

***SOUTH KEMPSEY
INDUSTRIAL AREA
REZONING
VEGETATION MAPPING***

Prepared for
Kempsey Shire Council

By



**Kendall & Kendall
Ecological Services
PO Box 196w
West Kempsey NSW 2440**

South Kempsey Industrial Area Rezoning Vegetation Mapping

Table of contents

South Kempsey Rezoning Vegetation Mapping.....	1
Introduction.....	5
Location	5
Objectives	6
Methodology	6
Literature review of previous studies.....	6
Regional studies	6
Local studies	6
Vegetation Survey.....	7
Air photo interpretation (API)	7
Floristic mapping	7
Flora Field survey	7
Structural mapping.....	8
Structural mapping.....	9
Canopy Density.....	9
Canopy forest age class.....	9
Mid strata type	10
Disturbance intensity	10
Ground truthing field survey.....	11
Results.....	11
Significant flora known to occur within 10km of the study area.....	11
DEC wildlife atlas search.....	11
Environment Australia website search.....	12
DEC Threatened species website search.....	12
Possibly occurring TSC Act & EPBC Act flora species	13
Vegetation communities	15
Ecosystem 32: Dry Foothills Blackbutt-Turpentine	15
Ecosystem 34: Dry Grassy Blackbutt-Tallowwood.....	15
Ecosystem 36: Dry Grassy Tallowwood-Grey Gum	16
Ecosystem 73: Lowlands Red Gum.....	16
Ecosystem 112: Paperbark.....	17
FE323: Hunter-Macleay dry sclerophyll forest	18
Highly modified or disturbed map units	18
FE 173: Cleared, partially cleared	18
FE 171: Water bodies.....	18
Regional Conservation Status of Vegetation communities	20
Endangered Ecological communities.....	20
DEC wildlife atlas endangered ecological communities (EEC)	20
Ecological community descriptors	21
Environmental determinates	21
Critical habitat.....	23
Structural integrity and disturbance	24

Connectivity	27
Recommendations	30
Bibliography	31

List of figures

Figure 1: Location map	5
Figure 2: Vegetation communities	19
Figure 3: Significant vegetation communities based on floristic composition	23
Figure 4: Structural mapping indicating forest senescence	25
Figure 5: Structural mapping indicating disturbance	26
Figure 6: Key habitat & corridor	27
Figure 7: Areas with high and moderate conservation values	29

List of tables

Table 1 Upper strata canopy cover classes	9
Table 2: Upper strata age class (CRAFTI 1999)	10
Table 3: Mid strata type	10
Table 4: Disturbance Intensity	11
Table 5: Threatened plants & ecological communities known or predicted to occur within the Hastings Macleay geographic region	12
Table 6: Possibly occurring significant flora species within the study area	14
Table 7: FE32 species	15
Table 8: FE34 species	16
Table 9: FE34 species	16
Table 10: FE73 species	17
Table 11: FE323 species	18
Table 12: Regional conservation status	20
Table 13: Flora species list	32
Table 14: Flora plot / survey locations	34

This project is a rapid survey based primarily on remote sensing and is intended to provide an overview of the vegetation communities throughout the study area. It has been undertaken as part of a wider regional vegetation mapping project. This study does not comply with the DEC regional survey guidelines as outlined in the *DEC, 2004, Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft)*, New South Wales Department of Environment and Conservation, Hurstville, NSW or the *Draft Regional Biodiversity Survey & assessment Guidelines Draft 2001*

In natural environments the composition and distribution of the various vegetation communities are complex and variable with often in-discrete boundaries, in mapping them a large degree of professional judgment is required in both locating polygon boundaries and assigning appropriate floristic and structural classes. Even though considerable effort has been applied to this project to ensure the accuracy and objectivity of the mapping, errors will occur, especially when applying the mapping to small areas or parts of polygons.

The author of this mapping and report is

P.A. Kendall

Principal Botanist, Flora Ecologist and Aerial Photograph Interpreter,
Kendall & Kendall Ecological Services Pty Ltd,
whose qualifications is B.A. (Biological Sciences) Macquarie University

Penny Kendall

Introduction

GECO Environmental was commissioned by Kempsey Shire Council to prepare a vegetation map for the eastern part of the Local Government Area (LGA). Penny Kendall from Kendall & Kendall Ecological Services was sub contracted by GECO to undertake the air photo interpretation and flora assessment for the project. The South Kempsey study area assessment was undertaken as part of the overall vegetation mapping project, with additional ground truthing field survey undertaken within parts of the study area.

Location

The study area is located immediately south of the existing Kempsey industrial area and Kempsey Golf Course. It extends westward to East West road and eastward for 750m east of the Pacific Highway.



Figure 1: Location map

Objectives

The objective of this survey is to:

- Map all vegetation communities to a forest ecosystem level of classification;
- Describe and quantify vegetation types and assess their conservation significance at a local, regional and state level;
- Prepare a predictive list of possibly occurring threatened flora.

Methodology

Literature review of previous studies

Regional studies

Resource & Conservation Division, (RACD) Dept of Urban Affairs & Planning (1999). Forest Ecosystem Classification & Mapping for Lower North East CRA Regions.

This study analysed plot data to derive a forest ecosystem classification system and it provides the most current benchmark for the distribution and conservation of forest ecosystems in northeastern NSW. The system was developed from the analysis of 4,730 vegetation plots and various vegetation mapping projects. The RACD modelling and mapping provides an indication of the regional extent and conservation status of the forest ecosystems. A recent publication using the data from this study is the *Field Key to Forest Ecosystems North East New South Wales* DEC 2004 provides a guide to the forest ecosystem classification system

NSW DEC (NPWS) Wildlife Atlas

The NSW Department of the Environment and Conservation (DEC) wildlife atlas is a database of records for flora and fauna species. Records of flora known to occur within 10 kilometres of the study area were obtained under license from the DEC wildlife atlas database and used to enhance the flora list and provide information on the location and habitats for threatened flora species.

Environment Australia Website

The interactive map on the commonwealth's Environment Australia website provides information on possibly occurring threatened ecological communities and threatened species as listed under the provisions of the commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Department of Environment and Conservation Threatened species website

The website provides information on the threatened flora and plant communities predicted to occur on within the study area.

Local studies

A Flora & Fauna assessment for Local environmental plan for South Kempsey

This study was undertaken in 2003 by Kendall & Kendall for GHD. This study covered portion 10, Parish of Kalateenee which includes most of the current study area to the east of the highway. The findings of this previous study were utilised in the current study.

Vegetation Survey

The vegetation mapping was undertaken as part of a larger study covering the eastern portion of the Kempsey LGA. The mapping methodology is to be detailed below

Air photo interpretation (API)

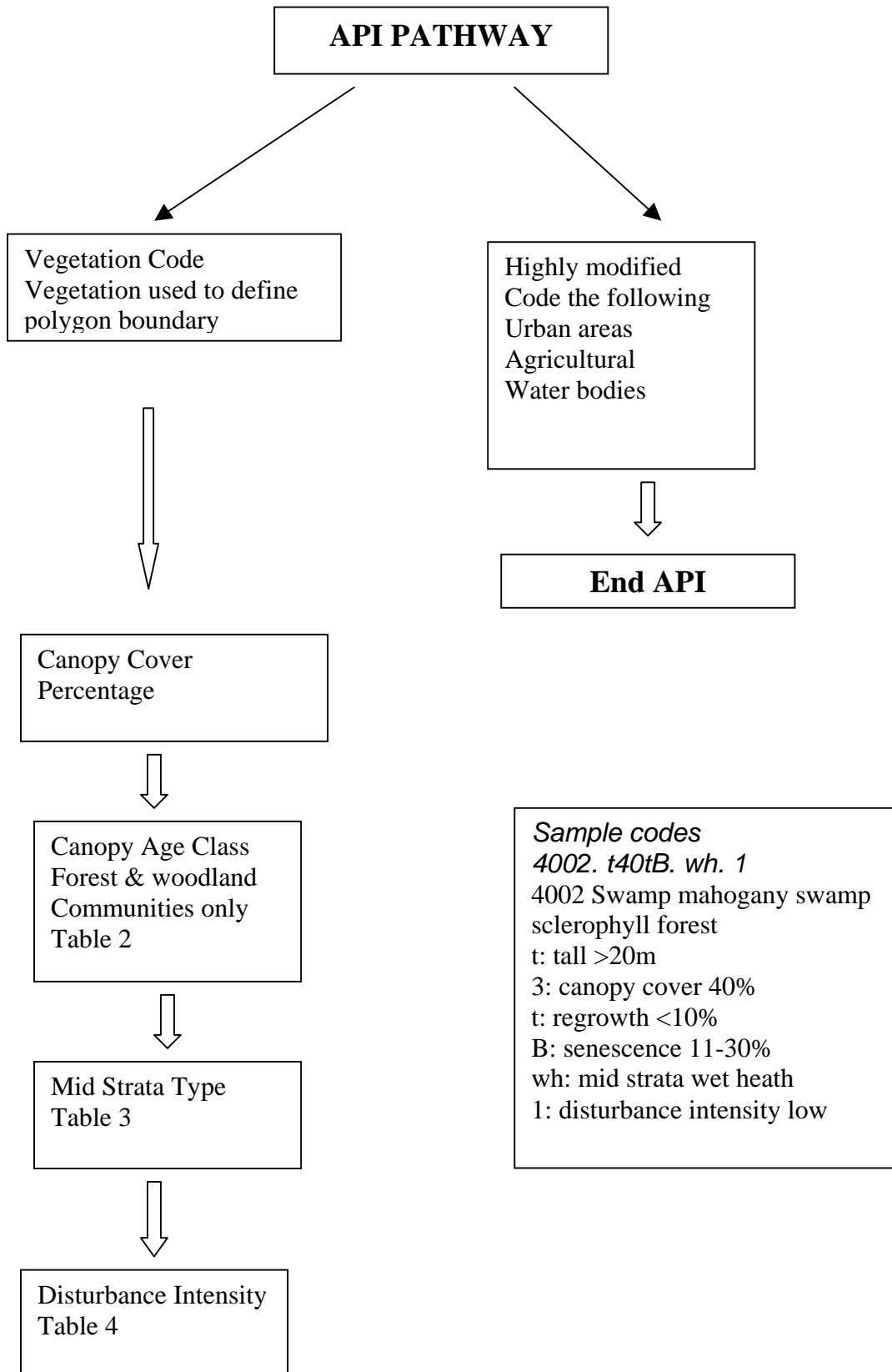
Stereoscopic interpretation of aerial photographs was undertaken across the study area. The photography used was 1:25 000 colour flown in August 2003. Clear overlays attached to the photos were marked using a fine (0.18mm) mapping pen. The photos were ortho rectified and digitised by GECO. The API Pathway is outlined below.

