freshwater Gahnia Sedgeland (bottom), & flowering *Angophora inopina* (greyscale).

Report produced for:

Lake Macquarie City Council
Box 1906
Hunter Region Mail Centre NSW 2310

Project Manager: Robbie Economos (Environmental Planner)

SUMMARY

Detailed high resolution vegetation mapping of the Lake Macquarie local government area was commenced in 2008, and this report summarises the work completed to June 2015. A staged approach has been adopted by Council, to allow for funding as it became available, and has included: the Wyee - Cooranbong area (Stage 1), the Glendale – Bolton Point – Seahampton area (Stage 2) the Bolton Point – Dora Creek area (Stage 3), the Mandalong Valley area (Stage 4), the Belmont – Charlestown – Speers Point area (Stage 5), and the Belmont – Catherine Hill Bay area (Stage 6). In total, approximately 65,300 ha have been mapped across the LGA. The mapping and classification adopts the LHCCREMS 2000 vegetation classification as its structural framework, but with updated sub-community and new community allocations to form an **Interim Community Classification (ICC)**. This ICC has been informed through preliminary regional multivariate data analysis undertaken for unrelated projects elsewhere in the region. Newly collected data as part of this project (105 plots, across all Stages) has been incorporated into an LGA-wide analysis to continue detailed data exploration. Results from a separate analysis examining the status of rainforest within the City (specifically littoral rainforest) are included in this report.

Volume 1 of this work presents the background to the project, together with methods and results of both the mapping and classification. Volume 2 presents profiles for all vegetation communities contained in the mapping.

Important Note: Work completed to date should remain a work-in-progress, and should not be considered as final or definitive. For any public release of the mapping, it is suggested that the following title and disclaimer be attached to it:

Title: *Lake Macquarie Working Draft Vegetation Community Map (version XX 2015)*

Disclaimer: This map layer has been compiled based on 18,100 ground control points (RDPs), although some small areas have been adopted directly from previous studies using different mapping methods. All data requires careful interpretation with consideration of the accuracy field at any location. Full floristic plot survey and multivariate analysis has not been undertaken for many of the map units, hence their position in the classification hierarchy is yet to be confirmed. This map should not be used as a substitute for full site-specific floristic survey using standard techniques (quadrats & transects etc) and should be used in conjunction with the accompanying reports.

Although every care has been taken in the preparation of these maps, Lake Macquarie City and the authors accept no responsibility for any misprints, errors, omissions, or inaccuracies in these maps or damages resulting from the use of this information.

Citation: Bell, S.A.J., Driscoll, C & Lake Macquarie City Council (2015) *Lake Macquarie Working Draft Vegetation Community Map 2015*. Lake Macquarie City Council.

TABLE OF CONTENTS

1.0	Background	2
1.1	Project Tasks.....	3
1.2	Project Limitations.....	3
2.0	Study Area	5
3.0	Previous Studies	7
4.0	Methods	9
4.1	Field Survey	9
4.2	Mapping.....	10
4.3	City-wide Mapping	11
4.4	Numerical Analysis	11
5.0	Results	13
5.1	RDP Coverage & Mapping	13
5.2	Numerical Analysis	14
5.2.1	Intuitive definitions & the Interim Community Classification.....	14
5.2.2	Analysis 1 (Lake Macquarie LGA)	14
5.2.3	Analysis 2 (Rainforest).....	16
5.3	A Note on Vegetation Structure	20
6.0	Discussion.....	21
6.1	Mapping Accuracy	21
6.2	Recommendations.....	23
6.3	Disclaimer & Public Release	24
7.0	References.....	25
	Appendix 1 – Previous Vegetation Studies within Lake Macquarie LGA.....	28
	Appendix 2 – Interim Community Classification Summary	30
	Appendix 3 – Interim Community Classification: EEC, Keith & Greater Hunter Equivalents	60

1.0 BACKGROUND

Lake Macquarie City Council is seeking an improved vegetation community map layer for the entire local government area (LGA), of which approximately 38,557 hectares is vegetated. Previous mapping projects undertaken by various organisations (government & private) have been inconsistent or locally inaccurate, and have not been reliable for strategic planning initiatives.

Since 2008, *Eastcoast Flora Survey* has been commissioned to prepare a locally accurate vegetation map layer for the LGA, consistent with similar mapping completed elsewhere in the Lower Hunter and Central Coast. Completion of the entire Lake Macquarie map layer has been contingent on the availability of annual funding, which necessitated a staged approach to the project. Six stages have encompassed the Wyee - Cooranbong area (Stage 1), the Glendale – Bolton Point – Seahampton area (Stage 2), the Bolton Point – Dora Creek area (Stage 3), the Mandalong Valley area (Stage 4), the Belmont – Charlestown – Speers Point area (Stage 5), and the Swansea – Catherine Hill Bay area (Stage 6).

In summary, the objectives of the LGA mapping project have been to:

1. Review available vegetation mapping datasets for the City including the LHCCREMS 2003 vegetation mapping to determine accuracy and utility (predominantly in the early Stages);
2. Identify data gaps and seek to obtain additional data for these gaps;
3. Undertake field surveys to enhance the accuracy of the LHCCREMS 2003 vegetation mapping (or other suitable base data). Field surveys to include spot checks and transects of existing mapping boundaries, and full floristic plots for any new vegetation communities;
4. Provide a report which documents the methods, results and recommendations and includes detailed vegetation descriptions for any new vegetation communities;
5. Produce a vegetation data set and map that is suitable for use at the local area planning scale and is capable of progressive updating and improvement.

Stage 6 incorporated the first LGA-wide multivariate numerical data analysis of available full floristic data, and included the collection of an additional 60 sample plots. This dataset was used to develop a *hybrid intuitive-numerical classification*, recognizing data gaps in the LGA dataset for poorly sampled communities. The classification employed in the mapping is consequently an ***Interim Community Classification*** (ICC), and requires further refinement as additional data becomes available. In all likelihood, some mapping units based on the ICC will require revision to ensure all map units are supported by data analysis.

This report (**Volume 1**) summarises the mapping and classification process that has occurred since 2008, while detailed vegetation community profiles and associated supporting information is contained in **Volume 2**.

1.1 PROJECT TASKS

Following discussions with Council staff at commissioning for Stage 1, it was agreed that the following tasks would be undertaken throughout the course of the project:

- Complete detailed, locally-accurate mapping for Council-defined priority areas in the following areas:
 1. Wyee – Morisset - Cooranbong - Barnsley (Stage 1: 2008-9)
 2. Glendale – Bolton Point - Seahampton (Stage 2: 2010), later amended to include data and mapping collected for a separate project on the Lower Hunter Spotted Gum – Ironbark Forest EEC (Bell 2009)
 3. Bolton Point – Dora Creek (Stage 3: 2011)
 4. Mandalong Valley (Stage 4: 2013)
 5. Belmont – Charlestown – Speers Point (Stage 5: 2012)
 6. Swansea – Catherine Hill Bay (Stage 6: 2014).
- Vegetation community nomenclature to be consistent with the LHCCREMS classification (NPWS 2000), applying sub-communities or new communities where considered appropriate;
- Prepare a draft base map layer for the entire LGA, incorporating available locally-accurate mapping sourced from Council, and utilising the same community nomenclature (initiated in Stage 1, but requiring progressively less emphasis during later Stages);
- Prepare a brief report after each Stage summarising the methods and findings, and including sufficient description of newly defined communities or sub-communities to allow third parties to identify them in the field.

1.2 PROJECT LIMITATIONS

A number of limitations were evident with respect to the mapping produced as part of this project, and these dictate how the information should be used:

Previous studies - A requirement of the project, particularly in the early stages, was to utilise as much existing information as possible, such as that made available through various development application reports, re-zonings, specific mapping projects, surveys of conservation reserves, etc. While a large body of such information has been reviewed for this purpose, it was important that stringent rules be applied to ensure a quality result (outlined later). As the project progressed, the use of previous studies was superseded by more current data.

Private property access – In some areas, restrictions to access on many private properties throughout the LGA resulted in a lower quality of mapping.

Extant vegetation base layer – Council required that all new mapping be constrained by the extant vegetation map layer produced by Council in 2004 (for the Stage 1 area), 2007 (for Stage 2) and 2010 (for Stages 3 - 6). In reality, this meant that a compromise had to be made between newly collected ground information and what had previously been mapped as extant vegetation. Examples include the mapping of shadows as vegetation, recently cleared areas, missed polygons of vegetation, cleared powerline easements etc, particularly in the 2004 extant mapping. The more recent native vegetation extant mapping (ie 2010) has improved in accuracy although there remain some discrepancies. The coastal zone in particular has raised some important issues, such as portrayal of Beach Spinifex and Coastal Headland Grassland (a listed TEC) as cleared vegetation, meaning that some areas have been excluded from the LGA map when clipped to the 2010 extant vegetation layer. New extant vegetation cover mapping is undertaken by Council as updated remote sensing or aerial photography becomes available, and the Lake Macquarie City Working Draft Composite Vegetation Community Map will continue to be clipped and constrained to any updated vegetation extant base layer by Council.

Vegetation classification - Importantly, although broadly based on the regional vegetation classification first released by NPWS (2000), the allocation of specific vegetation types and locations to this scheme has been done intuitively by the authors using the ***Interim Community Classification*** (ICC). Up until Stage 6, there has been no full floristic analysis of standard plot data specifically for this project, although ongoing research in the region in recent years has involved numerous data analyses in this regard. Sub-communities and variations within the original NPWS (2000) classification, while based broadly on these ongoing analyses, are yet to be fully tested as to their appropriate hierarchical position in the classification. As a consequence, the positioning of some units described in this report may change with future work. From 2013 a start was made on the numerical classification, concentrating on areas within Stages 1-3 requiring clarification, and with specific questions over Littoral Rainforest. Overall, this approach is in effect the reverse of standard classification and mapping projects, where mapping portrays a previously defined classification.

Completion of the Stage 5 mapping area coincided with the release of the Greater Hunter Vegetation Mapping (Sivertsen et. al. 2012), and attempts were made to incorporate units defined in the GHVM with the Lake Macquarie mapping. However, differences in resolution of defined communities (regional vs local) meant that this was to be a difficult task (see also Hunter 2015). Wherever possible, equivalent communities in the GHVM have been included in the data tables accompanying the Lake Macquarie units. Ultimately, GHVM units were applied by conversion of the allocated ICC Map Unit rather than allocating the GHVM unit in the field directly or to the RDP (refer to further note in Section 3). In total, 25 Lake Macquarie units proved difficult to apply to GHVM units (annotated in Volume 2 with '?'), and 27 had no equivalent at all (annotated 'no equivalent').

2.0 STUDY AREA

Throughout the staged process, Council has defined priority areas for detailed mapping as funding became available. Across the life of the project, priorities have included:

- the Wyee, Morisset, and Cooranbong areas (Stage 1), a total area of 9,027 ha.
- the north-west of the LGA, a further 7,590 ha. Later expanded with an additional 2,381 ha to encompass the area around Sugarloaf SCA (Stage 2).
- Stage 3 linked mapping between Stages 1 and 2, and covered approximately 17,000 ha.
- the Mandalong Valley in the south-west of the LGA (Stage 4), encompassing 12,730 ha between Stage 1 and the conservation reserves of Jiliby SCA and Watagans NP.
- Stage 5 focused on 10,270 ha in the north-eastern portion of the City, extending from Belmont north to Charlestown and Dudley, and west to Speers Point and Glendale.
- Stage 6 completed the south-eastern sections, south from Belmont to Catherine Hill Bay and encompassing the Wallarah Peninsula, covering 9,063 ha.

Note that some areas of conservation reserve managed by the NSW Office of Environment and Heritage (Watagans NP, Jiliby SCA, Sugarloaf SCA) have been excluded from all stages, as mapping using identical methods has already been completed by the authors (Bell & Driscoll 2006b, 2009) and has been incorporated into the City-wide map layer. Glenrock SCA and Awabakal NR, although mapped using different methods (Bell 1998), has now been updated and included. Existing mapping of all other reserves managed by OEH (Tingira Heights NR, Wallarah NP, Lake Macquarie SCA, Pulbah Island NR, Munmorah SCA) have been included and revised in the current work.

Figure 1 shows the distribution of all six Stages over the course of the project, within the LGA.

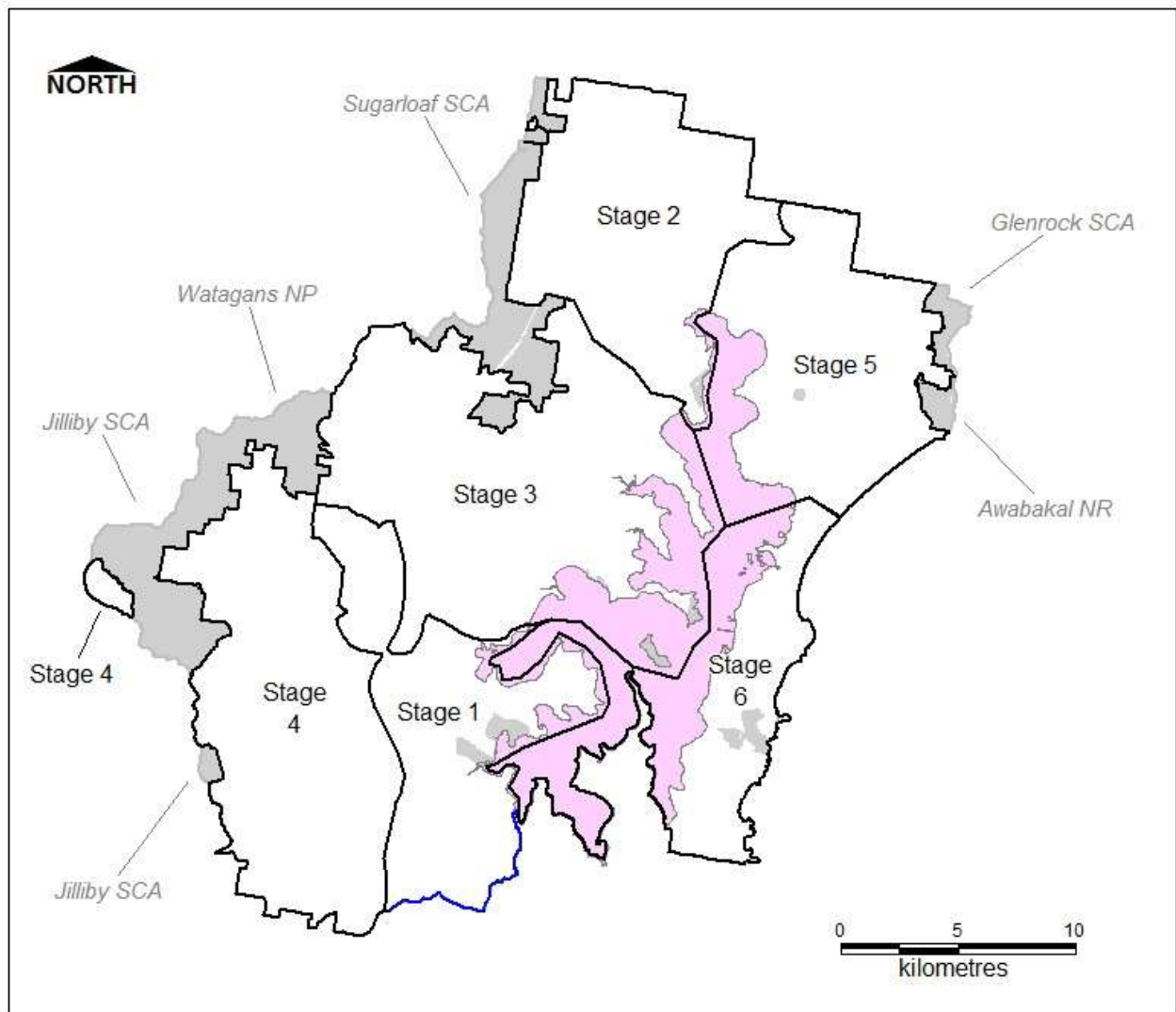


Figure 1 Stages 1 - 6 study areas within Lake Macquarie LGA: Stage 6 is the most recently completed area, comprising 9,063 ha. Location of NPWS estate mapped previously by the authors also shown.

3.0 PREVIOUS STUDIES

A large number of flora and vegetation mapping studies have been completed within Lake Macquarie LGA. Council maintains a biodiversity database in this regard, and where possible useful documents have been sourced from this database for progressive incorporation into the mapping (see Appendix 1 in Bell & Driscoll 2014). **Appendix 1** (this Volume) lists those previous studies that have been used directly in the production of the current City-wide map. In some instances, floristic data provided in the body of reports were reformatted to assist in creating and truthing sections of the mapping.

In all cases, newer ground-based mapping completed as part of Stages 1-6 was preferred over older mapping and reports, to ensure that consistency in interpretation and community nomenclature was maintained.

Other information provided by Council for review included:

Lake Macquarie Biodiversity Project (1994) - Although a large amount of information is contained within the Lake Macquarie Biodiversity Landsat Project conducted in 1994 (involving the ground truthing of nearly 100 sites within the region, ~50 within Lake Macquarie LGA), mapping produced as part of that project was of little use to the current project. However, floristic data collected at each site was potentially suitable to assist in validating specific areas, and this data was converted to a useable format from the paper hard copies supplied by Council.

Lake Macquarie City Wide Vegetation, Fauna Habitat and Biodiversity Mapping Project (1998) – Similarly, summaries of floristic information are available at 46 locations around the City, and this information has been converted into a usable format for truthing of the current project. However, as this information was collected prior to the wide availability of accurate GPS units, recorded positional accuracy is likely to vary. Some species identifications are also questionable, with many entries including “stringy” as the only clue to dominant species.

Lake Macquarie Wetlands Mapping (1998) – mapping comprising twenty categories of wetland vegetation (mud flat; non-wetlands; intermittent fresh meadow; open water; perennial fresh/brackish rushland, reedswamp, meadow; *Phragmites* reedswamp; saltmarsh; sand; seagrass; swamp forest – *Casuarina glauca*; swamp forest – *Casuarina glauca* & mangrove; swamp forest – *Casuarina glauca* & *Melaleuca*; swamp forest – *Eucalyptus robusta*; swamp forest – *Eucalyptus robusta* +/- *Melaleuca* +/- *Casuarina*; swamp forest – *Livistona australis* +/- *Melaleuca* +/- *Casuarina*; swamp forest – *Livistona australis* +/- *Melaleuca* +/- *Casuarina* +/- *Eucalyptus robusta*; swamp forest/ scrubland – mangrove; swamp forest/ scrubland – *Melaleuca*; *Typha* rushland; wet heath). Each wetland has been reviewed and incorporated into both the high resolution extant map layer and the City-wide map layer where more recent ground data is lacking.

Lower Hunter & Central Coast Regional Environmental Management Strategy (LHCCREMS2003) – this major classification and mapping project (originally described in full in NPWS 2000) attempted to describe and map the vegetation diversity across seven LGA’s in the lower Hunter Valley and Central Coast. Maps produced were the result of modeling vegetation distribution in relation to 43 environmental variables, and

consequently errors and inaccuracies were expected. The classification behind the modeling was based on over 1100 detailed survey plots, and generally provided a strong basis for categorising all vegetation. This classification has been used as the basis of the current project. Mapping has only been adopted for the City-wide map layer where existing locally mapped information is absent, and will be progressively phased out with continuation of detailed mapping.

Since 2000, a revised classification has been presented for the Central Coast by Hunter Councils on behalf of the Hunter-Central Rivers CMA (McCauley et. al. 2006), and a separate one for the Hunter, Central and lower North Coast region (Somerville 2009). Where possible, these units have been rationalized with the classification used for Lake Macquarie, although the McCauley et. al. (2006) product has not been widely adopted in the region.

Lake Macquarie Community Ecosystem Monitoring (2010 onwards) – a community-based monitoring program co-ordinated by Lake Macquarie City Council and harnessing the expertise of volunteers has been in operation since 2010. Floristic data has been supplied for designated sites within the City, which have been converted to rapid data points for use in the mapping process and community mapping verification. Because these data did not include application of cover abundance values to each species (eg: the Braun-Blanquet 1-6 scale: see Section 4.4), their use in numerical classification was limited.

Greater Hunter Vegetation Mapping (Sivertsen et. al. 2012) – a major mapping initiative for the Hunter Region (incorporating the Hunter-Central Rivers Catchment Management Authority area), and utilizing the classification of Somerville (2009) as its basis. Existing field data, mapping, classification and remote sensing interpretation were augmented with new survey data to produce a vegetation community classification, describing over 252 native communities. The GHVM builds on a wealth of information and previous mapping from throughout the Hunter region, but has produced disappointing results (see Hunter 2015). Despite this, units described for the GHVM have been reviewed and incorporated as equivalent vegetation types where reasonable matches are evident. Locally-defined Lake Macquarie units that have been difficult to align have been annotated as ‘no equivalent’. A review of the mapping component of GHVM project conducted within Council has demonstrated that the accuracy of the linework and attribution is very poor, and is consistent with that found by Hunter (2015) for the upper Hunter region. Whilst the classification component of the GHVM may be useful in providing a regional context, the mapping is not recommended by Council or Hunter (2015) to be used at any scale (regional or local) for any purpose.

4.0 METHODS

The methods used in the classification and mapping of Lake Macquarie have not followed a traditional pathway. In most projects such as this, the classification of vegetation is normally undertaken first, and then mapping the distribution of each defined unit follows. However, limited funding availability from year to year meant that the mapping of putative vegetation communities (*floristic strata*) was undertaken initially, using the progressively updated and intuitively-based Interim Community Classification (ICC). Upon completion of floristic strata mapping, additional sampling at full floristic plots was undertaken, and then all data analysed to produce a classification. Such retro-fitting of a classification to a map will never result in a perfect outcome, and invariably there remain some outstanding issues that will require resolution.

4.1 FIELD SURVEY

As funding allowed, priority areas identified by Council were targeted for survey and mapping (see Section 2). To date, the entire LGA (with the exception of some larger private lands with limited access) has now been mapped. Field survey focused on the gathering of dominant floristic species from the canopy, shrub and ground layers at as many locations as possible, through a new method of mapping being developed by the authors for accurate spatial depiction of vegetation biodiversity (see Bell 2013 for details). Central to this method is the recognition that variability in vegetation distribution at the local scale cannot yet be predicted blindly using computer GIS programs, and that documenting what actually occurs on the ground is an essential component in producing a reliable final map. Many recent mapping programs have relied heavily on GIS capabilities to predict where certain vegetation communities occur, with often limited results (eg: the LHCCREMS vegetation modeling, NPWS 2000; Greater Hunter Mapping, Sivertsen et. al. 2012). Effective modeling using these techniques is determined by the scale and accuracy of predictor values, and at a local scale these are rarely available.

Rapid Data Points (RDP's) are summaries of floristic information recorded at specific points in the field. These points are not standard plot sizes (such as a 20x20m plot) but are variable in size, and are aimed at briefly summarising the vegetation within view. This will vary with differing vegetation types, but the aim is to collect enough RDP's so that an averaging of progressive points occurs and provides a realistic picture of the dominant trends. A live GPS feed to a laptop computer, running Manifold[®] GIS, shows location information in real-time. At specific and regular locations, summaries of the vegetation are entered onto a database table within the GIS. Information recorded includes:

- Canopy layer dominant species
- Shrub layer dominant species
- Ground layer dominant species
- Draft (field-observed) vegetation unit
- Miscellaneous notes
- representative locations for later full floristic data collection

Initially, all trafficable roads, tracks and trails across the study area are driven recording RDP's. Those areas lacking extensive trail networks are then walked with hand-held GPS units, recording the same information that is later added to the main database. In this way, a large dataset of summary information can be rapidly

collected and used in vegetation mapping procedures. The data also proves invaluable as a ground-truthing mechanism for the final vegetation map, where potential discrepancies can be referred directly back to raw data. Where necessary, RDP data is also collected across highly urbanised or fragmented areas (such as remnant trees in backyards, etc), and is particularly informative in assigning small remnants of vegetation to community type using landscape trends.

This method has been used by the authors in a number of studies over the last decade, most notably for the Tomago and Tomaree Sandbeds north of Newcastle (Bell & Driscoll 2006a), Watagans National Park and Jiliby State Conservation Area (Bell & Driscoll 2006b), and the Cessnock-Kurri region (DECC 2008). By comparison to traditional modeling methods, it offers a time-efficient alternative for producing a map of vegetation biodiversity based on real ground data, and one with a considerably longer 'shelf-life'.

In some circumstances, existing studies submitted to and held by Council may have provided data and mapping in support of development applications, rezoning studies and the like. If ready access to the public is available in these areas, then the collection of new RDP data has still occurred during the current mapping process. In most cases, newly collected RDP has taken precedence over older existing studies, if for no other reason than to maintain consistency and context with surrounding lands. Some areas would allow only partial access to collect new data: in these situations, review of existing studies would include adoption of mapping for those more inaccessible locations.

4.2 MAPPING

Each of the Rapid Data Points collected across the study area were allocated initially to broad vegetation units previously defined for the area (NPWS 2000). As the process progressed, sufficient floristic differences could often be recognised and draft sub-communities or variants of those broad communities created, and a second community attribute (subunit) added to the data table. Regular revision and updating of the broad units and subunits occurred at the completion of each field day, and at the cessation of all data collection. A final review of the allocated coding to each point was made following completion of the intuitive classification process, where changes in the classification hierarchy (community, sub-community, variant) were made to reflect classification units. Given the absence of a full LGA-wide numerical analysis of full floristic data prior to mapping (but see Section 4.4), community allocations were made against the intuitive ICC maintained by the authors.

For Stage 5, attempts were made to allocate RDP directly to the new Greater Hunter Vegetation Mapping classification, but it quickly became apparent that this would be difficult due to the differing scales of resolution, and was not economical with available project time. Several GHVM units were also difficult to rationalize with on-ground observations.

