



Revised Vegetation Mapping of Wyong LGA:

Stage 1 – West of F3 Freeway

Report to

Wyong Shire Council

**PO Box 20
Wyong
NSW 2259**

September 2008

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Colin Driscoll**

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Summary

A revised vegetation map has been prepared for the western half of Wyong Local Government Area, covering 48,530ha west of the F3 Freeway. Extensive and detailed data collection and API has been undertaken in Olney, Ourimbah and Wyong State Forests, covering 14 680ha, and used to produce a new vegetation map broadly based on the NPWS (2000) classification scheme. In addition, previous mapping projects, including those for Jilliby State Conservation Area, have been incorporated with new API of unmapped areas to produce a single seamless vegetation layer for western Wyong, covering 50 native vegetation map units. Multivariate data analysis has not been undertaken as part of this project, but it is recommended that further data collection and analysis be prioritised in those defined communities that are currently poorly sampled. Of the 50 defined communities, 39 (78%) are represented by fewer than 5 sampling plots within the current Wyong dataset, 14 (28%) have had only a single plot completed, and a further 14 (28%) have yet to be sampled at all. New plot data collection and re-classification is seen as a priority for the Wyong LGA, so that clarification can be achieved for the conservation status of the 50 units intuitively defined here.

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Acknowledgements

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1.0 Background

Wyong Shire Council is seeking an improved vegetation community map layer for the entire local government area (LGA), approximately 82,760 hectares. Previous mapping exists for the Shire, in the form of the Lower Hunter & Central Coast Regional Environmental Management Strategy (LHCCREMS: NPWS 2000) and the Wyong LGA survey and mapping project (Bell 2002). The model developed in the former project has been shown to be inconsistent and locally inaccurate for the majority of the Shire, while the latter over-simplifies vegetation diversity in the western half of the Shire. Both studies incorporated computer models for the western half of Wyong LGA. Recent vegetation modelling by McCauley et al (2006) is also locally inconsistent and inaccurate, and does not meet Council requirements.

Eastcoast Flora Survey has been commissioned to produce a revision to the western half of the 2002 vegetation map, consistent with other similar mapping completed elsewhere in the Lower Hunter and Central Coast in recent years. The current contract covers only the western parts of the LGA (west from the F3 Freeway), with detailed map data collected only for State Forest estate. Council staff were also to provide some map data for selected private property lands for incorporation into the western Wyong map.

GIS staff at Council are concurrently revising the linework and extant vegetation layer for the LGA east of the F3 Freeway, with the intention that the two halves will be merged at a later date to form a consistent LGA-wide layer.

In summary, the objectives of this phase of the overall LGA mapping project are to:

1. collect detailed ground control data within State Forest estate west of the F3 Freeway;
2. utilise ground control data supplied by Council staff for selected non-State Forest and non-DECC estate;
3. provide detailed mapping of all lands west of the F3 Freeway, including State Forest estate and private lands, based broadly on the LHCCREMS classification of 2000;
4. provide a brief report which documents the methods, results and recommendations and includes vegetation descriptions for any new vegetation communities;

1.1 Project Tasks

As a result of discussions with Council staff, and recognising the available budget, it was agreed that the following tasks would be undertaken within this stage of the project:

- Complete detailed, locally-accurate mapping for State Forest estate west of the F3 Freeway, dependant on accessibility to such areas;
- Provide vegetation community nomenclature consistent with the LHCCREMS 2003 classification, applying sub-communities or new communities where considered appropriate and in keeping with the wider LHCCREMS-based classification;
- Prepare a map layer for the western Wyong LGA, incorporating available locally-accurate mapping sourced from Council, and utilising the same community nomenclature;
- Prepare a brief report 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 are evident with respect to this mapping project:

Private property access – In many areas west of the F3 Freeway, restrictions on access to many private properties throughout the LGA resulted in limited ground control data being available, and consequently a lower quality of mapping in those areas.

Extant vegetation base layer – available aerial photographs ranged in age and quality across the study area. This has obvious implications on the accuracy of linework and interpretation of vegetation patterns in those areas where the collection of ground control data was not possible.

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. There has been no full floristic data analysis of standard plot data specifically for this project, although ongoing research in the region by the authors 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, and it is recommended that additional sampling and data analysis be undertaken at the completion of mapping for the entire LGA.

2.0 Study Area

All lands west of the F3 Freeway and within Wyong LGA form the study area of the current project. This encompasses some 48,530ha, of which ~14,680ha are contained within State Forest estate (Olney SF 10,510ha; Ourimbah SF 3,443ha and Wyong SF 728ha), and ~9200ha within DECC estate (Jilliby State Conservation Area). State Forest estate remained the focus of the detailed mapping studies, while the balance was also completed at a lower resolution, and where possible incorporating previous mapping studies. Jilliby SCA had been previously mapped by the authors on behalf of the DECC (Bell & Driscoll 2006a).

Figure 1 shows the study area, including the targeted State Forest lands, within the overall City-wide LGA.

3.0 Previous Studies

A number of previous mapping studies have been completed within or include the Wyong LGA. While not all of these were completed using a compatible methodology to the present study, information contained within each of them is useful to differing levels. Wherever possible, data collected as part of these prior studies has been incorporated into the present study.

