Macleay Estuary *Data Compilation Study*

FLORA and FAUNA HABITAT STUDY

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for
Kempsey Shire Council
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1 EXECUTIVE SUMMARY

16 Vegetation Communities have been recorded throughout the survey as occurring along the riparian zones of the Macleay River from Belgrave Falls upstream of Kempsey to the entrance into the Ocean at South West Rocks. The Belmore River, Kinchella Creek, Andersons Inlet, Macleay Arm, Clybucca Creek, Spencers Creek and South-west Rocks Creek have also been included in the survey.

150 different Vegetation Areas have been identified over the 347 kilometres of riparian zone investigated. Each of these areas has been described according to Vegetation Community, Native Vegetation Status, Weeds Status, Disturbance Level, Vulnerability Class, Flora and fauna Significance and Habitat Value.

The Riparian Zone is comprised of :

- 59.7% Improved Pasture and cropland;
- 23.4% Mangrove Forest and Woodland;
- 3.6% artificial breakwalls;
- 3.3% Saltmarsh vegetation dominated by Maritime Rush, Samphire and Samphire;
- 1.6% Littoral Rainforest (incorporates Tuckeroo and Headland Brush Box types);
- 1.4% Introduced Scrub;
- 1.4% typical River Oak vegetation;
- 1.2% Sand-hill Black-butt vegetation;
- 1.1% degraded Dry Rainforest – Myrtle Scrub;
- 1.1% Banksia Woodland along the coastal zone;
- 1.5% settlements, roads and semi-maintained lands partially cleared;
- 0.3% Swamp Oak vegetation;
- 0.2% Dry Sclerophyll Forest (Grey Gum - Grey Ironbark);
- 0.2% Wet Sclerophyll (Brush Box), and
- 0.05% Littoral Rainforest (Headland Brush Box).

The **degree of disturbance** of riparian vegetation has been documented as:

- 66.9% or 232 km having a HIGH degree of disturbance;
- 13.8% or 48 km considered to be INTACT;
- 10.1% or 35 km having a LOW degree of disturbance;
- 9.1 % or 31.6km of the vegetation varying in disturbance from LOW - MODERATE disturbance levels.

Weed Species have been grouped into 3 categories depending on their invasiveness, capacity to dominate natural vegetation communities and degree of difficulty to control. The abundance of these species has been listed for each of the identified Vegetation Areas.

282.4 km or 81.4% of the mapped riparian zone contains Category 1 Weeds which are the most serious environmental weeds on the North Coast, capable of displacing native communities. For approximately half of this length, 130.1 km, these Category 1 Weeds are ranked as Common – Heavy.

24 km or 6.9% of the mapped riparian zone contains Category 2 Weeds, as the worst environmental weeds recorded. Category 2 weeds are highly invasive but control is considered to be easier than for Category 1 weeds.

40.5 km or 11.7% of the mapped riparian zone does not contain any significant environmental weeds.

Three Vegetation Zones have been identified which correlate reasonably with the Geomorphic Process Zones described by Tim Cohen.

Zone A is where *Maritime* influences are predominant and extends from the Jerseyville Bridge to the mouth of the Macleay River (corresponds to Cohens Marine Flood-tide Process Zone).

Zone B is a *Transition Zone* with both freshwater and saline influences affecting vegetation composition. It extends from the Belmore River Confluence to some 5 km upstream of the Jerseyville Bridge (corresponding closely to Cohens Fluvial Reach 3 and Fluvial – Marine Transition Zone).

Zone C is where *Freshwater* is the dominant influence on vegetation composition. It extends from some 5 km upstream of the Jerseyville Bridge to Belgrave Falls. (corresponding closely to Cohens Fluvial Reach 1 and 2).

The typical identifying species for each of these zones are listed and provide a guide to the species suitable for inclusion in riparian revegetation projects.

Significant Flora and Fauna has been researched and documented.

FLORA
Eight 'Endangered Ecological Communities', 4 Endangered and 5 Vulnerable Flora species listed under the Threatened Species Conservation Act (TSCAct) have been identified as occurring within the Macleay estuary. Six of these species are also listed on the Commonwealth Government's Environment Protection and Biodiversity Conservation Act (EPBCAct). A further 7 flora species are known to be at or near their southern geographical limits in the area.

In addition, 4 other threatened flora species listed under the TSCAct are considered to potentially occur in the Macleay Estuary. Three of these species are also listed on the EPBCAct.

FAUNA
Seven Endangered and 39 Vulnerable Fauna species listed under the Threatened Species Conservation Act (TSCAct) have been identified as occurring within the Macleay estuary. Seven of these species are also listed on the Commonwealth Government's Environment Protection and Biodiversity Conservation Act (EPBCAct).

In addition, 21 other threatened fauna species listed under the TSCAct are considered to potentially occur in the Macleay Estuary. 3 of these species are also listed on the EPBCAct.

Eighty-two Migratory species (71 birds, 6 mammals, 3 reptiles, and 2 sharks) are also listed under the EPBCAct as occurring or potentially occurring in the Macleay estuary.

Habitat Corridors
A considerable proportion of the Macleay estuary is recognised as Key Habitat or within a Regional Corridor under the NSW NPWS 'Key Habitats and Corridors' mapping of NE NSW. The Regional Corridor identified under this NPWS Project is the Fishermans Bend Nature Reserve Regional Corridor which links from Hat Head NP and Arakoon SRA through Yarrahappini Wetlands, Tamban State Forest to Fishermans Bend NR and Mt Yarrahappini and Yarriabini National Park and then

westwards to Ngambaa NR. This corridor has a good deal of continuity of native vegetation cover and where gaps occur they are not large distances.

The Macleay River 'riparian corridor' is highly degraded due to the extent of clearing and the paucity of remnant pockets along the riparian margin or in pockets across the floodplain. Weed infestations are extensive. Nevertheless the riparian margin does act as a conduit for a variety of mobile species.

Threats and Habitat Vulnerability

The identification of threats, both current and potential, to the long-term sustainability of the identified flora and fauna habitat has been included for each mapped vegetation area. The relative vulnerability of each site to these threats has been identified and grouped into 3 classes - High, Medium, Low.

33.5 km or 9.6% of the riparian zone mapped has been classed as having a HIGH vulnerability to identified threats.

184.6 km or 53% of the riparian zone mapped has been classed as having a MEDIUM vulnerability to identified threats.

129 km or 37.18% of the riparian zone mapped has been classed as having a LOW vulnerability to identified threats.

The information compiled on Vegetation Status, Weed Status and Significant Species is in a format which makes it readily usable for determining management strategies revegetation priorities and 'action plans'. These proposed strategies, priorities and plans would provide a sound basis for on-going management and the preparation of funding submissions for implementing on-ground works.