The vegetation mapping process began with the generation of a base community layer in Manifold[®] GIS, extrapolated using the Voronoi algorithm from collected RDP's, and their associated ICC unit tags. The Voronoi area algorithm creates polygons such that the boundary of the polygon lies halfway between the next neighbouring point in any direction; in the absence of any other information as to where a community boundary lies, halfway is often the only acceptable assumption. Within MapInfo © GIS, the extrapolated linework was overlaid onto high resolution digital ortho-rectified aerial photographs supplied by Council (flown 2004 for Stage 1, 2007 for Stage 2, 2010 for Stages 3 - 5), and each polygon manually edited where necessary to reflect observable changes in photo-patterns (eg: riparian vegetation, rainforest patches,

heath) which the extrapolation process did not adequately replicate. Subsequent to this, additional interpretation of areas was undertaken on-screen to highlight potentially different types of vegetation for follow-up ground-truthing. This layer was then cut to the extant vegetation layer supplied by Council; for Stage 1 this was the LMCC2004 v4 layer, for Stage 2 LMCC2007, and for Stages 3 - 6 Veg2010. For Stages 3 to 6, LMCC extant vegetation polygons 'b' (bushland) and 'pc' (partly-cleared) were used in the cutting process, with 'water' and 'pf' (plantation forestry) polygons also added.

At all times in the vegetation mapping process, reference was made to the data collected during the RDP phase to confirm specific ICC units. In some limited cases, perimeters of certain vegetation types were walked with a hand-held GPS to further refine the map. Final polygon attributes relied predominantly on ground data wherever possible, rather than remotely assessed data.

In heavily urbanised parts of the City, such as much of Stages 2, 3 and 5, a landscape approach to mapping was required to address the likely identity of the numerous small and degraded patches of weed-infested native vegetation remaining. Remnant trees (in backyards, along road verges) or canopy species within disturbed patches of bushland were used as markers to point towards the original vegetation community, akin to the development of a pre-1750 vegetation map (eg: DECC 2008). Use of the Voronoi area algorithm described above essentially provides the basis for this, which was modified within GIS through comparisons to topography and the geographical spread of soil landscape and drainage data. Areas supporting more remnant trees provide a better representation of the original community distribution than do those areas with fewer trees.

4.3 CITY-WIDE MAPPING

At the commencement of this project in 2008, a City-wide vegetation map was prepared by reviewing existing studies completed for development-related work and incorporating them into the LHCCREMS 2003 model of vegetation. This process subsequently entailed the progressive replacement of pre-existing studies with the higher resolution mapping from Stages 1 – 6, meaning that the current final map layer includes few of those originally incorporated (see Bell & Driscoll 2008). Appendix 1 lists those existing studies that remain a part of the final City-wide layer, either in the form of map polygons or as RDP used in the mapping process.

Previous studies identified as suitable for the City-wide mapping met the following criteria:

- Provision of a vegetation map (preferably digital, but hard copy was acceptable);
- Provision of enough floristic information for each mapping unit to enable categorisation into the regional framework;
- Evidence of comprehensive field effort across the specific study area.

From Stage 3 onwards, Council managed the importation of high resolution maps into the City-wide layer.

4.4 NUMERICAL ANALYSIS

Stage 6 included a more formalized analysis of full floristic data across the entire LGA using numerical techniques (Analysis 1), building on that undertaken in 2014. New sampling was undertaken preferentially in poorly sampled putative vegetation communities during Stage 6, with reference to the existing dataset.

One intention of this was to provide guidance on the integrity of units within the ICC, particularly in regard to other similar units. In addition, confusion over the composition and distribution of Littoral Rainforest (a listed TEC) within the City in 2014 led to a separate analysis of rainforest vegetation, which has now been updated with newly collected data (Analysis 2).

Existing datasets – prior to Stage 6, an existing dataset of 420 full floristic plots sampled by the authors within Lake Macquarie LGA (Analysis 1) provided a substantial base upon which to build a new classification. Many of these sites were completed on public lands on behalf of various government bodies, while others lay on private land and formed part of development assessment studies. For rainforest vegetation (Analysis 2), a dataset of 156 existing plots from within the region (Sydney Basin and environs) was used to place potential littoral rainforest stands in Lake Macquarie within a regional rainforest context. All plots utilized the same sampling method, and most are now publically available from the NSW OEH VIS web site (<http://www.environment.nsw.gov.au/research/vegetationinformationsystem.htm>).

Data collection - new plot sampling as part of Stage 6 followed standard techniques consistent with previous data collection initiatives in the region. Within designated plots of 0.04 ha, all vascular plant species were recorded and applied a cover abundance score using the modified Braun-Blanquet scale: 1 (<5% cover and rare); 2 (<5% cover and common); 3 (5-25% cover); 4 (26-50% cover); 5 (51-75% cover); and 6 (76-100% cover). Sivertsen (2010) recommends the use of a 24-point cover abundance scale; however this has not been adopted in the current study due to the large amount of existing regional data using the 1-6 scale (see Bell 2000). Physical attributes of the site (vegetation structure, soil type, elevation, slope, aspect, physiographical position, etc) are also recorded, and photographs taken of the site for later reference. The location of new plots was undertaken preferentially within representative stands of poorly sampled vegetation, generally in areas identified as being suitable during previous RDP collection.

Plant identification - plant specimens of unknown or significant status were collected for later identification or lodgement with the National Herbarium in Sydney. Orchid specimens were identified in the field with the aid of Bishop (2000), or digital photographs taken to assist later identification.

Data analysis - prior to data analysis, a review of plant taxonomy was undertaken for all taxa included in the analysis dataset to ensure consistency of nomenclature. Nomenclature according to Harden (1990-1993; 2002) and Harden and Murray (2000) was used as the standard, except where more recent revisions have been published in recognised scientific journals and accepted by the National Herbarium of New South Wales (<http://plantnet.rbgsyd.nsw.gov.au/floraonline.htm>). Floristic data were analysed with *Primer* V6 (Clarke & Gorley 2006), using multivariate techniques to assist in classifying the vegetation present in the study area. Agglomerative hierarchical cluster analysis and non-metric multidimensional scaling (nMDS) were performed on the dataset using the group averaging strategy, the Bray-Curtis similarity measure and a Beta value of – 0.1. Ordinations were performed in two and three dimensions with 25 random starts and a minimum stress of 0.01. The SIMPROF routine in *Primer* was used to examine the structure of the data and look for significant splits, while SIMPER was used to identify diagnostic species for each community.

5.0 RESULTS

5.1 RDP COVERAGE & MAPPING

Figure 2 shows the extent of field-collected RDP's utilised in the mapping process for Stages 1-6 combined, together with pre-existing RDP for Sugarloaf SCA, Jilliby SCA and Watagans NP. In total, over 18,100 RDPs have been used to inform mapping across this 65,300 ha land area.

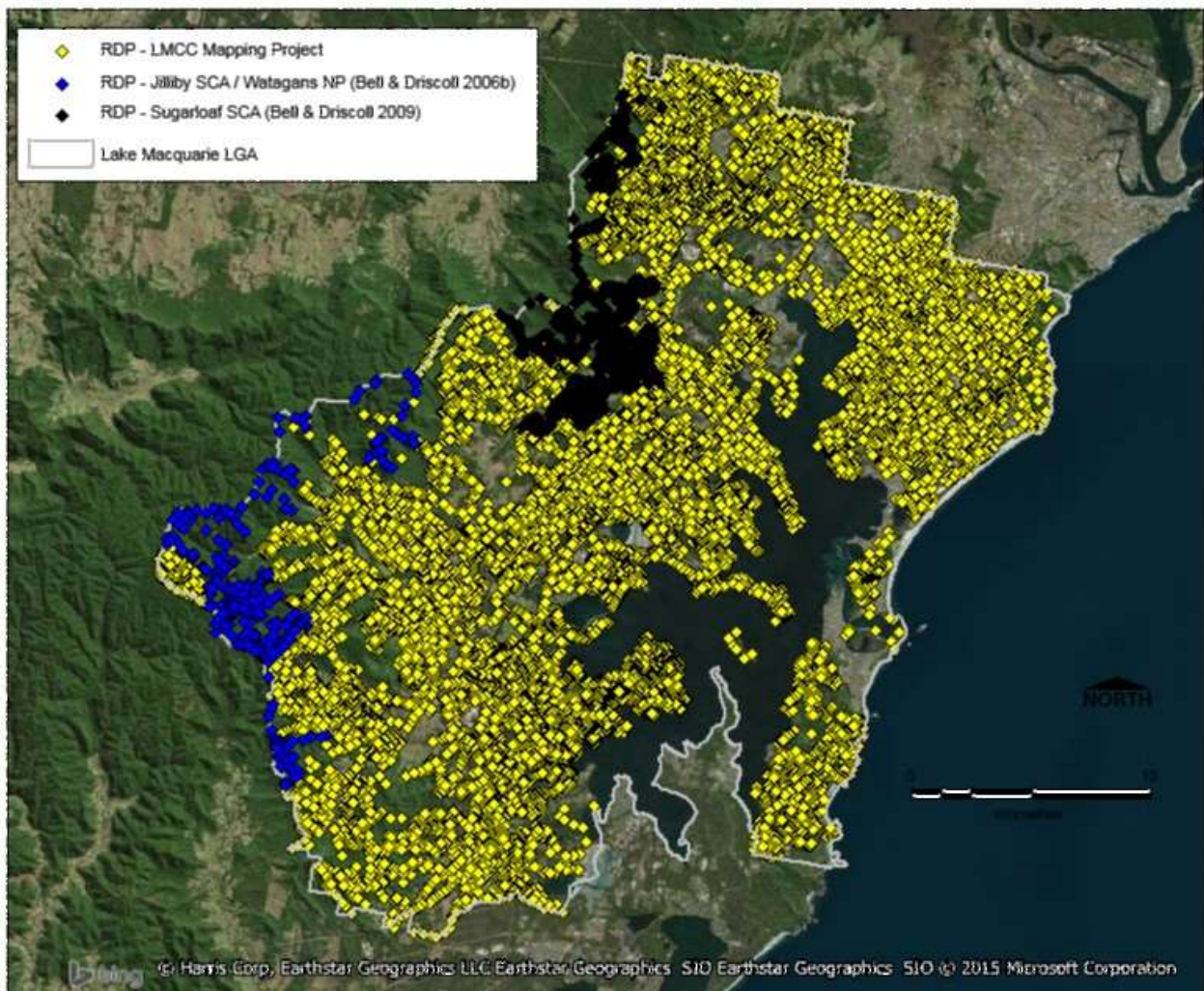


Figure 2 Field-collected Rapid Data Points (RDP) within Lake Macquaire LGA.

Progressive drafts of the high resolution vegetation map layer have been submitted to Council over the course of the project, and reviewed where necessary. Data fields within the map layer include cross-referencing to previous LHCCREMS vegetation units (NPWS 2000), Endangered Ecological Communities (TSC Act 1999), Keith Classes (Keith 2004), Hunter Councils Lower North Coast 2011 vegetation units (Somerville 2009) and NSW Vegetation Classification & Assessment types (Benson 2006). For Stages 4 to 6, cross-referencing to the Greater Hunter Vegetation Mapping units (Sivertsen et. al. 2012) has also been

undertaken. Accuracy of mapping has been inferred based on the level of field effort expended in a particular area (see Section 6.1).

5.2 NUMERICAL ANALYSIS

5.2.1 INTUITIVE DEFINITIONS & THE INTERIM COMMUNITY CLASSIFICATION

As noted previously, in the absence of funding to fully sample and analyse full floristic plot data for the entire LGA, amendments to the regional ICC have been intuitively based. Up until Stage 6, classification has relied on *ad hoc* additional sampling undertaken for other projects within Lake Macquarie and surrounding areas, but with some targeted survey (45 plots in Stage 4). As a result, the Lake Macquarie classification is a work in progress and documents potential and probable new communities or sub-communities based on field experience and the ongoing regional ICC in development by the authors. This intuitive classification is cased within the NPWS (2000) numerical classification, so that direct cross-referencing can be made. Coding of new vegetation units recognises the existing NPWS (2000) coding, and do not overlap. Units that could not be readily housed within the NPWS (2000) classification were attributed a new 3-digit code (>100). Some of the newly defined vegetation units have not been fully tested statistically to determine their place in the classification hierarchy. In addition, as this intuitive classification is regionally based (as opposed to Lake Macquarie LGA only), not all of the defined regional communities occur within Lake Macquarie City.

As an example, the NPWS (2000) defined community *Coastal Plains Smooth-barked Apple Woodland* (Unit 30) currently supports nine intuitively-based subunits within the region, and six within Lake Macquarie LGA. Three of these units (30c, 30d, 30g) are absent from Lake Macquarie (**Table 1**):

Table 1 Example of new vegetation community units within their NPWS (2000) parent community.

Coastal Plains Smooth-barked Apple Woodland	30a Buttonderry Footslopes Forest
	30b Sugarloaf Uplands Bloodwood-Apple Forest
	30e Coastal Plains Stringybark-Apple Forest
	30f Freemans Peppermint-Apple-Bloodwood Forest
	30h Sugarloaf Lowlands Bloodwood-Apple Forest
	30i West Wallsend Stringybark Forest

5.2.2 ANALYSIS 1 (LAKE MACQUARIE LGA)

In total, over 100 new full floristic plots have been sampled as part of the Lake Macquarie mapping project (45 in Stage 4; 60 in Stage 6), bringing the total number of plots available for analysis to 480. New plots targeted poorly sampled communities as identified during the mapping process (**Figure 3**). A spreadsheet of ICCs and the floristic samples that have been completed within them was used to prioritize new sampling within the designated areas during Stage 6. Despite the additional new samples completed, there remain 24 ICCs with no samples, 29 with only 1 sample, and 23 with 2 samples within them for the entire Lake Macquarie LGA. It is suggested that as a minimum at least 3 (but preferably 6) replicated samples be completed for all ICCs so that floristic relationships can be examined in depth during future numerical analysis. Further discussion on this aspect is included in Volume 2.

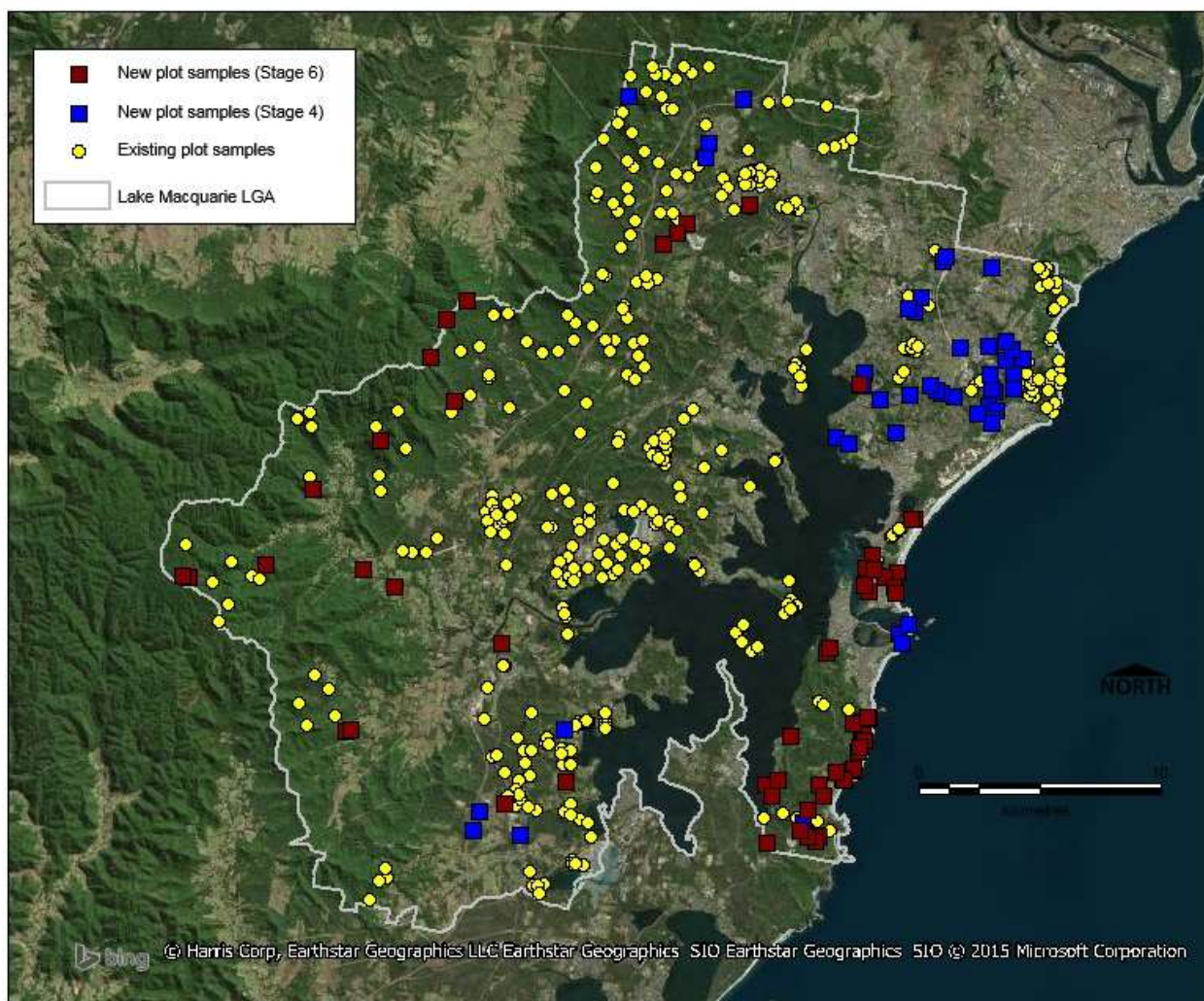


Figure 3 Distribution of new and existing full floristic samples.

Given that 74 ICCs currently have less than 3 samples within them, it is difficult to make conclusive statements about the validity of the complete ICC undertaken to date. Analysis of the available data set showed that some of the targeted ICCs may be better classified as other groups (such as littoral rainforest - see Analysis 2). Continuing data sampling and analysis is required before further assessment of the full ICCs can be made. Due to the large size of the Lake Macquarie dataset (480 sample plots and 782 plant taxa), it is difficult to incorporate plot dendrograms into this document. In addition, the incomplete dataset available as detailed above adds to this difficulty, and it would be premature to include such detail at this stage.

Despite this, Volume 2 contains detailed profiles for all communities within the ICC defined to date, and the reader is directed there to see more detailed information on each map unit. Some of these may be amalgamated in the future with ongoing sampling and analysis, but as a starting point each profile provides basic identification information and diagnostic species lists. **Appendix 2** in this report (Volume 1) summarises all vegetation map units mapped to date, while **Appendix 3** shows the equivalent Keith classes, EECs and Greater Hunter vegetation units.

5.2.3 ANALYSIS 2 (RAINFOREST)

Fourteen new plots (8 as part of Stage 4, 6 as part of Stage 6) were sampled within stands of rainforest in Lake Macquarie LGA as part of the mapping project, primarily in locations where potential Littoral Rainforest or Dry Rainforest was thought to occur. Together with the pre-existing dataset of regional rainforest samples, this enabled analysis of 179 samples spread across much of the Sydney Basin bioregion and immediate surrounding areas. Interpretation of this data has been made within the context of listed threatened communities (specifically Littoral Rainforest EEC & Lower Hunter Valley Dry Rainforest VEC) and this wider regional dataset. The 2-dimensional ordination undertaken on this data, supported by cluster analysis, shows recognition of four main rainforest formations in the region, and several variations within them (**Figure 4**). While it is not the intent of this preliminary analysis to provide a thorough classification of the regions rainforest, it does highlight the discrepancies between numeric data analysis techniques and current perceptions of both Littoral and Dry Rainforest.

Littoral Rainforest - From **Figure 4**, only six of the twenty-two samples falling within the Lake Macquarie LGA can be confidently assigned to Littoral Rainforest (“Littoral – sand” or “Littoral - headland” on **Figure 4**): Swansea Heads (SH), Salts Bay (SB), Illawong Reserve (IR), Pinny Beach (PB) and Nords Wharf (NW). With the exception of NW (a small patch adjacent to Lake Macquarie), these locations are within the immediate influence of salt-laden coastal winds from Swansea and south, and among other traits show evidence of wind-shearing. All other putative Littoral Rainforest samples along the coastal plains and hinterland, including those collected in Green Point Reserve and in the Floraville area, form part of the more widespread Warm Temperate Rainforest formation. In the context of this dataset, Littoral Rainforest EEC occurs only at Swansea Heads, Salts Bay, Illawong Reserve, Pinny Beach and Nords Wharf.

The results of this analysis, particularly for the SEPP26 gazetted stand at Green Point, presents a quandary that will be difficult to resolve. The floristic composition of this site (GP in **Figure 4**) is clearly more closely related to gallery and gully Warm Temperate Rainforests present in the coastal ranges than it is to true Littoral Rainforest. Many of the species present in this patch also occur in rainforest gullies throughout the City, and its presence on an alluvial fan in a gully environment is characteristic of Warm Temperate Rainforests elsewhere. Littoral Rainforests, either on sand or headland substrates, occur in areas subjected to strong coastal and salt-laden winds, and these features are absent from Green Point and nearby stands. In essence, the Green Point stand is nothing more than a warm temperate gully rainforest that now occurs adjacent to a saltwater lake.

The species list for Green Point SEPP26 Littoral Rainforest prepared by Carl Fulton (Lake Macquarie Council) lends support to this result. Based on Williams et al. (1984), a number of species in that list rarely if ever occur in littoral rainforest (eg: *Toona australis*, *Diploglottis australis*, *Stenocarpus salignus*, *Neolitsea dealbata*, *Streblus brunonianus*, **Dysoxylum fraserianum*, **Synoum glandulosum*, **Cryptocarya glaucescens*, **Ehretia acuminata*, **Scolopia braunii*), although some of these (marked *) are included in the broader definition of Littoral Rainforest adopted by the NSW Scientific Committee. All of these species are more typically associated with warm temperate or sub-tropical rainforests, which are widespread in protected gullies of the region. Floyd (1990), in his assessment of the rainforests of New South Wales, states that Littoral Rainforest “usually occupies beach sands or quartz-rich sediments, metasediments and volcanics on coastal headlands”.

The Final Determination for Littoral Rainforest EEC includes a number of key characteristics that are to be used to diagnose a particular site as Littoral Rainforest (LR):

- *the structure and composition of LR is strongly influenced by proximity to the ocean* (paragraph 1) - within Lake Macquarie, only the Salts Bay, Swansea Heads, Illawong Reserve and Pinny Beach sites occur near the ocean.
- *areas mapped for inclusion in SEPP26 are examples of LR* (paragraph 1) - there appear to be inconsistencies between some rainforests mapped for SEPP 26 and the Scientific Committee's definition, both in floristic composition and abiotic features.
- *LR occurs on both sand dunes and on soils derived from underlying rocks. In more sheltered sites and in hind dunes, LR is taller but still with wind pruning on the windward sides* (paragraph 2) - there is no evidence of such wind pruning on stands at Green Point or nearby areas.
- *LR comprises several suballiances within the Cupaniopsis anacarioides - Acmena spp. alliance of Floyd (1990)* (paragraph 3) - only sites at Salts Bay, Swansea Heads, Illawong Reserve and Pinny Beach align with these suballiances; other sites equate to one of more suballiances in his Warm Temperate Rainforest alliance.
- *many but not all stands of LR have been included in SEPP26 mapping* (paragraph 6) - those in the Swansea area are not included, while Green Point is.

Dry Rainforest - In regard to Dry Rainforest, there is a commonly held perception that dominance by *Backhousia myrtifolia* indicates the presence of this formation, when in fact this species is merely indicative of a dryer, less well developed form of Warm Temperate Rainforest. West of Lake Macquarie LGA where rainfall is lower, such as in northern Wollemi and Yengo NPs, most gully and sheltered slopes are dominated by this species, but with increasing rainfall this grades into rainforest where *Acmena smithii*, *Doryphora sassafras* and *Ceratopetalum apetalum* are more prominent. Within this analysis, three samples preferentially targeting Lake Macquarie vegetation where *Backhousia myrtifolia* dominates the sub-canopy [at Olney SF (OL), Cams Wharf (CW), and Bangalay Reserve (BR)], grouped with a large group of coastal *Backhousia myrtifolia*-dominated vegetation ("Warm Temp Grey Myrtle – Coastal") within the broader Warm Temperate Rainforest formation (see **Figure 4**). A fourth sample in a small depauperate gully on a dry peninsular protruding into Lake Macquarie [Wangi Point (WP)] was more closely aligned with drier *Backhousia myrtifolia* stands away from the coast ("Warm Temp Grey Myrtle – Inland") from elsewhere in the region, and this may be an artefact of low species diversity and high exposure at this site. None of this vegetation falls within the current listing for Lower Hunter Valley Dry Rainforest VEC, and stands dominated by *Backhousia myrtifolia* within Lake Macquarie represent this drier expression of Warm Temperate Rainforest found elsewhere in the region.

Figure 5 shows the distribution of all rainforest samples and groups within the region. Littoral Rainforest sites occur only in close proximity to the coast, while Warm Temperate Rainforest sites dominated by *Backhousia myrtifolia* (Grey Myrtle) are spread across the region.