Floristic mapping

The floristic mapping was the primary attribute used to define the polygon location and extent. This project used the forest ecosystem vegetation classification developed by RACD 1999 and refined by DEC 2004.

Flora Field survey

A brief flora field survey was undertaken in the areas not included in the 2003 survey. This entailed recording the dominant flora species for each mapped community whilst undertaking short random searches for targeted significant flora species. This study does not comply with the DEC regional survey guidelines as outlined in the *DEC, 2004, Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft), New South Wales Department of Environment and Conservation, Hurstville, NSW* or the *Draft Regional Biodiversity Survey & assessment Guidelines Draft 2001*



Structural mapping

Although the floristic composition of the polygons was the primary determinate for polygon location and extent, each polygon was also assigned a structural code based on several structural attributes. Structural mapping is important in determining the habitat and conservation values of vegetation communities. The structural attributes recorded include upper strata density and age, mid strata type and relative disturbance. A description of the methodology used to map the structural attributes is provided below.

Canopy Density

The upper strata canopy cover for each polygon was recorded, five classes were used to assign canopy cover, Canopy cover is a measure of the area covered by a vertical projection of the periphery of the crowns recorded as a percentage of the polygon area.

Table 1 Upper strata canopy cover classes

Class	Upper strata CCP
1	<10%
2	10-20%
3	20-50%
4	50-80%
5	>80%

Canopy forest age class

In 1999 an air photo interpretation project (CRAFTI) was undertaken as part of the comprehensive regional assessment. The CRAFTI project developed standardised upper strata age classes. These CRAFTI classes have been used in this study.

An undisturbed forest contains a mixture of regrowth mature and senescent trees with the proportions of each being related to the expected time span the trees will be at each age stage. Although this varies between species, trees generally are mature and senescent for most of their life span so an undisturbed forest would be expected to contain a low proportion of regrowth trees and a high proportion of mature and senescent trees.

The characteristics of trees in each of the three growth stages has been documented by Jacobs 1955, and these definitions were adopted for this project.

Although different disturbance regimes produce different forest structures it is considered that a relatively undisturbed forest would be dominated by mature and senescent trees with very few regrowth trees. In a moderately disturbed forest the proportion of regrowth trees would be higher but mature and senescent trees would still be present. In a highly disturbed forest the proportion of regrowth trees would be very high and mature and senescent trees would be uncommon or absent.

The canopy age class was recorded for each polygon. The proportion of regrowth and senescent trees were recorded for each polygon. The relative proportions of regrowth and senescent trees in the canopy are indicative of the past disturbance. An undisturbed forest contains a mixture of regrowth mature and senescent trees with the proportions of each being related to the expected time span the trees will be at each age stage. Although this varies between species trees generally are mature and

senescent for most of their life span so an undisturbed forest would be expected to contain a low proportion of regrowth trees and a high proportion of mature and senescent trees. Although different disturbance regimes produce different forest structures it is generally considered (Pers obs) that in a moderately disturbed forest the proportion of regrowth trees would be higher but mature and senescent trees would still be present. In a highly disturbed forest the proportion of regrowth trees would be very high and mature and senescent trees would be low or absent.

Table 2: Upper strata age class (CRAFTI 1999)

Upper strata age class	Upper strata proportion
t	Regrowth trees comprise <10% of the upper strata
s	Regrowth trees comprise 11 to 30% of the upper strata
e	Regrowth trees comprise >31% of the upper strata
A	Senescent trees comprise >31% of the upper strata
B	Senescent trees comprise 11 to 30% of the upper strata
C	Senescent trees comprise <10% of the upper strata

Mid strata type

A generalised mid strata type was recorded for each polygon. Mid strata type can be indicative of habitat type and quality. The mid strata classes used in this project are listed in Table 3.

Table 3: Mid strata type

Mid strata – lower strata type		
g	grassy	Grasses native or introduced but not cultivated
h	heath	Epacridaceae, protaceae etc
m	mesic	Rainforest species not continuous canopy
d	shrubby dry	Dry shrubs
r	rock	Rock
s	sedge	Sedges & rushes
a	absent	Lower strata absent
w	weed	Dominated by introduced species
p	pasture	Cultivated pasture
r	rainforest	Continuous canopy Rf species

Disturbance intensity

The disturbance attribute was assigned to indicate relative disturbance, it is assigned according to the amount of visible disturbance and is generally subjective. It was intended to provide only a general indication of disturbance levels within a polygon.

Table 4: Disturbance Intensity

Disturbance Intensity		
0	Negligible	Disturbance not visible or confined to very small isolated points, the polygon structure appears undisturbed.
1	Low	Some disturbance is visible but covers only small portion of the polygon
2	Moderate	Disturbance is widespread but natural vegetation retains some structural and floristic integrity
3	High	Disturbance severe natural vegetation significantly denuded both structurally and floristically
4	Very high	Disturbance severe natural vegetation absent

Ground truthing field survey

A preliminary over view was undertaken in January 2006. This involved an orientation drive around the study area to determine the broad vegetation and land use patterns and access constraints. Following API and polygon coding ground truthing was conducted along all roads providing access to the study area. Walking traverses were conducted on Lot 153 DP752417, Lot 822 DP773764 and Lot 1523 DP545114 to ground truth mapping and search for Threatened plants.

No systematic flora survey was undertaken and this study does not comply with the recommended survey effort as outlined in the for Threatened Species Survey & Assessment Guidelines for Developments and Activities Working Draft NSW NPWS and SMEC Australia (2003) guidelines.

Results

Significant flora known to occur within 10km of the study area

Significant flora are species listed as:

- On the schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act);
- Under the provisions of the commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act); &
- As rare or threatened ROTAP (rare or threatened Australian plants) species.

DEC wildlife atlas search

The Department of environment and conservation (DEC) wildlife atlas records were provided by Council. These records indicate that no threatened flora species occur on the study area or within 10km of the study area. *Allocasuarina defungens*, *Thesium australe* and *Parsonsia dorrigoensis* are all recorded on the atlas between 10 and 20km from the study area. The study area is not considered to contain suitable habitat for *Allocasuarina defungens* which has been recorded from wet heath communities on sand substrates. *Thesium australe* and *Parsonsia dorrigoensis* are considered as possible occurrences.

Environment Australia website search

A EPBC protected matters search centred around the following lat longs -31.118, 152.828 with a 10km buffer was attempted on several occasions however the website was off line, subsequently this search was not undertaken.

DEC Threatened species website search

The DEC Threatened Species website

<http://www.threatenedspecies.environment.nsw.gov.au> was searched using the combined geographic and habitat search parameters. The results are indicated in Table 5. This table lists potentially occurring threatened flora species and endangered ecological communities within the Hastings & Macleay geographic region.