State Environmental Planning Policy #26 – Littoral Rainforest listings

Three State Environmental Planning Policy 26 – Littoral Rainforests are listed for the Macleay Estuary. They are Sites #100, 101 and 101B at Shark Island, the breakwall Island and Clybucca Historic Site. This vegetation has been mapped under the current project and has been found to cover 62.6 hectares in 9 fragments. The main Shark Island remnant is 32 hectares.

Twenty-six smaller fragments of littoral / lowland rainforest have also been identified and mapped in this project. These fragments have a combined total of 39.2 hectares in 24 small remnants of varying degrees of degradation. These fragments are however considered important as part of a habitat conservation program as they offer a diversity of species and genetic material for restoration programs. With appropriate management these fragments will hopefully be sustainable and provide an important element of diversity within the identified habitat corridors.

The listing of 'Littoral Rainforest' as an 'Endangered Ecological Community' means that where there are recognised inadequacies in the SEPP 26 mapping the significant vegetation is protected under the Threatened Species Conservation Act.

State Environmental Planning Policy #14 – Wetlands listings

Seven different accepted wetland types - Mangroves, Saltmarshes, Melaleuca Forests, Casuarina Forests, Sedgelands, Brackish and Freshwater Swamps, Wet Meadows - were mapped at a scale of 1:25,000 under SEPP #14.

The consistency of mapping and level of accuracy has been criticised due to the exclusion of a number of groundwater dependent ecosystems such as Wet Heath and Wet Shrubland and low-lying forests such as Swamp Mahogany *Eucalyptus robusta*, Red Mahogany *Eucalyptus resinifera* from the mapping.

On this study site there is a degree of discrepancy between the communities mapped under SEPP#14 and their actual physical extent within the estuary. Discrepancies can be attributed to the scale of photography being at 1:25,000 and environmental changes over the preceding years.

Whilst there are inconsistencies and inaccuracies with the SEPP #14 mapping within the study area it is not considered relevant to identify all discrepancies as the new 'Endangered Ecological Communities' gazetted under the TSCAct address the ecological significance of 'wetland' vegetation. Coastal Slatmarsh, Freshwater Wetlands, Swamp Sclerophyll on Floodplains, Subtropical Coastal Floodplain Forest, Swamp Oak Floodplain Forest and River-flat Eucalypt Forest on Coastal Floodplains which may have been excluded under SEPP 14 have now been protected under the new legislation.

NSW Fisheries Mapping of Mangrove, Saltmarsh, Sea Grass sp. (Zostera sp.) is currently being updated and is anticipated to be available during 2005.

Macleay Wetlands Management Plan and Mapping

This Mapping produced by the North Coast Environment Council Inc in 1999 defined 21 Vegetation Units representing an area of 40,232 hectares. Problems with distortion associated with transferral into a digital layer in ArcView have reduced the usability of this information as digital layer without considerable work in corrections. However, it still supplies important information which can be integrated into other update mapping.

Active Riparian Restoration Projects

Tenty-four riparian and wetland / floodgate management projects have been listed as active within the Macleay estuary. Funding is from a range of sources including Kempsey Council, the Catchment Management Authority, Natural Heritage Trust, Envirofund, Voluntary Streamacre Grants Scheme, corporate initiatives from Nestles, plus considerable landholder contributions.

2 SUMMARY OF IDENTIFIED GAPS IN THE DATA BASE

1. Lack of definitive mapping for vegetation recently listed as 'Endangered Ecological Communities'. The specific vegetation communities included within the 'Endangered Ecological Communities' needs to be clarified and mapped accordingly.

   For example, Subtropical Coastal Floodplain Forest on the NSW North Coast bioregion potentially occurs along the Clybucca Creek in a number of places beyond the immediate riparian fringe. This needs further investigation and mapping.
   Saltmarsh communities will be mapped as part of the NSW Fisheries Mapping.

2. Lack of a strategic long-term plan guide to riparian, coastal and rainforest regeneration / restoration activities.

3. What impact do the weed species of submerged aquatic vegetation – *Elodea sp*. and *Egeria sp*. have on aquatic habitat?

   How do these species react to drought, normal flow, flood and increased nutrient from discharges?
   To what degree do these species displace native submerged vegetation.

4 Lack of specific local documentation on habitat corridors and a clear strategic plan for conserving or establishing local corridors.

   There is a need to preserve and consolidate a diverse mosaic of vegetation types for the conservation of flora and dependent fauna species. Many species utilize a variety of vegetation communities habitat types for different parts of their lifecycles e.g. Blossom bats, Fruit doves, migratory waders.

   Another important factor is 'altitudinal migration' for fruit and nectar dependent species – species of rainforest plants flower and fruit earlier at lower elevations than higher due to warmer conditions that prevail at low elevations or near the coast.

5 Lack of control program for the Serious Environmental Weed Spike Rush *Juncus acutus* in the Rainbow Reach locality . Spike Rush is encroaching on estuarine Rushlands and Samphire – Sand-Couch Vegetation listed as an 'Endangered Ecological Communities'.

6 Lack of data on the invasion of Saltmarsh communities by Mangroves in the locality and the potential subsequent changes to adjoining wetland and swamp forest communities and understanding of the implications of this in terms of habitat changes. The mangrove invasion limits the use of saltmarshes by birds that would normally make use of this habitat and has been a factor in their decline

7 The integration of Aboriginal Heritage Issues into the estuary planning process has not been highlighted.

3 SUMMARY OF RECOMMENDATIONS

1 Prepare definitive mapping for vegetation which encompasses recently listed as 'Endangered Ecological Communities' and ensure that all future mapping be able to be incorporated into the ArcView database with accuracy for use in development and planning scenarios.

2 Develop a strategic approach to prioritising restoration and revegetation works based on the weed status and degree of disturbance defined in this Project. A 'Conservation and Restoration Plan' should be developed as a framework with specific goals and actions to guide activities to ensure long term aims are achieved. Such a Plan would be a useful document to aid in sourcing funding for the works over extended periods as opposed to short-term options currently available.

The 'degree of disturbance' data collected in this Project can be used to determine the selection of sites which have reasonable native canopy condition (e.g Intact, Low, Low-Moderate, Moderate) as high priorities for weed control and regeneration activities.

3 Undertake investigation into:
- The impact of weed species of submerged aquatic vegetation – *Elodea sp*. and *Egeria sp*. - on aquatic habitat.
- The reaction of these weed species and native species of submerged aquatic vegetation to drought, normal flow, flood and increased nutrient from discharges.
- The degree to which these species displace native submerged vegetation.

4 It is recommended that a two pronged approach to 'habitat corridor conservation' be adopted:

a) The NPWS 'Key Habitats & Corridors' regional corridor be identified as a priority for habitat protection and rehabilitation activities. Lands within and adjoining the mapped areas should be targeted to maximize habitat opportunity. This corridor contains a diverse mosaic of vegetation types for the conservation of flora and dependent fauna species.