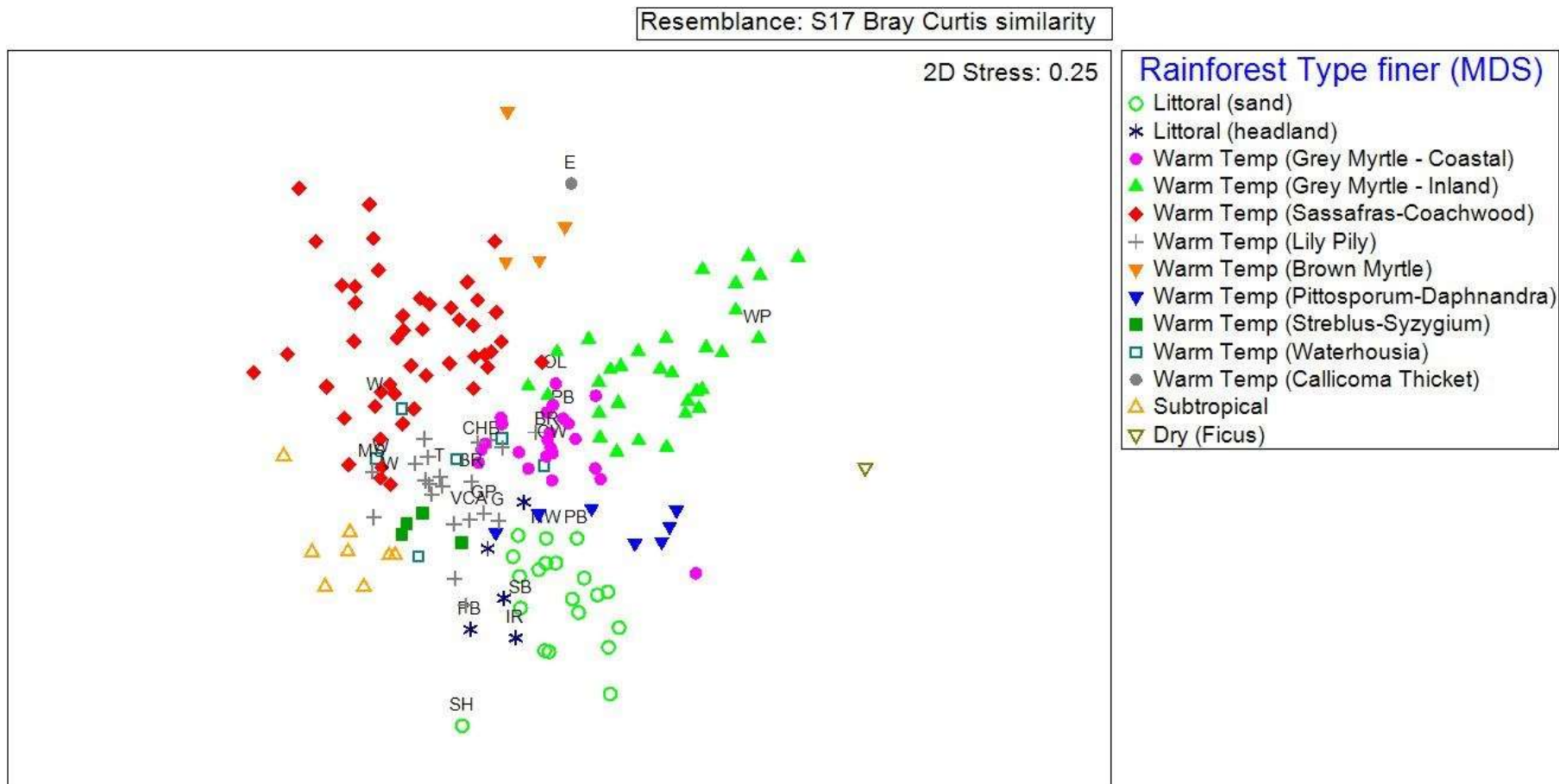


Figure 4 Non-metric Multi Dimensional Scaling ordination of regional rainforest data (179 plots), showing distribution of samples within broad rainforest formations. Samples completed within Lake Macquarie LGA are annotated (BR = Bangalay Reserve; CHB = Catherine Hill Bay; CW = Cams Wharf; E = Eraring Power Station; IR = Illawong Reserve; G = Glenrock SCA; GP = Green Point; MS = Mt Sugarloaf; NW = Nords Wharf; OL = Olney SF; PB = Pinny Beach; SB = Salts Bay; SH = Swansea Heads; T = Seahampton; VCA = Nicholls VCA Floraville; W = Watagans; WP = Wangi Point).

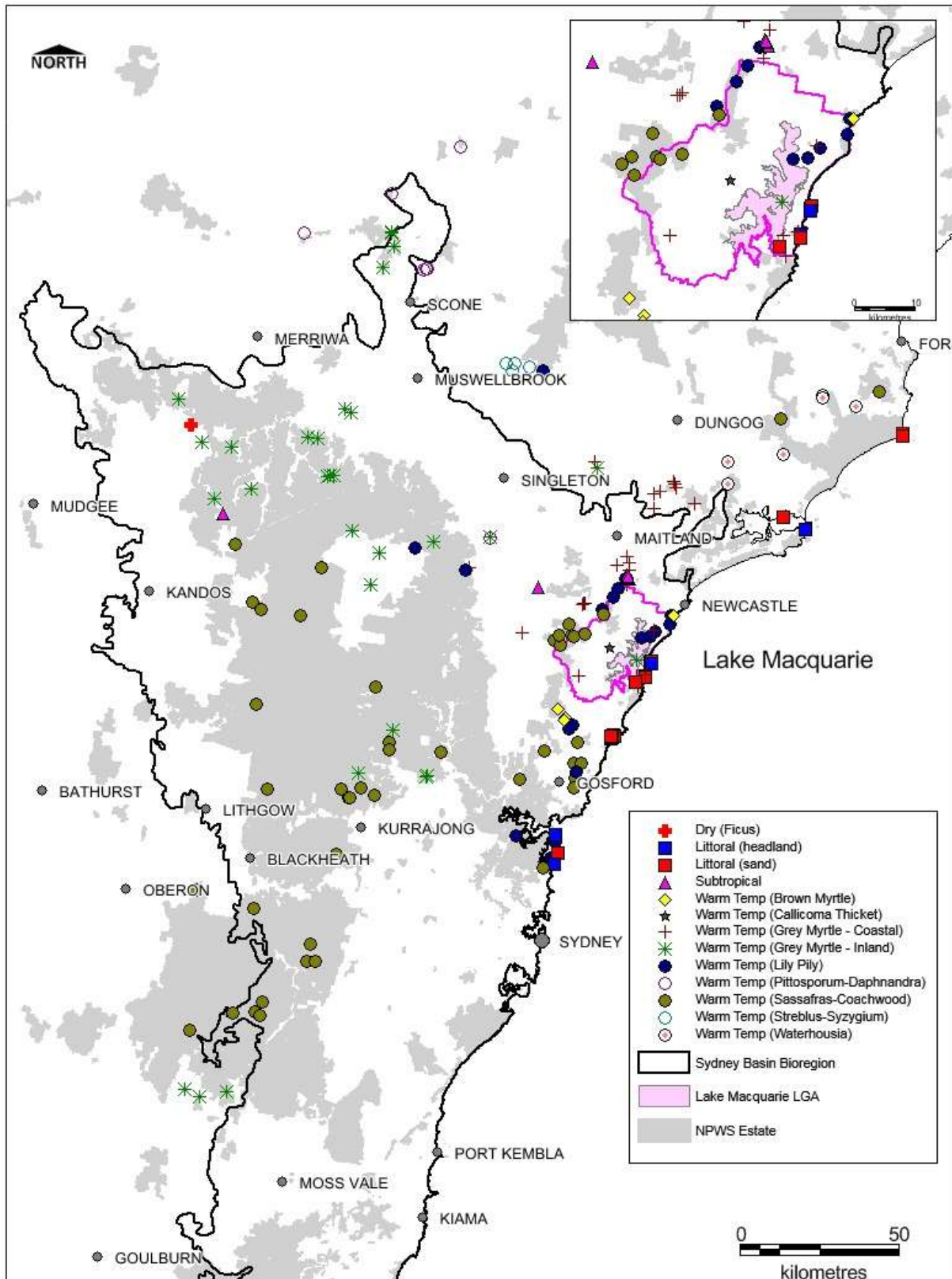


Figure 5 Distribution of 179 samples from across the Sydney Basin bioregion, showing their affiliations with major rainforest groups in ordination analysis (Figure 4 above).

5.3 A NOTE ON VEGETATION STRUCTURE

A comment in relation to the structural form of new communities is also necessary. In general terms, use of the terms ‘Forest’ or ‘Woodland’ etc to a community name has been applied following the widely used Specht system, however in the absence of sufficient ground data such terms have been used rather loosely. As a guide, the following table summarises the Specht system of classification, and can be used to aid interpretation of new community names (**Table 2**).

Table 2 Summary of Specht vegetation structure classes.

Life form	Foliage projective cover of tallest stratum				
	<10%	10-30%	30-50%	50-70%	70-100%
Trees >30m	-	(Tall woodland)	(Tall open-forest)	Tall forest	Tall closed-forest
Trees 10-30m	Open-woodland	Woodland	Open-forest	Forest	Closed-forest
Trees <10m	Low open-woodland	Low woodland	Low open-forest	Low forest	Low closed-forest
Shrubs>2m	Tall open-shrubland	Tall shrubland	Open-scrub	Scrub	Closed-scrub
Shrubs 0.25-2m Sclerophyllous	Open-shrubland	Shrubland	Open-heathland	Heathland	Closed-heathland
Shrubs 0.25-2m Non-sclerophyllous	Low open-shrubland	Low shrubland	Low shrubland	-	-
Shrubs <0.25m Sclerophyllous	Dwarf open-heathland	Dwarf open-heathland	-	-	-
Shrubs <0.25m Non-sclerophyllous	Dwarf open-shrubland	Dwarf shrubland	-	-	-
Hummock grasses	Open hummock grassland	Hummock grassland	-	-	-
Herbaceous layer Graminoids	Very open (tussock) grassland	Open (tussock) grassland	(Tussock) grassland	(Tussock) grassland	Closed (tussock) grassland
Herbaceous layer Sedges	Very open-sedgeland	Open-sedgeland	Sedgeland	Sedgeland	Closed-sedgeland
Herbaceous layer Herbs	Very open-herbland	Open-herbland	Herbland	Herbland	Closed-herbland
Herbaceous layer Ferns	-	-	Fernland	Fernland	Closed-fernland

6.0 DISCUSSION

6.1 MAPPING ACCURACY

By virtue of the fact that this mapping project has incorporated over 18,100 ground control points (RDPs) into the final map layer, accuracy is considered superior than previously available map products (LHCCREMS, NPWS 2000; McCauley et al 2006; GHV, Sivertsen et al 2012). This is particularly the case across areas with a greater density of RDP's, such as where ready access was available (see **Figure 2**).

A map indicative of mapping accuracy has been prepared using proximity analysis (**Figure 6**). Using all available RDP for the Lake Macquarie LGA and the immediately adjacent (1 km buffer) LGAs of Wyong, Cessnock and Newcastle (over 20,000 RDP), minimum distances between adjacent RDP were calculated in MapInfo (using the Distance Calculation tool), and then subjected to a thematic grid analysis to derive a Triangular Irregular Network (TIN) interpolated image that can be used to represent mapping accuracy. Areas where minimum distances between RDP are low can be expected to exhibit more accurate mapping, both in terms of community boundaries and attribution. The grid image also allows an assessment of those areas within the City where reliable ground data is lacking, and where additional resources may be directed to improve resolution.

From **Figure 6**, the majority of the LGA has now been well ground-truthed, with minimum distances of between 100 and 300m occupying the bulk of the land area, and higher resolution (0-50m) in many urban/rural areas. Key data gaps are in the south of the City near Wyee, private lands in the Teralba area, north of Dora Creek, Mannering Park, and the more rugged valleys of the Watagan Ranges.

For the outstanding areas remaining in the City-wide map layer, accuracy is entirely reliant on the original source data. In the past, six accuracy classes including previously completed studies had been included within the mapping (**Table 3**), but Class 4 and Class 6 are no longer represented in the current map. Note, however, that ongoing refinement of extant vegetation mapping by Council may result in the continuation of Class 6 accuracy application. Thematic mapping of the City-wide map layer now shows which areas retain older mapping with amendments (**Figure 7**).

Table 3 Accuracy classes used in City-wide mapping.

Class 1	GPS Ground-truth Data
Class 2	Previous Study with Amendments
Class 3	Previous Study with no Amendments
Class 4	LHCCREMS Modelled Data
Class 5	API only
Class 6	LMCC Native Vegetation Extant Discrepancies

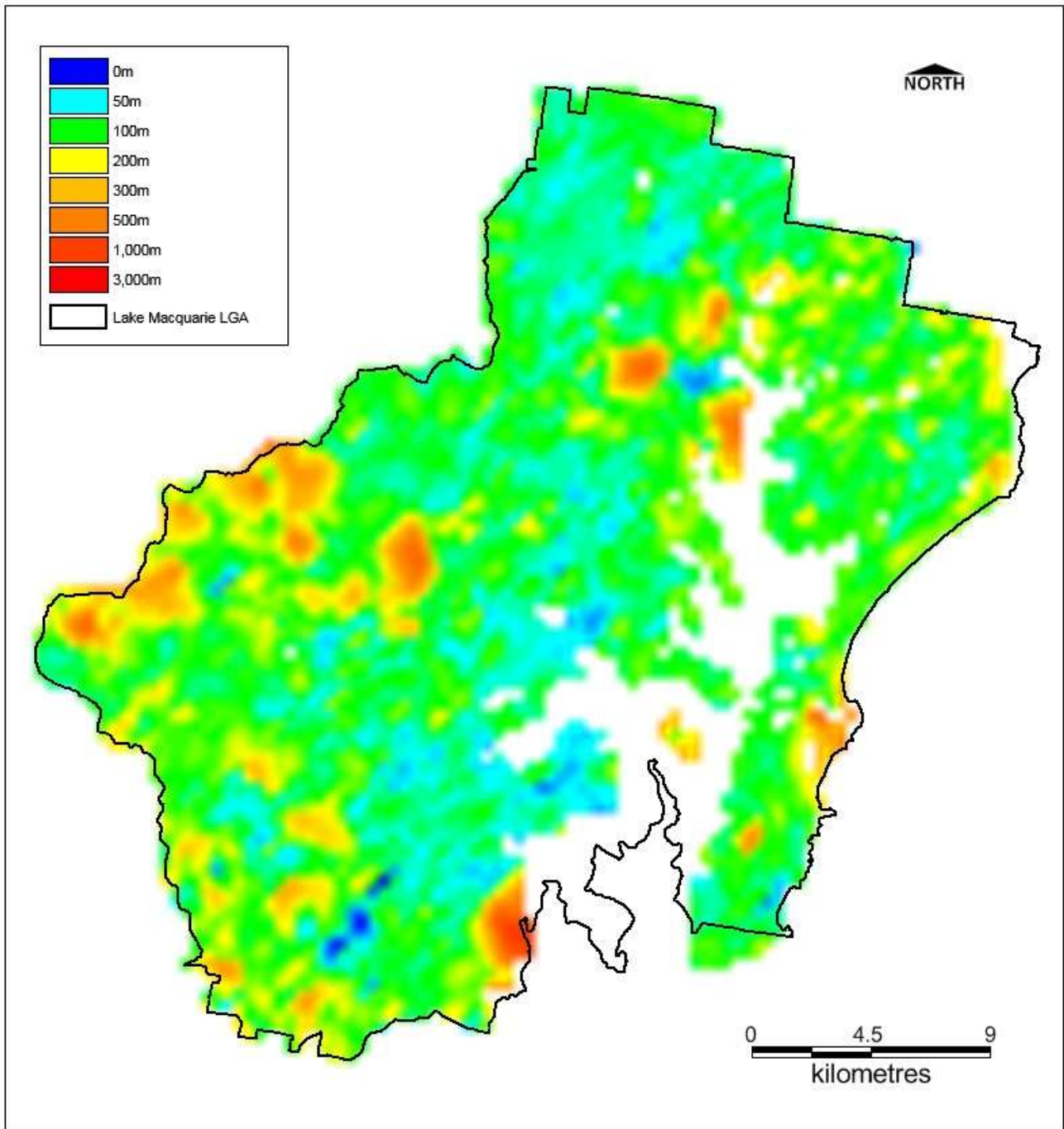


Figure 6 Interpolated TIN grid image of Lake Macquarie LGA, based on proximity analysis of 20,005 RDP. Areas showing as red and orange support limited ground data and should be targeted to improve mapping resolution and accuracy.

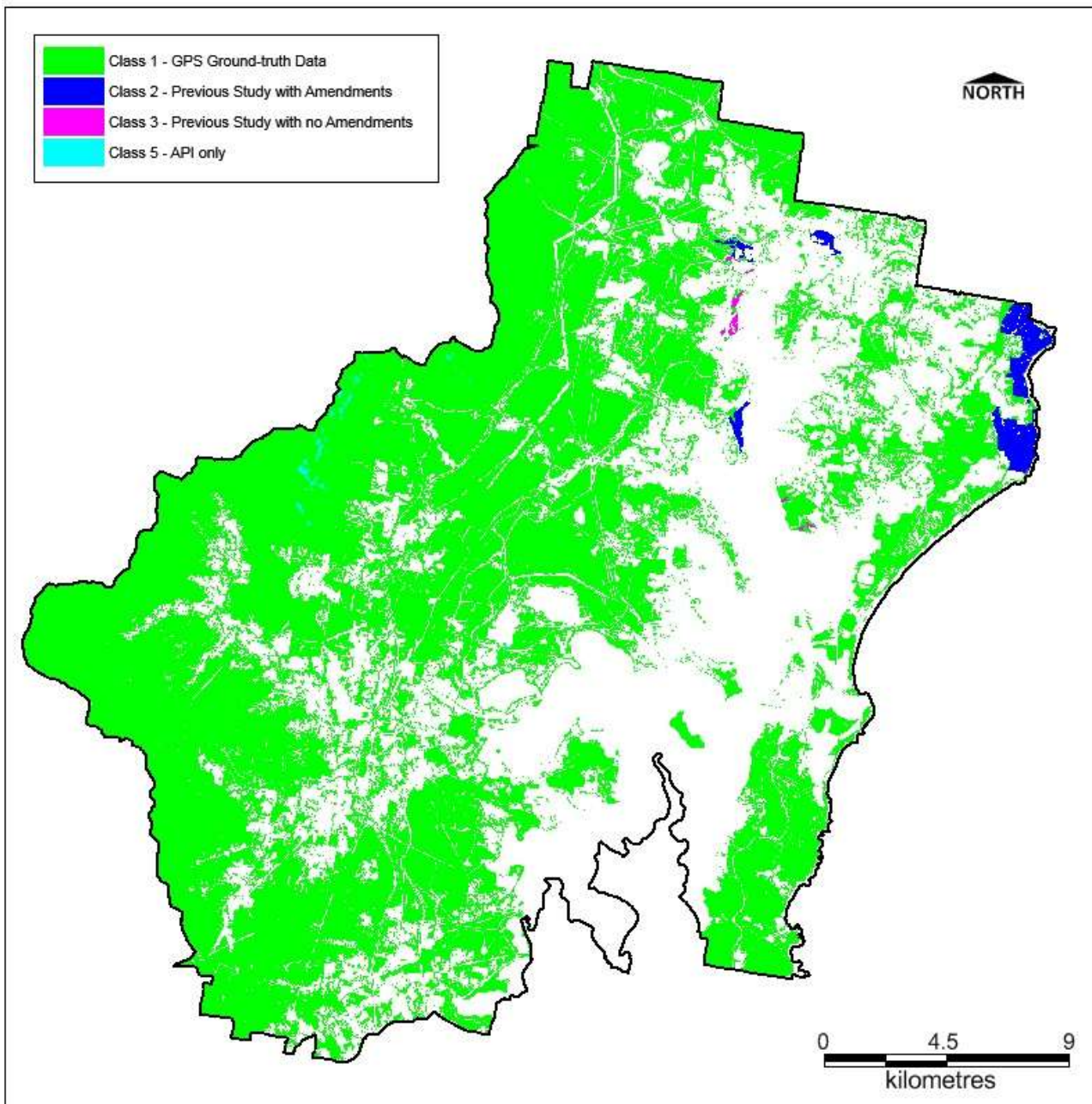


Figure 7 Map showing remaining four of six accuracy classes used in the current City-wide vegetation map layer.

In those areas where previous localised mapping and survey reports have been made available, re-aligning of polygon boundaries has been done for some (Class 2) using current high resolution aerial photography; however community tags are based solely on the original source information adapted to the current classification. Other previous studies have been adopted without review (Class 3).

6.2 RECOMMENDATIONS

Recommendations arising from this stage of the project include:

- Continuation of detailed high resolution mapping across lower accuracy areas, such as larger parcels of private lands with owners consent, as funding allows;
- Continuation of new data collection in poorly sampled communities (those currently with <3 samples, listed in Appendix 1 of Volume 2) as identified in the Interim Community Classification, leading to a revised numerical classification for the entire LGA at some time in the future.
- Review of the hierarchical position of all Interim Community Classification units, in keeping with the latest numerical classification, to ensure consistency between analysis outcomes and mapping products;
- Mapping provided to date should not be used as a substitute for detailed on-ground field survey for a specific site-based project, such as for a proposed development. Such studies should independently collect floristic data using standard techniques;
- Consideration be given to the development of a digital diagnostic key to the Interim Community Classification that can be used on mobile devices such as tablets, ipads and mobile phones, and updated as new information becomes available, and;
- If the current working draft Lake Macquarie mapping is shown to be in error, corrections should be submitted (with supporting data) to Council for amendment.

6.3 DISCLAIMER & PUBLIC RELEASE

Importantly, work completed to date should remain a work-in-progress, and should not be considered as final or definitive. For any public release of the City-wide mapping, it is suggested that the following title and disclaimer be attached to it:

Title: *Lake Macquarie Working Draft Vegetation Community Map (version XX 2015)*

Disclaimer: This map layer has been compiled based on 18,100 ground control points (RDPs), although some small areas have been adopted directly from previous studies using different mapping methods. All data requires careful interpretation with consideration of the accuracy field at any location. Full floristic plot survey and multivariate analysis has not been undertaken for many of the map units, hence their position in the classification hierarchy is yet to be confirmed. This map should not be used as a substitute for full site-specific floristic survey using standard techniques (quadrats & transects etc) and should be used in conjunction with the accompanying reports.

Although every care has been taken in the preparation of these maps, Lake Macquarie City and the authors accept no responsibility for any misprints, errors, omissions, or inaccuracies in these maps or damages resulting from the use of this information.

Citation: Bell, S.A.J., Driscoll, C & Lake Macquarie City Council (2015) *Lake Macquarie Working Draft Vegetation Community Map 2015*. Lake Macquarie City Council.

7.0 REFERENCES

- Anne Clements & Associates (2004a) *Flora assessment: North Cooranbong*. Unpublished Report to Johnson Property Group. December 2004.
- Anne Clements & Associates (2004b) *Flora assessment: Scarborough Street, Morisset*. Unpublished data for assessment on Scarborough Street, Morisset. Data supplied to Lake Macquarie City Council.
- Anne Clements & Associates (2005) *Flora assessment: Lots 479 and 481 DP 755242, corner of Dora Street and Wyee Road, Morisset*. Unpublished Report to Mirvac Homes. February 2005.
- Anne Clements & Associates (2007) *Flora assessment: 190 Stingaree Road, Dora Creek*. Unpublished Report to Lake Macquarie City Council. March 2007.
- Australian Wetlands (2007) *Draft Local Environmental Plan Report, 270 Fishery Point Road, Bonnells Bay*. Unpublished Report to Lake Macquarie City Council, January 2007. Final Report.
- Bell, S.A.J. (1998) *Lake Macquarie SRA, Pulbah Island NR, and Tingira Heights NR vegetation survey. A fire management document*. Volumes 1 & 2. Eastcoast Flora Survey - Report to NSW National Parks and Wildlife Service (Hunter and Central Coast Districts). April 1998.
- Bell, S.A.J. (1998) *Glenrock SRA and Awabakal NR vegetation survey. A fire management document*. Volumes 1 & 2. Eastcoast Flora Survey - Report to NSW National Parks and Wildlife Service (Hunter District). August 1998.
- Bell, S.A.J. (2000) *Data audit of vegetation survey in the Hunter Region: Status report*. Eastcoast Flora Survey - Report to Department of Land and Water Conservation, Hunter Region. July 2000.
- Bell, S.A.J. (2005) *Vegetation mapping of the Pelican Flats area, Lake Macquarie*. Progress Report to Lake Macquarie City Council.
- Bell, S.A.J. (2009) *Lower Hunter Spotted Gum – Ironbark Forest: Distribution and composition in Lake Macquarie LGA*. Unpublished Report to Lake Macquarie City Council. Eastcoast Flora Survey. September 2009.
- Bell, S.A.J. (2013) *Defining and mapping rare vegetation communities: Improving techniques to assist land-use planning and conservation*. PhD Thesis, University of Newcastle.
- Bell, S.A.J. & Driscoll, C. (2006a) *Vegetation of the Tomago and Anna Bay Sandbeds, Port Stephens, New South Wales: Management of Groundwater Dependent Ecosystems. Part 1 – Vegetation Classification*. Unpublished Report to Hunter Water. Eastcoast Flora Survey. September 2006.
- Bell, S.A.J. & Driscoll, C. (2006b) *Vegetation Mapping of Watagans National Park and Jilliby State Conservation Area*. Summary Report to Parks & Wildlife Division, Department of Environment and Conservation. January 2006.
- Bell, S.A.J. & Driscoll, C. (2008) *Vegetation Mapping of Lake Macquarie LGA: Stage 1 – Wyee to Cooranbong*. Unpublished Report to Lake Macquarie City Council. June 2008. Eastcoast Flora Survey.
- Bell, S.A.J. & Driscoll, C. (2009) *Vegetation survey and mapping of Sugarloaf State Conservation Area, Lake Macquarie*. Unpublished report and map to Department of Environment & Climate Change.