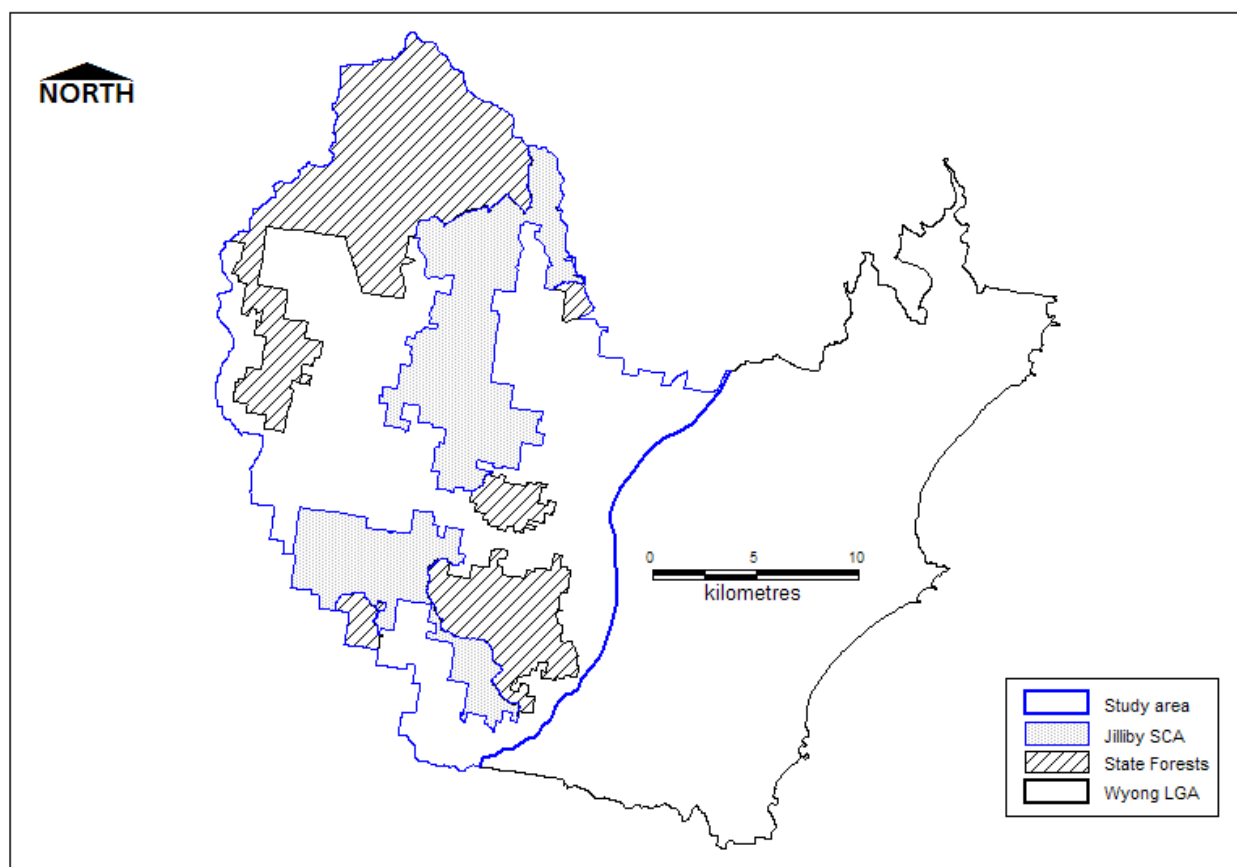


Figure 1 Study area showing public lands and high resolution (State Forests) focus area, Wyong LGA.

Lower Hunter & Central Coast Regional Environmental Management Strategy (NPWS 2000) – this major classification and mapping project 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 modelling vegetation distribution in relation to 43 environmental variables, and consequently errors and inaccuracies were expected. The classification behind the modelling 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, but is modified where applicable.

Wyong LGA (2002) – Wyong Shire Council instigated a Shire-wide vegetation survey and mapping project in response to observed inadequacies in the NPWS (2000) regional modelling (Bell 2002). This project collected an additional 90 full floristic survey plots across the LGA (but with the main focus on the eastern half), and re-analysed and classified the vegetation. Mapping was based on aerial photographic interpretation and extensive ground truthing in the east, but relied on modelling in the west. Evidently, the western half of the LGA closely resembled that done by NPWS (2000), and adopted similar inadequacies. Few vegetation communities were delineated and mapped west of the F3 Freeway.

Jiliby State Conservation Area (2005) – a heavily ground-based mapping project was undertaken within Jiliby SCA on behalf of DECC, using the same methodology as that used in the current study (Bell & Driscoll 2006a). A requirement of this project was to map communities using the NPWS (2000) classification, but no funding was available for further collection of full floristic plot data or classification analysis. The rugged terrain in the reserve meant that few of the deeper gullies and gorges were inspected and consequently mapping relied on aerial photographic interpretation.

Kulnura GDE Validation Mapping (2005) – validation mapping was carried out on the Kulnura Plateau on behalf of the Department of Natural Resources, to assist in a Groundwater Dependant Ecosystem (GDE) identification study (Bell 2005). This project spanned both Wyong and Gosford LGA's, and aimed to update and refine parts of the LGA mapping previously completed for Wyong Shire Council and Gosford City Council (Bell 2004). Parts of the Kulnura Plateau in the south-west of Wyong LGA were included in this study, which involved field inspections at a number of ground sites.

Precinct 14 (2006) – vegetation survey, analysis and mapping was undertaken within Precinct 14 on behalf of Council, and forms part of the Wyong Employment Zone strategy (Murray & Bell 2006). Mapping and data collected for this project used the same methods as the current project, and was adopted with little change.

Central Coast Revised Mapping (2006) – Hunter Councils undertook a revised classification and mapping project with the aim of improving on the product initially completed by NPWS (2000), and then provisionally updated by LHCCREMS (2003). This covered the three coastal Councils in the region (Lake Macquarie, Wyong and Gosford), but again relied on modelling to define local vegetation diversity (McCauley et. al. 2006). Given the complexities of coastal ecosystems, this project has not delivered to Council expectations, and has been difficult to rationalise with on-ground observations in many places.

Wallarrah 2 Coal Project (2007-8) – mapping undertaken as part of a proposed underground coal mine in the Jilliby Valley used methods comparable with the current study (OzArk 2007, 2008). This project examined the vegetation at both direct impact and non-impact areas around Buttonderry and Warnervale, including proposed conservation offset areas, and also mapped remaining vegetation in potential subsidence lands around Jilliby. Classification of vegetation adopted the nomenclature of the Shire-wide study, and additional sample plots were collected and analysed in this regard.

4.0 Methodology

4.1 Field Survey

4.1.1 State Forest Estate

Funding for the current project focused on State Forest estate within the Wyong LGA. This covered an area of 14,680ha, encompassing parts of Olney, Ourimbah and Wyong State Forests. Field survey within these areas targeted the gathering of data on dominant floristic species from the canopy, shrub and ground layers at as many locations as possible, through a new method of mapping developed by the authors for more accurately depicting vegetation biodiversity. 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 modelling: NPWS 2000; McCauley et. al. 2006). Effective modelling using these techniques is determined by the scale and accuracy of predictor values, and at a local scale these are rarely available at a suitable resolution.

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 immediate 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 plant species in an area. A live GPS feed to a laptop computer, running Manifold[®] GIS, shows locational information in real-time. At regular locations and where changes in the vegetation are observed, summaries of the floristic composition 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

Initially, all trafficable paths across the study area are driven recording RDPs. Those areas lacking extensive trail networks are then walked on foot 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 to be used in modelling and vegetation mapping procedures. The data also proves invaluable as a ground-truthing mechanism for the final vegetation map.

This method has been used by the authors in number of studies in recent years, most notably for the Tomago and Tomaree Sandbeds north of Newcastle, Watagans National Park and Jilliby State Conservation Area, and the Cessnock-Kurri region (Bell & Driscoll 2006a, 2006b, 2008). By comparison to traditional modelling methods, it offers a time-efficient alternative for producing a map of vegetation biodiversity based on real ground data.

4.1.2 All Other Lands

Field survey undertaken within lands other than State Forest estate as part of the current project was very limited. Wyong Shire Council targeted selected private lands and collected RDP data specifically for use in this project. This required liaison with landholders who were not always amenable to having their land inspected, and most often involved foot traverses in steep terrain. In some cases, a 1 hour return trip on foot could yield only a single RDP, once cleared agricultural lands were traversed and native vegetation reached. However, within the western study area (west of the F3 Freeway) a large number of previously collected RDP and other field data were also incorporated into the mapping, including that for Jilliby State Conservation Area (Bell & Driscoll 2006a), the Wallarah 2 Coal Project (OzArk 2007, 2008), the Kulnura 1:100 000 mapsheet field validation project (Bell 2005), and studies undertaken for the proposed development of Precinct 14 (Murray & Bell 2006).

4.2 Mapping

4.2.1 State Forest Estate

The production of a vegetation map for State Forest estate followed a simple pathway. Each of the RDP's collected across the area of interest were allocated initially to broad vegetation units previously defined for the area (the classification of NPWS 2000). As the process progressed, sufficient floristic differences could be recognised and draft sub-communities or variants of broad communities were matched to the regional classification maintained by the authors, 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 completion of all data collection. A final review of the allocated coding to each point was made following completion of the classification process, where changes in the classification hierarchy (community, subcommunity, variant) were made to reflect classification units.