Table 5: Threatened plants & ecological communities known or predicted to occur within the Hastings Macleay geographic region

Scientific Name	Common Name	Status
Threatened Ecological Communities		
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Endangered Ecological Community
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Freshwater wetlands on coastal floodplains	Endangered Ecological Community
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Endangered Ecological Community
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	Lowland Rainforest on Floodplain	Endangered Ecological Community
Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion	Sub-tropical Coastal Floodplain Forest	Endangered Ecological Community
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp oak floodplain forest	Endangered Ecological Community
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp sclerophyll forest on coastal floodplains	Endangered Ecological Community
Trees		
Melaleuca biconvexa	Biconvex Paperbark	Vulnerable
Amorphospermum whitei	Rusty Plum	Vulnerable
Acronychia littoralis	Scented Acronychia	Endangered
Climbers		
Tylophora woollsii	Cryptic Forest Twiner	Endangered
Parsonsia dorrigensis	Milky Silkpod	Vulnerable
Marsdenia longiloba	Slender Marsdenia	Endangered

Scientific Name	Common Name	Status
Tinospora smilacina	Tinospora Vine	Endangered
Cynanchum elegans	White-flowered Wax Plant	Endangered
Algae, mosses & lichens	none	
Aquatic plants	none	
Ferns & cycads		
Arthropteris palisotii	Lesser Creeping Fern	Endangered
Herbs & forbs		
Thesium australe	Austral Toadflax	Vulnerable
Maundia triglochinos	Maundia triglochinos	Vulnerable
Chamaesyce psammogeton	Sand Spurge	Endangered
Galium australe	Tangled Bedstraw	Endangered
Asperula asthenes	Trailing Woodruff	Vulnerable
Malleys	none	
Orchids		
Peristeranthus hillii	Brown Fairy-chain Orchid	Vulnerable
Phaius tankervilleae	Lady Tankerville's Swamp Orchid	Endangered
Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable
Oberonia titania	Red-flowered King of the Fairies	Vulnerable
Phaius australis	Southern Swamp Orchid	Endangered
Dendrobium melaleucaphilum	Spider orchid	Endangered
Diuris disposita	Willawarrin Doubletail	Endangered
Shrubs		
Hakea archaeoides	Big Nellie Hakea	Vulnerable
Pultenaea maritima	Coast Headland Pea	Vulnerable
Allocasuarina defungens	Dwarf Heath Casuarina	Endangered
Melaleuca groveana	Grove's Paperbark	Vulnerable
Grevillea guthrieana	Guthrie's Grevillea	Endangered
Allocasuarina simulans	Nabiac Casuarina	Vulnerable
Acacia courtii	North Brother Wattle	Vulnerable
Senna acclinis	Rainforest Cassia	Endangered
Pomaderris queenslandica	Scant Pomaderris	Endangered
Sophora tomentosa subsp. australis	Silverbush	Endangered
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	Vulnerable
Hibbertia hexandra	Tree Guinea Flower	Endangered
Zieria lasiocaulis	Willi Willi Zieria	Endangered

Source: <http://www.threatenedspecies.environment.nsw.gov.au>

Possibly occurring TSC Act & EPBC Act flora species

The following species were considered as possibly occurring within the study area. This list has been compiled from Atlas records, DEC Threatened species website and

Kendall's knowledge of the vegetation communities on the site and the species habitat requirements. This list is considered to contain the species most likely to occur at the site, however any of the species predicted by the Atlas, EPBC or DEC websites search should be targeted during surveys. No EPBC or TSC Act species were found on the study area, during the brief survey undertaken.

Table 6: Possibly occurring significant flora species within the study area

Name	Common Name	Status	Rotap & Significant	Habitats
<i>Cynanchum elegans</i>	White-flowered Wax Plant	TSC E1; EPBC E	3ECi	Rainforest & wet sclerophyll forest
<i>Parsonsia dorrigoensis</i>		TSC-V; EPBC-E	2VCi	Rainforest & wet sclerophyll forest
<i>Thesium australe</i>	Austral Toadflax	TSC V; EPBC V	2Vci+	Dry sclerophyll forest

Categories of Threatened Species

Endangered

A native species is eligible to be included in the *endangered* category at a particular time if, at that time:

- (a) it is not critically endangered; and
- (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria. Vulnerable; and

Vulnerable

A native species is eligible to be included in the *vulnerable* category at a particular time if, at that time:

- (a) it is not critically endangered or endangered; and
- (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Threatened Species Conservation Act, 1995 (TSC-Act) Categories of Threatened Species

Endangered (E)

Schedule 1 Part 1 Species that are likely to become extinct in NSW unless action is taken to stop their decline

Vulnerable (V)

Schedule 2 Species that are likely to become endangered in NSW unless action is taken to stop their decline

Rare or Threatened Australian Plants (ROTAP) Categories of Species

Distribution

2 The geographic range of the taxon in Australia is less than 100 km; and,

3 The geographic range of the taxon in Australia is greater than 100 k.;

Status

Endangered (E)

Taxon in serious risk of disappearing from the wild within 10- 20 years if present land use and other threats continue to operate. This category includes taxa with populations possibly too small (usually less than 100 individuals) to ensure survival even if present in proclaimed reserves

Vulnerable(V)

Taxon not presently Endangered, but at risk over a longer period (20-50 years) of disappearing from the wild through continued depletion, or which occurs on land whose future use is likely to change and threaten its survival;

Reservation Status

(C) Reserved

Taxon has at least one population (a, within a National Park, other proclaimed conservation reserve or in an area otherwise dedicated for the protection of flora. The taxon may or may not be considered adequately conserved within the reserve(s), as reflected by the conservation status assigned to it. Where applicable, the 'C' symbol immediately follows the conservation status symbol in the written code;

(i) less than 1000 plants are known to occur within a conservation reserve(s);

(+) overseas occurrence -included if the taxon has a natural occurrence overseas.

Vegetation communities

Forest ecosystems were used as the mapping units these are described below, these descriptions are from the *Field key to Forest Ecosystems North East New South Wales* Dept of Environment & Conservation (DEC) 2004. Six forest ecosystems were mapped within the study area, their extent and location is indicated on Figure 2 .

Ecosystem 32: Dry Foothills Blackbutt-Turpentine

Tall to very tall forest dominated by Blackbutt (*Eucalyptus pilularis*) and Turpentine (*Syncarpia glomulifera*) with Tallowwood (*E. microcorys*) sometimes an associate. There is usually a midstorey of Forest Oak (*Allocasuarina torulosa*) and a sparse, patchy shrub layer which usually includes Elderberry Panax (*Polyscias sambucifolia*) and Tree Heath (*Trochocarpa laurina*). The ground layer is dominated by Blue Flax Lily (*Dianella caerulea*), Climbing Guinea Flower (*Hibbertia scandens*), Bracken (*Pteridium esculentum*), Blady Grass (*Imperata cylindrica*) and Spiny-headed Mat-rush (*Lomandra longifolia*).

This ecosystem is patchily distributed in coastal foothills and escarpment ranges from Dingo Tops north the Corindi River. It is reserved in Ulidarra, Willi Willi and Kumbatine National Parks.

Table 7: FE32 species

Upper strata species	Mid strata species	Lower strata species
<i>Syncarpia glomulifera</i> , <i>Eucalyptus pilularis</i> <i>Eucalyptus microcorys</i>	<i>Allocasuarina torulosa</i> <i>Polyscias sambucifolia</i> <i>Smilax australis</i> <i>Cissus hypoglauca</i> <i>Trochocarpa laurina</i>	<i>Dianella caerulea</i> <i>Hibbertia scandens</i> <i>Lomandra longifolia</i> <i>Pteridium esculentum</i> <i>Imperata cylindrica</i> <i>Pandorea pandorana</i>

Ecosystem 34: Dry Grassy Blackbutt-Tallowwood

Tall to very tall forest dominated by Blackbutt (*Eucalyptus pilularis*) with Tallowwood (*E. microcorys*) occurring as a sub-dominant. There is a midstorey of Forest Oak (*Allocasuarina torulosa*) and there is often an open shrub layer of species such as Coffee Bush (*Breynia oblongifolia*), Hopbush (*Dodonea triquetra*) and White Dogwood (*Ozothamnus diosmifolius*). The ground layer is dominated by Blady Grass (*Imperata cylindrica*), Bracken (*Pteridium esculentum*), Kangaroo Grass (*Themeda australis*) and Spiny-headed Mat-rush (*Lomandra longifolia*).

This ecosystem is concentrated on coastal lowlands and foothills of the Nambucca and Macleay Valleys, although it is also scattered more patchily from the Myall Lakes north to the

Wooli River. It is reserved in Wallingat National Park, and Khappingat and Ngambaa Nature Reserves.

Table 8: FE34 species

Upper strata species	Mid strata species	Lower strata species
<i>Eucalyptus pilularis</i> <i>Eucalyptus microcorys</i>	<i>Allocasuarina torulosa</i> , <i>Breynia oblongifolia</i> <i>Ozothamnus diosmifolius</i>	<i>Imperata cylindrica</i> <i>Lomandra longifolia</i> <i>Pteridium esculentum</i> <i>Vernonia cinerea</i> <i>Glycine clandestina</i> <i>Lepidosperma laterale</i> <i>Themeda australis</i> <i>Hardenbergia violacea</i>

Ecosystem 36: Dry Grassy Tallowwood-Grey Gum

Tall to very tall forest which generally includes a mixed canopy of species such as Tallowwood (*Eucalyptus microcorys*), Small-fruited Grey Gum (*E. propinqua*), Grey Ironbark (*E. siderophloia*), Broad-leaved White Mahogany (*E. carnea*) and Turpentine (*Syncarpia glomulifera*). This ecosystem has a midstorey of Forest Oak (*Allocasuarina torulosa*) and a scattered shrub layer of species such as Coffee Bush (*Breynia oblongifolia*) and Lantana (*Lantana camara*). The ground layer is a mixture of forbs and grasses with species such as Blue Flax Lily (*Dianella caerulea*), Spiny-headed Mat-rush (*Lomandra longifolia*), Climbing Guinea Flower (*Hibbertia scandens*), Kangaroo Grass (*Themeda australis*) and Blady Grass (*Imperata cylindrica*) common.