- Bell, S.A.J. & Driscoll, C. (2014) *Vegetation Mapping of Lake Macquarie LGA: Stages 1 - 5*. Unpublished Report to Lake Macquarie City Council. March 2014. Eastcoast Flora Survey.
- Benson, J.S. (2006) New South Wales Vegetation Classification and Assessment: Introduction – the classification, database, assessment of protected areas and threat status of plant communities. *Cunninghamia* 9(3): 331-382.
- Bishop, T. (2000) *Field Guide to the Orchids of New South Wales and Victoria*. University of New South Wales Press, Sydney.
- Clarke, K.R. & Gorley, R.N. (2006) *PRIMER v6: User Manual/ Tutorial*. PRIMER-E: Plymouth.
- Department of Environment & Climate Change (2008) *Vegetation of the Cessnock-Kurri Region, Cessnock LGA, New South Wales: Survey, Classification & Mapping*. Department of Environment & Climate Change.
- Ecotone Ecological Consultants (2007) *Ecological assessment for a Local Environment Study for properties at Griffen Road and The Weir Road, north of Teralba*. Unpublished Report to Lake Macquarie City Council. May 2007.
- Floyd, A.G. (1990) *Australian Rainforests in New South Wales. Volume 1*. Surrey Beatty and Sons, Chipping Norton.
- Forest Fauna Surveys, EcoPro Pty Ltd & Fly By Night Bat surveys Pty Ltd (1996) *SRA Land Glendale: Species Impact Statement*. Unpublished Report to Lake Macquarie City Council. August 1996.
- Harden, G.J. (Ed) (1990) *Flora of New South Wales. Volume 1*. Royal Botanic Gardens: Sydney. New South Wales University Press.
- Harden, G.J. (Ed) (1992) *Flora of New South Wales. Volume 3*. Royal Botanic Gardens: Sydney. New South Wales University Press.
- Harden, G.J. (Ed) (1993) *Flora of New South Wales. Volume 4*. Royal Botanic Gardens: Sydney. New South Wales University Press.
- Harden, G.J. (Ed) (2002) *Flora of New South Wales. Volume 2*. Royal Botanic Gardens: Sydney. New South Wales University Press. Revised Edition.
- Harden, G.J. & Murray, L.J. (2000) *Supplement to Flora of New South Wales Volume 1*. Royal Botanic Gardens Sydney.
- Hunter, J.T. (2015) Assessment of the GHM mapping within the Upper Hunter. Unpublished report to the Environmental Division, Hunter Councils. January 2015.
- Keith, D.A. (2004) *Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT*. Department of Environment and Conservation: Hurstville.
- McCauley, A., DeVries, R., Elith, J., & Gilmour, P. (2006) *Vegetation of Regional Significance on the NSW Central Coast*. A report prepared for the Hunter-Central Rivers Catchment Management Authority by the Environment Division of Hunter Councils Inc., NSW.

- Murray, M. & Bell, S.A.J. (2006) *Flora and fauna assessment, proposed residential subdivision Lot 2076 and 2077 DP1002743, Lamington Drive, Mount Hutton, City of Lake Macquarie*. Unpublished Report to Coastplan Consulting. June 2006.
- Murray, M. & Bell, S.A.J. (2008) *Review of ecological issues: Proposed rezoning, Ramsgate Estate, DP1596 Wyee Point, City of Lake Macquarie*. Unpublished DRAFT Report to Lake Macquarie City Council. June 2008.
- National Parks and Wildlife Service (2000) *Vegetation survey, classification and mapping: Lower Hunter and Central Coast region*. A project undertaken for the Lower Hunter and Central Coast Regional Environmental Management Strategy by CRA Unit, Sydney Zone, NPWS. April 2000.
- Roberts, D.E. & Sainty, G.R. (2006) *Impacts associated with construction of a channel and lagoon on wetland habitat at 160 Stingaree Road, Dora Creek*. Unpublished DRAFT Report. April 2006.
- Sivertsen, D. (2010) *Native Vegetation Interim Type Standard*, Department of Environment, Climate Change and Water NSW, Sydney.
- Sivertsen, D., Roff, A., Somerville, M., Thonell, J., & Denholme, B. (2012) *Hunter Native Vegetation Mapping. Geodatabase Guide (Version 4)*. Internal Report for the Office of Environment and Heritage, Department of Premier and Cabinet, Sydney, Australia.
- Somerville, M. (2009) *Hunter, Central Coast & Lower North Coast Vegetation Classification & Mapping Project Volume 2: Vegetation Community Profiles*. Report prepared by HCCREMS/ Hunter Councils Environment Division for Hunter-Central Rivers Catchment Management Authority, Tocal, NSW.
- SWC Shortland Wetland Centre (undated) *Wetlands mapping of Lake Macquarie*.
- Travers (2008) *Ecological Assessment, Ramsgate Estate DP1596 Wyee Point*. Report by Travers Environmental Consultants. January 2008.
- Williams, J.B., Harden, G.J. & McDonald, W.J.F. (1984) *Trees and Shrubs in Rainforests of New South Wales and Southern Queensland*. University of New England, Armidale.
- Woodward-Clyde (1996) *Flora and fauna assessment study for the proposed redevelopment of the Ramsgate Estate, Wyee Point*. Unpublished Report to Woromar Pty Ltd. August 1996.

APPENDIX 1 – PREVIOUS VEGETATION STUDIES WITHIN LAKE MACQUARIE LGA

Previously completed vegetation studies within Lake Macquarie LGA incorporated directly into revised mapping.

Project/ Location	Author/ Year	Comments
Awabakal NR	Bell (1998)	Digital map layer. Twelve natural communities defined through multivariate analysis with other regional data. Replicated and adapted for LGA map layer.
Cooranbong BioBanking site	Bell & Driscoll (2007)	Digital map layer. Incorporated directly into LGA map layer.
Eraring Power Station	Bell (2007)	Digital map layer. Sixteen natural communities based on multivariate analysis of plot data. Imported directly into LGA map layer.
Fishery Point Rd, Bonnells Bay	Australian Wetlands (2007)	Hard copy of GIS map layer. Extensive data collection and analysis. Selected data points extracted and utilised in LGA map layer.
Glenrock SCA	Bell (1998)	Digital map layer. Thirteen natural communities defined through multivariate analysis with other regional data. Replicated and adapted for LGA map layer.
Jilliby SCA / Watagans NP	Bell & Driscoll (2006)	Digital map layer. Incorporated directly into LGA map layer. Also extends into Cessnock and Wyong LGA's.
Lake Macquarie SCA	Bell (1998)	Digital map layer. Several natural communities defined through multivariate analysis with other regional data. Replicated and adapted for LGA map layer.
Lamington Drive, Mt Hutton	Murray & Bell (2006)	Digital map layer. Two natural communities defined through multivariate analysis with other regional data. Imported directly into LGA map layer.
Morisset golf course	Anne Clements & Associates (2005)	Data points converted to RDP's and utilised in LGA map layer.
North Cooranbong LES	Anne Clements & Associates (2004a)	Data points converted to RDP's and utilised in LGA map layer.
Pelican Flats	Bell (2005)	Digital map layer. Several natural communities defined and mapped based on intuitive assessment. Imported directly into LGA map layer.
Pulbah Island NR	Bell (1998)	Digital map layer. Seven natural communities defined through multivariate analysis with other regional data. Replicated and adapted for LGA map layer.
Scarborough Street, Morisset	Anne Clements & Associates (2004b)	Data points converted to RDP's and utilised in LGA map layer. Subsequent detailed survey on site superseded 2004 work (C.Driscoll, unpublished data).

Project/ Location	Author/ Year	Comments
SRA land, Glendale	Forest Fauna Surveys et al (1996)	Hand drawn map only. Communities based on intuitive assessment and include some at fine resolution. Replicated and adapted for LGA map layer.
Stingaree Road, Dora Creek	Roberts & Sainty (2006)	No mapping provided, but information incorporated into LGA map layer.
Stingaree Road, Dora Creek	Anne Clements & Associates (2007)	No map layer, but 9 point locations converted to RDP's and incorporated into LGA map layer.
Sugarloaf SCA	Bell & Driscoll (2009)	Detailed mapping following identical methods. Mapping incorporated into LGA map layer.
Teralba LES	Ecotone (2007)	Digital copy of map layer. Seven natural communities based on intuitive assessment, replicated and adapted for LGA map layer.
Tingira Heights NR	Bell (1998)	Digital map layer. Two natural communities defined through multivariate analysis with other regional data. Replicated and adapted for LGA map layer.
Wetlands mapping	SWC (undated)	Digital map layer available. Several natural communities defined based on intuitive assessment. Imported and updated into LGA map layer on a selective basis, dependant on existence of more recent ground data.
Wyee Point	Murray & Bell (2008)	Digital map layer. Incorporated directly into LGA map layer. Supersedes Woodward-Clyde (1996) & Travers (2008).

APPENDIX 2 – INTERIM COMMUNITY CLASSIFICATION SUMMARY

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
1	<u>Coastal Wet Gully Forest</u>	<i>Eucalyptus saligna</i> , <i>Syncarpia glomulifera</i> , <i>Eucalyptus acmenoides</i> and <i>Allocasuarina torulosa</i> in the often widely spaced emergent layer, over a sub-canopy of rainforest species such as <i>Cryptocarya microneura</i> , <i>Claoxylon australe</i> and <i>Dorophora sassafras</i> . Ground layer vegetation includes <i>Cordyline stricta</i> , <i>Blechnum cartilagineum</i> , <i>Adiantum hispidulum</i> , <i>Gahnia melanocarpa</i> , and the vines <i>Cissus hypoglauca</i> , <i>Cissus antarctica</i> , <i>Marsdenia rostrata</i> and <i>Ripogonum fawcettianum</i>	Most well protected gullies and lower slopes of the Watagan Ranges support Coastal Wet Gully Forest, which in places merges over broad ecotones with Coastal Warm Temperate Rainforest (MU1a). This is an original REMS2000 community, and it has been interpreted to mean the sheltered slopes and gullies along the Watagan/Sugarloaf escarpments.
1a	<u>Coastal Warm Temperate - Subtropical Rainforest</u>	Species typically present include <i>Cryptocarya microneura</i> , <i>Acmena smithii</i> , <i>Claoxylon australe</i> , <i>Neolitsea dealbata</i> , <i>Ficus rubiginosa</i> , and <i>Eupomatia laurina</i> . Vines are prominent in this community and a sparse fern layer including <i>Adiantum aethiopicum</i> , <i>Adiantum formosum</i> , <i>Doodia aspera</i> , <i>Pellaea falcata</i> and <i>Blechnum</i> species is characteristic.	Closely related to Coastal Wet Gully Forest (MU1), and supports a large number of rainforest species, but generally without the emergent canopy of Bluegums (<i>Eucalyptus saligna</i>) and Turpentine (<i>Syncarpia glomulifera</i>). Occurs in well protected gullies on alluvium, along major creeks and in gully heads
1g	<u>Permian Gully Rainforest</u>	Prominent species in the canopy include <i>Pittosporum undulatum</i> , <i>Acmena smithii</i> , <i>Synoum glandulosum</i> , <i>Cryptocarya microneura</i> and <i>Elaeodendron australe</i> var. <i>australe</i> .	Represents gully rainforest occurring on the coastal plains on Permian sediments, generally in incised drainage systems. This type occurs in rocky gullies (not sandy alluvium), and tends not to be as well developed as MU 1a. It requires further testing against similar rainforest types on other substrates to ascertain real differences.
3e	<u>Lake Macquarie Dry Rainforest</u>	Floristically simple; <i>Backhousia myrtifolia</i> usually dominant in the poorest sites, under a canopy of emergent eucalypts including <i>Eucalyptus acmenoides</i> and <i>Corymbia maculata</i> .	Occurs in shallow gullies mostly on Permian geology. Floristically simple - <i>Backhousia myrtifolia</i> usually dominant in the poorest sites. Very depauperate rainforest occurring as narrow bands in eastern LM. Inadequately sampled so true relationships difficult to resolve. Related to MU 21 but lower diversity.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
4	<u>Littoral Rainforest</u>	Typically very low in stature and tightly packed with a few dominant tree species such as <i>Cupaniopsis anacaroides</i> , <i>Acmena smithii</i> , and <i>Guioa semiglauca</i> . Other species include <i>Syzygium paniculatum</i> , <i>Glochidion ferdinandi</i> , <i>Livistona australis</i> , <i>Rapanea variabilis</i> , <i>Endiandra sieberi</i> , <i>Pittosporum undulatum</i> , <i>Notelaea longifolia</i> , <i>Smilax glycyphylla</i> , <i>Smilax australis</i> , <i>Cissus Antarctica</i> , <i>Cissus hypoglauca</i> .	A simple rainforest occurring close to the ocean on coastal headlands or at the back of coastal dunes. Often merges into surrounding headland scrub. The definition of Littoral Rainforest taken in the strict sense for this work, meaning that superficially similar rainforest stands away from the immediately effects of coastal exposure (onshore salt-laden winds and sea spray) have not been included. Analysis has shown that these stands are floristically more complex and are closer to warm temperate rainforest than they are to littoral rainforests.
5	<u>Alluvial Tall Moist Forest</u>	<i>Eucalyptus saligna</i> is prominent in the emergent canopy layer, often co-occurring with <i>Syncarpia glomulifera</i> and <i>Angophora floribunda</i> , over a lower tree layer of <i>Acmena smithii</i> , <i>Melaleuca styphelioides</i> , <i>Glochidion ferdinandi</i> , <i>Cryptocarya microneura</i> and <i>Claoxylon australe</i> . Ground layer vegetation includes the grasses <i>Oplismenus imbecillus</i> and <i>Microlaena stipoides</i> var. <i>stipoides</i> , the ferns <i>Calochlaena dubia</i> , <i>Blechnum cartilagineum</i> and <i>Adiantum aethiopicum</i> , and shrubs <i>Cordyline stricta</i> , <i>Hymenosporum flavum</i> , and <i>Breynia oblongifolia</i> . The sedges <i>Gymnostachys anceps</i> and <i>Carex longebrachiata</i> are also common. In some areas, <i>Archontophoenix cunninghamiana</i> is dominant, and most likely forms a distinct community of its own.	Typically occurs on deeper alluvial sandy loams at the bases of the larger gullies
5a	<u>Alluvial Bluegum-Paperbark Forest</u>	Typified by a canopy of <i>Eucalyptus saligna</i> and an often dense sub-canopy of <i>Melaleuca biconvexa</i> and <i>Callistemon salignus</i> . Other species include <i>Syncarpia glomulifera</i> , <i>Eucalyptus deanei</i> , <i>Melaleuca styphelioides</i> , <i>Livistona australis</i> , <i>Acmena smithii</i> , <i>Ficus coronate</i> , <i>Pittosporum revolutum</i> , <i>Glochidion ferdinandi</i> , <i>Gahnia clarkei</i> .	Occurs along major creek systems with alluvial flats in the south-western Lake Macquarie and Wyong areas, and extending into Gosford LGA. Only a few remnants remain in Lake Macquarie, such as around the Cooranbong and Mandalong Valleys.
5b	<u>Alluvial Bluegum-Apple Moist Forest</u>	A moist forest type of <i>Eucalyptus saligna</i> and <i>Angophora floribunda</i> , with <i>Callistemon salignus</i> and <i>Acacia parramattensis</i> common in the mid-storey,	Noted in the Cooranbong area of south-western Lake Macquarie, on alluvial flats. Related to but drier than other moist forest types on alluvial flats, such as Cooranbong Blackbutt Tall Forest

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		over <i>Pteridium esculentum</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> and <i>Adiantum aethiopicum</i> .	(MU123), Alluvial Bluegum – Paperbark Forest (MU5a) and Floodplain Redgum – Rough-barked Apple Forest (MU38a). Further exploratory analyses in this group are required to clarify relationships..
5e	Alluvial Bluegum -Spotted Gum Moist Forest	An alluvial forest where <i>Eucalyptus saligna</i> co-occurs with <i>Corymbia maculata</i> , but other canopy species are also present and may be locally dominant. These include <i>Angophora floribunda</i> , <i>Eucalyptus amplifolia</i> , <i>Eucalyptus siderophloia</i> and <i>Eucalyptus globoidea</i> . Understorey vegetation includes species such as <i>Melaleuca decora</i> , <i>Melaleuca linariifolia</i> , <i>Acacia longifolia</i> and <i>Daviesia ulicifolia</i> , and a range of grasses and herbs occur on the ground.	This vegetation type may be ecotonal between the wetter alluvial Bluegum-dominated communities and the drier Spotted Gum communities, and further sampling and investigation is required.
5h	Alluvial Riparian Blackbutt Forest	<i>Eucalyptus pilularis</i> is dominant. Common understorey species include <i>Acacia longifolia</i> , <i>Leptospermum polygalifolium</i> , <i>Pteridium esculentum</i> , <i>Dodonaea triquetra</i> , <i>Banksia spinulosa</i> var. <i>collina</i> , <i>Lomandra longifolia</i> , <i>Entolasia stricta</i> and <i>Gahnia clarkei</i> .	Occurs along major creek systems such as Dora Creek and Cockle Creek and environs, extending south into Wyong LGA. This type is related to Cooranbong Blackbutt Tall Forest (MU123) but further investigation is required to determine how the two differ. Little extant area left to sample well.
6a	Coastal Narrabeen Bluegum Ridge Forest	<i>Eucalyptus deanei</i> , <i>Eucalyptus saligna</i> , <i>Syncarpia glomulifera</i> and <i>Eucalyptus acmenoides</i> are prominent. The open or dense mid-layer comprises species such as <i>Acacia maidenii</i> , <i>Trocarpa laurina</i> , <i>Persoonia linearis</i> , and <i>Synoum glandulosum</i> , over a well developed herb and grass layer.	A moist ridgetop vegetation occurring in the Watagan Mountains, where <i>Eucalyptus deanei</i> , <i>Eucalyptus saligna</i> , <i>Syncarpia glomulifera</i> and <i>Eucalyptus acmenoides</i> are prominent. This community generally occurs in higher rainfall areas at the top of the Olney SF catchment, such as along the ridges around Heaton Gap. Few areas remain untouched by logging operations. Some further sampling is required to clarify the relationship of this type with Coastal Wet Gully Forest (MU1).
9a	Coastal Ranges Mesic Blackbutt Forest	A tall forest where <i>Eucalyptus pilularis</i> is clearly dominant, but may also occur with <i>Eucalyptus saligna</i> or <i>Allocasuarina torulosa</i> . The mesic understorey of semi-rainforest species includes <i>Acacia parramattensis</i> , <i>Astrotricha latifolia</i> , <i>Clerodendrum tomentosum</i> , <i>Synoum glandulosum</i> , <i>Claoxylon australe</i> and <i>Cryptocarya glaucescens</i> .	A widespread forest type in the Watagan Mountains system, but is currently poorly sampled across its distribution. Merges with Coastal Wet Gully Forest (MU1) and other similar moist vegetation types in protected slope positions.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
9b	Coastal Ranges Dry Blackbutt Forest	Characteristically, it comprises a canopy dominated by <i>Eucalyptus pilularis</i> , together with <i>Allocasuarina torulosa</i> and <i>Angophora floribunda</i> . Understorey vegetation is generally sparse, but includes <i>Pteridium esculentum</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Lepidosperma laterale</i> , <i>Acacia implexa</i> and <i>Themeda australis</i> .	Occurs along the drier parts of the Watagan Mountains and Sugarloaf Range. Commonly impacted upon by past logging practices.
9d	Coastal Ranges Dry Spotted Gum - Blackbutt Forest	Characterised in the canopy by <i>Eucalyptus pilularis</i> and <i>Corymbia maculata</i> , but other important species include <i>Angophora costata</i> and <i>Allocasuarina torulosa</i> . The understorey supports species such as the shrubs <i>Acacia ulicifolia</i> , <i>Bossiaea obcordata</i> and <i>Gompholobium latifolium</i> , with a ground layer of <i>Themeda australis</i> , <i>Aristida vagans</i> , <i>Entolasia stricta</i> , <i>Gonocarpus tetragynus</i> and <i>Imperata cylindrical</i> .	A dry grassy variant of the wider Coastal Ranges open forests, occurring west of Cooranbong and Wye. It may represent a disturbed form of Coastal Ranges Dry Blackbutt Forest (MU9b), again occurring in the vicinity of that unit and Coastal Foothills Spotted Gum – Ironbark Forest (MU15).
9e	Coastal Ranges Mesic Peppermint Forest	<i>Eucalyptus piperita</i> is the dominant canopy species present, co-occurring with <i>Allocasuarina torulosa</i> and <i>Angophora costata</i> . A moderately dense understorey of species such as <i>Cryptocarya rigida</i> , <i>Glochidion ferdinandi</i> , and <i>Astrotricha latifolia</i> occurs over <i>Entolasia marginata</i> , <i>Cymbopogon refractus</i> , <i>Gahnia melanocarpa</i> and <i>Lomandra longifolia</i> .	Present in the Watagan Mountains in and around Watagans NP, and some parts of the Sugarloaf Range. Further investigation is required to determine its relationship to similar moist forests.
9f	Coastal Ranges Dry Peppermint - Blackbutt Forest	Characterised in the canopy by <i>Eucalyptus piperita</i> and <i>Eucalyptus pilularis</i> , but other species such as <i>Corymbia gummifera</i> , <i>Allocasuarina torulosa</i> , <i>Banksia serrata</i> and <i>Eucalyptus scias</i> also occur. Common understorey species include <i>Pteridium esculentum</i> , <i>Podolobium ilicifolium</i> , <i>Persoonia linearis</i> , <i>Acacia implexa</i> , <i>Dampiera stricta</i> , <i>Entolasia stricta</i> and <i>Imperata cylindrica</i>	Perhaps an ecotonal community occurring at the interface of remnant Hawkesbury sandstone geology and older Narrabeen sediments. Very closely related to Watagans Remnant Hawkesbury Forest (MU26h), and with further data collection and analysis the two may be merged.
9h	Coastal Ranges Dry Tallowwood – Blackbutt Forest	Canopy species present include <i>Eucalyptus pilularis</i> , <i>Eucalyptus microcorys</i> , <i>Allocasuarina torulosa</i> and <i>Syncarpia glomulifera</i> . Understorey vegetation includes <i>Platysace lanceolata</i> , <i>Pteridium esculentum</i> , <i>Gompholobium virgatum</i> , <i>Persoonia linearis</i> ,	Represents a variant of Coastal Ranges open forest from the Martinsville Valley where <i>Eucalyptus microcorys</i> is characteristic, and co-occurs with <i>Eucalyptus pilularis</i> . Further data collection and analysis is required to clarify relationships with other similar

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		<i>Themeda australis</i> , <i>Entolasia stricta</i> , <i>Goodenia heterophylla</i> and <i>Dianella caerulea</i> .	communities within the Coastal Ranges open forest complex.
9i	Coastal Ranges Mesic Stringybark - Mahogany Forest	Dominated in the canopy by the prominent <i>Eucalyptus agglomerata</i> with <i>Allocasuarina torulosa</i> , <i>Syncarpia glomulifera</i> , <i>Eucalyptus acmenioides</i> and <i>Angophora floribunda</i> . Common mid-storey species include <i>Cryptocarya rigida</i> , <i>Synoum glandulosum</i> , <i>Cordyline stricta</i> and <i>Gymnostachys anceps</i> , over a rich and diverse ground layer of herbs and grasses.	Occurs in the Watagan Mountains on high rainfall slopes and ridges, and merges with other moist forest types. Further investigation is required to determine the relationship between this and similar communities, although the distribution of <i>Eucalyptus agglomerata</i> is distinctive where it occurs.
9l	Coastal Ranges Mesic Blackbutt-Tallowwood Forest	Typified by a canopy of <i>Eucalyptus pilularis</i> , <i>Eucalyptus microcorys</i> , and <i>Allocasuarina torulosa</i> , over an understorey of <i>Xanthorrhoea malocophylla</i> , <i>Synoum glandulosum</i> , <i>Persoonia linearis</i> , <i>Daviesia ulicifolia</i> , <i>Gompholobium latifolium</i> , <i>Calochlaena dubia</i> , <i>Poa affinis</i> and <i>Themeda australis</i> . Other eucalypts may also be present, including <i>Eucalyptus propinqua</i> , <i>Corymbia maculata</i> and <i>Eucalyptus acmenioides</i> .	Occurs in two areas in the hills west of Morisset and Wyee, but has not yet been sampled.
11	<u>Coastal Sheltered Apple-Peppermint Forest</u>	Clearly dominated by <i>Eucalyptus piperita</i> and <i>Angophora costata</i> , and with a sparse or moderate cover of understorey shrubs and grasses such as <i>Allocasuarina littoralis</i> , <i>Pteridium esculentum</i> , <i>Entolasia stricta</i> , <i>Themeda australis</i> , and <i>Imperata cylindrica</i> .	Occurs in dry drainage lines and associated slopes, generally at southerly to south-easterly aspects. Dominates in shallow drainage lines in small catchments around northern and central Lake Macquarie. Often cleared for grazing, cropping or horticulture, and is generally restricted in extent. <i>Eucalyptus piperita</i> as a dominant is diagnostic.
11a	Riparian Paperbark-Peppermint Forest	Canopy of <i>Eucalyptus piperita</i> , <i>Eucalyptus punctata</i> and <i>Angophora costata</i> . The tall shrub layer includes <i>Callicoma serratifolia</i> , <i>Glochidion ferdinandi</i> and <i>Melaleuca linariifolia</i> , and with a dense ground layer of <i>Gahnia clarkei</i> .	Minor drainage lines on the lower elevation undulating country of the coastal plains support a swampy community, typically occupies only narrow bands 15m or less in width.
11c	Awaba Peppermint-Black Wattle Riparian Forest	Emergent <i>Eucalyptus piperita</i> , <i>Angophora costata</i> , <i>Allocasuarina torulosa</i> +/- <i>Corymbia gummifera</i> ; over <i>Callicoma serratifolia</i> , <i>Glochidion ferdinandi</i> , <i>Calochlaena dubia</i> , <i>Prostanthera incise</i> , <i>Gahnia</i>	Narrow rocky gully lines high in the catchment where <i>Callicoma serratifolia</i> dominates the small tree/ shrub layers. Emergent <i>Eucalyptus piperita</i> and <i>Angophora costata</i> with <i>Allocasuarina torulosa</i>