The vegetation mapping process began with the generation of a broad structural layer using available digital aerial photographs. High resolution digital orthorectified aerial photographs supplied by Council (© Wyong Shire Council) were available for the eastern sections (flown December 2003), while photographs of lower resolution were used in the west (© Lands & Property Information, flown 2004). Rainforest, moist forest, heaths, water bodies, cleared and modified lands were delineated in this way. Using the classified RDP's, extrapolation using unweighted Voronoi areas (Aurenhammer 1991; Okabe et. al. 2000) in Manifold[®] GIS was then undertaken to establish the areal extent of each observed variation. The Voronoi area algorithm creates polygons such that the boundary of each 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, linework produced from Voronoi areas was overlaid onto the available orthorectified aerial photographs and where necessary polygons edited to reflect observable changes in photopatterns (eg: riparian vegetation, rainforest patches, heath) which the extrapolation process did not adequately mirror.

At all times in the vegetation mapping process, reference was made to the data collected during the RDP phase to confirm specific vegetation units. In some 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.

4.2.2 All Other Lands

With the exception of the RDP process and the associated Voronoi extrapolation, mapping of lands outside of State Forest estate followed a similar process. However, the existence of high quality, ground-truthed vegetation maps for Jilliby State Conservation Area, parts of the Jilliby Valley and areas around Buttonderry, and parts of the Kulnura Plateau, meant that much of the area outside of State Forest estate was already suitably mapped. Additional RDP data points collected on private lands by Council for this project, and the authors for previous projects, allowed for a considerable number of spot checks of vegetation types to inform the polygon tagging phase.

4.2.3 West of F3 Freeway Combined

The combined vegetation map for all lands west of the F3 Freeway involved the merging of the following mapping projects into a single seamless layer:

- Olney, Ourimbah and Wyong State Forests (the main focus of the current project);
- Jilliby State Conservation Area (2006);
- Wallarah 2 Coal Project (proposed disturbance, conservation offset, and potential subsidence lands areas: 2007-8);
- Kulnura GDE map validation (2005);
- Precinct 14 proposed development areas (2006);
- the balance of lands west of the F3 Freeway (lower resolution, mostly API).

For this to occur effectively, attribute tables for each layer were standardised and updated to current community nomenclature and coding prior to merging. New aerial photographic interpretation and mapping was edge-matched to previous studies, and some revisions to polygon

boundaries were also undertaken during this stage. Data fields retained in the combined attribute table included those identifying the source of the information, the original vegetation code and the revised regional vegetation code. Tagging of polygons in those areas with little or no ground data was based on observable trends in community transitions from nearby areas.

4.3 Vegetation Classification

The classification of vegetation communities throughout this project has been intuitive, drawing on the extensive field and data analysis experience of the authors. There was not scope within the project brief for a full floristic vegetation survey and analysis, however the results of numerous regional and sub-regional classifications, using non-hierarchical agglomerative clustering and non-metric Multi Dimensional Scaling, have been drawn upon to assist in classification. In certain groups of communities, such as those involving Endangered Ecological Communities, preliminary results obtained from specialist sub-sets of the regional dataset analysed through other projects have been used to assist in hierarchical positions in the classification.

Community codes and preliminary names are based on an on-going regional classification developed and maintained by the authors, which itself is broadly based on the NPWS (2000) classification scheme. With increasing detail of investigation, it is becoming difficult to satisfactorily attribute certain vegetation types encountered in the field to one of the NPWS (2000) units, and the time for a full regional re-classification is fast approaching. In the interim, community codes and names are based on intuition, and it is possible that some may be subsumed within other communities following data analysis. The most recent regional classification which covers the Wyong LGA (McCauley et. al. 2006) is too broad for useful comparisons, and is difficult to rationalise with field data and communities.

5.0 Results

5.1 Field Survey

5.1.1 State Forest Estate

A total of 2111 RDP's were collected from Olney, Ourimbah and Wyong State Forests during the current project, equating to approximately 1 RDP per 6.95 ha. The generally rugged nature of the terrain in these areas did not allow a comprehensive coverage of all areas within this estate, however relative to previous mapping exercises in the region a considerable amount of reliable ground data was collected for mapping purposes. For obvious reasons, the greatest amount of RDP data was collected along ridgetops and slopes, where existing 4WD trails occur. Gullies and lower slopes, which typically support rainforest and tall moist sheltered forests, are difficult to navigate without extensive foot traverses, and were beyond the capabilities of the current budget. As a result, it is possible that the diversity of vegetation presented in the mapping of this landscape position has been oversimplified.

Figure 2 shows the distribution of all RDP's, including those collected within State Forest estate.

5.1.2 All Other Lands

Existing RDP's from previous mapping and survey projects, together with the 156 supplied by Council, meant that in excess of 1680 RDP's were available for mapping of other lands (approximately 1 RDP per 20 ha, although some areas such as Jilliby SCA achieved a sampling density of 1 RDP per 12 ha). However, together with the State Forest RDP data (Figure 2), they do

provide an indication of the perceived accuracy of the final map layer, and highlight those areas requiring further field truthing.

In total, 3800 RDP data points have been used in the construction of the western Wyong LGA vegetation map, equating to a sampling density of 1 RDP per 12.8 ha. This compares to a density of 1 RDP per 476 ha by NPWS (2000) for the LHCCREMS mapping, and 1 per 1000 ha for the State Forests vegetation mapping (Binns 1996).