This ecosystem is distributed throughout the coastal lowlands and foothills of the mid-north coast from the Manning Valley north to the Corindi River. Extensive stands are protected in Kumbatine and Bago Bluff National Parks and Ngambaa Nature Reserve.

Table 9: FE34 species

Upper strata species	Mid strata species	Lower strata species
<i>Eucalyptus microcorys</i> <i>Eucalyptus propinqua</i> <i>Eucalyptus siderophloia</i> <i>Syncarpia glomulifera</i> <i>Eucalyptus carnea</i> <i>Corymbia intermedia</i>	<i>Allocasuarina torulosa</i> <i>Breynia oblongifolia</i> <i>Lantana camara</i> <i>Smilax australis</i> <i>Solanum densevestitum</i>	<i>Dianella caerulea</i> <i>Lomandra longifolia</i> <i>Imperata cylindrica</i> <i>Glycine clandestina</i> <i>Hibbertia scandens</i> <i>Vernonia cinerea</i> <i>Desmodium rhytidophyllum</i> <i>Pseuderantherum variabile</i> <i>Themeda australis</i> <i>Desmodium varians</i>

Ecosystem 73: Lowlands Red Gum

Tall to very tall forest dominated by either Forest Red Gum (*Eucalyptus tereticornis*) or Swamp Box (*Lophostemon suaveolens*) with Pink Bloodwood (*Corymbia intermedia*) and Grey Ironbark (*E. siderophloia*) sometimes present. There is a relatively open understorey with Red Ash (*Alphitonia excelsa*) common, and a ground layer dominated by species such as

Blady Grass (*Imperata cylindrica*), Spiny-headed Matt-rush (*Lomandra longifolia*) and Kangaroo Grass (*Themeda australis*).

This ecosystem is distributed on high and low quartz sediments in the Clarence lowlands. It is reserved in Bungawalbin National Park.

Table 10: FE73 species

Upper strata species	Mid strata species	Lower strata species
<i>Lophostemon suaveolens</i> <i>Eucalyptus tereticornis</i> <i>Corymbia intermedia</i> <i>Eucalyptus siderophloia</i>	<i>Alphitonia excelsa</i>	<i>Imperata cylindrica</i> <i>Pratia purpurascens</i> <i>Lomandra longifolia</i> <i>Vernonia cinerea</i> <i>Cymbopogon refractus</i> <i>Themeda australis</i> <i>Entolasia stricta</i>

Although the primary classification of this community occurring within the study is FE 73 it also contains many elements of Forest ecosystem 112 Paperbark.

Ecosystem 112: Paperbark

Low to very tall woodland and forest in which Broad-leaved Paperbark (*Melaleuca quinquenervia*) commonly dominates the overstorey, or occasionally another paperbark (e.g. *M. alternifolia*, *M. sieberi*, *M. linariifolia*, *M. styphelioides*). Associates include Swamp Mahogany (*Eucalyptus robusta*), Swamp Oak (*Casuarina glauca*) and Swamp Box (*Lophostemon suaveolens*). Understorey and ground layer composition varies with substrate, depth and extent of waterlogging, and water quality. Saw-sedges (*Gahnia* spp.), twig-rushes (*Baumea* spp.), *Carex* spp., Bungwahl Fern (*Blechnum indicum*), Feather Plant (*Baloskion tetraphyllum*), tea-tree (e.g. *Leptospermum juniperinum*), bottlebrush (e.g. *Callistemon pachyphyllus*) and certain grasses (e.g. *Hemarthria uncinata*, *Ischaemum australe*) may dominate, or alternatively rainforest trees, shrubs and vines such as Cabbage Tree Palm (*Livistona australis*), Cheese Tree (*Glochidion ferdinandi*) and Common Silkpod (*Parsonsia straminea*) can be common.

This ecosystem is widespread on the coastal lowlands in both CRA Regions (e.g. Bundjalung, Crowdy Bay and Myall Lakes National Parks).

Upper	Mid	Lower
<i>Melaleuca quinquenervia</i> , <i>Melaleuca alternifolia</i> , <i>Melaleuca sieberi</i> , <i>Eucalyptus robusta</i> , <i>Casuarina glauca</i> , <i>Lophostemon suaveolens</i>	<i>Livistona australis</i> , <i>Glochidion ferdinandi</i> , <i>Parsonsia straminea</i> , <i>Leptospermum juniperinum</i> , <i>Callistemon pachyphyllus</i> ,	<i>Gahnia</i> spp., <i>Baumea</i> spp., <i>Carex</i> spp., <i>Blechnum indicum</i> , <i>Baloskion tetraphyllum</i> , <i>Hemarthria uncinata</i> , <i>Ischaemum australe</i> ,

FE323: Hunter-Macleay dry sclerophyll forest

This community is not recognised in the Field Key to Forest Ecosystems (DEC2004) however it is equivalent to the Hunter Macleay dry sclerophyll forest class as described in Keith 2004. *Ocean Shores to Desert Dunes: The Native Vegetation of NSW and ACT*. The following description is derived from the DEC threatened species website and is based on Keith 2004.

FE 323 consists of dry open eucalypt forest to 30 m tall, with a mixed sclerophyll and mesophyll shrub stratum and semi-continuous grassy groundcover.

This ecosystem occurs in the eastern parts of the Hunter, Manning and Macleay river valleys, on the foothills and undulating terrain in rain shadow areas below 400 m elevation. The soils are well-drained loams derived from shales.

Table 11: FE323 species

Upper strata species	Mid strata species	Lower strata species
<i>Corymbia maculata</i> <i>Eucalyptus crebra</i> <i>Eucalyptus propinqua</i> <i>Eucalyptus siderophloia</i> <i>Syncarpia glomulifera</i>	<i>Allocasuarina torulosa</i> <i>Daviesia ulicifolia</i> <i>Breynia oblongifolia</i> <i>Notelaea longifolia</i> <i>Persoonia linearis</i> <i>Pultenaea villosa</i> <i>Rapanea variabilis</i>	<i>Desmodium varians</i> <i>Dichondra repens</i> <i>Pratia purpurascens</i> <i>Vernonia cinerea</i> , <i>Cheilanthes sieberi</i> <i>Cymbopogon refractus</i> <i>Entolasia stricta</i> <i>Microlaena stipoides</i> var. <i>stipoides</i> <i>Themeda australis</i>

Highly modified or disturbed map units

FE 173: Cleared, partially cleared

Lands originally forested, subsequently cleared and generally are devoid of native vegetation.

FE 171: Water bodies

This forest ecosystem includes natural and artificial water bodies. The water body identified in this study is an artificial farm dam.