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		<i>melanocarpa</i> , <i>Oplismenus imbecillus</i> .	
12	<u>Hunter Valley Moist Forest</u>	In most cases a canopy of <i>Corymbia maculata</i> with <i>Eucalyptus acmenioides</i> is present, although other species such as <i>Eucalyptus siderophloia</i> and <i>Eucalyptus punctata</i> may also occur. Important understorey species include <i>Polyscias sambuccifolia</i> , <i>Pteridium esculentum</i> , <i>Pittosporum undulatum</i> , <i>Notelaea longifolia</i> , <i>Poa affinis</i> , <i>Oplismenus imbecillus</i> and <i>Pseuderanthemum variabile</i> .	A broadly defined unit requiring further clarification and assessment, and it may overlap considerably with other MU12 subunits so far defined. As defined here, this is an original REMS2000 unit that has been subdivided regionally (see MU12 subunits). This community is effectively an ecotonal unit between moister forests in sheltered locations, and dryer ridgetop types.
12a	Hunter Valley Moist Spotted Gum – Blackbutt Forest	Typified by the presence of <i>Eucalyptus pilularis</i> with <i>Corymbia maculata</i> in the canopy, with common understorey species including <i>Daviesia ulicifolia</i> , <i>Acacia implexa</i> , <i>Pultenaea villosa</i> , <i>Billardiera scandens</i> , <i>Entolasia stricta</i> and <i>Dianella caerulea</i> .	Only on the lower hinterland hills near Mandalong, and in a small area of Pulbah Island. Further investigation is required to determine the relationship of this community with other vegetation in Units 12 and 15. In particular, it may simply be a lower-elevation, moister form of Coastal Ranges Dry Spotted Gum – Blackbutt Forest (MU9d).
12b	Hunter Valley Moist Spotted Gum – Turpentine Forest	<i>Corymbia maculata</i> , <i>Syncarpis glomulifera</i> , <i>Eucalyptus propinqua</i> and <i>Allocasuarina torulosa</i> in the canopy, over shrubs such as <i>Glochidion ferdinandi</i> , <i>Acacia prominens</i> , and <i>Acrotriche divaricata</i> . Ground layer vegetation includes <i>Lomandra longifolia</i> , <i>Entolasia stricta</i> and <i>Poa labillarderi</i>	Previously recorded within parts of Jilliby SCA (outside of Lake Macquarie LGA), and has now also been noted at the top end of the Mandalong Valley. May not differ significantly from other MU12 types, and full sampling is required.
12c	Hunter Valley Moist Spotted Gum – Ironbark Forest	Dominated by <i>Corymbia maculata</i> with <i>Eucalyptus paniculata</i> and/or <i>Eucalyptus siderophloia</i> . <i>Eucalyptus punctata</i> may be locally present but is not consistent, and in many areas <i>Eucalyptus fergusonii</i> and <i>Eucalyptus microcorys</i> are also locally common.	Mapped extensively on sheltered slopes in the Mandalong region of the LGA, generally in the vicinity of Coastal Foothills Spotted Gum – Ironbark Forest (MU15). Despite this, only very limited sampling has been completed there, and hence true relationships with related types are yet to be determined. This and the closely related northern unit Hunter Valley Moist Spotted Gum – Ironbark Forest (MU12d) require detailed revision, as it is possible that floristically they are very similar.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
12d	Hunter Valley Moist Spotted Gum - Fergusons Forest	Dominated by <i>Corymbia maculata</i> , <i>Eucalyptus acmenoides</i> , <i>Allocasuarina torulosa</i> and <i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i> . <i>Eucalyptus punctata</i> and <i>Syncarpia glomulifera</i> may also be present in some areas. The mesic shrub layer includes <i>Melaleuca styphelioides</i> , <i>Indigofera australis</i> , <i>Rhodamnia rubescens</i> , <i>Acrotricha divaricata</i> , <i>Croton verreauxii</i> , and <i>Cordyline stricta</i> . Ground layer species include <i>Oplismenus imbecillus</i> , <i>Smilax australis</i> , <i>Gymnostachys anceps</i> , <i>Adiantum formosum</i> , <i>Doodia aspera</i> and <i>Dichondra repens</i> .	Hunter Valley Moist Spotted Gum – Ironbark Forest is one of several communities where <i>Corymbia maculata</i> is prominent in the canopy. This more northern community is very closely related to Hunter Valley Moist Spotted Gum – Ironbark Forest (MU12c) occurring in the south of the LGA around Mandalong, and the two require careful revision.
15	<u>Coastal Foothills Spotted Gum - Ironbark Forest</u>	Dominated in the canopy by <i>Eucalyptus siderophloia</i> , <i>Allocasuarina torulosa</i> and <i>Eucalyptus acmenoides</i> , with <i>Corymbia maculata</i> in some areas. The shrub layer supports species such as <i>Clerodendrum tomentosum</i> , <i>Hibbertia aspera</i> , <i>Polyscias sambuccifolia</i> , and <i>Persoonia linearis</i> . Ground layer vegetation includes <i>Microlaena stipoides</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Lomandra longifolia</i> , <i>Entolasia stricta</i> , <i>Themeda australis</i> and <i>Desmodium gunnii</i> .	Mainly occurs on the coastal foothills west of Lake Macquarie, however variants of it extend along drainage lines into the Wyee area, and other parts of the Wyong LGA. Requires some further testing.
15d	Coastal Foothills Spotted Gum - Ironbark Forest (Kurri Kurri)	<i>Corymbia maculata</i> , <i>Eucalyptus siderophloia</i> , <i>Eucalyptus paniculata</i> , <i>Allocasuarina torulosa</i> , and <i>Eucalyptus acmenoides</i> . Common understorey species include <i>Acacia falcata</i> , <i>Podolobium ilicifolium</i> , <i>Acacia implexa</i> , <i>Bursaria spinosa</i> and <i>Dodonaea triquetra</i> , over <i>Themeda australis</i> , <i>Entolasia stricta</i> and <i>Imperata cylindrica</i> .	Yet to be sampled in detail, and occurs on the low rises of Permian sediments in the southern section of Sugarloaf State Conservation Area near Awaba. Relates to a similar form found in the Cessnock LGA, and further sampling and analysis is required to determine its relationship to Coastal Foothills Spotted Gum – Ironbark Forest (MU15).
15h	Lake Macquarie Spotted Gum Forest	Characterised by <i>Corymbia maculata</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus paniculata</i> and <i>Eucalyptus umbra</i> , over an understorey of species such as <i>Breynia oblongifolia</i> , <i>Acacia implexa</i> , <i>Persoonia linearis</i> , <i>Dodonaea triquetra</i> and <i>Daviesia ulicifolia</i> . On the ground, grasses such as <i>Entolasia stricta</i> , <i>Themeda australis</i> , <i>Imperata cylindrica</i> and <i>Poa affinis</i> dominate, together with <i>Dianella caerulea</i> ,	Prevalent on the low hills of Permian sediments around Lake Macquarie, where it merges with various forms of forest dominated by <i>Angophora costata</i> .

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		<i>Desmodium rhytidophyllum</i> and <i>Lomandra longifolia</i> . In places, <i>Macrozamia reducta</i> forms a conspicuous ground layer.	
15i	Lake Macquarie Ironbark Forest	Dominated by <i>Eucalyptus paniculata</i> , <i>Eucalyptus siderophloia</i> and <i>Eucalyptus punctata</i> , with occasional <i>Angophora costata</i> . Understorey vegetation includes <i>Notelaea longifolia</i> , <i>Persoonia linearis</i> , <i>Bursaria spinosa</i> , <i>Acacia longifolia</i> , <i>Dodonaea trquetra</i> , and <i>Acacia falcata</i> . The ground layer is rich in grasses and herbs, and includes <i>Oplismenus imbecillis</i> , <i>Dichondra repens</i> , <i>Imperata cylindrica</i> , <i>Glycine clandestina</i> and <i>Poranthera microphylla</i> .	Occurs in exposed locations on narrow peninsulas on the shores of Lake Macquarie (eg Point Wolstoncroft), in fine-grained sediments on near-level ground, most likely corresponding to a specific stratum within the Permian rock layers.
15k	Coastal Foothills Moist Grey Gum-Mahogany Forest	Canopy of <i>Eucalyptus propinqua</i> , <i>Corymbia maculata</i> and <i>Eucalyptus umbra</i> , with <i>Eucalyptus microcorys</i> and <i>Syncarpia glomulifera</i> occasionally occurring. The understorey is typified by <i>Daviesia ulicifolia</i> , <i>Podolobium ilicifolium</i> and <i>Podolobium aciculiferum</i> , with <i>Themeda australis</i> , <i>Entolasia stricta</i> and <i>Imperata cylindrica</i> on the ground.	Occurs on sheltered slopes in the south-eastern parts of the LGA. This community is yet to be sampled in detail, and hence relationships between it and other units within the Coastal Foothills group (MU15's) are yet to be clarified. However, the presence of <i>Eucalyptus propinqua</i> in this community distinguishes it from several others.
15l	Sugarloaf Uplands Dry Spotted Gum - Ironbark Forest	Dominated by <i>Corymbia maculata</i> , <i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i> , <i>Eucalyptus umbra</i> and <i>Eucalyptus punctata</i> . The typical open shrub layer includes <i>Persoonia linearis</i> , <i>Macrozamia reducta</i> , <i>Podolobium ilicifolium</i> , and <i>Maytenus silvestris</i> , over a diverse range of grasses and herbs such as <i>Themeda australis</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Panicum simile</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Entolasia stricta</i> and <i>Lepidosperma laterale</i> .	Occurs on the higher ridges and exposed slopes of the Sugarloaf Range. <i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i> is a listed rare eucalypt, however it is a community dominant in this community.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
15m	Jiliby Spotted Gum-Northern Ironbark-Mahogany Forest	Supports <i>Corymbia maculata</i> , <i>Eucalyptus umbra</i> and <i>Eucalyptus siderophloia</i> , and an understorey of species such as <i>Podolobium ilicifolium</i> , <i>Leucopogon juniperinus</i> and <i>Podolobium aciculiferum</i> occurs over a ground layer of <i>Entolasia stricta</i> , <i>Themeda australis</i> , <i>Aristida vagans</i> and <i>Joycea pallida</i> .	Occurs in the Mandalong Valley in the south-west of the LGA. Fulfils an almost equivalent role to Jiliby Spotted Gum – Fergusons Ironbark – Mahogany Forest (MU15n), which occurs in a similar locality.
15n	Jiliby Spotted Gum-Ferguson's Ironbark-Mahogany Forest	<i>Corymbia maculata</i> with <i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i> , <i>Eucalyptus punctata</i> and <i>Eucalyptus umbra</i> . Understorey vegetation includes <i>Podolobium aciculiferum</i> , <i>Daviesia ulicifolia</i> , <i>Persoonia linearis</i> and <i>Bursaria spinosa</i> , over <i>Entolasia stricta</i> , <i>Dianella caerulea</i> , <i>Lomandra filiformis</i> subsp. <i>coriacea</i> , and <i>Lepidosperma laterale</i> .	Occurs in and around the Mandalong Valley, where it adjoins areas currently mapped as Jiliby Spotted Gum – Northern Ironbark – Mahogany Forest (MU15m). These two communities are floristically very similar, and differ most markedly in the different Ironbark species co-dominating. Further sampling and analysis is required to clarify the relationship between this community and MU15m.
15o	Sugarloaf Uplands Moist Spotted Gum – Ironbark Forest	Supports a canopy of <i>Corymbia maculata</i> and <i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i> , joined by <i>Eucalyptus acmenoides</i> and <i>Eucalyptus punctata</i> . Understorey vegetation supports species such as <i>Hibbertia aspera</i> , <i>Persoonia linearis</i> , <i>Macrozamia reducta</i> and <i>Clerodendrum tomentosum</i> , over a ground layer of <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Desmodium gunnii</i> , <i>Gymnostachys anceps</i> , <i>Pratia purpurascens</i> , <i>Dichondra repens</i> and <i>Oplismenus imbecillus</i> . Vines and scramblers, such as <i>Hibbertia scandens</i> , <i>Smilax australis</i> , <i>Eustrephus latifolius</i> , and <i>Pandorea pandorana</i> are also common.	Occurs on the more sheltered slopes of the Sugarloaf Range. Currently not represented on LGA mapping, but is included within other units of the Coastal Foothills complex. Relative to its dryer counterpart (MU15l), understorey vegetation is slightly more mesic.
15p	Sugarloaf Uplands Paperbark Thicket	Paperbark scrub clearly dominated by <i>Melaleuca nodosa</i> . Emergent canopy trees can include any of <i>Corymbia maculata</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i> or <i>Eucalyptus umbra</i> . Few other shrub species are common in this vegetation type, but <i>Epacris pulchella</i> , <i>Leptospermum polygalifolium</i> subsp. <i>cistmontanum</i> or <i>Acrotricha divaricata</i> may occur. Grasses and graminoids dominate the ground layer, including <i>Themeda australis</i> , <i>Panicum simile</i> , <i>Ptilothrix deusta</i>	Occurs on level or very gently sloping spurs and ridgetops with compacted clay soils. This type is currently not represented in associated mapping.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		and <i>Aristida vagans</i>	
17o	Hinterland Spotted Gum - Red Ironbark Forest	Dominated by <i>Corymbia maculata</i> and <i>Eucalyptus fibrosa</i> , with occasional <i>Angophora costata</i> , <i>Eucalyptus umbra</i> or <i>Eucalyptus punctata</i> . Understorey species commonly include <i>Pultenaea villosa</i> , <i>Daviesia ulicifolia</i> subsp. <i>ulicifolia</i> and <i>Leptospermum polygalifolium</i> subsp. <i>cismontanum</i> in the shrub layer, over a grassy ground layer of <i>Themeda australis</i> , <i>Entolasia stricta</i> , <i>Joycea pallida</i> , <i>Microlaena stipoides</i> var <i>stipoides</i> , and <i>Panicum simile</i> . In some areas, thickets of <i>Melaleuca nodosa</i> can occur.	Occurs on the lowlands of the north-western side of Lake Macquarie.
21a	Hunter Range Dry Escarpment Apple Forest	Prominent canopy species include <i>Angophora costata</i> , <i>Eucalyptus agglomerata</i> and <i>Eucalyptus umbra</i> . The understorey varies between sparse and dense, but invariably includes <i>Podolobium aciculiferum</i> , <i>Cassinia cunninghamii</i> , <i>Daviesia ulicifolia</i> and <i>Leucopogon lanceolatus</i> . Ground layer species are typified by <i>Lomandra confertifolia</i> subsp. <i>rubiginosa</i> , <i>Lepidosperma laterale</i> , <i>Aristida vagans</i> and <i>Austrostipa pubescens</i> .	Occurs on exposed and rocky sandstone escarpment edges and spur ends within the Watagan Ranges. This community is similar to others within the Hunter Range dry forests, and some further clarifications are required.
21d	Hunter Range Dry Ironbark – Grey Gum Forest	<i>Eucalyptus punctata</i> and <i>Eucalyptus paniculata</i> are dominant. Other canopy species present in this community include <i>Eucalyptus agglomerata</i> , <i>Allocasuarina torulosa</i> , <i>Syncarpia glomulifera</i> and <i>Eucalyptus acmenioides</i> . <i>Eucalyptus pilularis</i> is also present in some parts.	Mapped for a single location at the top of the Martinsville Valley, and is yet to be sampled in detail. With further investigation this community may simply be seen as a localised form of the more widespread Hunter Ranges Dry Stringybark – Blackbutt Forest (MU21g). No data on understorey species is yet available.
21e	Hunter Range Dry Mahogany - Grey Gum Forest	Key canopy species include <i>Eucalyptus acmenioides</i> , <i>Eucalyptus umbra</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus microcorys</i> , <i>Eucalyptus scias</i> , <i>Syncarpia glomulifera</i> and <i>Eucalyptus agglomerata</i> .	Mapped from only a single location along Lemon Tree Road in the Jilliby Ranges. It is a dry, rocky low forest with many eucalypts present but no clear dominants. As with MU21d, this community is yet to be sampled in detail. No data on understorey species is yet available. Further investigation is required to ascertain

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
			relationships between this community and other closely related units within the Hunter Range forest complex. It is likely that sampling and analysis will reveal this community to be a localised form of the more widespread Hunter Ranges Dry Stringybark – Blackbutt Forest (MU21g).
21f	Hunter Range Dry Mahogany - Apple Forest	Generally supports <i>Eucalyptus umbra</i> as the key dominant species, but with any of <i>Angophora floribunda</i> , <i>Eucalyptus paniculata</i> , <i>Eucalyptus fergusonii</i> , <i>Eucalyptus agglomerata</i> , <i>Eucalyptus punctata</i> and <i>Allocasuarina torulosa</i> often present. Understorey vegetation commonly includes <i>Podolobium aciculiferum</i> , with <i>Olearia tomentosa</i> , <i>Asterolasia correifolia</i> , <i>Entolasia stricta</i> , <i>Paspalidium distans</i> , <i>Paspalidium criniforme</i> and <i>Lomandra longifolia</i> .	Best developed on exposed rocky spur ends and exposed slopes within Jilliby State Conservation Area, off Prickly Ridge Road. Further sampling and analysis is required to determine the relationship of this community with other forms of Hunter Range forest types.
21g	Hunter Range Dry Stringybark – Blackbutt Forest	Dominated by a canopy of <i>Eucalyptus agglomerata</i> and <i>Eucalyptus pilularis</i> , with other species such as <i>Eucalyptus punctata</i> , <i>Eucalyptus paniculata</i> , <i>Allocasuarina torulosa</i> and <i>Angophora floribunda</i> also present. Understorey species include <i>Acacia implexa</i> , <i>Podolobium aciculiferum</i> and <i>Acacia ulicifolia</i> , with <i>Entolasia stricta</i> , <i>Cleistochloa rigida</i> and <i>Panicum simile</i> on the ground.	Floristically similar to Hunter Range Dry Mahogany – Apple Forest (MU21f), and some further investigation is required to determine the status of both. While <i>Eucalyptus agglomerata</i> is occasionally present in MU21f, it is clearly not a dominant feature as it is in this community.
22	<u>Coastal Narrabeen Shrub Forest</u>	<i>Eucalyptus pilularis</i> , <i>Angophora costata</i> , <i>Allocasuarina torulosa</i> , <i>Corymbia gummifera</i> and <i>Eucalyptus umbra</i> . Important understorey vegetation includes <i>Pteridium esculentum</i> , <i>Persoonia linearis</i> , <i>Glochidion ferdinandi</i> , <i>Bossiaea obcordata</i> and <i>Gompholobium latifolium</i> . Ground layer species include <i>Entolasia stricta</i> , <i>Panicum simile</i> , <i>Dampiera stricta</i> , <i>Dianella caerulea</i> and <i>Themeda australis</i> .	Currently included in the Dudley-Whitebridge area. This community requires additional sampling to clarify its relationship with Coastal Ranges Dry Blackbutt Forest (MU9b).
22e	Coastal Narrabeen Dry Bloodwood - Apple - Mahogany Forest	<i>Angophora costata</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus umbra</i> , <i>Eucalyptus pilularis</i> , <i>Eucalyptus scias</i> , and <i>Banksia serrata</i> . Understorey vegetation includes <i>Allocasuarina littoralis</i> , <i>Leptospermum trinervium</i> ,	Mapped for a ridge system on Narrabeen sandstone north of Cooranbong, but requires sampling and analysis to determine its relationship to similar communities. Further investigation is required to clarify relationships to Coastal Narrabeen Shrub

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		<i>Banksia spinulosa</i> , <i>Xylomelum pyriforme</i> , <i>Leptospermum polygalifolium</i> , <i>Lambertia formosa</i> , and <i>Bossiaea obcordata</i> , over <i>Xanthorrhoea latifolia</i> , <i>Entolasia stricta</i> , <i>Themeda australis</i> , and <i>Imperata cylindrical</i> .	Forest (MU22).
25a	Narrabeen Peppermint - Apple Forest	<i>Eucalyptus piperita</i> , <i>Angophora costata</i> , <i>Allocasuarina torulosa</i> and <i>Corymbia gummifera</i> . Shrub species include <i>Hibbertia aspera</i> , <i>Olearia tomentosa</i> , <i>Polyscias sambuccifolia</i> , <i>Gompholobium latifolium</i> and <i>Gymnostachys anceps</i> . The sparse ground layer typically supports <i>Entolasia stricta</i> , <i>Brunoniella australis</i> , <i>Goodenia heterophylla</i> subsp. <i>heterophylla</i> , <i>Poa affinis</i> , and <i>Microlaena stipoides</i> var. <i>stipoides</i>	Sheltered upper slopes on Narrabeen Sandstone along the Sugarloaf Range, such as around The Gap, support this vegetation. Very similar to MU25 but likely to have a different suite of understorey species - yet to be tested.
26h	Watagans Remnant Hawkesbury Forest	Dominated in the canopy by <i>Eucalyptus sieberi</i> , <i>Eucalyptus piperita</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus scias</i> , and <i>Banksia serrata</i> , over an understorey of species such as <i>Banksia spinulosa</i> , <i>Acacia kulnurensis</i> , <i>Lambertia formosa</i> , <i>Xylomelum pyriforme</i> , <i>Styphelia tubiflora</i> , <i>Caustis flexuosa</i> , <i>Comesperma defoliatum</i> , <i>Lomandra cylindrica</i> , and <i>Tetrarhena juncea</i> .	Occurs only on remnant Hawkesbury Sandstone geology in and around 'The Pines' picnic area in Olney State Forest. Vegetation in this unit is more typical of that found on Hawkesbury Sandstone further to the south and west, where that geological strata outcrops more consistently.
30	<u>Coastal Plains Smooth-barked Apple Woodland</u>	<i>Angophora costata</i> occurs with <i>Corymbia gummifera</i> , <i>Eucalyptus umbra</i> and <i>Eucalyptus capitellata</i> , over an understorey of species such as <i>Allocasuarina littoralis</i> , <i>Banksia spinulosa</i> , <i>Acacia myrtifolia</i> , <i>Leptospermum polygalifolium</i> , <i>Lambertia formosa</i> , <i>Dillwynia retorta</i> , <i>Themeda australis</i> , <i>Entolasia stricta</i> , <i>Pteridium esculentum</i> , <i>Lomandra obliqua</i> , <i>Phyllanthus hirtellus</i> , <i>Imperata cylindrica</i> , and <i>Lepidosperma laterale</i> .	An original REMS2000 vegetation unit which has been progressively sub-divided to accommodate more detailed revision across the region. Some areas remain on the current map layer which will require allocation to new divisions.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
30a	Buttonderry Footslopes Forest	<i>Eucalyptus globoidea</i> , <i>Angophora costata</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus umbra</i> , and <i>Eucalyptus capitellata</i> occurs over an understorey of <i>Pteridium esculentum</i> , <i>Bossiaea obcordata</i> , <i>Daviesia squarrosa</i> , <i>Banksia spinulosa</i> , <i>Epacris pulchella</i> , <i>Gompholobium latifolium</i> , and <i>Polyscias sambuccifolia</i> . The ground layer supports <i>Entolasia stricta</i> , <i>Lomandra cylindrica</i> , <i>Lomandra obliqua</i> , <i>Joycea pallida</i> , <i>Xanthorrhoea latifolia</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , and <i>Phyllanthus hirtellus</i> .	Originally defined for the northern Wyong area, and parts of southern Lake Macquarie (mainly south of Morisset) appear to support similar vegetation. Further clarification of this type and other defined forms of MU30 is required to determine its position in the classification.
30b	Sugarloaf Uplands Bloodwood - Apple Forest	Dominated by <i>Angophora costata</i> , <i>Corymbia gummifera</i> and <i>Eucalyptus umbra</i> , and dominant shrub and understorey species include <i>Persoonia linearis</i> , <i>Podolobium ilicifolium</i> , <i>Macrozamia reducta</i> , <i>Daviesia ulicifolia</i> subsp. <i>ulicifolia</i> , and <i>Pteridium esculentum</i> in the shrub layer, over <i>Themeda australis</i> , <i>Joycea pallida</i> , <i>Lomandra confertifolia</i> subsp. <i>pallida</i> , <i>Lepidosperma laterale</i> and <i>Entolasia stricta</i> on the ground.	Common across parts of the Sugarloaf Range and surrounding areas, occurring principally on Narrabeen Sandstone geology.
30e	Coastal Plains Stringybark - Apple Forest	<i>Eucalyptus globoidea</i> and <i>Angophora costata</i> , with some <i>Corymbia gummifera</i> , <i>Eucalyptus umbra</i> and <i>Eucalyptus resinifera</i> also present. Understorey species include <i>Pultenaea euchila</i> , <i>Acacia terminalis</i> , <i>Dodonaea triquetra</i> and <i>Leptospermum polygalifolium</i> subsp. <i>cismontanum</i> .	Occurs on the lowlands near the F3 Freeway in the north-west of the LGA. It is possible that this community equates to a localised form of MU30h (Sugarloaf Lowlands Bloodwood – Apple Forest), but requires further investigation.
30f	Freemans Peppermint-Apple-Bloodwood Forest	Characterised by <i>Eucalyptus piperita</i> in the canopy, where it occurs with <i>Angophora costata</i> and <i>Corymbia gummifera</i> . Understorey species include the dominant presence of <i>Doryanthes excelsa</i> in the shrub layer, with <i>Pteridium esculentum</i> , <i>Gompholobium latifolium</i> , <i>Acacia myrtifolia</i> , <i>Hibbertia empetrifolia</i> subsp. <i>empetrifolia</i> , <i>Podolobium ilicifolium</i> , <i>Bossiaea obcordata</i> , <i>Banksia spinulosa</i> var. <i>collina</i> and <i>Leptospermum trinervium</i> . On the ground, <i>Themeda australis</i> is common, along	Centred on Freeman's Waterhole, this vegetation type is characterised by <i>Eucalyptus piperita</i> .