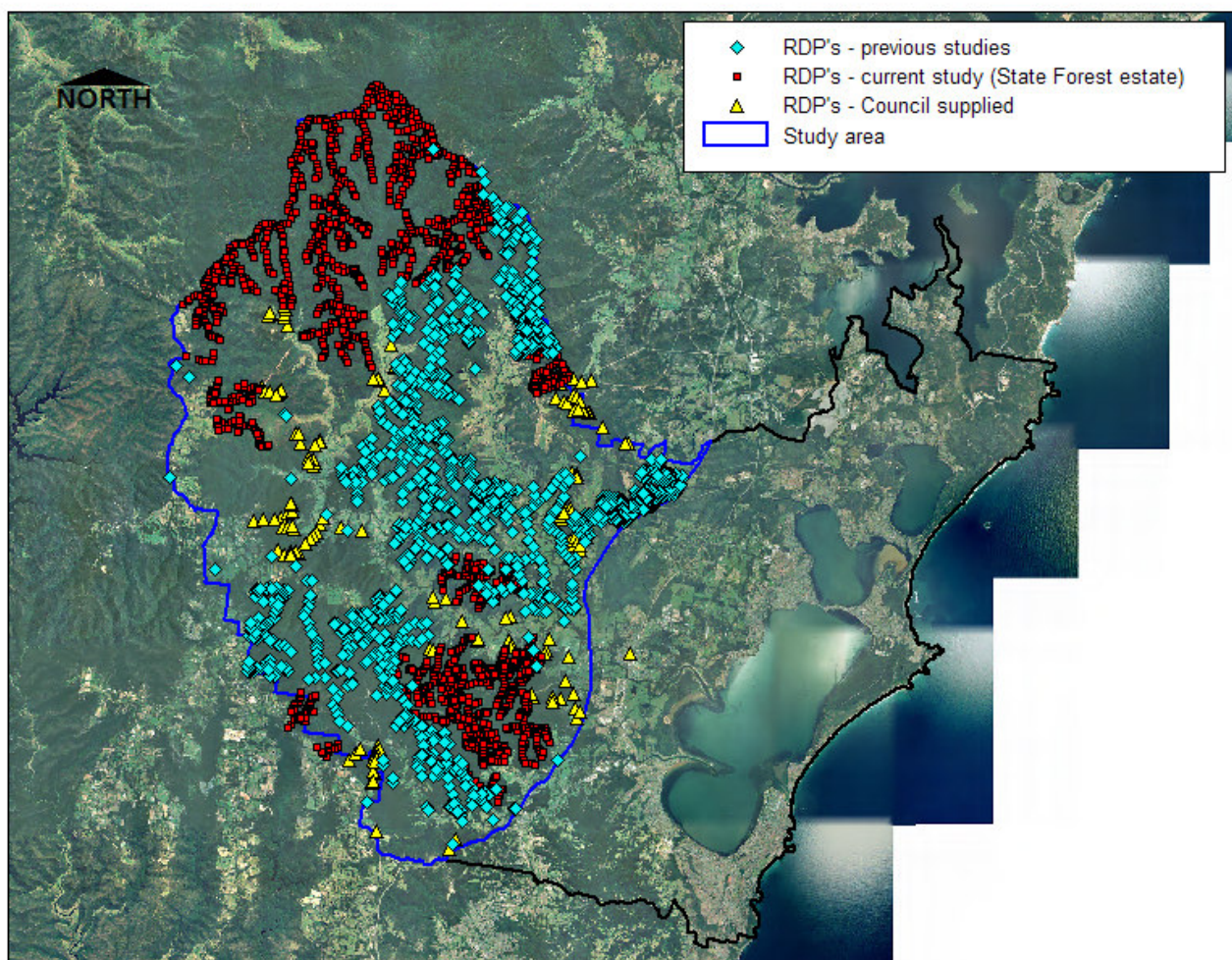


Figure 2 Field-collected RDP's within the western study area.

5.2 Mapping

The combined vegetation map of all lands west of the F3 Freeway accompanies this report. This map layer incorporates the detailed State Forest mapping that has been the main focus of this study, together with previous mapping of Jilliby SCA, the Kulnura Plateau, Wallarah 2 Coal Project lands, and Precinct 14 lands. In total, 7111 polygons comprise the new layer, including disturbed categories and water bodies.

Data fields within the map layer include cross-referencing to previous Wyong LGA, Jilliby SCA and LHCCREMS vegetation units, Endangered Ecological Communities, and Keith Classes. A canopy label field has also been included, for quick recognition of the key canopy species in each unit. Within a GIS, theming can be undertaken on any field, but those on Master_Comm, REMS_Unit, EEC_Equivalent or Keith_Class are likely to be the most useful. An example of the fields for each polygon is reproduced below (Table 1).

Appendix 9.1 summarises all vegetation map units mapped for the western Wyong study area, and is an extract of the full spreadsheet submitted to Council. This table can be updated as further improvements to the mapping are undertaken, or as progressive reclassification of the regions vegetation occurs.

Table 1 Example of attribute table for a polygon from the revised vegetation layer.

Master_Unit	21f
Master_Comm	21f – Hunter Range Dry Mahogany/ Apple Forest
Canopy_Label	E.umbra/ A.floribunda/ E.paniculata/ E.placita
Wyong_Unit	35
Wyong_Comm	Coastal Ranges Moist Layered Forest
REMS_Unit	21
REMS_Comm	Hunter Range Grey Gum Forest
JSCA_Unit	21f
JSCA_Comm	Hunter Range Dry Mahogany/ Apple Forest
Data_Source	Jilliby SCA
EEC_Equivalent	Not currently listed
Keith_Class	Sydney Coastal Dry Sclerophyll Forests

6.0 Discussion

6.1 Mapping Accuracy

For the State Forest lands, map accuracy is considered high across the majority of this estate. Those areas with limited access, such as the southern parts of Olney SF with low densities of RDP's, can readily be updated as access and new data collection is achieved.

Other lands within the western study area have varying levels of accuracy. As with the State Forest lands, Jilliby SCA has been mapped at a high resolution given the amount of ground data used in that project (~1100). Minor modifications to the Jilliby mapping have occurred during the current project, principally around the margins of that estate. Similarly, mapping undertaken for Precinct 14 and the Wallarah 2 Coal Project relies heavily on ground data. For all areas, reference should be made to the extent of ground data (RDP) shown in Figure 2 to determine relative accuracy.

As an indication of the accuracy of the LHCCREMS modelling, a total of 1633 ground control data points (RDPs from the current project, excluding those in plantation areas etc) for the State Forest lands have been coded with the most appropriate LHCCREMS vegetation unit, and intersected via GIS with the 2003 LHCCREMS vegetation model. The resulting Table 2 is a confusion matrix which describes the accuracy of the LHCCREMS mapping in relation to these ground-truthed data points. In the left hand column are the LHCCREMS community map units and in the top row are the same units as interpreted from the ground-truthed data. Taking unit 9 as an example, 424 of the ground-truthed data points that were coded as unit 9 matched the LHCCREMS code at those locations. However the remainder of the entries in that column are where the ground-truthed data is coded as unit 9 but the LHCCREMS mapped communities are incorrect at those locations. So, at 424 locations the LHCCREMS map was correct but at 72 locations it was incorrect for unit 9 (85% correct). The overall accuracy for all LHCCREMS mapped communities assessed in this way with

the 1633 data points is 52%. Furthermore, the current mapping includes ~840ha of State Forest plantation that is mapped by LHCCREMS as containing 8 different vegetation communities.

Figure 4 graphically shows the extent to which the various LHCCREMS units have been accurately portrayed, recognising that the data used to test the accuracy of mapping is biased towards those more accessible areas along ridges and slopes. LHCCREMS Units 1 and 1a (Coastal Wet Gully Forest & Rainforest), 5 (Alluvial Tall Moist Forest), 12 (Hunter Valley Moist Forest), 25 (Sheltered Dry Hawkesbury Woodland), and 37 (Swamp Mahogany-Paperbark Forest) all score <50% accuracy, suggesting that sheltered slope and gully vegetation may be less reliably modelled.

Table 2 Confusion matrix of RDP data (columns) vs LHCCREMS mapped polygons (rows) for State Forest lands, using 1633 ground-control points. Correct RDP data are shaded.

		Vegetation Community as per RDP data											
		1	1a	5	6	9	12	15	21	22	25	26	37
Vegetation Community as per LHCCREMS Map Polygons	1	41	5	0	107	244	4	30	45	8	9	8	0
	1a	5	1	0	16	59	1	11	11	0	2	7	0
	5	0	0	0	0	1	0	3	0	0	0	0	0
	6	1	0	0	64	9	0	0	1	0	0	0	0
	9	16	2	3	8	424	0	7	5	15	6	10	0
	12	6	0	0	0	5	9	15	0	0	0	0	0
	15	18	0	1	0	16	11	154	9	0	0	0	0
	21	2	1	0	0	7	0	0	38	0	0	0	0
	22	0	0	0	0	1	0	0	0	21	0	0	0
	25	1	0	0	0	3	0	0	3	0	20	13	0
	26	0	0	0	0	1	0	0	0	0	7	76	0
	37	3	0	0	0	2	0	0	0	0	0	0	1