This should be considered as a high priority and integrated into landuse planning and development control processes and recognized as a priority to attract funding assistance for rehabilitation and extension works.

b) Floodplain and Riparian forest remnants should be targeted as part of a long-term 'Macleay Riparian Corridor Restoration Program'. Actions such as:
- undertaking priority weed control to promote natural regeneration and sustainability of the remnants;
- development of a seed bank and propagation program to maintain genetic integrity and expand diversity of species for fauna foraging and extension of habitat area.
- establishment of revegetation areas in priority locations and extension of works and areas over realistic period of time, should be initiated as soon as possible as this is a long term strategic project.

The 'Landcare' movement and Community Support Officers could play a vital role in this priority as ~90% of floodplain and riparian rainforest

(subtropical) of the Macleay is within private land. However, a definitive 'Conservation and Restoration Plan' as a framework with specific goals and actions should be established early-on to guide activities to ensure long term aims are achieved.

This 'Conservation and Restoration Plan' would need to integrate resources from the community, NSW NPWS, DIPNR and the local aboriginal community.

Rehabilitation projects should also integrate Australian Bass habitat features identified in the NSW Fisheries documentation.

5 Develop a strategic works plan for the control of Spike Rush *Juncus acutus*, an introduced rush which has been identified in the Rainbow Reach locality, downstream of Jerseyville.

In terms of community structure and function this species is considered as the most serious threat to 'coastal saltmarsh' communities. In the current study we have identified where its occurrence is noted during field assessment however a more detailed appraisal of the extent of the infestation, which at this point in time seems localised, should be made.

Other weed species of threat are Groundsel Bush *Baccharis halimifolia*, Pampas Grass *Cortaderia selloana* and in some localities Pennywort *Hydrocotyle bonariensis*. Groundsel Bush is a listed Noxious Weed and as such does undergo control activities through Kempsey Council and its liaison with landholders.

Work should not only focus on mapping the current extent of Spike Rush *Juncus acutus* but also in establishing control works. Control works should be aimed at:

- limiting the spread of the species beyond current by identifying isolated populations and targeting them;
- reducing the extent of main population areas.

This is seen as an urgent priority which should be addressed now and not wait until the preparation of the overall Estuary Management Plan.

This study could be undertaken by a Research Student associated with the New England or Newcastle Universities where some work has already been done in association with this species and impacts on the Hunter wetlands.

Alternatively, and possibly preferably, by a Consultant who can manage the determination of extent of infestation in a relatively short time frame and then instigate control works in association with Kemspey Shire Council, DIPNR, NSW Fisheries and landowners.

6 In recent decades there has been widespread invasion of Saltmarsh in south-east Australia by mangroves and the factors causing this are unclear The factors driving mangrove invasion are still unclear. Sea level rises as a result of global warming are considered likely to pose an increasing threat to the survival of many areas of Coastal Saltmarsh.

Mangrove colonization of Saltmarsh has been noted for some areas have been recorded as part of this Data Compilation Study.

It is recommended that a series of survey transects and monitoring points be established from river through Saltmarsh to Swamp Forest at a variety of locations to track the progression or change within the vegetation communities over time and identify areas where Saltmarsh communities etc are vulnerable due to rises in sea level and the implications on adjoining vegetation communities. This study could be undertaken by a Research Student.

Progression and change can be rapid and it is therefore seen as a high priority which should be commenced now to further our understanding for incorporation into the Estuary Management Plan.

7 Aboriginal Heritage Issues need to be addressed within the estuary and incorporation of the NSW Indigenous Fisheries Strategy and Implementation Plan should be undertaken.

Integration of Vegetation Restoration works with Aboriginal communities is necessary so that there is a cohesive approach to restoration programs (e.g Shark Island has the Landcare network which has a history of funding weed control activities and now Department of Infrastructure, Planning and Natural Resources has funded a Management Agreement with the local Aboriginal Community.

4 VEGETATION DESCRIPTION

4.1 Methodology

Field investigations were undertaken in order to verify the mapping of the vegetation communities, degree of disturbance of canopy, understorey, groundcover and the weed status from Belgrave falls in the west to the top of the Macleay Arm and the new entrance of the Macleay River.

16 different 'Vegetation Communities' were identified over the 347 kilometres of riparian zone investigated. These are listed below and summarised in Table 1 below. Descriptions of each 'Vegetation Community' are on the following pages.

3 different 'Vegetation Zones' have been identified (see 4.2 for details).

150 different 'Vegetation Areas' have been described according to Vegetation Community, Native Vegetation Status, Weeds Status, Disturbance Level, Vulnerability Class, Flora and fauna Significance and Habitat Value.
See Appendix 1 for full details.

Vegetation has been described in terms of forest types (Forestry Commission NSW 1989); the codes are indicated in square brackets [ ]. Supplementary vegetation associations in coastal areas are from National Parks and Wildlife Service classifications and these codes are quoted in round brackets ( ).

Table 1 – Vegetation Type – length of Riparian Zone Summary

Vegetation Type	Length of Riparian Zone	% of total length of riparian Zone surveyed
[33] (2502) Mangrove Forest and Woodland	81.285 km	23.4%
(6502) Maritime Rush and Sand Couch	7.198 km	2.07%
[25] (0503) Headland Brushbox	5.489 km	1.58%
[211] River Oak	4.725 km	1.36%
[23] Myrtle – degraded	4.726 km	1.36%
(6102) Samphire – Sand Couch	4.124 km	1.19%
[41] (3506) Sand-hill Black-butt	4.074 km	1.17%
[24] (0502) - Tuckeroo	3.851 km	1.11%
[107] Banksia	3.587 km	1.03%
[32] (4005) Swamp Oak	1.180 km	0.34%
[62] Grey Gum – Grey Ironbark	0.738 km	0.21%
[53] Brush Box	0.660 km	0.19%
[216] Improved Pasture and Cropland	207.331 km	59.74%
Breakwall	12.507 km	3.60%
[221] Introduced Scrub	4.854 km	1.39%
[220] Cleared and Partially Cleared	3.293 km	0.95%
[219] Settlements and Roads	2.074 km	0.60%
TOTAL	**347.077 km**	

* [24] Tuckeroo and [25] Headland Brushbox have been grouped into Littoral Rainforest in the Executive summary

Plan 1

Plan 2

Plan 3

Plan 4

GRASSLAND / HIGHLY DISTURBED

[216] Improved Pasture and Crop Land.