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		with <i>Entolasia stricta</i> , <i>Gonocarpus tetragynus</i> , <i>Brunoniella australis</i> , <i>Lomandra obliqua</i> and <i>Patersonia glabrata</i> .	
30h	Sugarloaf Lowlands Bloodwood - Apple Forest	<i>Angophora costata</i> , <i>Corymbia gummifera</i> and <i>Eucalyptus umbra</i> dominate the canopy, while <i>Dillwynia retorta</i> , <i>Pultenaea paleacea</i> , <i>Pimelea linifolia</i> subsp. <i>linifolia</i> and <i>Epacris pulchella</i> are common in the shrub layer. <i>Themeda australis</i> , <i>Entolasia stricta</i> , <i>Ptilothrix deusta</i> , <i>Joycia pallida</i> , <i>Lepidosperma laterale</i> , <i>Lomandra obliqua</i> , <i>Aristida warburgii</i> , <i>Mirbelia rubifolia</i> , <i>Paspalidium distans</i> and <i>Gompholobium pinnatum</i> are common in the ground layer.	Closely related to the Sugarloaf Uplands Bloodwood – Apple Forest (MU30b), Sugarloaf Lowlands Bloodwood - Apple Forest occurs largely on Narrabeen and Permian sediment (Moon Island Beach subgroup) geology, and is floristically simpler.
30i	West Wallsend Stringybark Forest	<i>Eucalyptus globoidea</i> , <i>Eucalyptus capitellata</i> and <i>Eucalyptus umbra</i> , and. <i>Angophora costata</i> is also occasionally present. Understorey vegetation includes a sparse shrub layer of <i>Acacia ulicifolia</i> , <i>Callistemon linearis</i> and <i>Leptospermum trinervium</i> , over a dense grassy layer of <i>Aristida vagans</i> , <i>Dichelachne micrantha</i> , <i>Entolasia stricta</i> , <i>Eragrostis brownii</i> , <i>Lomandra filiformis</i> subsp. <i>filiformis</i> , <i>Panicum simile</i> , <i>Joycea pallida</i> and <i>Themeda australis</i> .	Mapped for areas immediately around West Wallsend in the north-west of the LGA. This community is characterised by a dominance of stringybarks over a grassy understorey. The current floristic composition of this community may reflect a history of disturbance, particular frequent fire, and further investigation is required to determine if such disturbance drives the differences to other units in the MU30 complex.
30j	Sugarloaf Lowlands Bloodwood-Apple-Scribbly Gum Forest	Supports a canopy of <i>Corymbia gummifera</i> , <i>Eucalyptus capitellata</i> , <i>Eucalyptus haemastoma</i> , and <i>Angophora costata</i> . Understorey vegetation includes <i>Leptospermum trinervium</i> , <i>Lambertia formosa</i> , <i>Epacris pulchella</i> , <i>Dillwynia retorta</i> , <i>Banksia spinulosa</i> and <i>Allocasuarina littoralis</i> , over <i>Xanthorrhoea latifolia</i> , <i>Entolasia stricta</i> , <i>Ptilothrix deusta</i> , <i>Lomandra obliqua</i> and <i>Themeda australis</i> .	Occurs in the Cardiff to Valentine and Kahibah areas of the north-eastern portion of the LGA, principally on the Boolaroo subgroup of the Permian sediments in these areas. This community is floristically very similar to Sugarloaf Lowlands Bloodwood – Apple Forest (MU30h), but supports <i>Eucalyptus haemastoma</i> as a prominent canopy component. That community also occurs on different geological strata (Narrabeen sediments and Permian Moon Island Beach subgroup). Some limited further investigation may help clarify relationships with this and similar units.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
31	<u>Coastal Plains Scribbly Gum Woodland</u>	<i>Eucalyptus haemastoma</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus capitellata</i> and <i>Angophora costata</i> in the canopy, over a diverse understorey of heathy shrubs, sub-shrubs and forbs, including <i>Lambertia formosa</i> , <i>Leptospermum trinervium</i> , <i>Banksia oblongifolia</i> , <i>Allocasuarina littoralis</i> , <i>Hakea laevipes</i> , <i>Isopogon anemonifolius</i> , <i>Aristida warburgii</i> , <i>Entolasia stricta</i> , <i>Ptilothrix deusta</i> , <i>Xanthorrhoea latifolia</i> , <i>Lomandra obliqua</i> .	Widespread on Narrabeen sediments of the Central Coast hinterland.
31h	Coastal Plains Dry Heath	Common species include <i>Banksia oblongifolia</i> , <i>Angophora inopina</i> (shrub form), <i>Hakea laevipes</i> and <i>Ptilothrix deusta</i> .	Occurs on the Narrabeen coastal plains of southern Lake Macquarie LGA, and forms a mosaic within the wider matrix of Coastal Plains Scribbly Gum Woodland (MU31). Mapable on aerial photographs, the distribution of this community is dynamic and responds to disturbance events such as fire or partial clearing. Very often good habitat for terrestrial orchids.
31i	Coastal Sandstone Laterite Heath	<i>Banksia oblongifolia</i> is prominent, with other important species including <i>Lambertia formosa</i> , <i>Epacris pulchella</i> , <i>Isopogon anemonifolia</i> , <i>Ptilothrix deusta</i> , <i>Lomandra obliqua</i> , <i>Patersonia sericea</i> and <i>Themeda australis</i> .	Filling a similar niche to Coastal Plains Dry Heath (MU31h), Coastal Sandstone Laterite Heath occurs as small patches on the Permian sandstones of north-eastern Lake Macquarie. Some additional sampling and analysis is required to clarify the relationship between these two heaths.
31j	Snappy Gum Ridgetop Heathy Forest	<i>Eucalyptus racemosa</i> , <i>Angophora costata</i> and <i>Corymbia gummifera</i> are key canopy species in this community. Understorey species include <i>Pultenaea paleacea</i> , <i>Daviesia ulicifolia</i> , <i>Pimelea linifolia</i> and <i>Acacia myrtifolia</i> , together with <i>Xanthorrhoea latifolia</i> , <i>Entolasia stricta</i> and <i>Themeda australis</i> on the ground.	Substantial variant of Coastal Plains Scribbly Gum Woodland (MU31), as it replaces <i>Eucalyptus haemastoma</i> in that community with <i>Eucalyptus racemosa</i> . Known from Narrabeen sandstone ridgetops between Moriseet and Catherine Hill Bay (separated by the southern reaches of Lake Macquarie), with a small outlier near Toronto. With further investigation, this latter site may instead form the southern extent of Killingworth Snappy Gum Forest (MU111c).
31k	Narrabeen Dune Forest	<i>Corymbia gummifera</i> with <i>Eucalyptus haemastoma</i> and <i>Angophora costata</i> , over a shrub layer of <i>Ricinocarpus pinifolius</i> , <i>Dillwynia retorta</i> , <i>Leptospermum polygalifolium</i> , <i>Platysace linearifolia</i> , <i>Acacia suaveolens</i> and <i>Bossiaea heterophylla</i> .	Evident as small sandy old alluvial dunes within the wider Narrabeen Sandstone landscape. These deeper sand deposits support some species more typical of larger Pleistocene sand deposits along the coast, and which are rare within the surrounding Coastal Plains Scribbly Gum Woodland (MU31). At present, this type has been noted in only two locations in the

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
			Morisset district.
33	<u>Coastal Sand Apple-Blackbutt Forest</u>	Dominated by <i>Eucalyptus pilularis</i> with <i>Angophora costata</i> and <i>Corymbia gummifera</i> , and <i>Banksia serrata</i> is also prominent. The understorey includes species such as <i>Bossiaea rhombifolia</i> , <i>Pteridium esculentum</i> , <i>Acacia longifolia</i> , <i>Ricinocarpus pinifolius</i> and <i>Acacia terminalis</i> , over a sparse ground layer of <i>Dianella caerulea</i> , <i>Lomandra longifolia</i> and <i>Poa affinis</i> .	Occurs on coastal sand bodies within parts of Awabakal Nature Reserve and in the Jewells Swamp area.
33c	Pelican Bangalay Forest	<i>Eucalyptus botryoides</i> dominates the canopy with <i>Angophora costata</i> , <i>Banksia serrata</i> , and some <i>Corymbia gummifera</i> . Understorey vegetation includes <i>Aotus ericoides</i> , <i>Monotoca elliptica</i> , <i>Acacia longifolia</i> , <i>Pimelea linifolia</i> , <i>Acacia suaveolens</i> , <i>Pteridium esculentum</i> , <i>Lomandra longifolia</i> , <i>Pomax umbellata</i> and <i>Imperata cylindrica</i> .	Occurs on the poorly drained sandy plains and rises in the Belmont South and Pelican Flats area. Floristically, this community has strong affinities to the Umina Coastal Sandplain Woodland EEC from the Gosford LGA, but under current legislation this type is not included in that community.
33d	Awabakal Sand Mantled Blackbutt Forest	Dominated by a canopy of <i>Eucalyptus pilularis</i> , <i>Eucalyptus paniculata</i> , <i>Angophora costata</i> and <i>Allocasuarina torulosa</i> . Other species present include <i>Acacia longifolia</i> , <i>Acacia falcata</i> , <i>Polyscias sambuccifolia</i> , and <i>Pteridium esculentum</i> , with the grasses <i>Themeda australis</i> , <i>Imperata stricta</i> , <i>Entolasia stricta</i> and <i>Poa affinis</i> prominent.	Occurs on a sandy substrate overlying bedrock, often on slopes, and lies in close proximity to larger aeolian sand bodies, but lacks the full diversity of typical 'sand' species in the understorey. At present, this community is noted only for a small section of Awabakal Nature Reserve, and full revision is required to determine its correct place in the classification. It may, for example, represent a minor variant of Coastal Narrabeen Shrub Forest (MU22).
33m	Sand Mantled Banksia Forest	Open forest of <i>Angophora costata</i> , <i>Banksia serrata</i> and <i>Corymbia gummifera</i> on sandy wind-blown deposits. Common understorey species include <i>Monotoca elliptica</i> , <i>Persoonia linearis</i> , <i>Acacia longifolia</i> , <i>Pteridium esculentum</i> , <i>Macrozamia communis</i> , <i>Gonocarpus teucroides</i> , <i>Lomandra</i>	Occurs in a few location in the south-east of Lake Macquarie LGA, such as near Catherine Hill Bay and Swansea. These areas occur on small and typically isolated wind-blown sand deposits, often overlying Permian aged, clay-based sediments. Differs from Coastal Sand Apple – Blackbutt Forest most prominently in the absence of <i>Eucalyptus pilularis</i>

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		<i>longifolia</i> , and <i>Themeda australis</i>	
34a	Coastal Sand Wallum Heath	Characterised by an often dense mid-layer of <i>Banksia aemula</i> , with stunted <i>Corymbia gummifera</i> and <i>Angophora costata</i> also present. Other prominent shrubs include <i>Ricinocarpus pinifolius</i> , <i>Aotus ericoides</i> , <i>Dillwynia retorta</i> , <i>Monotoca scoparia</i> , and <i>Leucopogon ericoides</i> .	Occurs only on the elevated coastal sand masses in the vicinity of Awabakal NR and Munmorah SCA. Further clarification is required between this community and the related Coastal Sandplain Dry Heath (MU34c), which appears to occur on shallower sands.
34b	Coastal Sand-Mantled Clay Heath	Typical species in this community include <i>Melaleuca nodosa</i> , <i>Banksia spinulosa</i> , <i>Banksia oblongifolia</i> , <i>Isopogon anemonifolius</i> , <i>Epacris pulchella</i> and <i>Hakea laevipes</i> . On the ground, <i>Xanthorrhoea latifolia</i> is characteristic, together with <i>Ptilothrix deusta</i> and various grasses.	Present in areas close to the coast around Catherine Hill Bay and Caves Beach, principally on clay soils, but where a light veneer of wind-blown sand allows other 'sand-based' species to also predominate.
34c	Coastal Sandplain Dry Heath	<i>Banksia aemula</i> , <i>Allocasuarina distyla</i> , <i>Bossiea ensata</i> , <i>Isopogon anemonifolius</i> , <i>Lambertia formosa</i> and <i>Monotoca scoparia</i> .	Occurs on shallower sands of the coastal sand masses in and around Awabakal NR and Munmorah SCA. Closely related to Coastal Sand Wallum Heath (MU34a), and requires further investigation.
36c	Tomago Clay Wallum Scrub	Characterised by the co-dominance of <i>Banksia aemula</i> with <i>Melaleuca nodosa</i> , together with shrub species more typical of sandy habitats including <i>Leptospermum trinervium</i> , <i>Banksia oblongifolia</i> , and <i>Melaleuca sieberi</i> .	Only at Pelican Flats within Lake Macquarie, but is present on the Tomago Sandbeds north of Newcastle. The only known stand in Lake Macquarie has been bisected by the Pacific Highway, and is becoming weed infested.
37	<u>Swamp Mahogany - Paperbark Forest</u>	Typified by the presence of <i>Eucalyptus robusta</i> in the canopy, and may occur with a range of associates including <i>Melaleuca linariifolia</i> , <i>Melaleuca sieberi</i> , <i>Eucalyptus resinifera</i> , and <i>Eucalyptus tereticornis</i> . The understorey is variable, often with a dense shrub layer of species such as <i>Acacia longifolia</i> , <i>Omalanthus nutans</i> , <i>Leptospermum juniperinum</i> , <i>Melaleuca thymifolia</i> and <i>Pultenaea villosa</i> , and the sedges <i>Gahnia clarkei</i> , <i>Chorizandra cymbaria</i> and <i>Baloskion tetraphyllum</i> subsp. <i>meiostachyus</i> .	Common in the better defined drainage lines. It is also a stronghold for <i>Eucalyptus robusta</i> in the area, a known Koala feed tree, and is a winter-flowering eucalypt that provides a food source for several other threatened fauna species.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
37a	Alluvial Paperbark Sedge Forest	Typical species present in this type include <i>Eucalyptus robusta</i> , the characteristic <i>Melaleuca biconvexa</i> , and <i>Melaleuca linariifolia</i> and <i>Gahnia clarkei</i> .	More common in the Wyong and Gosford LGAs to the south. Within Lake Macquarie, remnants have been noted in the Coorangong and Martinsville valleys on private lands. No detailed sampling has yet been undertaken in this community in Lake Macquarie due to access constraints, but it is anticipated that the full floristic composition will differ little from the more southern stands on the Central Coast.
37b	Alluvial Floodplain Woollybutt Forest	<i>Eucalyptus longifolia</i> characterizes this community, along with <i>Melaleuca decora</i> , <i>Melaleuca nodosa</i> and <i>Melaleuca ericifolia</i> .	Few remaining stands, predominantly on the Cocked Hat Creek floodplain near Edgeworth where remnants are small and fragmented. Plot sampling is also problematic here, as previous clearing under the canopy has resulted in dense invasion by tall grassy weeds such as <i>Paspalum urvillei</i> . Ideally, better condition remnants require identification and sampling, and are seen as a priority.
37d	Alluvial Floodplain Cabbage Gum Forest	Dominant canopy species include <i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i> and occasionally <i>Angophora floribunda</i> . In better condition sites, a sub-canopy of <i>Melaleuca styphelioides</i> , <i>Melaleuca linariifolia</i> and <i>Melaleuca decora</i> is also present. Understorey vegetation includes the shrubs <i>Breynia oblongifolia</i> , <i>Notelaea longifolia</i> forma <i>longifolia</i> , and <i>Bursaria spinosa</i> ; the grasses <i>Microlaena stipoides</i> , <i>Cymbopogon refractus</i> and <i>Cynodon dactylon</i> ; the herbs <i>Dichondra repens</i> and <i>Commelina cyanea</i> ; the vines <i>Glycine tabacina</i> , <i>Parsonsia straminea</i> , <i>Cayratia clematidea</i> and <i>Geitonoplesium cymosum</i> ; and the fern <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> .	Occupies the broader creeklines and flats on deep alluvial soils, particularly in the south-west of Lake Macquarie LGA.
37e	Coastal Sand Swamp Forest	Characterised by dense stands of <i>Melaleuca quinquenervia</i> with scattered <i>Eucalyptus robusta</i> . Understorey vegetation generally contains <i>Gahnia clarkei</i> , various ground ferns and a small number of other sedge species, and is dependent on water depth and degree of waterlogging.	Occurs on coastal sand deposits where drainage is poor and is a common component of coastal sandplain vegetation along the New South Wales coastline.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
37f	Swamp Mahogany - Livistona Swamp Forest	Comprises a distinct canopy of <i>Livistona australis</i> with <i>Eucalyptus robusta</i> and occasional <i>Melaleuca quinquenervia</i> and <i>Casuarina glauca</i> . A scattered mid-layer of species such as <i>Ficus coronata</i> and <i>Omalanthus populifolius</i> occurs with young <i>Livistona</i> over a ground layer of <i>Hypolepis muelleri</i> , <i>Oplismenus imbecillis</i> , <i>Commelina cyanea</i> and <i>Gahnia clarkei</i> .	Occurs principally on the poorly drained sand flats around Pelican and Belmont South. As with many communities where <i>Livistona</i> is characteristic, considerable frond-fall litter prevents the development of a diverse ground layer.
37g	Swamp Mahogany - Tallowwood Swamp Forest	<i>Eucalyptus microcorys</i> co-dominants with <i>Eucalyptus robusta</i> . Mid-layer vegetation includes <i>Melaleuca styphelioides</i> , <i>Callistemon salignus</i> and <i>Glochidion ferdinandi</i> , with <i>Gahnia clarkei</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Adiantum aethiopicum</i> and <i>Oplismenus imbecillis</i> prominent on the ground.	Recorded at Wye near the M1 motorway, and additional stands may become apparent with further work, particularly to the west. There is some uncertainty regarding how this community differs from other forms of MU37.
37j	Dune Swale Swamp Forest	<i>Eucalyptus robusta</i> over a scrubby understorey of species such as <i>Callicoma serratifolia</i> , <i>Elaeocarpus reticulatus</i> , <i>Dodonaea triquetra</i> , <i>Leptospermum polygalifolium</i> subsp. <i>cismontanum</i> and <i>Pteridium esculentum</i> . Ground layer vegetation is distinct in the high abundance of <i>Baloskion tetraphyllum</i> , <i>Gahnia clarkei</i> and <i>Entolasia marginata</i> .	Occurs in poorly drained drainage lines on coastal sandplains. Currently poorly sampled (a single sample from Awabakal NR), and further clarification of species composition is required through additional sampling.
38	Foreshore Redgum-Rough-barked Apple Forest	<i>Eucalyptus tereticornis</i> with <i>Angophora floribunda</i> , and <i>Allocasuarina littoralis</i> , <i>Acacia longifolia</i> , <i>Leptospermum polygalifolium</i> , <i>Melaleuca styphelioides</i> , <i>Melaleuca linariifolia</i> , <i>Breynia oblongifolia</i> , <i>Dodonaea triquetra</i> , <i>Imperata cylindrical</i> , <i>Lomandra longifolia</i> , and <i>Entolasia stricta</i> .	Remnants of this type occur on alluvial flats of Lake Macquarie and associated lagoons. Restricted in distribution in the region, and has commonly been converted to foreshore parks and picnic areas. Some good intact examples occur in the Eraring area, and Landcare groups have been removing extensive stands of Lantana from these stands.
38a	Floodplain Redgum-Rough-barked Apple Forest	<i>Eucalyptus tereticornis</i> and <i>Angophora floribunda</i> occurs over a moderately dense mid-storey of <i>Acacia irrorata</i> , and a rich ground layer of species such as <i>Entolasia marginata</i> , <i>Dichondra repens</i> , <i>Oplismenus imbecillis</i> , <i>Pratia purpurascens</i> and <i>Microlaena stipoides</i> var. <i>stipoides</i> .	Related to Foreshore Redgum – Rough-barked Apple Forest (MU38), but occurs on larger floodplain environments distant from and to the west of the current lake shoreline (eg: Killingworth-Teralba).