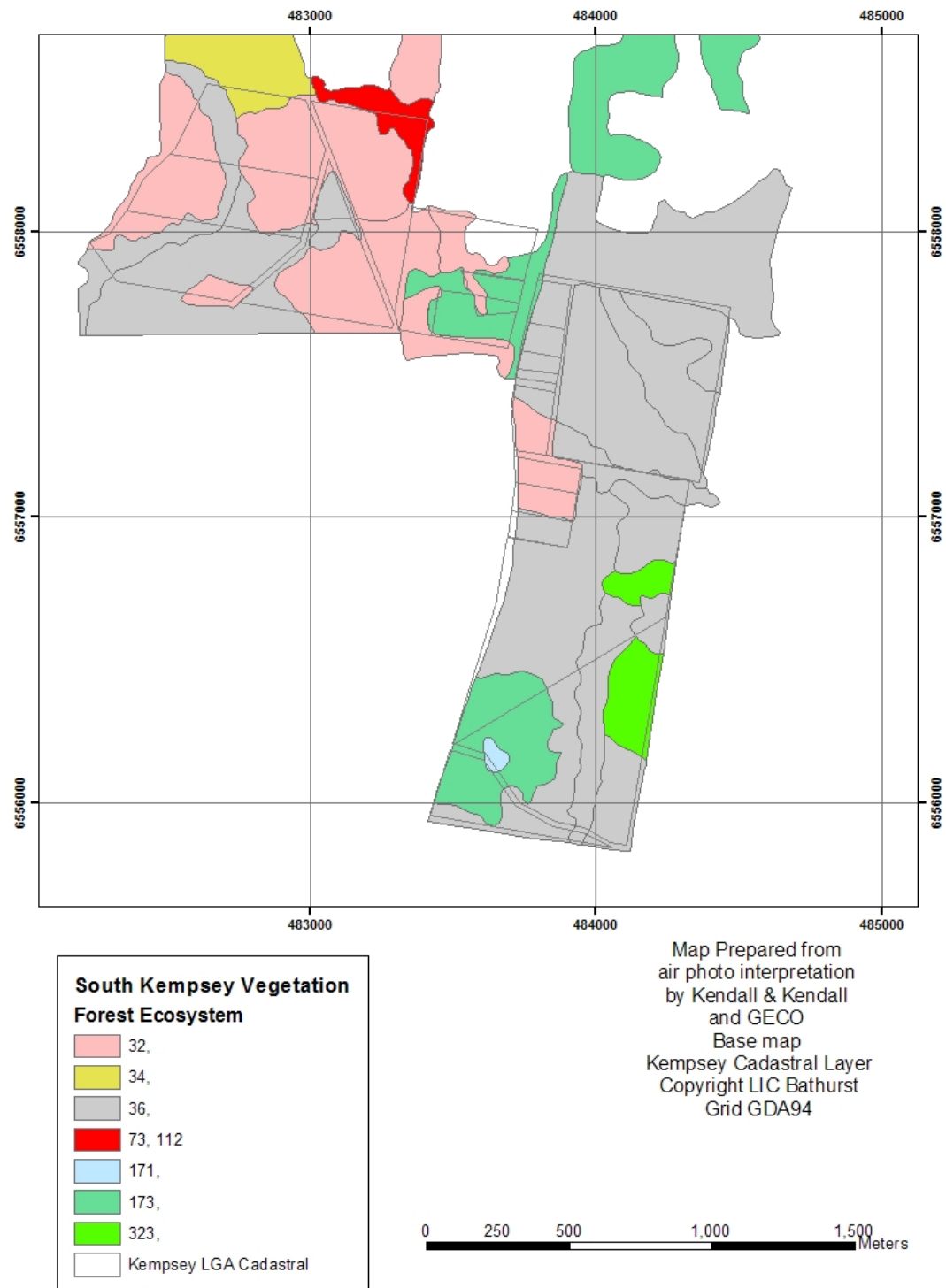


Figure 2: Vegetation communities

Regional Conservation Status of Vegetation communities

The regional conservation status of the natural vegetation communities within the study area have been assessed using the: Field Key to Forest Ecosystems Natural Resource Management Field Assessment Guidelines - (DEC 2004) and the Scientific determinations for Endangered ecological communities. The regional conservation status of each forest ecosystem is indicated in Table 12 and the spatial distribution of each regional conservation class is indicated in Figure 3.

Table 12: Regional conservation status

Forest Ecosystems	Status DEC 2004
FE:32	60.22% of reservation target met Under represented in the reserve system most remaining examples occur on private property
FE:34	37.38% of reservation target met Highly inadequately reserved Under represented in the reserve system most remaining examples occur on private property
FE:36	89.07% of reservation target met
FE:73	35.25% of reservation target met Rare, Under represented in the reserve system most remaining examples occur on private property Candidate TSC Act EEC
FE:323	No data on the reservation target 33% of original extent remains most of which is disturbed (Keith 2004) Reserved in Skillion NR

Endangered Ecological communities

DEC wildlife atlas endangered ecological communities (EEC)

The DEC threatened species website search (11 July 2005) indicated that the following endangered ecological communities might potentially occur within the Hastings Macleay catchment:

- Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion;
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South east Corner bioregions;
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions;
- Lowland Rainforest on Floodplain in the NSW North Coast Bioregion
- White Box Yellow Box Blakely's Red Gum Woodland;
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South east Corner Bioregions;
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney basin and South East Corner bioregions; &

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Graminoid clay heath.

The DEC has indicated that this list is indicative and should be only used as a guide.

An ecological community is defined in the TSC Act as an assemblage of species occupying a particular area.

When considering potential for an ecological community to be part of an Endangered Ecological Community the species composition and location should be considered as the primary determinate because the TSC Act defines an ecological community as an assemblage of species in a particular area. However it is also important to consider the structure habitat, distribution and other environmental characteristics that, in combination provide strands of evidence to facilitate an informed diagnosis of an ecological community. (pers com. David Keith Aug 2005)

The determinants for a particular EEC include ecological community descriptors and environmental determinates.

Ecological community descriptors include:

- Species composition; and,
- Vegetation structure.

Environmental determinates include:

- Habitat;
- Distribution; and.
- Other determinants such as elevation, soils, periodic flooding etc.

Ecological community descriptors

The final determinations for each EEC generally contain a descriptive paragraph indicating the most common floristic components for that EEC. It would be expected that each occurrence of the EEC contain the majority of these species. A list of the characteristic assemblage of species is also provided. As the TSC act defines an ecological community as “an assemblage of species occupying a particular area.” species composition is therefore considered to be the primary determinate of an EEC.

The determinations also describe the structural features of the EEC. It would be expected that each occurrence of the EEC would generally conform to the structural attributes described in the final determination.

Environmental determinates

Information in the final determination about environmental characteristics should be used as guides to further describe the ecological community and provide strands of evidence to assist in deciding whether an ecological community is part of the EEC. (pers com. David Keith Aug 2005).

Although it would be expected that most of the environmental determinants would be present for a community to be included as an EEC, it is the combination of these strands of evidence that provides a weight of evidence to enable an informed decision to be made for a particular ecological community. Provided that the weight of evidence of the environmental factors indicate that an ecological community is part of

the EEC, then some deviations from these environmental determinants are not considered enough to eliminate it as an EEC.

FE73 occurring on the site contains a floristic species assemblage and environmental determinants included in the Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion and/or Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; The detailed descriptions of these communities are provided in their respective Scientific committee final determinations. The determinations are available from the NPWS website.

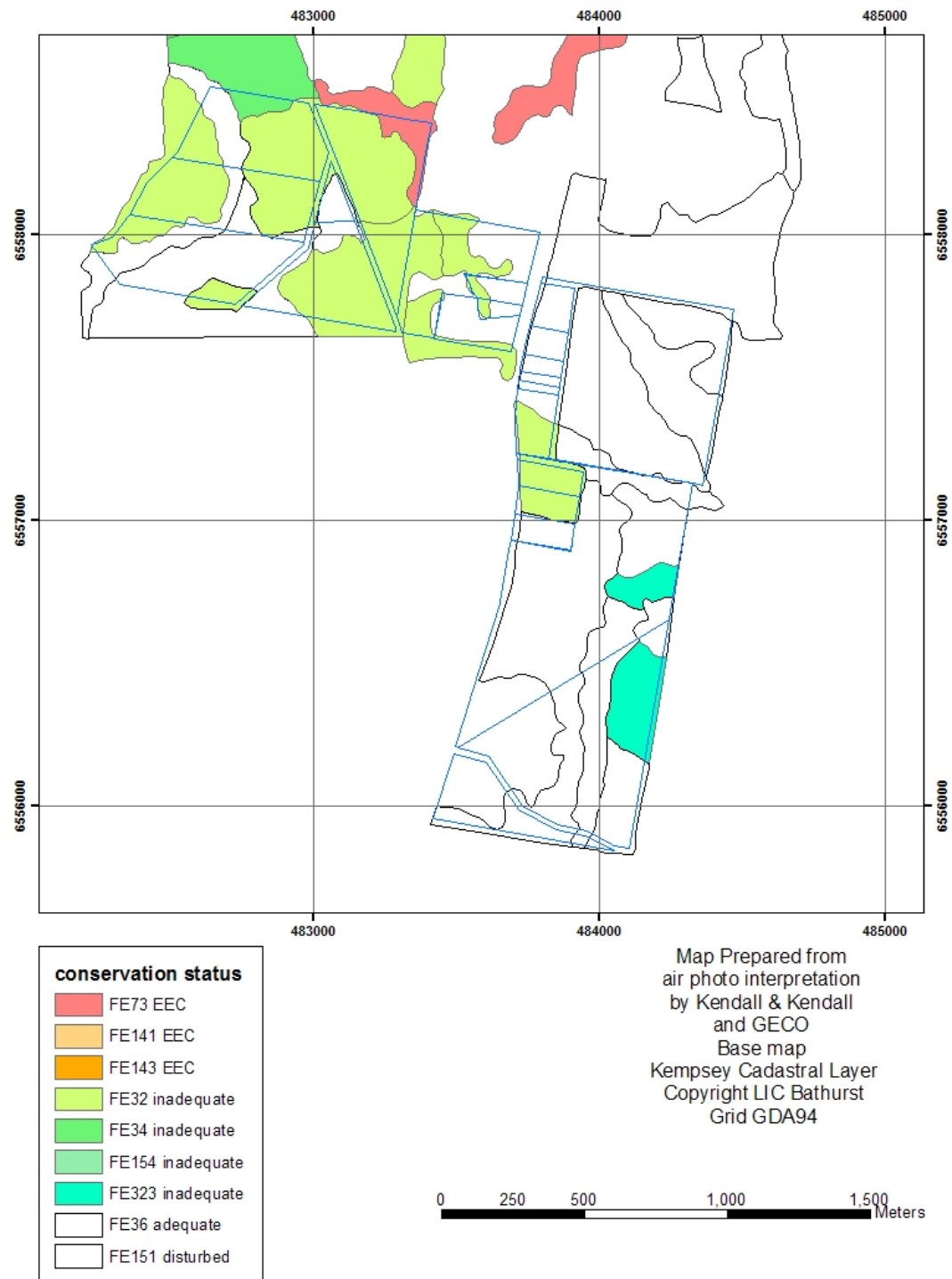


Figure 3: Significant vegetation communities based on floristic composition

Critical habitat

A search of the DEC website 21st March 2006 indicated that no critical habitat has been declared in the study area.