Typical example of riparian zone within [216] Improved Pasture and Cropland

[219] Settlements, roads etc
[220] Cleared / Partially Cleared – this type covers land that was forested and which is now maintained in an open condition by grazing and periodic burning
[221] Introduced scrub – Introduced woody weeds dominate the site. E.g. Bitou Bush dominated coastal scrubland

CHENOPOD SHRUBLAND (Saltmarsh)

(6102) Samphire – Sand Couch *Sarcocornia quinqueflora – Sporobolus virginicus*
Forms a shrubland (often termed Saltmarsh) on estuarine mudflats inland of Mangroves, inundated by high spring tides. Maritime Rush *Juncus krausii* is common and forms an inland intergrade.
Synonymous with NSW Fisheries *Saltmarsh* category.

Samphire- Sand Couch along Clybucca Creek

RUSHLAND

(6502) Maritime Rush *Juncus kraussii* and Sand Couch *Sporobolus virginicus*
Forms a common association on estuarine mudflats just above the high tide level. Occasional emergents of Swamp Oak *Casuarina glauca*. Grades into Chenopod Shrubland downslope and *Casuarina glauca* swamp sclerophyll forest above tidal influence.
Synonymous with NSW Fisheries *Saltmarsh* category.

MANGROVE FOREST AND WOODLAND

[33] (2502) Mangrove Forest and Woodland – fringing tidal estuaries. Grey mangrove *Avicennia marina* as the dominant tree with River Mangrove *Aegiceras corniculatum* common as a shrub. Milky Mangrove *Exocecaria agallocha* occurs less frequently. Located on mudflats in intertidal zone of estuaries as a narrow stripalong deepwater shore lines, creeks and constructed drains or as broader forests on shallow water mudflats. Grades sharply into chenopod shrubland (Saltmarsh) or Rushland above high tide level.
Synonymous with NSW Fisheries *Saltmarsh* category.

DRY RAINFOREST

[23] Myrtle Scrub – a type dominated by the family Myrtaceae excluding water gum, coachwood and Lilly Pilly. Includes grey Myrtle Backhousea myrtifolia, Silky Myrtle Decaspermum paniculatum, Brush Cherry Syzygium oleosum, Blackwood Acacia melanoxylon and Brushbox.

LITTORAL RAINFOREST

24] (0502) Tuckeroo *Cupaniopsis anacardioides* - a type of Littoral Rainforest dominated by Tuckeroo with associated Plum Pine *Podocarpos elatus* Red-fruited Olive Plum *Cassine australe*, Black Plum *Diospryos australis*, Yellow Tulip *Drypetes australasica*, Rusty Fig *Ficus rubiginosa* Lilly Pilly *Acmena smithi*, Elk Horn Fern *Platycerium bifurcatum*, and Birds Nest Fern *Asplenium australasicum* .

[25] (0503) Headland Brush Box (*Lophostemon confertus*) Littoral rainforest on exposed coastal headlands. Dominated by Brush Box with associated Tuckeroo *Cupaniopsis anacardioides*, Scentless Rosewood *Synoum glandulosum*, Black Apple *Planchonella australis* and Grey Myrtle *Backhousea myrtifolia*.

SWAMP SCLEROPHYLL FOREST

[31] Paperbark *Melaleuca quinquenervia* has been extensively cleared on the Macleay Floodplain for agricultural purposes. This community is often dominated by *Melaleuca quinquenervia* but may be associated with other paperbarks including *Melaleuca alternifolia* and *Melaleuca linarifolia* or Swamp Oak *Casuarina glauca*, Willow Bottlebrush *Callistemon salignus*, Swamp Mahogany *Eucalyptus robusta* and Forest Red Gum *Eucalyptus tereticornis.*

[32] (4005) Swamp Oak *Casuarina glauca*. Usually consists of almost pure stands of Swamp oak with Broad leaved Paperbark *Melaleuca quinquenervia* and Swamp Mahogany *Eucalyptus robusta* as occasional associates.

FLOODPLAIN RIPARIAN FOREST – WOODLAND

This type is a mixed community often difficult to define due to past disturbance such as clearing, grazing, burning and bank erosion.

Elements of Swamp Sclerophyll Forest tend to dominate where levee banks are lower and Littoral Rainforest on higher banks. Fragments of the following communities are generally evident within this community:

[31] Paperbark *Melaleuca quinquenervia* has been extensively cleared on the Macleay Floodplain for agricultural purposes. This community is often dominated by *Melaleuca quinquenervia* but may be associated with other paperbarks including *Melaleuca alternifolia* and *Melaleuca linarifolia* or Swamp Oak *Casuarina glauca*, Willow Bottlebrush *Callistemon salignus*, Swamp Mahogany *Eucalyptus robusta* and Forest Red Gum *Eucalyptus tereticornis.*

[32] (4005) Swamp Oak *Casuarina glauca*. Usually consists of almost pure stands of Swamp oak with Broad leaved Paperbark *Melaleuca quinquenervia* and Swamp Mahogany *Eucalyptus tereticornis* as occasional associates.

[24] (0502) Tuckeroo *Cupaniopsis anacardioides* Littoral Rainforest - a type dominated by Tuckeroo with associated Plum Pine *Podocarpos elatus* Red-fruited Olive Plum *Cassine australe*, Black Plum *Diospryos australis*, Yellow Tulip *Drypetes australasica*, Rusty Fig *Ficus rubiginosa* Lilly Pilly *Acmena smithi*, Elk Horn Fern *Platycerium bifurcatum*, and Birds Nest Fern *Asplenium australasicum* .

Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion has been recently listed under the Threatened Species Act as an Endangered Ecological Community. This classification and the species composition listed under the Act indicate that this would also be an appropriate classification for what we have described here as Floodplain Riparian Forest – Woodland.

DRY SCLEROPHYL FOREST

[62] Grey Gum-Grey Ironbark – White Mahogany (*Eucalyptus propinqua – E.paniculata – E. carnea*).

[41](3506) Sand Blackbutt – Bloodwood (*Eucalyptus pilularis – Corymbia intermedia*)

[107] Banksia *Banksia integrifolia* Open stands on deep sands usually only a short distance in from the ocean**.** Scattered Eucalypts may be found.

[211] River Oak *Casuarina cunninghamiana**.***

WET SCLEROPHYLL FOREST

[53] Brush Box *Lophostemon confertus*

4.2 Zonation of Vegetation within the Estuary

Zonation of Vegetation types is apparent throughout the estuary dependent on the degree of maritime influence such as salt laden winds and saline waters and levels of tidal fluctuation. The degree of clearing has somewhat masked clear definition of these boundaries or transition zones.

3 vegetation zones have been identified which correlate reasonably with the Geomorphic Process Zones described by Tim Cohen. These are described in Table 2 below.