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
38c	Foreshore Redgum-Ironbark Forest	<i>Eucalyptus tereticornis</i> and <i>Angophora floribunda</i> are joined by <i>Eucalyptus paniculata</i> and <i>Eucalyptus siderophloia</i> in the canopy, over a scattered shrub layer of <i>Melaleuca nodosa</i> , <i>Acacia falcata</i> and <i>Glochidion ferdinandi</i> . The well-developed ground layer is dominated by <i>Lomandra longifolia</i> , <i>Entolasia stricta</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Panicum simile</i> and <i>Imperata cylindrical</i> .	Occurs as remnant stands around the foreshore of Lake Macquarie, typically on clayey footslopes rather than alluvial deposits. Further investigation is required, including additional sampling, to ascertain relationships between all units currently ascribed to MU38.
39	<u>Apple-Palm Gully Forest</u>	Typified by a canopy of <i>Livistona australis</i> , <i>Corymbia maculata</i> and <i>Eucalyptus paniculata</i> . Other characteristic species include <i>Melaleuca styphelioides</i> , <i>Acmena smithii</i> , <i>Diospyros australis</i> , <i>Pittosporum undulatum</i> and <i>Glochidion ferdinandi</i> , over a ground layer of <i>Adiantum aethiopicum</i> , <i>Oplismenus imbecillis</i> and <i>Dioscorea transversa</i> .	Originally defined during the REMS2000 regional project, but has not yet been examined since in any detail. This community occurs on narrow alluvial deposits in the well-protected gullies of the Wallarah Peninsula in the south-east. Apple (<i>Angophora costata</i>), as defined in the original circumscription, is not apparent in areas sampled to date.
40	<u>Swamp Oak - Rushland Forest</u>	<i>Casuarina glauca</i> clearly dominates this community, with an understorey of sedges and rushes such as <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Baumea juncea</i> , and the herb <i>Apium prostratum</i> .	Occurs adjacent to tidal estuaries on Lake Macquarie and associated inlets. Areas that have been previously cleared and then left to regenerate are quickly re-colonised by monospecific stands of Swamp Oak (eg: on Crooked Creek at Myuna Bay), however other components of the community do not always return, and are replaced by weed species.
40a	<u>Phragmites Rushland</u>	Almost exclusively dominated by <i>Phragmites australis</i> .	A secondary vegetation community occupying previously cleared areas of Swamp Oak – Rushland Forest (MU40) and associated wetlands near coastal estuaries.
40c	Estuarine Juncus Rushland	Dominated almost exclusively with <i>Juncus kraussii</i> subsp. <i>australiensis</i> .	Occurs on near-level tidal flats associated with Mangrove-Estuarine Complex (MU47) and Swamp Oak – Rushland Forest (MU40).
40d	Lake Macquarie Headland Swamp Oak Forest	<i>Casuarina glauca</i> dominates the canopy in these areas, over an understorey of <i>Acacia longifolia</i> , <i>Breynia oblongifolia</i> , <i>Myrsine variabilis</i> and <i>Pteridium esculentum</i> . At Catherine Hill Bay, the large sedge <i>Gahnia melanocarpa</i> is prominent.	Occurs in localised stands on some exposed headlands on the edge of Lake Macquarie, and also on one coastal headland near Catherine Hill Bay. There is some uncertainty over whether some or all of these stands are the result of previous clearing events, which have subsequently re-established as dense stands of <i>Casuarina glauca</i> . Similar effects have been noted to the south in Pittwater LGA.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
42	Red Mahogany-Apple Paperbark Forest	<i>Eucalyptus resinifera</i> , <i>Angophora costata</i> , <i>Melaleuca linariifolia</i> , <i>Melaleuca sieberi</i> and <i>Eucalyptus globoidea</i> in the canopy, over a sparse understorey of <i>Acacia longifolia</i> , <i>Pultenaea villosa</i> and <i>Banksia spinulosa</i> var. <i>collina</i> in the shrub layer, and several grasses and sedges on the ground. <i>Gahnia clarkei</i> can be common, although generally not in large, dense stands.	Occupies shallow drainage lines and open depressions, such as on the lowlands around Awaba.
42a	Narrabeen Alluvial Paperbark Thicket	Dense stands of <i>Melaleuca linariifolia</i> within shallow drainage lines on the coastal plains, where impeded drainage supports a dense ground layer of <i>Gahnia clarkei</i> . Other common species include the shrub <i>Glochidion ferdinandi</i> and the tree ferns <i>Cyathea australis</i> and/or <i>Cyathea leichhardtiana</i> .	This community represents one of several where <i>Melaleuca linariifolia</i> forms an important component, and further investigation is required to elucidate relationships between them.
42c	Wye Turpentine - Red Mahogany - Apple Riparian Forest	Dominant canopy species include <i>Eucalyptus resinifera</i> , <i>Angophora costata</i> and <i>Syncarpia glomulifera</i> , over <i>Glochidion ferdinandi</i> , <i>Melaleuca sieberi</i> and <i>Allocasuarina littoralis</i> .	Known from two locations at Wye and near Morisset, and the presence of <i>Syncarpia glomulifera</i> in it distinguished it from related types. Targeted sampling and assessment will likely subsume this type back as a localised variant of Red Mahogany – Apple – Paperbark Forest (MU42).
43a **	Estuarine Paperbark Scrub Forest	Characterised by dense thickets of paperbarks (<i>Melaleuca nodosa</i> , <i>Melaleuca sieberi</i>) with stunted emergent eucalypts such as <i>Eucalyptus resinifera</i> , <i>Eucalyptus paniculata</i> or <i>Angophora costata</i> . Understorey vegetation is often limited, although clumps of <i>Gahnia clarkei</i> and <i>Baumea juncea</i> are typical. Grasses, such as <i>Microlaena stipoides</i> var. <i>stipoides</i> , are common.	Occurs in limited extent on compacted clay soils near estuarine swamp systems. As all forms of MU43 have been poorly sampled, further investigation is required to determine relationships between this community and the related units White Stringybark – Paperbark Scrub-Forest (MU43e) and Forest Redgum – Paperbark Scrub-Forest (MU43f), which may simply be variants of the one community.
43c	Paperbark Clay Heath	Dominated by paperbark shrubs including <i>Melaleuca nodosa</i> and <i>Melaleuca thymifolia</i> , with other species such as <i>Isopogon anemonifolius</i> , <i>Mirbelia rubiifolia</i> , <i>Themeda australis</i> and <i>Aristida warburgii</i> also present.	Occurs as small, disjunct and restricted patches within the lower Hunter region, generally within a wider matrix of Hinterland Spotted Gum – Ironbark Forest (MU17o). Only a single stand is currently known from Lake Macquarie LGA, and additional patches are present in the adjacent Cessnock LGA west of Mt Sugarloaf. Current-day occurrences may possibly be an artefact of previous disturbances.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
43e	White Stringybark Paperbark Scrub-Forest	<i>Eucalyptus globoidea</i> characterises the emergent canopy. The mid-storey comprises a dense layer of <i>Melaleuca nodosa</i> and <i>Melaleuca decora</i> , over a sparse shrub layer but well developed ground layer.	Occupies a similar landscape position to Estuarine Paperbark Scrub-Forest (MU43a), and differs principally in the replacement of <i>Eucalyptus resinifera</i> and <i>Eucalyptus paniculata</i> with <i>Eucalyptus globoidea</i> in the emergent canopy. As all forms of MU43 have been poorly sampled, further investigation is required to determine relationships between this community and the related units Estuarine Paperbark Scrub-Forest (MU43a) and Forest Redgum – Paperbark Scrub-Forest (MU43f).
43f	Forest Red Gum Paperbark Scrub-Forest	<i>Eucalyptus tereticornis</i> characterises the emergent canopy. The mid-storey comprises a dense layer of <i>Melaleuca nodosa</i> , over a sparse shrub layer and well developed ground layer.	Occupies a similar landscape position to Estuarine Paperbark Scrub-Forest (MU43a), but supports <i>Eucalyptus tereticornis</i> in the emergent canopy. As all forms of MU43 have been poorly sampled, further investigation is required to determine relationships between this community and the related units Estuarine Paperbark Scrub-Forest (MU43a) and White Stringybark – Paperbark Scrub-Forest (MU43f).
44a	Munmorah Grasstree Wet Heath	<i>Xanthorrhoea fulva</i> characterises this community and is the dominant species present.	Occurs in broad, impeded basins and drainage lines in the southern parts of the LGA, generally within a Narrabeen sandstone landscape. Stands are typically relatively small, and may form a mosaic with other wet heaths on the coastal plain. Larger occurrences are present to the south in Wyong LGA.
44g	Coastal Sand Bottlebrush Wet Heath	<i>Acacia elongata</i> , <i>Callistemon citrinus</i> and <i>Leptospermum juniperinum</i> , over sedges such as <i>Leptocarpus tenax</i> and <i>Schoenus brevifolius</i>	Occurs on the coastal sand sheets in the Belmont-Jewells area. Similar floristically to other wet heaths in Lake Macquarie, and further work is required to clarify relationships.
44j	Tomago Strand Plain Intermediate Heath	Prominent species include the shrubs <i>Leptospermum polygalifolium</i> , <i>Banksia oblongifolia</i> , <i>Melaleuca nodosa</i> , <i>Personia lanceolata</i> and <i>Epacris microphylla</i> , and the sedges <i>Leptocarpus tenax</i> and <i>Lepyrodia scariosa</i> .	Parts of the heath complex within the Jewells Swamp area supports vegetation that is floristically similar to that present on the Tomago Sandbeds north of Newcastle. This unit has not yet been mapped, but is included in 44m at present.
44l	Munmorah Impeded Sand Sedgeland	Prominent species present include <i>Leptospermum juniperinum</i> , <i>Sprengelia sprengelioides</i> , <i>Epacris obtusifolia</i> , <i>Banksia oblongifolia</i> and <i>Xanthorrhoea fulva</i> .	A wet heath occurring on coastal sands where drainage is particularly poor, and a range of sedge species dominate the ground layer. Closely related to other wet heaths, further analysis of sample data is required to clarify relationships.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
44m	Coastal Plains Wet Heath	<i>Banksia oblongifolia</i> , <i>Hakea tereifolia</i> , <i>Baeckea diosmifolia</i> and <i>Melaleuca thymifolia</i> . Scattered taller shrubs of <i>Melaleuca sieberi</i> or <i>Angophora inopina</i> may also be present.	Occurs in broad shallow drainage lines on the coastal plains in the south of the LGA, most commonly within a landscape supporting Coastal Plains Scribbly Gum Woodland (MU31). In places, this community merges with Munmorah Grass-tree Wet Heath (MU44a).
45	<u>Lepironia Swamp</u>	<i>Lepironia articulata</i> dominates, with the ground layer supporting species such as the grass <i>Pseudoraphis paradoxa</i> and the herb <i>Villarsia exaltata</i> .	Known only from Redhead Lagoon within the Awabakal NR, where it forms a band of tall sedgeland around the rim of the deeper water body. Regionally, this vegetation type is rare, and occurs only in coastal sand swamp systems.
46	<u>Freshwater Wetland Complex</u>	Various, but may include <i>Persicaria strigose</i> , <i>Azolla pinnata</i> , <i>Maundia triglochinoidea</i> , <i>Phragmites australis</i> , <i>Triglochin procerum</i> , <i>Typha australis</i> , <i>Hemarthria uncinata</i> .	Commonly represented only in dis-used man-made dams or previously cleared swamp forests across much of Lake Macquarie LGA. Variation in dominant sedge species can occur, depending on the colonisation history of the particular water body, and depth of water. Some attempt has been made to differentiate different wetland communities (see other Unit 46s), but further variations will likely be documented with additional sampling.
46a	Freshwater Typha Wetland	<i>Typha orientalis</i> dominates these areas almost exclusively.	A floristically simple community occupying man-made dams or other disturbed areas that results in water impoundment or poor drainage.
46b	Freshwater Baumea Sedgeland	<i>Baumea articulata</i>	Commonly present in disused water bodies throughout the region. Mapped only for a single site at Catherine Hill Bay, but likely to occur across the City
46c	Freshwater Carex Rainforest Sedgeland	Species present include <i>Carex fascicularis</i> , <i>Carex appressa</i> and <i>Cyperus exaltatus</i> .	Within rainforest patches in poorly drained depressions. Very few stands have been recorded for Lake Macquarie, but it is also present in Wyong LGA
46f	Freshwater Philydrum Sedgeland	<i>Philydrum lanuginosum</i> +/- <i>Eleocharis</i> and <i>Baumea</i> spp.	Disused farm dams or open depressions with reasonable levels of water retention support a sedgeland of <i>Philydrum lanuginosum</i> . In shallower areas, species such as <i>Eleocharis</i> and <i>Baumea</i> may also be present. Only known areas have been mapped to date, and it is likely that additional stands are present throughout the LGA.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
46h	Freshwater Cladium Sedgeland	<i>Cladium procerum</i> +/- <i>Phragmites australis</i> and <i>Typha orientalis</i>	Forms large monospecific stands in the coastal sands of Jewells and Belmont, merging into surrounding sedgelands of <i>Phragmites</i> and/ or <i>Typha</i> . May also include stunted but widely scattered <i>Melaleuca quinquenervia</i> .
46i	Freshwater Gahnia Sedgeland	Species present include <i>Gahnia sieberiana</i> , <i>Banksia robur</i> , <i>Leptospermum juniperinum</i> , <i>Callistemon citrinus</i> and <i>Gleichenia dicarpa</i> ; however <i>Gahnia</i> is always the dominant species. Also present may be the occasional stunted <i>Eucalyptus robusta</i> or <i>Melaleuca quinquenervia</i> .	Dominated by <i>Gahnia sieberiana</i> , and forms large dense stands in enclosed sand-based freshwater wetland systems.
47	<u>Mangrove - Estuarine Complex</u>	Solely dominated by <i>Avicennia marina</i> subsp. <i>australasica</i> in the canopy. Ground layer vegetation is variable and depends on the extent of tidal inundation: areas at slightly higher elevation will support species more typical of Saltmarsh, such as <i>Sarcocornia quinqueflora</i> and <i>Sporobolus virginicus</i> , while locations regularly inundated support little if any ground vegetation	Occurs immediately within and adjacent to tidal estuaries, and in close association with Saltmarsh (MU47a) and Swamp Oak – Rushland Forest (MU40), but differs structurally and floristically.
47a	<u>Saltmarsh</u>	<i>Sarcocornia quinqueflora</i> subsp. <i>quinqueflora</i> , <i>Samolus repens</i> and <i>Suaeda australis</i> in saltmarsh; and <i>Sporobolus virginicus</i> in grasslands.	Occurs immediately within and adjacent to tidal estuaries. This community occurs in close association with Swamp Oak – Rushland Forest (MU40), but differs structurally and floristically.
50a	Coastal Sand Foredune Scrub	<i>Acacia sophorae</i> dominates this shrubland, and stunted individuals of <i>Leptospermum laevigatum</i> may also be present in this wind-sheared vegetation. Few other species are evident, although <i>Carpobrotus glaucescens</i> and <i>Spinifex sericeus</i> invariably occur.	Occurs immediately behind the low grassland of Beach Spinifex (MU53) along the foredunes of the coastal zone. Although many areas, particularly north of Swansea, have been impacted upon by Bitou Bush invasion, some relatively good quality examples of this community remain towards the south. Current mapping of this community under-estimates the total present within the LGA, given mapping procedures used to cut original interpretation and linework against Councils veg-noveg layer

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
50b	Coastal Sand Banksia Scrub	<i>Leptospermum laevigatum</i> , <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> and <i>Monotoca elliptica</i> dominate the tallest layer, with occasional shrubs such as <i>Leucopogon parviflorus</i> and <i>Correa alba</i> also present. In some areas, <i>Cupaniopsis anacarioides</i> occurs as scattered individual shrubs, and <i>Acacia sophorae</i> is often present. <i>Chrysanthemoides monilifera</i> is also a component of this community.	Occuring on the land-ward side of Coastal Sand Fore-dune Scrub (MU50a), Coastal Sand Banksia Scrub is structurally more complex than that community, yet remains floristically simple.
50c	Bitou Bush Scrub	<i>Chrysanthemoides monilifera</i>	Extensive areas of coastline and the associated coastal headlands support dense shrublands of Bitou Bush. This species is particularly dominant on the beach foredunes, and has replaced much of the Coastal Dune Fore-dune Scrub (MU50a) north from Swansea. Mapping does not show the full extent of this community, as the process of cutting original linework to Councils veg-no veg layer has eliminated most beach environments.
51a	Coastal Headland Grassland	Characterised by high abundance of <i>Themeda australis</i> on the ground, and few or no shrubs or trees. Many other species also occur, including <i>Ptilothrix deusta</i> , <i>Pimelea linifolia</i> , <i>Acacia myrtifolia</i> , and <i>Lasiopetalum parvifolium</i> .	Occurs in highly exposed locations along the coast. Fire history and other disturbances have a role in the current distribution of this community, and it often forms a mosaic with Coastal Headland Shrubland (MU51b). Current mapping likely excludes some areas of this community, as the process of cutting original linework to Councils veg-noveg layer has eliminated some patches.
51b	Coastal Headland Shrubland	<i>Allocasuarina distyla</i> clearly dominates and characterises the community, with other common species including <i>Lasiopetalum parvifolium</i> , <i>Westringia fruticosa</i> and <i>Callistemon linearis</i> . On the ground, <i>Ptilothrix deusta</i> and <i>Entolasia stricta</i> commonly occur, although <i>Lasiopetalum parvifolium</i> often forms expansive carpets, particularly after fire damage.	Occurs on wind-swept coastal headlands, and forms a mosaic with both Coastal Headland Grassland (MU51a) and Coastal Headland Paperbark Scrub (MU51d) Boundaries between the three are dynamic in response to fire events.
51c	Coastal Headland Low Forest	<i>Eucalyptus umbra</i> and <i>Angophora costata</i> , over an understorey of <i>Banksia spinulosa</i> , <i>Hibbertia aspera</i> , <i>Lasiopetalum parvifolium</i> , <i>Acrotriche divaricata</i> , <i>Leptospermum polygalifolium</i> and <i>Polyscias sambuccifolia</i> . Ground vegetation includes species	Occurs on coastal headlands and associated low hills where there is some immediate protection from onshore winds.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		such as <i>Entolasia stricta</i> , <i>Dianella caerulea</i> , <i>Imperata cylindrica</i> and <i>Lomandra longifolia</i> . In some areas, <i>Eucalyptus paniculata</i> may also occur in the canopy.	
51d	Coastal Headland Paperbark Scrub	<i>Melaleuca nodosa</i> dominates these areas, often forming impenetrable thickets interspersed with more open grassy patches. Other emergent shrubs include <i>Callistemon linearis</i> , <i>Acrotriche divaricata</i> and <i>Lissanthe strigosa</i> . Within openings in the shrub layer, <i>Themeda australis</i> is the dominant ground cover, together with <i>Aristida warburgii</i> , <i>Lasiopetalum parviflorum</i> and <i>Ptilothrix deusta</i> .	Forms a low or tall dense heath on exposed coastal headlands on clay soils.
53	<u>Beach Spinifex</u>	Dominated by <i>Spinifex sericeus</i> . The weed <i>Hydrocotyle bonariensis</i> is present in all stands, along with native species such as <i>Carpobrotus glaucescens</i> and <i>Scaevola calendulaceae</i>	Beach lines south of Swansea support good stands of Beach Spinifex, where <i>Spinifex sericeus</i> dominates. Much of the beach sands north of Swansea have been invaded by Bitou Bush following sand mining, and indiscriminant 4WD use has assisted in the demise of this community.
54	Hawkesbury Hanging Swamps	Prominent species present include <i>Gleichenia microphylla</i> , <i>Gahnia sieberiana</i> , <i>Baeckea linifolia</i> and <i>Empodisma minus</i> .	Occurs in a single area of impeded drainage on Hawkesbury Sandstone geology within Olney State Forest. This swamp is the only one known from Lake Macquarie LGA, although the community becomes more common to the south into Wyong and Gosford LGAs, and into western Sydney and beyond. Floristic diversity is dependant on fire history, and the Olney stand supports a more fern-based form as well as a shrubby form.
54e	Munmorah Sedge Swamp	<i>Baumea juncea</i> , <i>Baumea articulata</i> , <i>Gleichenia dicarpa</i>	Currently known only from a single location of very small extent, on a small cliff adjacent to the ocean. Affinities with Hawkesbury Hanging Swamps. Yet to be sampled in any detail.
100a	Swamp Paperbark Thicket (Floodplain Alluvials)	<i>Melaleuca ericifolia</i> over <i>Baumea juncea</i> , <i>Phragmites australis</i> and <i>Centella asiatica</i> .	Occurs principally as a fringe around coastal estuaries or lagoons. This fringe is typically less than 20m in width. Similar vegetation also occurs in previously cleared floodplain habitats, such as in the Mandalong Valley, where <i>Melaleuca ericifolia</i> forms small, dense thickets. This vegetation type occurs in similar situations to the south and north of Lake Macquarie.
108b	Paperbark Depression Forest	Dense low trees of <i>Melaleuca styphelioides</i> over scattered <i>Glochidion ferdinandi</i> in the mid-storey,	Distinct low forest of drainage depressions within a wider moist forest matrix at the foot of the coastal ranges. Only a single

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		and a ground layer of <i>Carex longibracthiata</i>	occurrence of this type has been mapped to date, and only limited sampling has occurred. Further investigation is required to determine if this may be a disturbance artefact from previous logging activities, such as off the end of Alton Road, Cooranbong, in Olney State Forest.
110a	Red Ironbark - Paperbark Forest	Characterised by a dominance of <i>Eucalyptus fibrosa</i> in the canopy, often forming monospecific stands of this species. Other canopy species present include <i>Eucalyptus capitellata</i> and <i>Corymbia gummifera</i> . Paperbarks (<i>Melaleuca decora</i> , <i>Melaleuca nodosa</i>) form a mid-layer, with other shrubs including <i>Dodonaea triquetra</i> , <i>Acacia longifolia</i> subsp. <i>longifolia</i> and <i>Pultenaea paleacea</i> . <i>Themeda australis</i> , <i>Ptilothrix deusta</i> , <i>Entolasia stricta</i> , <i>Panicum simile</i> and <i>Gahnia radula</i> are prominent in the ground layer.	A dryer forest of Red Ironbark and characteristically dense thickets of paperbarks. <i>Corymbia maculata</i> is generally present in the surrounding areas, where it forms a component of Hinterland Spotted Gum – Red Ironbark Forest (MU170). See Bell (2009) for further information.
110b	Depression Paperbark Thicket	<i>Melaleuca decora</i> , <i>Melaleuca nodosa</i> , <i>Bursaria spinosa</i> (+/- <i>Eucalyptus fibrosa</i>), with a well developed grass and herb layer.	Within the wider landscape of Red Ironbark – Paperbark Forest (MU110a), moist depressions support a range of wetter grasses and sedges, and less <i>Eucalyptus fibrosa</i> , but a more prominent <i>Melaleuca decora</i> subcanopy. Often occur adjacent to roads or easements and hence may be an artefact of these. See Bell (2009) for further information.
111a	Lake Macquarie Snappy Gum Forest	<i>Eucalyptus racemosa</i> , <i>Angophora costata</i> , <i>Corymbia gummifera</i> , over <i>Dodonaea triquetra</i> , <i>Acacia longifolia</i> , <i>Pultenaea villosa</i> , <i>Pteridium esculentum</i> , and <i>Imperata cylindrical</i> .	Occurs in low elevations areas on Narrabeen sediments around southern and south-western Lake Macquarie, in between the drainage line swamp forests and the higher elevation Coastal Plains Scribbly Gum Woodland (MU31). Has been described and mapped for the northern parts of Wyong LGA, with which Lake Macquarie stands are analogous
111c	Killingworth Snappy Gum Forest	Characterised by a canopy of <i>Eucalyptus racemosa</i> and <i>Angophora costata</i> , with occasional <i>Corymbia gummifera</i> or <i>Eucalyptus capitellata</i> . Understorey vegetation includes <i>Dillwynia retorta</i> , <i>Gonocarpus tetragynus</i> , <i>Leptospermum trinervium</i> and <i>Acacia ulicifolia</i> , over high abundance of <i>Entolasia stricta</i> , <i>Aristida vagans</i> , <i>Joycea pallida</i> and <i>Lomandra</i>	Floristically similar to Snappy Gum Ridgetop Heathy Forest (MU31j) and Kahibah Snappy Gum Forest (MU119), and with further analysis the three may be shown to be variants of the one type. Of the three, only MU31j occurs on Narrabeen sandstone geology while the other two lie on older Permian sediments (MU111c on Moon Island Beach subgroup; MU119 on Adamstown subgroup). At present, Killingworth Snappy Gum

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		<i>obliqua</i> .	Forest has been mapped for areas immediately around the township of Killingworth in north-western Lake Macquarie, with a smaller outlier near Fassifern.
113	Paperbark – Carex Backswamp Forest	Dominated by <i>Melaleuca linariifolia</i> in the low canopy, over a dense ground layer of <i>Carex appressa</i> . Other wetland species present include <i>Pericaria hydropiper</i> , <i>Alternanthera denticulata</i> and <i>Pseudoraphis paradoxa</i> .	Currently known from only a single location within Lake Macquarie SCA. This occurrence lies adjacent to Lake Macquarie, and occurs in an area of impeded drainage with limited release of accumulated moisture.
114	Mesic Paperbark Thicket	Dense stands of <i>Gahnia clarkei</i> dominate the ground, often with <i>Carex longibrachiata</i> , <i>Adiantum aethiopicum</i> and the occasional <i>Cyathea spp.</i> <i>Melaleuca linariifolia</i> dominates the sub-canopy, often with some <i>Melaleuca styphelioides</i> and <i>Eucalyptus piperita</i> as an emergent or overhanging species. Other characteristic species present include <i>Ficus coronata</i> and <i>Glochidion ferdinandi</i> .	Present in narrow, poorly drained riparian strips in low-relief creeks in the Freeman's Waterhole area.
119	Kahibah Snappy Gum Forest	<i>Eucalyptus racemosa</i> occurs with <i>Corymbia gummifera</i> , <i>Angophora costata</i> and occasionally <i>Eucalyptus piperita</i> . Understorey vegetation includes <i>Pteridium esculentum</i> , <i>Allocasuarina littoralis</i> , <i>Hibbertia empetrifolia</i> , <i>Polyscias sambuccifolia</i> , <i>Dodonaea triquetra</i> , <i>Tetratheca juncea</i> , <i>Entolasia stricta</i> , <i>Themeda australis</i> and <i>Lomandra obliqua</i> .	Occurs principally on ridges and slopes of Permian geology (Adamstown subgroup), in and around the townships of Kahibah and Whitebridge and extending to near Jewells. As with other similar communities, <i>Eucalyptus racemosa</i> is diagnostic for this type. Some further targeted sampling and analysis is required to confirm relationships between this unit and Snappy Gum Ridgetop Heathy Forest (MU31j) and Killingworth Snappy Gum Forest (MU111c).
121	Seagrass	<i>Zostera sp.</i> <i>Posidonia sp.</i> <i>Halophila sp.</i>	Seagrass occurs in the shallower reaches of Lake Macquarie, but has not been targeted or sampled during this study.
122	Cockle Creek Dune Forest	<i>Eucalyptus racemosa</i> with <i>Corymbia gummifera</i> , <i>Banksia serrata</i> and <i>Angophora costata</i> . <i>Xanthorrhoea glauca</i> is prominent in the understorey, together with <i>Lambertia formosa</i> , <i>Pteridium esculentum</i> , <i>Acacia ulicifolia</i> , and <i>Allocasuarina littoralis</i> . Grasses, such as <i>Entolasia stricta</i> , <i>Imperata cylindrica</i> and <i>Themeda australis</i> ,	A distinct vegetation type occurring presumably on old fluvial dunes formed by Cockle Creek, in the north-eastern parts of the LGA. This community is broadly similar to several threatened communities elsewhere in the region, but supports a differing suite of component species.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Floristic Summary (Characteristic Spp *)	Notes
		comprise the ground layer vegetation.	
123	Cooranbong Blackbutt Tall Forest	Often tall stands of <i>Eucalyptus pilularis</i> on the undulating valley flats around Cooranbong and Martinsville. Largely depleted due to clearing and logging, other species co-occurring include <i>Allocasuarina torulosa</i> , <i>Calistemon salignus</i> and <i>Glochidion ferdinandi</i> in the mid layer, over a rich herb and grass layer.	Tall forests of Blackbutt, mostly depleted, on the undulating valley flats around Cooranbong and Martinsville. Broadly related to Coastal Narrabeen Shrub Forest (MU22) and Coastal Ranges Open Forest (MU9) through the sharing of Blackbutt in the canopy, but occurs in a very different landscape position. It is also very similar to Alluvial Riparian Blackbutt Forest (MU5h), and further clarification of differences with that community is required.
125	Water Couch Meadow	<i>Paspalum distichum</i> dominates in mostly monospecific meadows.	Occurs as small patches or strips along the side of freshwater lagoons or creeks, where sufficient shallow water is present. No targeted sampling of these areas has yet been undertaken, and known occurrences are too small to map.
W	Water body	Open water	Open water
Xr	Disturbed - Canopy only		Generally include areas where canopy remains but understorey is cleared
Xs	Disturbed - Regrowth		Generally indiscriminant regrowth of native species
B	Beach sands		May contain elements of MU53
R	Mining Rehabilitation	<i>Leptospermum laevigatum</i> in some areas, a range of other sand-based shrubs elsewhere.	Much of the lands in the Belmont South – Jewells area have a history of sand mining from the 1970s, and extensive rehabilitation has occurred there. Some of these areas support a relatively diversity shrubland community of species typical of coastal sandy heaths, while other areas are monospecific stands of <i>Leptospermum laevigatum</i> . All have been mapped collectively as Mining Rehabilitation.
Xx	Exotic Plantings	various plantations	Plantations of exotic or native plant species

* *Characteristic Species* defined as indicators that make this vegetation community appear visually different from others. Full floristic plot survey and analysis will be required across the whole map unit to properly define this unit/subunit.

** For the purposes of this project/map, MU43a is a subgroup and is not the LHCCREMS MU43a, and MU43 is equivalent to LHCCREMS MU43a.

APPENDIX 3 – INTERIM COMMUNITY CLASSIFICATION: EEC, KEITH & GREATER HUNTER EQUIVALENTS

Note: Some vegetation units (grey text) are no longer represented in the current map version. These have been re-allocated to sub-units following a review of the ICC, or are old LHCCREMS units that have now been replaced by more accurate mapping. All have been retained in this table for backwards compatibility at the request of Council. Newly defined units (from Stage 6) are shown shaded orange.