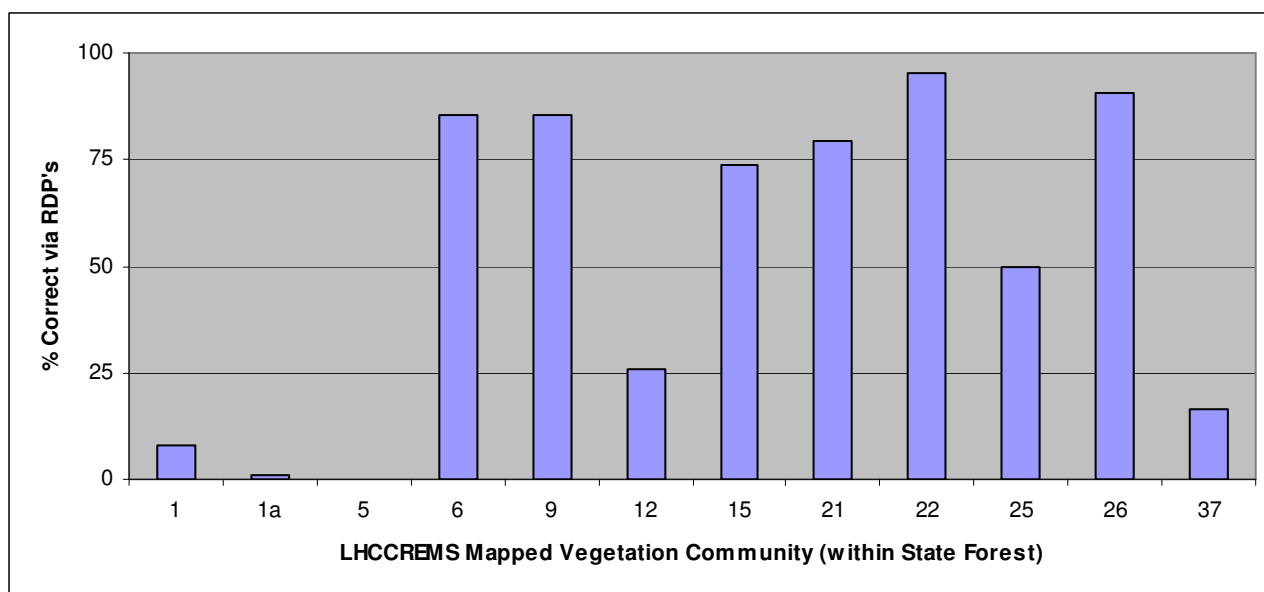


Figure 4 Accuracy of LHCCREMS mapped polygons for State Forest estate within Wyong LGA, tested with 1633 ground-control points.

6.2 Future Classification

Given the high number of provisionally new vegetation communities mapped and outlined as part of this project, it is important that work continue towards a re-classification of floristic plot data. In this context, a brief analysis of all existing plots completed in the western sections of the LGA, intersected with the final vegetation map layer, reveals only 11 of the 50 communities defined for the western section of the LGA have had 5 or more plots sampled within them (Table 3). Thirty-nine of the 50 communities (78%) have had less than 5 full floristic plots sampled within them. Fourteen communities (28%) have had only a single plot within them, and a further 14 (28%) have not been sampled at all.

Table 3 Existing full floristic sampling effort for currently recognised vegetation communities. Communities grouped in priority order.

Community	Existing Plots
2a - Water Gum/ Coachwood/ Sassafras Riparian Rainforest	0
9a - Coastal Ranges Mesic Blackbutt Forest	0
9h - Coastal Ranges Dry Tallowwood/ Blackbutt Forest	0
12 - Hunter Valley Moist Forest	0
15k - Coastal Foothills Moist Grey Gum/ Mahogany Forest	0
15m - Jilliby Spotted Gum/ Northern Ironbark/ Mahogany Forest	0
21a - Hunter Range Dry Escarpment Apple Forest	0
21g - Hunter Range Dry Stringybark/ Blackbutt Forest	0
21h - Hunter Range Dry Mahogany/ Bloodwood Forest	0
26d - Somersby Plateau Forest	0
26g - Hawkesbury Bloodwood/ Snappy Gum Forest	0
26i - Hawkesbury Apple/ Turpentine/ Bloodwood Shale Forest	0
31 - Narrabeen Doyalson Coastal Woodland	0
37 - Swamp Mahogany/ Paperbark Forest	0
5e - Alluvial Bluegum/ Spotted Gum Moist Forest	1
6a - Coastal Narrabeen Bluegum Ridge Forest	1
9b - Coastal Ranges Dry Blackbutt Forest	1
9e - Coastal Ranges Mesic Peppermint Forest	1
9g - Coastal Ranges Mesic Grey Gum/ Ironbark Forest	1
21e - Hunter Range Dry Mahogany/ Grey Gum Forest	1
25 - Hawkesbury Peppermint/ Apple Forest	1
29 - Hawkesbury Banksia Scrub-Woodland	1
54 - Hawkesbury Hanging Swamps	1
26d - Somersby Plateau Forest	1
26i - Hawkesbury Apple/ Turpentine/ Bloodwood Shale Forest	1
37a - Alluvial Paperbark Sedge Forest	1
37b - Alluvial Floodplain Woollybutt Forest	1
120 - Floodplain Wet Heath	1
5h - Alluvial Riparian Blackbutt Forest	2
9d - Coastal Ranges Dry Spotted Gum/ Blackbutt Forest	2
9f - Coastal Ranges Dry Peppermint/ Blackbutt Forest	2
22e - Coastal Narrabeen Dry Bloodwood/ Apple/ Mahogany Forest	2
37 - Swamp Mahogany/ Paperbark Forest	2
42 - Red Mahogany/ Apple/ Paperbark Forest	2
37d - Alluvial Floodplain Cabbage Gum Forest	2
6f - Coastal Narrabeen Mahogany/ Bluegum Forest	3
9k - Coastal Ranges Mahogany/ Ironbark Forest	3

12c - Hunter Valley Moist Spotted Gum / Ironbark Forest	3
9j - Coastal Ranges Dry Stringybark/ Mahogany Forest	4
21f - Hunter Range Dry Mahogany/ Apple Forest	5
15n - Jiliby Spotted Gum/ Ferguson Ironbark/ Mahogany Forest	6
9i - Coastal Ranges Mesic Stringybark/ Mahogany Forest	7
1h - Riverine Alluvial Rainforest/ Moist Forest	8
15j - Coastal Foothills Dry Grey Gum/ Ironbark Forest	8
26 - Exposed Hawkesbury Woodland	10
1a - Coastal Warm Temperate Rainforest	11
30a - Buttonderry Foothills Forest	11
15c - Warnervale Spotted Gum/ Red Ironbark Forest	13
15 - Coastal Foothills Spotted Gum/ Ironbark Forest	14
1 - Coastal Wet Gully Forest	29

Evidently, many of the communities mapped as part of this project are yet to be sampled adequately and analysed in detail, but this brief assessment provides some guidelines for future sampling effort. Future sampling should target the defined map units, specifically where resolution is high following ground truthing, and should not involve stratification of environmental variables within the study area to determine where sampling effort is to be concentrated. Field work undertaken for the current study, particularly within State Forest estate, has identified suitable locations for representative plots to be sampled in the differing vegetation communities.

7.0 Recommendations

As a result of the revised western LGA mapping study, it is recommended that:

- Amalgamation of the new western map layer with the revised eastern layer be undertaken, to provide seamless LGA-wide coverage for the whole LGA. Prior to this occurring, updating of community nomenclature and attribute tables within the eastern LGA layer should be undertaken, with the opportunity for review;
- Some targeted field traverses in deeper gullies and sheltered slopes be undertaken to collect additional RDP data and better inform the mapping in these areas. Ideally, this would be combined with the collection of full floristic survey plots (see below);
- A strategic and targeted full floristic data collection phase in those communities identified here as new and lacking in existing data, followed by a revised classification analysis of the full Wyong LGA dataset. Some modifications to community relationships, nomenclature and hierarchical positions are likely following analysis.