Structural integrity and disturbance

The study area is dominated by regrowth forest, there are however some more mature forest near the eastern boundary of the study area and in the southern portion of the western part. Senescent trees are generally absent or in low densities throughout the study area. There are however moderate numbers of senescent trees at the southern end of the area to the west of the highway and along the eastern boundary of the study area. The generally high regrowth low senescence composition of the forest communities within the study area is probably indicative of a past logging, frequent fire and other disturbance. This disturbance is likely to have reduced the areas habitat and general conservation values. The exception to this is , or value disturbance history Disturbance throughout the area to the west of the highway is moderate to very high while the area to the east of the highway has low to moderate.

The structural attributes of the study area are illustrated on Figure 4 and Figure 5

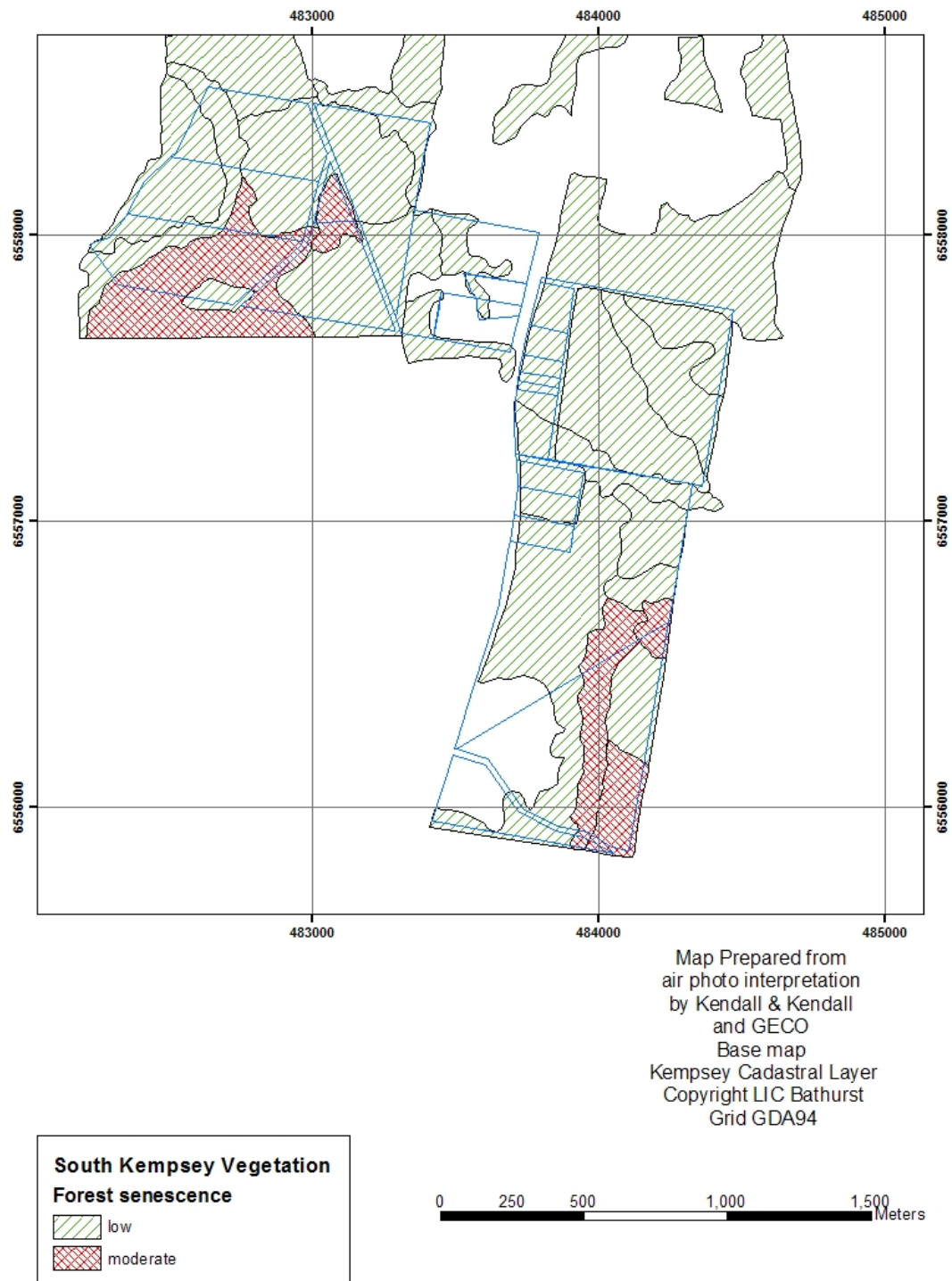


Figure 4: Structural mapping indicating forest senescence

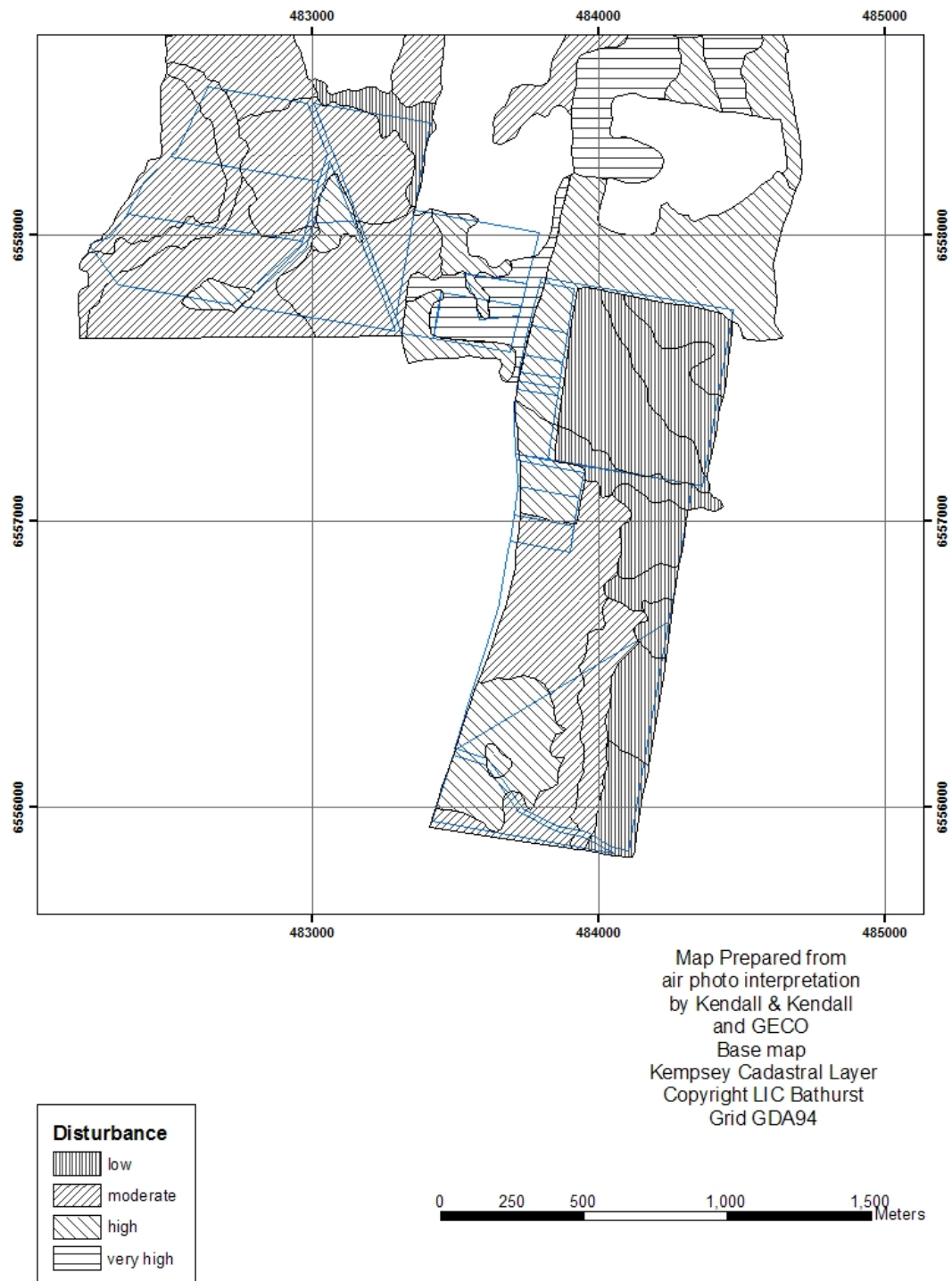


Figure 5: Structural mapping indicating disturbance

Connectivity

The study area is adjoined by naturally vegetated lands, part of which is recognised as key habitat and regional corridor. The study area is also located in close proximity to a state forest as indicated in Figure 6.