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
1	<u>Coastal Wet Gully Forest</u>	North Coast Wet Sclerophyll Forests	Lowland Rainforest (?)	MU048: White Mahogany/ Turpentine moist shrubby tall open forest
1a	<u>Coastal Warm Temperate - Subtropical Rainforest</u>	Northern Warm Temperate Rainforests/ Subtropical Rainforests	Lowland Rainforest	MU010: Jackwood/ Lilly Pilly/ Sassafras riparian warm-temperate rainforest of the Central Coast
1g	Permian Gully Rainforest	Northern Warm Temperate Rainforests/ Subtropical Rainforests	n/a	MU008: Lily Pilly/ Grey Myrtle/ Rasp Fern warm temperate rainforest on ranges of the Central and lower North Coast
3e	Lake Macquarie Dry Rainforest	Dry Rainforests	n/a	MU021: Grey Myrtle sheltered gully dry rainforest in gullies of the Sydney Basin
4	<u>Littoral Rainforest</u>	Littoral Rainforests	Littoral Rainforest	MU018: Tuckeroo/ Coast Banksia littoral rainforest
5	<u>Alluvial Tall Moist Forest</u>	North Coast Wet Sclerophyll Forests	River-Flat Eucalypt Forest on Coastal Floodplains	MU050: Blackbutt/ Turpentine/ Sydney Blue Gum mesic tall open forest on ranges of the Central Coast
5a	Alluvial Bluegum-Paperbark Forest	North Coast Wet Sclerophyll Forests	River-Flat Eucalypt Forest on Coastal Floodplains	?MU205: Melaleuca biconvexa/ Swamp Mahogany/ Cabbage Palm swamp forest of the Central Coast
5b	Alluvial Bluegum-Apple Moist Forest	North Coast Wet Sclerophyll Forests	River-Flat Eucalypt Forest on Coastal Floodplains	MU050: Blackbutt/ Turpentine/ Sydney Blue Gum mesic tall open forest on ranges of the Central Coast
5e	Alluvial Bluegum -Spotted Gum Moist Forest	North Coast Wet Sclerophyll Forest	River-Flat Eucalypt Forest on Coastal Floodplains	?MU205: Melaleuca biconvexa/ Swamp Mahogany/ Cabbage Palm swamp forest of the Central Coast
5g	Glenrock Sheltered Bluegum Forest	North Coast Wet Sclerophyll Forest	River-Flat Eucalypt Forest on Coastal Floodplains	MU050: Blackbutt/ Turpentine/ Sydney Blue Gum mesic tall open forest on ranges of the Central Coast

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
5h	Alluvial Riparian Blackbutt Forest	North Coast Wet Sclerophyll Forest	River-Flat Eucalypt Forest on Coastal Floodplains	?MU061: Smooth-barked Apple/ Turpentine/ Blackbutt open forest on ranges of the Central Coast
6	<u>Coastal Narrabeen Moist Forest</u>	North Coast Wet Sclerophyll Forest	n/a	MU050: Blackbutt/ Turpentine/ Sydney Blue Gum mesic tall open forest on ranges of the Central Coast
6a	Coastal Narrabeen Bluegum Ridge Forest	North Coast Wet Sclerophyll Forest	n/a	MU050: Blackbutt/ Turpentine/ Sydney Blue Gum mesic tall open forest on ranges of the Central Coast
9	<u>Coastal Ranges Open Forest</u>	Northern Hinterland Wet Sclerophyll Forests	n/a	MU046: Blackbutt/ Rough-barked Apple/ Turpentine/ ferny tall open forest of the Central Coast
9a	Coastal Ranges Mesic Blackbutt Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	MU046: Blackbutt/ Rough-barked Apple/ Turpentine/ ferny tall open forest of the Central Coast
9b	Coastal Ranges Dry Blackbutt Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	MU046: Blackbutt/ Rough-barked Apple/ Turpentine/ ferny tall open forest of the Central Coast
9d	Coastal Ranges Dry Spotted Gum - Blackbutt Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	No equivalent
9e	Coastal Ranges Mesic Peppermint Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	No equivalent
9f	Coastal Ranges Dry Peppermint - Blackbutt Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	No equivalent
9h	Coastal Ranges Dry Tallowwood – Blackbutt Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	?MU038: Tallowwood/ Smooth-barked Apple/ Blackbutt grass tall open forest of the Central and lower North Coast
9i	Coastal Ranges Mesic Stringybark - Mahogany Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	No equivalent
9l	Coastal Ranges Mesic Blackbutt-Tallowwood Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	?MU038: Tallowwood/ Smooth-barked Apple/ Blackbutt grass tall open forest of the Central and lower North Coast
11	<u>Coastal Sheltered Apple-Peppermint Forest</u>	Sydney Coastal Dry Sclerophyll Forests	n/a	?MU103: Smooth-barked Apple open forest on coastal lowlands of the Central Coast
11a	Riparian Paperbark-Peppermint Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	No equivalent
11c	Awaba Peppermint-Black Wattle Riparian Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	?MU103: Smooth-barked Apple open forest on coastal lowlands of the Central Coast

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
12	<u>Hunter Valley Moist Forest</u>	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU071: Spotted Gum/ Broad-leaved Mahogany/ Grey Gum grass/ shrub open forest on Coastal Lowlands of the Central Coast
12a	Hunter Valley Moist Spotted Gum – Blackbutt Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU071: Spotted Gum/ Broad-leaved Mahogany/ Grey Gum grass/ shrub open forest on Coastal Lowlands of the Central Coast
12b	Hunter Valley Moist Spotted Gum – Turpentine Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU071: Spotted Gum/ Broad-leaved Mahogany/ Grey Gum grass/ shrub open forest on Coastal Lowlands of the Central Coast
12c	Hunter Valley Moist Spotted Gum – Ironbark Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU071: Spotted Gum/ Broad-leaved Mahogany/ Grey Gum grass/ shrub open forest on Coastal Lowlands of the Central Coast
12d	Hunter Valley Moist Spotted Gum - Fergusons Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	No equivalent
15	<u>Coastal Foothills Spotted Gum - Ironbark Forest</u>	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU071: Spotted Gum/ Broad-leaved Mahogany/ Grey Gum grass/ shrub open forest on Coastal Lowlands of the Central Coast
15d	Coastal Foothills Spotted Gum - Ironbark Forest (Kurri Kurri)	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU070: Grey Ironbark/ Broad-leaved Mahogany/ Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast
15h	Lake Macquarie Spotted Gum Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU070: Grey Ironbark/ Broad-leaved Mahogany/ Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast
15i	Lake Macquarie Ironbark Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU070: Grey Ironbark/ Broad-leaved Mahogany/ Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast
15k	Coastal Foothills Moist Grey Gum-Mahogany Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	No equivalent
15l	Sugarloaf Uplands Dry Spotted Gum - Ironbark Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	No equivalent
15m	Jilliby Spotted Gum-Northern Ironbark-Mahogany Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	MU071: Spotted Gum/ Broad-leaved Mahogany/ Grey Gum grass/ shrub open forest on Coastal Lowlands of the Central Coast
15n	Jilliby Spotted Gum-Ferguson's Ironbark-Mahogany Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	No equivalent
15o	Sugarloaf Uplands Moist Spotted Gum – Ironbark Forest	Hunter-Macleay Dry Sclerophyll Forests	n/a	No equivalent
15p	Sugarloaf Uplands Paperbark Thicket	Coastal Valley Grassy Woodlands	n/a	No equivalent

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
17o	Hinterland Spotted Gum - Red Ironbark Forest	Hunter-Macleay Dry Sclerophyll Forests	Lower Hunter Spotted Gum - Ironbark Forest	MU074: Spotted Gum/ Red Ironbark/ Large-fruited Grey Gum shrub/ grass open forest of the Lower Hunter
19c	Redgum - Apple - Paperbark Riparian Forest	Coastal Valley Grassy Woodlands	Hunter Lowland Redgum Forest	MU080: Forest Red Gum grassy open forest on floodplains of the lower Hunter
21a	Hunter Range Dry Escarpment Apple Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU104: Grey Gum/ Smooth-barked Apple/ Blue-leaved Stringybark shrub/ grass open forest on coastal ranges of the Sydney Basin
21d	Hunter Range Dry Ironbark – Grey Gum Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	?MU104: Grey Gum/ Smooth-barked Apple/ Blue-leaved Stringybark shrub/ grass open forest on coastal ranges of the Sydney Basin
21e	Hunter Range Dry Mahogany - Grey Gum Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	?MU104: Grey Gum/ Smooth-barked Apple/ Blue-leaved Stringybark shrub/ grass open forest on coastal ranges of the Sydney Basin
21f	Hunter Range Dry Mahogany - Apple Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	No equivalent
21g	Hunter Range Dry Stringybark – Blackbutt Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU104: Grey Gum/ Smooth-barked Apple/ Blue-leaved Stringybark shrub/ grass open forest on coastal ranges of the Sydney Basin
22	<u>Coastal Narrabeen Shrub Forest</u>	Northern Hinterland Wet Sclerophyll Forests	n/a	MU061: Smooth-barked Apple/ Turpentine/ Blackbutt open forest on ranges of the Central Coast
22e	Coastal Narrabeen Dry Bloodwood - Apple - Mahogany Forest	Northern Hinterland Wet Sclerophyll Forests	n/a	MU061: Smooth-barked Apple/ Turpentine/ Blackbutt open forest on ranges of the Central Coast
25	<u>Sheltered Dry Hawkesbury Woodland</u>	Sydney Coastal Dry Sclerophyll Forests	n/a	MU109: Smooth-barked Apple/ Turpentine/ Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
25a	Narrabeen Peppermint - Apple Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU110: Turpentine/ Smooth-barked Apple/ Broad-leaved Mahogany shrubby open forest on sandstone ranges of the Central Coast
26h	Watagans Remnant Hawkesbury Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU110: Turpentine/ Smooth-barked Apple/ Broad-leaved Mahogany shrubby open forest on sandstone ranges of the Central Coast
30	<u>Coastal Plains Smooth-barked Apple Woodland</u>	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
30a	Buttonderry Foothills Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
30b	Sugarloaf Uplands Bloodwood - Apple Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
30e	Coastal Plains Stringybark - Apple Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
30f	Freemans Peppermint-Apple-Bloodwood Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
30g	Orica Apple - Bloodwood - Stringybark Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
30h	Sugarloaf Lowlands Bloodwood - Apple Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
30i	West Wallsend Stringybark Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
30j	Sugarloaf Lowlands Bloodwood-Apple-Scribbly Gum Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU101: Smooth-barked Apple/ Red Bloodwood/ Brown Stringybark/ Hairpin Banksia heathy open forest of coastal lowlands
31	<u>Coastal Plains Scribbly Gum Woodland</u>	Sydney Coastal Dry Sclerophyll Forests	n/a	MU118: Scribbly Gum/ Red Bloodwood/ Angophora inopina heathy woodland on lowlands of the Central Coast
31g	Scribbly Gum Open Woodland	Sydney Coastal Dry Sclerophyll Forests	n/a	MU118: Scribbly Gum/ Red Bloodwood/ Angophora inopina heathy woodland on lowlands of the Central Coast
31h	Coastal Plains Dry Heath	Sydney Coastal Dry Sclerophyll Forests	n/a	MU118: Scribbly Gum/ Red Bloodwood/ Angophora inopina heathy woodland on lowlands of the Central Coast
31i	Coastal Sandstone Laterite Heath	Sydney Coastal Dry Sclerophyll Forests	n/a	MU134: Camfield's Stringybark/ Narrow-leaved Stringybark heathy woodland on lowlands of the Central Coast
31j	Snappy Gum Ridgetop Heathy Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU118: Scribbly Gum/ Red Bloodwood/ Angophora inopina heathy woodland on lowlands of the Central Coast
31k	Narrabeen Dune Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	MU118: Scribbly Gum/ Red Bloodwood/ Angophora inopina heathy woodland on lowlands of the Central Coast
33	<u>Coastal Sand Apple-Blackbutt Forest</u>	Coastal Dune Dry Sclerophyll Forests	n/a	MU128: Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
33a	Coastal Sand Apple-Blackbutt Forest (redefined)	Coastal Dune Dry Sclerophyll Forests	n/a	MU128: Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
33c	Pelican Bangalay Forest	Coastal Dune Dry Sclerophyll Forests	n/a	?MU127: Old Man Banksia/ Rough-barked Apple/ Bangalay shrubby open forest on coastal sands of the Central Coast

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
33d	Awabakal Sand Mantled Blackbutt Forest	Coastal Dune Dry Sclerophyll Forests	n/a	?MU128: Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
33k	Coastal Sand Apple Forest	Coastal Dune Dry Sclerophyll Forests	n/a	MU128: Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
33m	Sand Mantled Banksia Forest	Coastal Dune Dry Sclerophyll Forests	n/a	?MU128: Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
34	<u>Coastal Sand Wallum Woodland-Heath</u>	Coastal Dune Dry Sclerophyll Forests	n/a	MU185: Wallum Banksia / Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast
34a	Coastal Sand Wallum Heath	Wallum Sand Heaths	n/a	MU185: Wallum Banksia / Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast
34b	Coastal Sand-Mantled Clay Heath	Wallum Sand Heaths	n/a	MU182: Dwarf Casuarina/ Prickly-leaved Paperbark/ Hairpin Banksia coastal heath of the Central Coast and lower North Coast
34c	Coastal Sandplain Dry Heath	Wallum Sand Heaths	n/a	MU184: Dwarf Casuarina/ Wallum Banksia coastal heath of coastal headlands of Central Coast
36c	Tomago Clay Wallum Scrub	Wallum Sand Heaths	n/a	No equivalent
37	<u>Swamp Mahogany - Paperbark Forest</u>	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU200: Swamp Mahogany/ Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
37a	Alluvial Paperbark Sedge Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU205: Melaleuca biconvexa/ Swamp Mahogany/ Cabbage Palm swamp forest of the Central Coast
37b	Alluvial Floodplain Woollybutt Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	?MU200: Swamp Mahogany/ Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
37d	Alluvial Floodplain Cabbage Gum Forest	Coastal Swamp Forests	River-Flat Eucalypt Forest on Coastal Floodplains	?MU205: Melaleuca biconvexa/ Swamp Mahogany/ Cabbage Palm swamp forest of the Central Coast
37e	Coastal Sand Swamp Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains (those areas NOT on coastal sand deposits)	MU207: Swamp Mahogany/ Broad-leaved Paperbark/ Swamp Water Fern/ Plume Rush swamp forest on coastal lowlands of the Central Coast and lower North Coast
37f	Swamp Mahogany - Livistona Swamp Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU199: Broad-leaved Paperbark/ Swamp Mahogany/ Swamp Oak/ Saw Sedge swamp forest of the Central Coast and lower North Coast
37g	Swamp Mahogany - Tallowwood Swamp Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	?MU200: Swamp Mahogany/ Flax-leaved Paperbark swamp forest of coastal lowlands of the Central Coast

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
37j	Dune Swale Swamp Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains EEC (?)	MU200: Swamp Mahogany/ Flax-leaved Paperbark swamp forest of coastal lowlands of the Central Coast
38	Foreshore Redgum-Rough-barked Apple Forest	Coastal Swamp Forests ?	River-Flat Eucalypt Forest on Coastal Floodplains	?MU202: Cabbage Gum/ Forest Red Gum/ Flax-leaved Paperbark Floodplain Forest of the Central Coast
38a	Floodplain Redgum-Rough-barked Apple Forest	Coastal Swamp Forests ?	River-Flat Eucalypt Forest on Coastal Floodplains	?MU202: Cabbage Gum/ Forest Red Gum/ Flax-leaved Paperbark Floodplain Forest of the Central Coast
38c	Foreshore Redgum-Ironbark Forest	Coastal Valley Grassy Woodlands	River-Flat Eucalypt Forest on Coastal Floodplains	?MU202: Cabbage Gum/ Forest Red Gum/ Flax-leaved Paperbark Floodplain Forest of the Central Coast
38d	Foreshore Redgum-Grey Gum Forest	Coastal Valley Grassy Woodlands	River-Flat Eucalypt Forest on Coastal Floodplains	?MU202: Cabbage Gum/ Forest Red Gum/ Flax-leaved Paperbark Floodplain Forest of the Central Coast
39	<u>Apple-Palm Gully Forest</u>	North Coast Wet Sclerophyll Forests	n/a	MU106: Smooth-barked Apple/ Swamp Mahogany/ Red Mahogany/ Cabbage Palm open forest on lowlands of the Central Coast OR Smooth-barked Apple/ Cabbage Palm/ Broad-leaved Mahogany woodland on Wallarah Peninsular
40	<u>Swamp Oak - Rushland Forest</u>	Coastal Floodplain Wetlands	Swamp Oak Floodplain Forest	MU209: Swamp Oak/ Sea Rush/ Baumea juncea swamp forest on coastal lowlands of the Central Coast and lower North Coast
40a	<u>Phragmites Rushland</u>	Coastal Floodplain Wetlands	Swamp Oak Floodplain Forest	?MU209: Swamp Oak/ Sea Rush/ Baumea juncea swamp forest on coastal lowlands of the Central Coast and lower North Coast
40c	Estuarine Juncus Rushland	Coastal Floodplain Wetlands	Swamp Oak Floodplain Forest	?MU209: Swamp Oak/ Sea Rush/ Baumea juncea swamp forest on coastal lowlands of the Central Coast and lower North Coast
40d	Lake Macquarie Headland Swamp Oak Forest	Coastal Floodplain Wetlands	n/a	MU209: Swamp Oak/ Sea Rush/ Baumea juncea swamp forest on coastal lowlands of the Central Coast and lower North Coast
41	<u>Swamp Oak Sedge Forest</u>	Coastal Floodplain Wetlands	Swamp Oak Floodplain Forest	MU209: Swamp Oak/ Sea Rush/ Baumea juncea swamp forest on coastal lowlands of the Central Coast and lower North Coast
42	Red Mahogany-Apple Paperbark Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU131: Smooth-barked Apple/ Red Mahogany/ Swamp Mahogany/ Melaleuca sieberi heathy swamp woodland of coastal lowlands
42a	Narrabeen Alluvial Paperbark Thicket	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU208: Flax-leaved Paperbark/ Tall Sedge shrubland of the Sydney Basin
42c	Wye Turpentine - Red Mahogany - Apple Riparian Forest	Coastal Swamp Forests	River-Flat Forest on Coastal Floodplains	?MU131: Smooth-barked Apple/ Red Mahogany/ Swamp Mahogany/ Melaleuca sieberi heathy swamp woodland of coastal lowlands

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
43	<u>Wyang Paperbark Swamp Forest</u>	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU197: Prickly-leaved Paperbark/ Flax-leaved Paperbark swamp forest on poorly drained soils of the Central Coast
43a **	Estuarine Paperbark Scrub Forest	Coastal Floodplain Wetlands/ Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU197: Prickly-leaved Paperbark/ Flax-leaved Paperbark swamp forest on poorly drained soils of the Central Coast
43c	Paperbark Clay Heath	Coastal Floodplain Wetlands/ Coastal Swamp Forests	Lower Hunter Spotted Gum – Ironbark Forest	No equivalent
43e	White Stringybark Paperbark Scrub-Forest	Coastal Floodplain Wetlands/ Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU197: Prickly-leaved Paperbark/ Flax-leaved Paperbark swamp forest on poorly drained soils of the Central Coast
43f	Forest Red Gum Paperbark Scrub-Forest	Coastal Floodplain Wetlands/ Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU197: Prickly-leaved Paperbark/ Flax-leaved Paperbark swamp forest on poorly drained soils of the Central Coast
44	<u>Coastal Wet Sand Cyperoid Heath</u>	Coastal Heath Swamps	n/a	MU188: Olive Tea-tree/ Crimson Bottlebrush/ Xanthorrhoea fulva wet heath on coastal sands of lower North Coast
44a	Munmorah Grasstree Wet Heath	Coastal Heath Swamps	n/a	No equivalent
44g	Coastal Sand Bottlebrush Wet Heath	Coastal Heath Swamps	n/a	MU188: Olive Tea-tree/ Crimson Bottlebrush/ Xanthorrhoea fulva wet heath on coastal sands of lower North Coast
44l	Munmorah Impeded Sand Sedgeland	Coastal Heath Swamps	n/a	MU188: Olive Tea-tree/ Crimson Bottlebrush/ Xanthorrhoea fulva wet heath on coastal sands of lower North Coast
44j	Tomago Strand Plain Intermediate Heath	Coastal Heath Swamps	n/a	?MU188: Olive Tea-tree/ Crimson Bottlebrush/ Xanthorrhoea fulva wet heath on coastal sands of lower North Coast
44m	Coastal Plains Wet Heath	Coastal Heath Swamps	n/a (assessment of the 2 sample plots within this unit show floristics to be different to existing EECs)	MU189: Fern-leaf Banksia/ Needlebush/ Leptocarpus tenax/ Lepyrodia scariosa wet heath on sandstone ranges of the Central Coast
45	<u>Lepironia Swamp</u>	Coastal Freshwater Lagoons	Sydney Freshwater Wetlands	MU223: Lepironia articulata sedgeland
46	<u>Freshwater Wetland Complex</u>	Coastal Freshwater Lagoons	Freshwater Wetlands on Coastal Floodplains	No equivalent
46a	Freshwater Typha Wetland	Coastal Freshwater Lagoons	Freshwater Wetlands on Coastal Floodplains	MU219: Typha rushland
46b	Freshwater Baumea Sedgeland	Coastal Freshwater Lagoons	Freshwater Wetlands on Coastal Floodplains	MU224: Baumea articulata Sedgeland
46c	Freshwater Carex Rainforest Sedgeland	n/a	n/a	No equivalent

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
46f	Freshwater Philydrum Sedgeland	Coastal Freshwater Lagoons	Freshwater Wetlands on Coastal Floodplains	MU221: Woolly Waterlily/ Sand Couch coastal freshwater wetland
46h	Freshwater Cladium Sedgeland	Coastal Freshwater Lagoons	Freshwater Wetlands on Coastal Floodplains	MU217: Cladium procerum coastal freshwater wetland
46i	Freshwater Gahnia Sedgeland	Coastal Freshwater Lagoons	Freshwater Wetlands on Coastal Floodplains	No equivalent
47	<u>Mangrove - Estuarine Complex</u>	Mangrove Swamps	n/a	MU229: Grey Mangrove low closed forest
47a	<u>Saltmarsh</u>	Saltmarshes	Coastal Saltmarsh	MU228: Saltmarsh/ Estuarine Complex
48	<u>Coastal Clay Heath</u>	Coastal Headland Heaths	EEC (?) May contain small patches of Themeda Grassland	MU182: Dwarf Casuarina/ Prickly-leaved Paperbark/ Hairpin Banksia Coastal Heath of the Central Coast and lower North Coast
50	<u>Coastal Sand Scrub</u>	Coastal Headland Heaths	n/a	MU135: Coast Tea Tree/ Coast Banksia/ Ficinia nodosa low open shrubland on coastal foredunes
50a	Coastal Sand Foredune Scrub	Coastal Headland Heaths	n/a	No equivalent
50b	Coastal Sand Banksia Scrub	Coastal Headland Heaths	n/a	MU135: Coast Tea Tree/ Coast Banksia/ Ficinia nodosa dune low open shrubland on coastal foredunes
51	<u>Coastal Headland Complex</u>	Maritime Grasslands/Coastal Headland Heaths	EEC (?) May contain small patches of Themeda Grassland	MU179: Kangaroo Grass/ Coastal Rosemary grassland on coastal headlands
51a	Coastal Headland Grassland	Maritime Grasslands	Themeda grassland on seacliffs and headlands	MU179: Kangaroo Grass/ Coastal Rosemary grassland on coastal headlands
51b	Coastal Headland Shrubland	Coastal Headland Heaths	Themeda grassland on seacliffs and headlands	MU183: Prickly-leaved Paperbark/ Fern-leaved Banksia heath on coastal headlands of the Central Coast
51c	Coastal Headland Low Forest	Sydney Coastal Dry Sclerophyll Forests	may support Themeda grassland on seacliffs and headlands in some areas	MU102: Grey Ironbark/ Broad-leaved Mahogany/ Smooth-barked Apple coastal headland low open forest of the Central Coast
51d	Coastal Headland Paperbark Scrub	Coastal Headland Heaths	Themeda grassland on seacliffs and headlands	MU183: Prickly-leaved Paperbark/ Fern-leaved Banksia heath on coastal headlands of the Central Coast
53	<u>Beach Spinifex</u>	Maritime Grasslands	n/a	No equivalent
54	Hawkesbury Hanging Swamps	Coastal Heath Swamps	Coastal Upland Swamp	MU189: Fern-leaf Banksia/ Needlebush/ Leptocarpus tenax/ Lepyrodia scariosa wet heath
54e	Munmorah Sedge Swamp	Coastal Heath Swamps	n/a	?MU224: Baumea articulata Sedgeland

New MU	New DRAFT Name (LHCCREMS units <u>underlined></u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
100a	Swamp Paperbark Thicket (Floodplain Alluvials)	Coastal Floodplain Wetlands	Swamp Oak Floodplain Forest (?)	MU212: Swamp Paperbark/ Baumea juncea swamp shrubland on coastal lowlands of the Central Coast and lower North Coast
108b	Paperbark Depression Forest (M. styphelioides)	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains (?)	MU197: Prickly-leaved Paperbark/ Flax-leaved Paperbark swamp forest on poorly drained soils of the Central Coast
110a	Red Ironbark - Paperbark Forest	Hunter-Macleay Dry Sclerophyll Forests	Lower Hunter Spotted Gum - Ironbark Forest	MU075: Red Ironbark/ Spotted Gum/ Prickly-leaved Paperbark shrubby open forest of the lower Hunter
110b	Depression Paperbark Thicket	Hunter-Macleay Dry Sclerophyll Forests	Lower Hunter Spotted Gum - Ironbark Forest	MU075: Red Ironbark/ Spotted Gum/ Prickly-leaved Paperbark shrubby open forest of the lower Hunter
111a	Lake Macquarie Snappy Gum Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	No equivalent
111c	Killingworth Snappy Gum Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	No equivalent
113	Paperbark – Carex Backswamp Forest	Coastal Swamp Forests	Swamp Sclerophyll Forest on Coastal Floodplains	MU208: Flax-leaved Paperbark/ Tall Sedge shrubland of the Sydney Basin
114	Mesic Paperbark Thicket	North Coast Wet Sclerophyll Forests	n/a	No equivalent
119	Kahibah Snappy Gum Forest	Sydney Coastal Dry Sclerophyll Forests	n/a	No equivalent
121	Seagrass	n/a	n/a	No equivalent
122	Cockle Creek Dune Forest	Coastal Dune Dry Sclerophyll Forests	n/a	No equivalent
123	Cooranbong Blackbutt Tall Forest	North Coast Wet Sclerophyll Forests	n/a	MU061: Smooth-barked Apple/ Turpentine/ Blackbutt open forest on ranges of the Central Coast
125	Water Couch Meadow	Coastal Floodplain Wetlands	n/a	n/a
W	Water body	n/a	n/a	n/a
ZZ	Mapped remnant veg now cleared	n/a	n/a	n/a
Xr	Disturbed - Canopy only	n/a	Unknown (Site-by-site assessment required)	n/a
Xs	Disturbed - Regrowth	n/a	Unknown (Site-by-site assessment required)	n/a
B	Beach sands	n/a	n/a	n/a

New MU	New DRAFT Name (LHCCREMS units <u>underlined</u>)	Keith Equivalent	EEC Equivalent	Greater Hunter Vegetation Equivalent
Xx	Exotic Plantings	n/a	n/a	n/a

** For the purposes of this project/map, MU43a is a subgroup and is not the LHCCREMS MU43a, and MU43 is equivalent to LHCCREMS MU43a

Notes