8.0 References

- Aurenhammer, F. (1991) Voronoi Diagrams - A Survey of a Fundamental Geometric Data Structure. *ACM Computing Surveys* 23(3):345-405.
- Bell, S.A.J. (2002) *The natural vegetation of Wyong Local Government Area, Central Coast, New South Wales*. (2 volumes). Unpublished Report to Wyong Shire Council. Eastcoast Flora Survey.
- Bell, S.A.J. (2004) *The natural vegetation of the Gosford local government area, Central Coast, New South Wales. Volumes 1 & 2*. Unpublished Report to Gosford City Council. April 2004. Eastcoast Flora Survey.
- Bell, S.A.J. (2005) *Updating of vegetation mapping on the Kulnura Plateau, with regard to GDE modelling*. Unpublished Map to Department of Natural Resources. Eastcoast Flora Survey. December 2005.
- Bell, S.A.J. & Driscoll, C. (2006a) *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. (2006b) *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. (2008) *Vegetation of the Cessnock-Kurri Region, Cessnock LGA, New South Wales: Survey, Classification & Mapping*. Unpublished Report to Department of Environment and Climate Change. Eastcoast Flora Survey. February 2008.
- Lower Hunter & Central Coast Regional Biodiversity Conservation Strategy (2003) *Briefing Notes – Results of Regional Conservation Assessment for the Lower Hunter & Central Coast*. Lower Hunter and Central Coast Regional Environmental Management Strategy. August 2003.
- NSW 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.
- 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) *Ecological investigations, Wyong Employment Zone: Warnervale Business Park, Warnervale Airport Lands, Precincts 11 & 13, and Precinct 14*. Unpublished Report to Wyong Shire Council. May 2006.
- Okabe, A., Boots, B., Sugihara, K. & Chiu, S. (2000) *Spatial Tessellations - Concepts and Applications of Voronoi Diagrams*. 2nd edition. John Wiley.
- OzArk (2007) *Ecological and Heritage assessments – Proposed Wallarah No 2 Coal Project (Direct Impact and Proposed Conservation Offset areas)*. Report to Wyong Areas Coal Joint Venture.
- OzArk (2008) *Proposed Wallarah 2 Coal Project: Ecology Assessment of the Proposed Mining Area, Wyong, NSW*. Report to Wyong Areas Coal Joint Venture. August 2008.

9.1 Vegetation Community Summary: Western Wyong LGA

Unit	Community	Characteristic Species	Comment
1	Coastal Wet Gully Forest	<i>Syncarpia glomulifera</i> , <i>Eucalyptus saligna</i> , <i>E. deanei</i> , <i>E. acmenioides</i> , <i>Acmena smithii</i> , <i>Guioa semiglaucosa</i>	Occupies most sheltered gullies within rugged topography.
1a	Coastal Warm Temperate Rainforest	<i>Asmithii Dsassafras Cglaucescens Capetalum</i> <i>Esaligna Aexcelsa Sglomulifera Gsemiglaucosa</i> <i>Ndealbata Sglandulosum Saustralis Soleosum</i>	Occurs in well protected gullies
1h	Riverine Alluvial Rainforest-Moist Forest	<i>Esaligna Sglomulifera Asmithii Aexcelsa Cglaucescens</i> <i>Cmicroneura Asubcinereus Gsemiglaucosa Cleptopetala</i> <i>Mmicrococca DspA Eacuminata Sstawellii Sthwaitesii</i> <i>Gferdinandi Wheugeliana Edicolor Acunninghamiana</i>	the rainforest remnants along major creek lines like Ourimbah, Wyong Rivers
2a	Water Gum – Coachwood – Sassafras Riparian Rainforest	<i>Tristania laurina</i> , <i>Doryphora sassafras</i> , <i>Ceratopetalum apetalum</i>	Known from upper Ourimbah Creek in the riparian zone, but likely to occur elsewhere
5e	Alluvial Bluegum-Spotted Gum Moist Forest	<i>Esaligna Cmaculata Mstypelioides Mbiconvexa</i>	Related to 5a but includes Spotted Gum and does not support as many mesic species as 5a. Requires some further investigation.
5h	Alluvial Riparian Blackbutt Forest	<i>Epilularis Aprominens Mnodosia Dtriquetra</i> <i>Pesculentum Estricta</i>	Moist alluvial forest. Need to see how different this one is to 5c from the precinct 14 area - with the addition of Cmaculata and Mbiconvexa.
6a	Coastal Narrabeen Bluegum Ridge Forest	<i>Esaligna Edeanei Atorulosa Sglomulifera</i> (+/- <i>Eacmenioides Epilularis</i>) <i>Gferdinandi Tlaurina</i> <i>Rrubescens Psambucifolia</i>	A moist ridgetop forest where <i>Esaligna</i> , <i>Edeanei</i> , <i>Sglomulifera</i> and <i>Eacmenioides</i> are common, over a mesic understorey of rainforest species. Occurs generally in higher rainfall areas at the top of the Olney SF catchment.
6f	Coastal Narrabeen Mahogany - Bluegum Forest	<i>Eumbra Sglomulifera Edeanei Esaligna Eacmenoides</i> <i>Atorulosa Afloribunda</i>	A drier form of MU6 but without the rainforest trees and shrubs in the mid storey. Still moist though.
9a	Coastal Ranges Mesic Blackbutt Forest	<i>Epilularis</i> , <i>Afloribunda</i> , <i>Atorulosa</i> , <i>Eacmenoides</i> <i>Esaligna</i> , <i>Edeanei</i> . In places, <i>Escias</i> and <i>Emicrocorys</i> .	A tall forest where <i>E. pilularis</i> is clearly dominant, and with a mesic understorey of semi-rainforest species.
9b	Coastal Ranges Dry Blackbutt Forest	<i>Epilularis</i> , <i>Afloribunda</i> , <i>Atorulosa</i> , <i>Icylindria</i> , <i>Pesculentum</i> , <i>Xmacronema</i>	A dryer tall open forest clearly dominated by <i>Eucalyptus pilularis</i> , over a grassy or dry shrubby understorey. Some areas have distinctive understorey of <i>Xanthorrhoea macronema</i> and <i>Patersonia glabrata</i> .
9d	Coastal Ranges Dry Spotted Gum - Blackbutt Forest	<i>Eucalyptus pilularis</i> , <i>Corymbia maculata</i> , <i>Allocasuarina torulosa</i> , <i>E. punctata</i> , <i>Syncarpia glomulifera</i> , <i>Angophora floribunda</i>	A dry, grassy variant which may represent a disturbed form of MU 9b, again occurring in the vicinity of MU's 9a and 15, which may itself be an ecotonal community. Present in only a few locations on the eastern side of Jilliby SCA.
9e	Coastal Ranges Mesic Peppermint Forest	<i>Eucalyptus piperita</i> , <i>Allocasuarina torulosa</i> , <i>Syncarpia glomulifera</i> , <i>E. scias</i> , +/- <i>E. saligna</i> , <i>E. deanei</i>	A moist variant very similar to MU9c, and may in fact represent ecotonal areas between this community and the bluegum forests of the sheltered slopes. Further investigation is required.