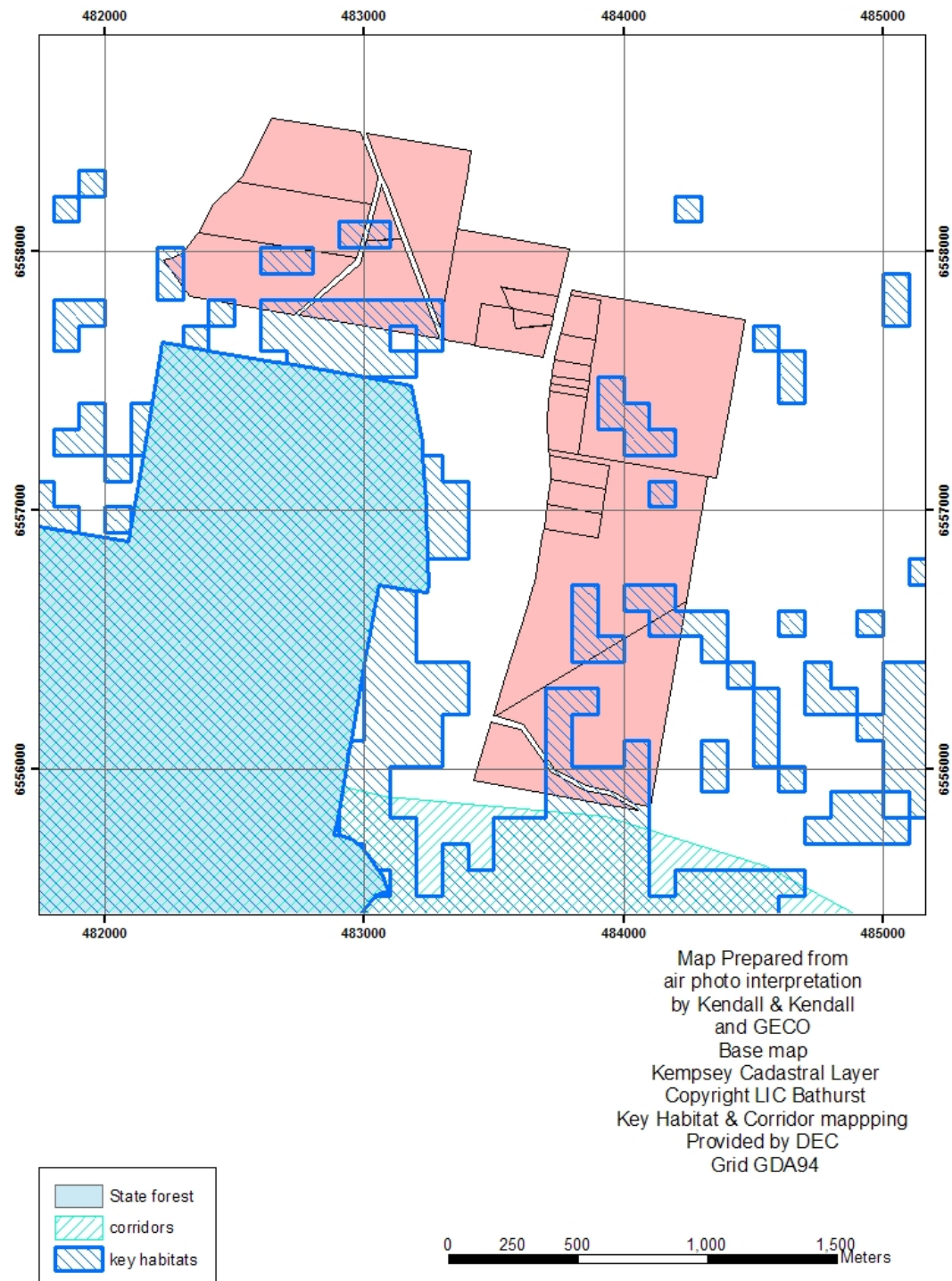


Figure 6: Key habitat & corridor

Conclusions

The majority of the study area is covered by dry sclerophyll forest. Several of these dry sclerophyll communities, are considered to be regionally inadequately conserved with FE 34 and FE323 have less than 50% of their reservation target met, One community FE73 is considered to be an endangered ecological community. The study area is part of a large mass of naturally vegetated coastal hinterland that includes and provides linkages to a number of national parks and state forests. And it is considered that the assemblage of dry sclerophyll forest communities occurring within the study area is likely to contribute towards the local areas biodiversity.

The majority of the study area is moderately to highly disturbed with evidence of logging, frequent fire and past clearing especially within the area to the west of the highway, this disturbance is considered to have reduced the areas habitat and conservation values.

The following conclusions are made as a result of this assessment of the study area. It is considered that the area has moderate to low conservation values because of:

- Moderate incidence of regionally poorly conserved ecological communities;
- Low incidence of senescent trees and high incidence of regrowth trees;
- The moderate to high disturbance of the site.

However the area does contain some conservation values, these include:

- Presence of regionally poorly conserved vegetation communities;
- Presence of a small area of potential EEC;
- Its contribution to the local and regional biodiversity; and,
- Connectivity with a relatively large area of predominantly naturally vegetated land.

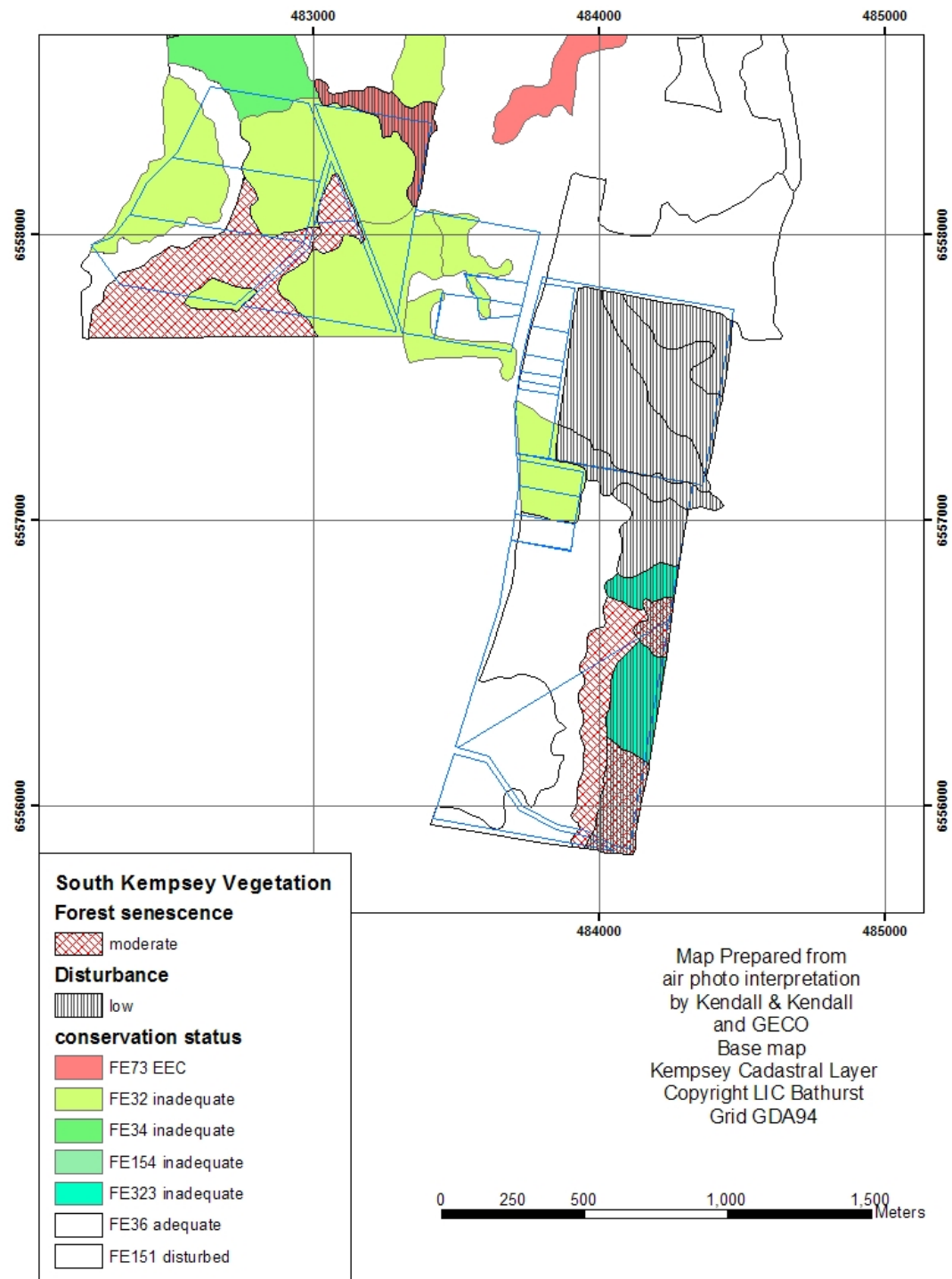


Figure 7: Areas with high and moderate conservation values

Recommendations

Retain the area of FE 73. This community is considered to be Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion which is listed as an endangered ecological community under the TSC Act.