Table 2 – Vegetation Zones within the Estuary

Geomorphic Process Zone	Vegetation Zones	*Identified Vegetation Communities within*
Fluvial Reach 1 Belgrave Falls to Kempsey Bridge **Fluvial Reach 2** Kemspey Bridge to Belmore River Confluence	**Zone C** *Freshwater the predominant influence on vegetation*	[221] River Oak [62] Grey Gum Ironbark [216] Improved Pasture and Crop Land [23] Myrtle [211] Introduced Scrub
Fluvial Reach 3 Belmore River Confluence to Kinchela **Fluvial - Marine Transition Zone** Kinchella to Jerseyville Bridge	**Zone B** *Transition Zone with both freshwater and saline influences affecting vegetation composition*	[216] Improved Pasture and Crop Land [33] (2502) Mangrove Forest and Woodland [211] River Oak
Marine Flood-tide Process Zone Jerseyville Bridge to the mouth of the Macleay	**ZONE A** *Maritime influences predominant*	(6502) Maritime Rush and Sand Couch [216] Improved Pasture and Crop Land [33] (2502) Mangrove Forest and Woodland (6102) Samphire – Sand Couch [24] (0502) Tuckeroo [53] Brush Box Forest [220] Cleared / Partially Cleared [32] (4005) Swamp Oak [107] Banksia [25] (0503) Headland Brush Box [41] (3506) Sand Blackbutt – Bloodwood [219] Settlements Roads etc [221] Introduced Scrub - Bitou

The typical identifying species for each of these zones are listed below. Table 3 on the following page provides a guide to the species suitable for inclusion in riparian revegetation projects.

Table 3: Species suitable for riparian revegetation projects for each Vegetation Zone

Vegetation Zone	Mid to high tide mark *Toe of bank*	High tide to upper bank *Mid Bank*	Top of bank *Upper bank*
A	**TREES & SHRUBS**	**TREES & SHRUBS**	**TREES & SHRUBS**
	Aegiceras corniculatum	*Acacia sophorae*	Species listed for Mid bank plus:
	Avicenna marina	*Banksia integrifolia*	*Acmena smithi*
	Casuarina glauca	*Callistemon salignus*	*Alphitonia excelsa*
		Cupaniopsis anacardioides	*Aphananthe philippinensis*
		Elaeocarpos obovatus	*Commersonia fraseri*
		Glochidion ferdinandi	*Ficus superba*
		Guoia semiglauca	*Ficus rubiginosa*
		Melaleuca bracteata	*Jagera pseudorhus*
		Melaleuca quinquenervia	*Podocarpos elatus*
		Melia azedarach	
		Myoporum acuminatum	
		Pittosporum undulatum	
		Rhagodia candolleana	
		Syzygium australe	
		Syzygium leuhmanni	
	TUSSOCKS & RUSHES	**TUSSOCKS & RUSHES**	**TUSSOCKS & RUSHES**
	Crinum pedunculatum	*Crinum pedunculatum*	*Dianella caerula*
	Juncus usitatus	*Dianella caerula*	*Lomandra longifolia*
	Phragmites australis	*Lomandra longifolia*	
		Tetragonia implexicoma	

B	**TREES & SHRUBS**	**TREES & SHRUBS**	**TREES & SHRUBS**
TRANSITION ZONE	*Aegiceras corniculatum*	*Acmena smithii*	Species listed for Mid bank plus:
	Avicenna marina	*Backhousia myrtifolia*	*Acacia irrorata*
	Callistemon viminalis	*Callistemon salignus*	*Acacia longifolia*
	Casuarina glauca	*Casuarina cunninghamiana*	*Acacia melanoxylon*
		Cupaniopsis anacardioides	*Alphitonia excelsa*
		Elaeocarpos obovatus	*Aphananthe philippinensis*
		Ficus coronata	*Commersonia fraseri*
		Glochidion ferdinandi	*Jagera pseudorhus*
		Guoia semiglauca	*Ficus rubiginosa*
		Melaleuca bracteata	*Ficus superba*
		Melia azedarach	*Ficus rubiginosa*
		Myoporum acuminatum	*Ficus superba*
		Pittosporum undulatum	
		Syzygium australe	
	TUSSOCKS & RUSHES	**TUSSOCKS & RUSHES**	**TUSSOCKS & RUSHES**
	Bolboschoenus sp.	*Crinum pedunculatum*	*Dianella caerula*
	Crinum pedunculatum	*Dianella caerula*	*Lomandra longifolia*
	Juncus usitatus	*Lomandra hystrix*	
	Phragmites australis	*Lomandra longifolia*	
	Typha sp.	*Tetragonia implexicoma*	

C	**TREES & SHRUBS**	**TREES & SHRUBS**	**TREES & SHRUBS**
	Backhousia myrtifolia	*Acmena smithii*	Species listed for Mid bank plus:
	Callistemon viminalis	*Alphitonia excelsa*	*Ficus superba*
	Casuarina cunninghamiana	*Aphananthe philipinensis*	*Ficus rubiginosa*
	Lept. brachyandrum	*Backhousia myrtifolia*	*Acacia melanoxylon*
	Tristaniopsis laurina	*Callistemon salignus*	*Commersonia fraseri*
		Cas. cunninghamiana	
	TUSSOCKS & RUSHES	*Elaeocarpos obovatus*	
	Juncus usitatus	*Glochidion ferdinandi*	**TUSSOCKS & RUSHES**
	Lomandra hystrix	*Guoia semiglauca*	*Dianella caerula*
	Potamophila parviflora	*Lept. brachyandrum*	*Lomandra hystrix*
		Melaleuca bracteata	*Lomandra longifolia*
		Melia azedarach	
		Tristaniopsis laurina	
		TUSSOCKS & RUSHES	
		Dianella caerula	
		Lomandra hystrix	
		Lomandra longifolia	

5 REVIEW OF EXISTING MAPPING

5.1 Existing State Environmental Planning Policy #26 – Littoral Rainforest

Three State Environmental Planning Policy 26 – Littoral Rainforests are listed for the Macleay Estuary. These 3 rainforest remnants are synonymous with Forest Type *[24] (0502)* Tuckeroo *Cupaniopsis anacardioides.* See Plan 4.

1 **Shark Island – SEPP26 Site # 100**
Floyd (1977) describes the significant features of the rainforest in the following terms:
- Widespread occurrence of Riberry *Syzygium leuhmanni* which is the southernmost occurrence of this species.
- Three-veined Laurel *Cryptocarya triplinervis*, Green Tree *Acronychia imperforata*, Bumpy Ash *Flindersia schottiana*, Malletwood *Rhodamnia argentea* and Smooth Clerodendron *Clerodendron floribundum* approach their southern limits in this remnant.
- 58 species of trees and 23 species of vines occur within the site.
- 7 of the 8 species of figs recorded in NSW occur on this site.

2 **Unnamed Island bounded by Spencers Creek and the NEW Entrance Breakwall - SEPP 26 Site # 101**

3 **Clybucca Historic Site (NSW NPWS Heritage Site) between Macleay Arm and Yarrahapinni Wetlands – SEPP 26 Site #101B**

When the SEPP 26 boundaries are overlain on the Ortho-rectified Aerial Photography for the Macleay Estuary there is a discrepancy which needs to be taken into consideration when determining management strategies. Within this Project 'littoral rainforest' vegetation has been identified and mapped on a separate ArcView Theme along with Lowland Floodplain Rainforest and Myrtle Scrub (some small degraded fragments in the upper estuary riparian zone).