9f	Coastal Ranges Dry Peppermint - Blackbutt Forest	<i>Eucalyptus pilularis</i> , <i>E. piperita</i> , <i>Allocasuarina torulosa</i> +/- <i>Corymbia gummifera</i> , <i>E. scias</i> , <i>Banksia serrata</i> , <i>E. sieberi</i>	An unusual community where a strong sandstone influence is evident, with species such as <i>Banksia serrata</i> , <i>Eucalyptus piperita</i> and several understorey species more typical of Hawkesbury Sandstone geology are present. <i>Eucalyptus pilularis</i> is also generally present in most areas.
9g	Coastal Ranges Mesic Grey Gum – Ironbark Forest	<i>Eucalyptus propinqua</i> , <i>E. siderophloia</i> , <i>Angophora floribunda</i> , <i>Allocasuarina torulosa</i> , <i>E. pilularis</i> , <i>E. paniculata</i>	Occupies lower slopes in a few locations south of the Scout Camp off Lemon Tree Road. A moist understorey of <i>Lomandra longifolia</i> and herbs/grasses, with occasional mesic shrub species. Possibly an artefact of logging, but requires statistical analysis.
9h	Coastal Ranges Dry Tallowwood – Blackbutt Forest	<i>Eucalyptus pilularis</i> , <i>E. microcorys</i> , <i>Allocasuarina torulosa</i> , <i>Syncarpia glomulifera</i>	A variant of MU 9a but where <i>Eucalyptus microcorys</i> is characteristic. Understorey vegetation is generally similar to MU9a, however full data analysis is required to confirm this
9i	Coastal Ranges Mesic Stringybark - Mahogany Forest	<i>Eucalyptus agglomerata</i> , <i>Angophora floribunda</i> , <i>Allocasuarina torulosa</i> , <i>E. umbra</i>	A tall open forest, currently known from in and around south-western Jilliby SCA. May represent a variant of MU21g, but the presence of the key canopy species is consistent. Andersons Point area recently selectively logged, but good condition areas are present off the end of the spur.
9j	Coastal Ranges Dry Stringybark – Mahogany Forest	<i>Eucalyptus agglomerata</i> , <i>E. scias</i> , <i>E. fergusonii</i> , <i>Angophora costata</i> , <i>E. umbra</i> , <i>Allocasuarina torulosa</i> , <i>Syncarpia glomulifera</i>	Occurs on ridges and slopes in the far south of Jilliby. Some of this could be the same as 9i or 21g, but 9j tends to be dryer
9k	Coastal Ranges Mahogany-Ironbark Forest	<i>Esiderophloia Eumbra Atorulosa Afloribunda Sglomulifera</i> +/- <i>Eacmenoides Efergusonii</i>	A tricky one. <i>E. propinqua</i> occurs sporadically but not consistently enough to call it MU15k or 9g, but <i>siderophloia</i> , <i>umbra</i> , <i>torulosa</i> and <i>floribunda</i> seem to typify it. More analysis required. Not really dry enough to be MU21f either, despite the <i>umbra</i> dominance in places.
12	Hunter Valley Moist Forest (REMS defined)	<i>Cmaculata Epunctata Epaniculata Ctomentosum Saustralis Ganceps</i>	Requires further clarification and assessment as to where in the classification it belongs. May overlap considerably with other MU12 subunits.
12c	Hunter Valley Moist Spotted Gum – Ironbark Forest	<i>Corymbia maculata</i> , <i>Eucalyptus paniculata</i> , <i>E. microcorys</i> , <i>E. acmenoides</i> , <i>E. punctata</i> , <i>Allocasuarina torulosa</i> , <i>Angophora floribunda</i>	A moist open forest occurring on sheltered upper slopes, generally in the vicinity of MU15. <i>Eucalyptus punctata</i> may be locally present but is not consistent.
15	Coastal Foothills Spotted Gum - Ironbark Forest (Jilliby defined)	<i>Corymbia maculata</i> , <i>Eucalyptus umbra</i> , <i>E. paniculata</i> , <i>E. siderophloia</i>	An open forest occurring on the dryer western and southern ridges and spurs, typically with an understorey of prickly shrubs such as <i>Daviesia ulicifolia</i> and <i>Podolobium aciculiferum</i> , and several grass species.
15c	Warnervale Spotted Gum/ Red Ironbark Forest	<i>Cmaculata Efibrosa Jpallida Taustralis Lobliqua Dulicifolia Phirtellus</i> +/- <i>Mnodosa</i>	Generally dominated by <i>C. maculata</i> and <i>E. fibrosa</i> , and potentially forms part of LHSGIF EEC. Current data analysis is suggesting a Hinterland form of <i>maculata-fibrosa</i> vegetation, stretching from Karuah to Lake Macquarie and Warnervale
15j	Coastal Foothills Dry Grey Gum-Ironbark Forest	<i>Eucalyptus propinqua</i> , <i>E. paniculata</i> , <i>E. umbra</i> , <i>Allocasuarina torulosa</i> , <i>Syncarpia glomulifera</i>	Principally on the ridges and slopes along Watagan Forest Road in the south of Jilliby SCA, this community possibly represents a variation of MU15, where Spotted Gum is replaced by Small-fruited Grey Gum, but

			all other components are essentially the same
15k	Coastal Foothills Moist Grey Gum-Mahogany Forest	<i>Eucalyptus propinqua</i> and <i>E. umbra</i> , plus some <i>Corymbia maculata</i>	Potentially a variant of MU12, but further investigation required. Occurs on sheltered slopes in areas between MU's 15 and 15b
15m	Jilliby Spotted Gum-Northern Ironbark-Mahogany Forest	<i>Cmaculata Eumbra Esiderophloia Pilicifolia Dulicifolia</i>	This needs further clarification. Its basically macu umbr and side in an almost equivalent community to the macu umbr ferg further north, currently included in MU15 (Jilliby defined).
15n	Jilliby Spotted Gum-Ferguson's Ironbark-Mahogany Forest	<i>Cmaculata Eumbra Efergusonii Paciculiferum Pilicifolia Dulicifolia</i>	As above, needs clarification. This and MU15m and likely to be the same community but with variation in ironbark component. Separated for now but probably will reamlgamate after full floristic analysis.
21a	Hunter Range Dry Escarpment Apple Forest	<i>Angophora costata</i> , <i>A. euryphylla</i> , <i>Eucalyptus agglomerata</i>	Occurs on exposed and rocky sandstone escarpment edges, where the characteristic species are best represented. Understorey species are sparsely distributed
21e	Hunter Range Dry Mahogany - Grey Gum Forest	<i>E. acmenoides</i> , <i>E. punctata</i> , <i>E. paniculata</i> , <i>E. microcorys</i> , <i>E. umbra</i> , <i>E. scias</i> , <i>Angophora floribunda</i>	Around the Lemon Tree Road/ Prickly Ridge Road intersection, a dry, rocky low forest occurs with many eucalypts present but no clear dominants. This community may represent a dry, rocky variant of MU6c, which occurs further to the south. Further investigation is also required to compare this type against MU21f
21f	Hunter Range Dry Mahogany - Apple Forest	<i>Eucalyptus umbra</i> , <i>Angophora floribunda</i> , <i>E. paniculata</i> , <i>E. placita</i> , +/- <i>Syncarpia glomulifera</i> , <i>Allocasuarina torulosa</i> , <i>E. fergusonii</i> , <i>E. punctata</i> , <i>Corymbia gummifera</i> , <i>E. pilularis</i> , <i>E. agglomerata</i> , <i>E. microcorys</i>	A variable community that generally supports <i>Eucalyptus umbra</i> as the dominant species, and with any of the above species being present. Generally best developed on exposed rocky spur ends. At The Null in Jilliby SCA, <i>E. umbra</i> , <i>A. floribunda</i> and <i>E. placita</i> dominate, while north of the Lemon Tree Road/ Prickly Ridge Road intersection, small areas of <i>Corymbia gummifera</i> are present. At Beecamp Point, dense stands of <i>Eucalyptus umbra</i> occur over species such as <i>Acacia terminalis</i> , <i>Caustis flexuosa</i> and <i>Patersonia glabrata</i>
21g	Hunter Range Dry Stringybark – Blackbutt Forest	<i>Eucalyptus agglomerata</i> , <i>E. pilularis</i> , <i>E. punctata</i> , <i>E. paniculata</i> , <i>Allocasuarina torulosa</i> , <i>A. floribunda</i> , <i>Syncarpia glomulifera</i> , + <i>Corymbia gummifera</i> in some places	Similar to MU's 21b and 21f, however MU21b does not support <i>E. pilularis</i> but does support <i>Corymbia maculata</i> . While <i>E. agglomerata</i> is occasionally present in MU21f, it is clearly not a dominant feature as it is in MU21g, but is instead dominated by <i>E. umbra</i> . Red Bloodwood (<i>Corymbia gummifera</i>) is scattered in some locations
21h	Hunter Range Dry Mahogany – Bloodwood Forest	<i>Eucalyptus umbra</i> , <i>Corymbia gummifera</i> , <i>Angophora costata</i> , <i>Allocasuarina torulosa</i> , <i>Syncarpia glomulifera</i>	Similar to MU 21g but the dominance of <i>E. agglomerata</i> is replaced by <i>E. umbra</i> , and <i>Corymbia gummifera</i> and <i>Angophora costata</i> are also present
22e	Coastal Narrabeen Dry Bloodwood – Apple – Mahogany Forest	<i>Angophora costata</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus umbra</i> , <i>E. pilularis</i> , <i>E. scias</i> , <i>Banksia serrata</i>	Limited in extent to ridgetops. May end up being the same as 22, but with a differing canopy mix
25	Hawkesbury Peppermint Apple Forest	<i>Epiperita Acostata Atorulosa Sglomulifera Cgummifera Escias Eumbra Plinearis Aulicifolia Pilicifolium Lpolygalifolium Lsilalifolia</i>	Occurs in sheltered gullies on Hawkesbury Sandstone, but also on southerly running ridges and spurs