Retain a proportion of each forest ecosystem occurring on the study area, particularly those that are inadequately conserved, retention of parts of each forest ecosystem will help retain biodiversity values, retention areas should target areas of lowest disturbance and highest senescence.

When considering retention areas the linkages to other areas of natural vegetation should be considered. The DEC key habitat and corridor mapping is a regional study and could be used as a guide to providing these linkages.

In applying the above recommendations consideration could be given to conserving similar ecological communities off the study area but within the general locality. Conservation of off set areas with higher biodiversity, less disturbance, greater structural integrity and higher connectivity than those on the study area are likely to yield higher conservation outcomes and could be considered. The regional mapping project being undertaken by GECCO and Kendall & Kendall along with other regional studies could provide a basis for preliminary selection of candidate areas for conservation off sets.

Bibliography

Atkinson G. (1999), *Soil Landscapes of the Kempsey -Korogo Point 1:100 000 Sheet Report & Map*, Department of Land & Water Conservation, Sydney

DEC (2004),*Field Key to Forest Ecosystems*

DEC (Scotts) 2003 *Key Habitats & Corridors for forest fauna A landscape framework for conservation in north-eastern NSW*. Occasional paper 32.

Department of Planning. 1995. - State Environmental Planning Policy - Koala Habitat Protection.

Department of Urban Affairs & Planning (1998). *Comprehensive Regional Assessment Aerial Photograph Interpretation (CRAFTI) Project Lower North East NSW*

Griffiths S (1993) *Conservation status of coastal plant communities in Northern New South Wales* Unpublished report for NSW NPWS

Harden GJ 1990. *Flora of New South Wales Vol 1*. New South Wales University Press Sydney

Harden GJ 1992. *Flora of New South Wales Vol 3*. New South Wales University Press Sydney

Harden GJ 1993. *Flora of New South Wales Vol 4*. New South Wales University Press Sydney

Harden GJ 2000. *Flora of New South Wales Vol 2(Revised Ed)*. New South Wales University Press Sydney

Kendall & Kendall., (2003) *Flora & fauna report for a local environmental study at South Kempsey* report prepared for GHD

NSW NPWS *Wildlife Atlas Records Database for Kempsey 1:100 000 Map sheet Provided by Kempsey Council Feb 2006*

NSW NPWS and SMEC Australia (2003), *Threatened Species Survey &Assessment Guidelines for Developments and Activities Working Draft*

NSW Scientific Committee (TSC Act) (17/12/2004) Final Determination to list "Subtropical coastal floodplain forest of the NSW North Coast bioregion" as an endangered ecological community.

Table 13: Flora species list

		SV_FAR-01	SV_FAR-02	SV_FAR-03	SV_FAR-04	SV_FAR-05	SEPP44-01	SEPP44-02	SEPP44-03	SEPP44-04	Thur-01	Thur-02
Species	Common Name											
<i>Acacia binervia</i>	Coast Myall		*		*							*
<i>Acacia concurrens</i>	Wattle	*	*	*	*	*					*	*
<i>Acacia floribunda</i>	White Sally	*	*								*	
<i>Acacia irrorata</i>	Green Wattle											*
<i>Acacia maidenii</i>	Maiden's Wattle		*									
<i>Acacia ulicifolia</i>	Prickly Moses											*
<i>Ageratina adenophora</i> *	Crofton Weed										*	
<i>Allocasuarina littoralis</i>	Black She-oak		*	*	*						*	*
<i>Allocasuarina torulosa</i>	Forest Oak	*	*				*					
<i>Aristida vagans</i>		*										
<i>Babingtonia angusta</i>	Beakea		*	*	*	*						*
<i>Billardiera scandens</i>	Appleberry											*
<i>Breynia oblongifolia</i>	Coffee Bush	*	*									
<i>Brunoniella australis</i>	Blue Trumpet-flower		*		*							
<i>Callistemon salignus</i>	Sweet Willow Bottlebrush		*									*
<i>Cheilanthes austrotenuifolia</i>	Rock fern	*		*								
<i>Corymbia intermedia</i>	Pink Bloodwood	*	*				*	*	*	*	*	
<i>Corymbia maculata</i>	Spotted Gum	*							*			
<i>Desmodium varians</i>	Slender Tick-trefoil		*									
<i>Dianella caerulea</i>		*										
<i>Dodonaea triquetra</i>	Hop Bush	*										
<i>Echinopogon caespitosus</i>	Hedgehog Grass				*							
<i>Entolasia marginata</i>	Bordered Panic		*		*							
<i>Entolasia stricta</i>	Wiry panic	*	*	*								
<i>Eragrostis sp</i>	lovegrass										*	
<i>Eucalyptus acmenoides</i>	Narrow-leaved White Mahogany	*		*			*	*	*	*	*	
<i>Eucalyptus carnea</i>	Thick-leaved Mahogany	*		*	*							
<i>Eucalyptus globoidea</i>	White stringybark	*	*	*								*
<i>Eucalyptus microcorys</i>	Tallowwood		*				*				*	*
<i>Eucalyptus pilularis</i>	Blackbutt										*	*
<i>Eucalyptus propinqua</i>	Small fruited grey Gum		*	*	*		*	*	*			
<i>Eucalyptus siderophloia</i>	Northern Grey Ironbark	*	*	*	*		*	*	*	*		
<i>Eucalyptus tereticornis</i>	Forest Red Gum	*					*					
<i>Gahnia melanocarpa</i>	Saw Sedge										*	
<i>Glycine clandestina</i>	Glycine	*										*
<i>Gonocarpus chinensis</i>	Gonocarpus										*	
<i>Goodenia hederacea ssp hederacea</i>	Goodenia										*	
<i>Goodenia ovata</i>	Goodenia										*	
<i>Hardenbergia violacea</i>	Flase Sarsaparilla											*
<i>Hibbertia obtusifolia</i>	Guinea Flower	*	*									
<i>Hybanthus enneaspermus</i>	Orange Spade Flower											*

		SV_FAR-01	SV_FAR-02	SV_FAR-03	SV_FAR-04	SV_FAR-05	SEPP44-01	SEPP44-02	SEPP44-03	SEPP44-04	Thur-01	Thur-02
Species	Common Name											
<i>Hybanthus stellarioides</i>	Purple Spade Flower											*
<i>Imperata cylindrica</i>	Blady Grass	*	*									*
<i>Jacksonia scoparia</i>	Dogwood	*		*								
<i>Lantana camara</i> *	Lantana										*	*
<i>Lepidosperma laterale</i>		*	*	*		*						*
<i>Lomandra longifolia</i>	Mat Rush	*	*	*	*							*
<i>Lomandra multiflora</i>	Mat Rush	*	*									
<i>Lophostemon confertus</i>	Brush Box	*	*	*	*		*					
<i>Melaleuca linariifolia</i>	Narrow-leaved Paperbark		*								*	
<i>Melaleuca nodosa</i>	Paperbark		*	*	*	*						
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark										*	
<i>Melaleuca styphelioides</i>	Prickly Paperbark										*	
<i>Notelaea longifolia</i>	Mock Olive											*
<i>Opismenus imbecillis</i>	Basket Grass		*									
<i>Pandorea jasminoides</i>	Bower Vine	*										
<i>Pomaderris lanigera</i>	podaderris										*	
<i>Pratia purpurascens</i>	White Root											*
<i>Pseuderanthemum variabile</i>	Pastel Flower	*	*		*							*
<i>Pteridium esculentum</i>	Bracken					*						*
<i>Ptilothrix deusta</i>	Horned Sedge		*	*	*	*						
<i>Senna x floribunda</i> *	Senna										*	
<i>Solanum mauritianum</i> *	Tobacco Bush										*	
<i>Syncarpia glomulifera</i>	Turpentine										*	
<i>Themeda australis</i>	Kangaroo Grass					*						*
<i>Typha orientalis</i>	Cumbungi										*	
<i>Viola hederacea</i>	Ivy-leaved Violet		*									
<i>Xanthorrhoea macronema</i>	Grass Tree											*
<i>Salix sp</i> *	Willow										*	

*indicates introduced species

Table 14: Flora plot / survey locations

Plot Id	Eastings	Northings
SV-FAR-01	484100	6556600
SV-FAR-02	483920	6556950
SV-FAR-03	484125	6546800
SV-FAR-04	483700	6556700
SV-FAR-05	483650	6556000
SEPP44_01	484150	6556940
SEPP44_02	484180	6556700
SEPP44_03	484050	6556580
SEPP44_04	483690	6556430
Thurg-01	483400	6558150
Thurg-02	483305	6557812
	AMG66	