26 smaller fragments of littoral / lowland rainforest have also been identified and mapped in this project. See Plan 4. With appropriate management these fragments will hopefully be sustainable and provide an important element of diversity within the identified habitat corridors. These fragments are also important from the perspective of providing *diversity* for seed collection and propagation materials for revegetation programs.

The SEPP 26 Policy applies to mapped areas of littoral rainforest which should be considered as 'core' areas and to a 'buffer area' surrounding the remnants to a distance of 100 metres. The original SEPP 26 mapping was not exhaustive and some areas along the NSW coastline were not included. The listing of 'Littoral Rainforest' as an 'endangered ecological community' means that where there are recognised inadequacies in the SEPP 26 mapping the significant vegetation is protected under the Threatened Species Conservation Act.

Plan 5a

Plan 5b

Plan 5c

Shark Island Littoral Rainforest

5.1.1 Threatened Species Conservation Act - New Legislation on Littoral Rainforests as 'Endangered Ecological Communities'

In June 2004 'Littoral Rainforest in the NSW North-coast, Sydney Basin and South-east Corner Bioregions' was listed as an 'endangered ecological community', under the Threatened Species Conservation Act.

The definition of this community from NSW NPWS Scientific Committee determinations is:

'Closed Forest strongly influenced by proximity to the ocean. Most stands occur within 2 kilometres of the sea but may occur further inland where there is strong maritime influence.

Littoral rainforest occurs on both sand dunes and soils derived from underlying rocks. Headland stands are severely wind-pruned thickets whilst in more sheltered sites in hind-dune situations the stands are generally taller behind the wind-sheared edge.'

Littoral Rainforest under this Legislation includes the *Cupaniopsis anacardioides – Acmena spp*. Alliance and the *Lophostemon confertus* Sub-alliance of Floyd(1990) which are synonymous with Forest Types *[24] (0502)* Tuckeroo *Cupaniopsis anacardioides* and [25] Headland Brush Box *Lophostemon confertus* which have been mapped in this study.

5.2 Existing State Environmental Planning Policy #14 – Wetlands listings

Under this Policy seven different accepted wetland types - Mangroves, Saltmarshes, Melaleuca Forests, Casuarina Forests, Sedgelands, Brackish and Freshwater Swamps, Wet Meadows - were mapped at a scale of 1:25,000. Appendix 2 defines the Wetland Components defined, and excluded in the Survey.

The consistency of mapping and level of accuracy has been criticised due to the exclusion of a number of groundwater dependent ecosystems such as Wet Heath and Wet Shrubland and low-lying forests such as Swamp Mahogany *Eucalyptus robusta*, Red Mahogany *Eucalyptus resinifera* from the mapping.

On this study site there is a degree of discrepancy between the communities mapped under SEPP 14 and their actual physical extent within the estuary. This was mainly noted with Saltmarsh / Rushland communities which may potentially have changed in extent since SEPP 14 was gazetted.

Discrepancies can also be attributed to the scale of photography being at 1:25,000.

Some of the designated wetlands along the north coast have taken a more liberal approach to the inclusion of a broader range of wetland landform patterns, for example Wetland #484 in Limeburners Creek Nature Reserve #'s 543 and 545 in Crowdy Bay National Park and # 686 in Myall Lakes National Park have included and protected extensive areas of beach ridge – swale (open depression) – swamp (closed depression) and dune – swale – swamp toposequences supporting mosaics of forest, shrubland, heathland and sedgeland.

Whilst there are inconsistencies and inaccuracies with the SEPP 14 mapping within the study area it is not considered relevant to identify all discrepancies as new Legislation gazetted under the TSCA addresses the ecological significance of 'wetland' vegetation and associated fauna habitat which may have been excluded under SEPP 14.

5.3 NSW Fisheries Mapping

An Interim Report mapping aquatic habitat elements:

- Mangrove;
- Saltmarsh,
- Zostera and
- Other

was prepared by NSW Fisheries for 3 rivers including the Macleay.

Ortho-rectified aerial photographs were processed and digital images were examined and overlain with data collected in the field. This work is currently being extended and updated reports and digital layers are expected to be available in 2005.

Gaps in the Information base are:

- What impact do the weed species of submerged aquatic vegetation – Elodea sp. and Egeria sp. have on aquatic habitat?
- How do they react to drought, normal flow, flood and increased nutrient from discharges?
- To what degree do these species displace native submerged vegetation.

NSW Fisheries is undertaking on-going research into these issues.

Recommendation

Undertake investigation into:

- The impact of weed species of submerged aquatic vegetation – Elodea sp. and Egeria sp. - on aquatic habitat.
- The reaction of these weed species and native species of submerged aquatic vegetation to drought, normal flow, flood and increased nutrient from discharges.
- The degree to which these species displace native submerged vegetation.

Another issue which needs to be addressed is the relationship between sea grass areas and freshwater outflow from aquifers.

5.4 Macleay Wetlands Management Plan and Mapping

This Mapping was produced by the North Coast Environment Council Inc in 1999. In this Plan vegetation was mapped initially from 1:25,000 colour aerial photography taken in 1997, using a stereoscope to aid in mapping.

The minimum size of map units used was about 1.5 hectares. The minimum unit size for vegetation maps obtained from the NPWS was about 0.5 hectares.

The Plan indicates that boundaries of the vegetation units mapped and the extent of wetland should not be considered exact for the following reasons:

- Distortion is an inherent feature of air photos from which the vegetation was mapped;
- It is often difficult to define the boundaries between plant formations such as gradational change from sedgeland to grassland which is influenced by seasonal climatic conditions
- It is evident from air photographs that some vegetation formations are intermingled such as saltmarsh and mangrove in estuarine environments
- Some distortion of boundaries would have occurred when maps were scanned into the computer and incorporated into MapInfo.

Twenty-one Vegetation Units were identified in this mapping representing an area of 40,232 hectares.

When reviewing this layer of vegetation mapping as a theme / layer over the Ortho-rectified imagery available for the current project considerable distortion of shape in polygons was detected and some inconsistencies were noted with mapped vegetation communities.

Recommendation

That the overall vegetation mapping be upgraded so as to maximise the capacity and usefulness of the ArcView database for management and development planning scenarios.

Belmore River – 5-leaf Morning Glory (a Category 2 Weed) smothering native trees.

Belmore River – native vegetation cover in pockets of ‘improved pasture land’.