26	Exposed Hawkesbury Woodland	<i>Ehaemastoma Cgummifera Acostata Bserrata Plinearifolia Ltrinervium Gbuxifolia Lformosa Bledifolia Aminor Aavenaceus Cdiandra</i>	Occurs on crests and ridges of Hawkesbury Sandstone geology. Highly diverse understorey vegetation and probably harbours a few definable variants.
26d	Somersby Plateau Forest	<i>Esieberi Eumbra Ecapitellata Cgummifera Epiperita Sglomulifera Bserrata Acostata Akulnurensis Dexcelsa Bpinnata Dfloribunda Aechinula Aoxycedrus Ggrandifolium Gbuxifolia Hbracteata</i>	Typically present on the Kulnura Plateau on orangey-red soils with ironstone. Needs some more investigation as there may be at least two forms present.
26g	Hawkesbury Bloodwood - Snappy Gum Forest	<i>Cgummifera Eracemosa +/- Esieberi Bspinulosa, lanemonifolius, Ltrinervium, Xmedia</i>	Occurs at the western extremities of Gosford and Wyong LGAs, extending into Hawkesbury LGA. Requires further sampling and analysis. Included in Gosford MU26 as variant (c)
26i	Hawkesbury Apple – Turpentine – Bloodwood Shale Forest	<i>Angophora costata, Corymbia gummifera, Eucalyptus umbra, Syncarpia glomulifera, Allocasuarina torulosa, E. scias</i>	Occurs on shale bands on Hawkesbury Sandstone, where it merges into Narrabeen Sandstone. A very distinctive forest type with a grassy/herbaceous understorey, some shrubs but with an obvious abundance of <i>Doryanthes excelsa</i>
29	Hawkesbury Banksia Scrub – Woodland	<i>Bericifolia Ehaemastoma Bserrata Eumbra Acostata Cgummifera Ahispida Boblongifolia Epulchella Hlaevipes Lformosa Ltrinervium Plinearifolia Alinifolia Asuaveolens Hteretifolia Lscariosa Cdiandra Pdeusta Aminor</i>	An often very dense vegetation type where <i>Banksia ericifolia</i> can be overly-dominant, or a scattered member of the shrub layer, dependant on fire history. Emergent eucalypts normally widely spaced
30a	Buttonderry Footslopes Forest	<i>Acostata Efibrosa Eresinifera Eumbra Sglomulifera Eglaboidea Cmaculata Mnodosia Dsquarrosa Bspinulosa Taustralis Gheterophylla</i>	Originally defined for the Wyong area. Appears to extend into the southern Lake Macquarie area. Further clarification of this type and other variants of MU30 required to determine position in classification.
31	Narrabeen Doyalson Coastal Woodland	<i>Ehaemastoma Cgummifera Ecapitellata Ainopina Lformosa Ltrinervium Boblongifolia Alittoralis Hlaevipes lanemonifolius Awarburgii Estricta Pdeusta Xlatifolia Lobliqua</i>	Widespread unit around southern Lake Macquarie and northern Wyong. Variants on coastal hills (as opposed to coastal plains) may require splitting off with further sampling, but very few observable differences evident.
37	Swamp Mahogany - Paperbark Forest	<i>Erobusta Eresinifera Mlinariifolia Msieberi Mstypheleoides Pvillosa Alongifolia Onutans Gclarkei +/- Etereticornis Afloribunda</i>	A broad community, which may include a few sub-types yet to be defined. Tomago area on sand needs more sampling to pull out some of the sand-based variants (see 37)). Equates to SSFCF EEC.
37a	Alluvial Paperbark Sedge Forest	<i>Erobusta Mbiconvexa Mstypheleoides Mlinariifolia Csalignus Laustralis Gclarkei</i>	Predominantly found in south-eastern Wyong and northern Gosford LGA's. Dense stands of Mbiconvexa are normally typical, over swards of Gclarkei.
37b	Alluvial Floodplain Woollybutt Forest	<i>Elongifolia Erobusta Afloribunda Alongifolia Gclarkei</i>	Elongifolia is characteristic but is mostly disturbed for grazing. Need to see how western stands relate to Woollybutt around Porters Creek.
37d	Alluvial Floodplain Cabbage Gum Forest	<i>Eamplifolia Erobusta Esaligna Cglauca Mbiconvexa Gclarkei</i>	Widely cleared in the past and few intact remnants remain. Cabbage Gum is diagnostic, but occurs with other canopy species on the fringes (which also happens to be where most remnants are). Equates to RFFCF EEC.

42	Red Mahogany-Apple Paperbark Forest	<i>Eresinifera Erobusta Acostata Mlinarifolia Gclarkei</i> <i>Lscariosa Sbrevifolius Lquadrangulatum Ccymbaria</i> <i>Eminus</i>	Most commonly found with a dominant sedge understorey, but some areas support a more shrubby component. Formerly called Narrabeen Alluvial Sedge Woodland.
54	Hawkesbury Hanging Swamps	<i>Various components including Banksia oblongifolia,</i> <i>Hakea teretifolia, B. ericifolia, and numerous sedge</i> <i>species</i>	Occurs in areas of impeded drainage on Hawkesbury Sandstone geology, typically at the top of a break in slope. Dependant on fire history, some swamps form a successional stage of Unit 29
120	Floodplain Wet Heath	<i>Sbrevifolius Xfulva Mthymifolia Ljuniperinum Gclarkei</i> <i>Msieberi Mlinarifolia</i>	Need to check if the more western stands are the same as that around Porters Wetland.