6 CONDITION OF THE VEGETATION AND WEED STATUS

6.1 Methodology

The status of native vegetation cover was recorded for each Area described. The status the Canopy, Understorey and Groundcover was described according to the following definitions and an overall description of the 'Degree of Disturbance' for native vegetation was also attributed for each area.

Table 4: Definitions for Native Vegetation Status

INTACT	*Vegetation showing negligible signs of disturbance, relatively continuous cover with natural regeneration occurring.*
LOW level of DISTURBANCE	*Low levels of disturbance from regimes including grazing, burning flood damage etc. Reduced levels of canopy continuity and regeneration occurring. May have some low levels of weed infestation.*
MODERATE level of DISTURBANCE	*Moderate levels of disturbance from a range of regimes including clearing and grazing. Minimal natural regeneration occurring and / or moderate levels of weed invasion*
HIGH level of DISTURBANCE	*High degree of removal of vegetation structure or degradation of native cover. Weed invasion can be extensive or minimal depending on management practices.*
nil	*No stratum naturally occurring. E.g Saltmarsh communities do not have canopy or understorey*

This information will be useful in determining management strategies and revegetation opportunities.

Recommendation
A strategic approach to prioritising restoration and revegetation works should be developed based on the weed status and degree of disturbance defined in this Project. A **'Conservation and Restoration Plan'** should be developed as a framework with specific goals and actions to guide activities to ensure long term aims are achieved.

The following Table summarises the results of the Native Vegetation Status - 'Degree of Disturbance' classifications.

Table 5: Native Vegetation Status Summary Table

Native Vegetation Status – Degree of Disturbance	**Length of Riparian Zone (km)**	**% of total length of Riparian Zone** (347.077 km)
Moderate – High	3.793 km	1.09%
Low – High	5.857 km	1.69%
Moderate	9.043 km	2.61%
Low – Moderate	12.936 km	3.73%
Low	35.075 km	10.11%
Intact	48.095 km	13.86%
High	232.278 km	66.92%

Recommendation
Further Outcomes from this 'degree of disturbance' data would include the selection of sites which have reasonable native canopy condition (e.g Intact, Low, Low-Moderate, Moderate) as high priorities for weed control and regeneration activities

6.2 WEED CATEGORY

Locally recorded environmental weeds have been ranked to aid in collation of information and determination of management priorities. The ranking defines 3 categories reflecting:

- Potential for significant ecological impacts;
- Potential for invasion and encroachment into native plant communities, and
- Degree of difficulty to control.

The ranking system has been adapted from Williams and Gerrand 1998 'Coastline Survey of Asparagaceae and other Environmental Weeds in the Manning Valley' with reference to the North-coast Environmental Weeds Task Force listings for the Worst Weeds on the North Coast collated in 2000.

Area 14 (north of Kempsey) – Heavy Weed infestations

Table 6 : Significant Environmental Weed Categories

Category 1 *Most Serious Environmental Weeds –highly invasive and difficult to control*
Anredera cordifolia Madeira Vine
Cardiospermum grandiflorum Balloon Vine
Chrysanthemoides monilifera subsp. rotundata Bitou Bush
Cinnamonum camphora Camphor Laurel
**Eichhornia crassipes* Water Hyacinth
Juncus acutus Spike Rush
Ligustrum lucidum Broad-leaf Privet
Ligustrum sinense Small-leaf Privet
Macfadyena unguis-cati Cats Claw Creeper
Protasparagus aethiopicus Asparagus Fern
Protasparagus plumosus Climbing Asparagus
Category 2 *Troublesome Environmental Weeds – highly invasive and moderate degree of difficulty in control*
Acacia salignus Golden Wattle
Araujia hortorum Moth Plant
**Baccharis halimifolia* Groundsel Bush
Delairea odorata Cape Ivy
Erythrina X sykesii Coral tree
Ipomea indica Blue Morning Glory
Ipomoea cairica 5-leaf Morning Glory
Lantana camara Pink Lantana
Lantana camara Red Lantana
Lonicera japonica Honeysuckle
Morus sp. Mulberry tree
Passiflora subpeltata White Passion Flower
Ricinus communis Castor Oil Plant
Senna sp. Cassia
Solanum seaforthianum Brazilian Nightshade
Category 3 *Problematic Environmental Weeds - invasive and moderate degree of difficulty in control*
**Ageratina adenophora* Crofton Weed
Albizzia sp Albizzia
Bambusa sp. Bamboo
Banana
Bryophyllum delagoense Mother-of-millions
Cestrum parqui Green Cestrum
Cyperus involucratus Umbrella Sedge
Gleditsea sp. Gleditsea
Jacaranda mimosifolia Jacaranda
Nephrolepis cordifolia Fishbone Fern
Ochna serrulata Ochna
Opuntia sp. Prickly Pear
Populus sp. Poplar
Rubus fruticosus Blackberry
Salix sp. Willow
Schefflera actinophylla Umbrella Tree
Solanum mauritianum Wild tobacco

**also listed as Noxious Weeds*

6.3 WEED STATUS

Definition
Weed status information has only been listed for species recognised as Category 1, 2 or 3 Significant Environmental Weeds (as listed in previous Table).

The following Table defines the abundance codes used.

Table 7: Weed Abundance Codes

Code	Abundance Code	DEFINITION
Not applicable	**N/A**	No category 1, 2 or 3 weed species noted during field survey.
Rare	**R**	Single or very few isolated plants, or single isolated small clump
Rare – Occasional	**R – O**	
Occasional	**O**	Infrequent , but dispersed plants and small clumps
Occasional - Common	**O - C**	
Common	**C**	Plants and small clumps readily located, sometimes uniformly distributed other times clustered. Occasional large clumps
Common – Heavy	**C - H**	
Heavy	**H**	Continuous infestations or extensive large clumps or combinations of numerous propagules and established plants

Abundance codes have been assigned to individual weed species within the identified Vegetation Area Descriptions. An overall Abundance Score for Weeds in general has been assigned to each AREA defined and listed (See the ATTRIBUTES Table in ArcView and Appendix 1). This overall weed abundance score has been determined by considering all the significant weeds present, their Category (i.e. Category 1, 2, or 3) and their relative abundances.

Recommendation

This system should be utilised to aid in determining Management Priorities as sites will be able to be selected on the basis of level of weed infestation and status of native vegetation cover.

Table 8: Summary of Riparian Weed Categories and Abundance Levels for the Estuary

Weed Category	Length of bank with this category of weeds (km) as the highest category listed	Abundance level
1 *Most Serious Environmental Weeds –highly invasive and difficult to control*	2.133 km	Rare
	63.17 km	Rare – Occasional
	24.767 km	Occasional
	21.222 km	Occasional – Common
	41.007 km	Common
	129.851 km	Common – Heavy
	0.333 km	Heavy
TOTAL	**282.483 km**	
% of Total Riparian length	**81.4%**	
2 *Troublesome Environmental Weeds – highly invasive and moderate degree of difficulty in control*	Nil	Rare
	3.206	Rare – Occasional
	10.186	Occasional
	Nil	Occasional – Common
	10.583	Common
	Nil	Common – Heavy
	Nil	Heavy
TOTAL	**24.055 km**	
% of Total Riparian length	**6.9%**	
3 *Problematic Environmental Weeds - invasive and moderate degree of difficulty in control*	NIL	Rare
		Rare – Occasional
		Occasional
		Occasional – Common
		Common
		Common – Heavy
		Heavy
TOTAL	**NIL**	
0 *No significant weeds species (i.e. Category 1, 2 or 3 as described)*	**40.539 km**	N/A
% of Total Riparian length	**11.7%**	

Gaps in the Data base

Spike Rush *Juncus acutus*, an introduced rush, has been identified in the Rainbow Reach locality, downstream of Jerseyville. See Plan 5 for preliminary mapping results.

In terms of community structure and function this species is considered as the most serious threat to 'coastal saltmarsh' communities. In the current study we have identified where its occurrence is noted during field assessment however a more detailed appraisal of the extent of the infestation, which at this point in time seems localised, should be made.

Plan 6

Recommendations

A clear indication of the extent of this species needs to be defined and a control program put in place.

Work should not only focus on mapping the current extent of Spike Rush *Juncus acutus* but also in establishing control works. Control works should be aimed at:

- limiting the spread of the species beyond current by identifying isolated populations and targeting them and
- reducing the extent of the main population areas.

This is seen as an *urgent priority* which should be addressed now and not wait until the preparation of the overall Estuary Management Plan.

This study could be undertaken by a Research Student associated with the New England or Newcastle Universities where some work has already been done in association with this species and impacts on the Hunter wetlands.

Alternatively, and possibly preferably, by a Consultant who can manage the determination of extent of infestation in a relatively short time frame and then instigate control works in association with Kemspey Shire Council, DIPNR, NSW Fisheries and landowners.

Spike Rush – *Juncus acutus* on Rainbow Reach.

7a SIGNIFICANT FLORA

7a.1 Significant Flora Species *Known* and *Potentially* occurring in the Macleay Estuary

Appendix 4 lists species listed as endangered or vulnerable under the State Governments Threatened Species Conservation Act (TSCAct) and the Commonwealths Environment Protection and Biodiversity Conservation Act (EPBCAct) and regionally significant species (e.g. those at or near their geographical limits in the locality).

Table 9: Significant Flora Species Summary

Number of Significant Flora Species *Known* to occur in the Study Area		
Status	**TSCAct**	**EPBCAct**
Endangered	4	3
Vulnerable	5	3

Approaching Geographical Limit	7

Number of Significant Flora Species *Potentially* occurring within the Study Area		
Endangered	1	0
Vulnerable	3	3

These lists have been derived from a compilation of information from existing documents, the NSW NPWS Database and local knowledge.

The following Tables show the threatened flora species known and considered to have potential to occur in the Macleay Estuary and the vegetation communities in which they occur or are considered likely to occur:

Table 10: Significant Flora Species (Known) listed under Vegetation Communities

Vegetation Community (as mapped)	**Areas noted in mapping** (See Appendix 1 or Arview Theme for details)	**Significant Flora species KNOWN to occur in Macleay estuary area**
Littoral Rainforest		**Endangered (3 species)** Marsdenia *Marsdenia longiloba* (TSCA & EPBCA) Scented Acronychia *Acronychia littoralis* (TSCA & EPBCA) White-flowered Wax Plant *Cynanchum elegans* (TSCA & EPBCA) **Vulnerable (2 species)** Asperula *Asperula asthenes* (TSCA / EPBCA) **Southern Geographical Limit (6 species)** Riberry *Syzygium leuhmanni* Three-veined Laurel *Cryptocarya triplinervis* Green Tree *Acronychia imperforata* Bumpy Ash *Flindersia schottiana* Malletwood *Rhodamnia argentea* Smooth Clerodendron *Clerodendron floribundum*
Lowland Rainforest		**Endangered (3 species)** Marsdenia *Marsdenia longiloba* (TSCA & EPBCA) Scented Acronychia *Acronychia littoralis* (TSCA & EPBCA) White-flowered Wax Plant *Cynanchum elegans* (TSCA & EPBCA) **Vulnerable (1 species)** Asperula *Asperula asthenes* (TSCA & EPBCA) Raspwort *Haloragis exaltata subsp. velutina* (TSCA & EPBCA) **Southern Geographical Limit (4 species)** Green Tree *Acronychia imperforata* Bumpy Ash *Flindersia schottiana* Malletwood *Rhodamnia argentea* Smooth Clerodendron *Clerodendron floribundum*

Vegetation Community (as mapped)	**Areas noted in mapping** (See Appendix 1 or Arview Theme for details)	**Significant Flora species KNOWN to occur in Macleay estuary area**
Mangroves		**Protected under NSW Fisheries Legislation (3 species)** River Mangrove *Aegiceras corniculatum* Grey Mangrove *Avicenna marina* Milky Mangrove *Exocecaria agallocha* **Southern Geographical Limit – approaching (1 species)** Milky Mangrove *Exocecaria agallocha*
Swamplands	Not within the immediate riparian zones mapped within this study	**Vulnerable (1 species)** *Maundia triglochinoides* (TSCA)
Heath	Not within the immediate riparian zones mapped within this study	**Endangered (1 species)** *Thesium australe* Austral Toadflax (TSCA & EPBCA)
Riparian Vegetation		**Southern Geographical Limit (1 species)** Paperbark *Melaleuca bracteata*

Table 11: Significant Flora Species (Potential) listed under Vegetation Communities

Vegetation Community (as mapped)	**Areas noted in mapping** (See Appendix 1 or Arview Theme for details)	**Significant Flora species POTENTIALLY occurring in Macleay estuary area**
Coastal Scrubland / Dunes /		**Endangered (1 species)** *Chamaesyce psammogeton* (TSCA)
Heath	Not within the immediate riparian zones mapped within this study	**Vulnerable (2 species)** *Melaleuca groveana* (TSCA) Leafless Tongue-Orchid *Cryptostylis hunteriana* (TSCA & EPBCA)
Wetlands		**Vulnerable (1 species)** Frog-bit *Hydrocharis dubia* (TSCA & EPBCA)
Subtropical / Littoral Rainforest		**Vulnerable (2 species)** Milky Silkpod *Parsonia dorrigoensis* (TSCA & EPBCA) Rusty Plum *Amophorspermum whitei* (TSCA)

Gap: Identification of all listed 'endangered ecological communities' within the Macleay estuary and floodplain.

For example, Subtropical Coastal Floodplain Forest on the NSW North Coast bioregion potentially occurs along the Clybucca Creek in a number of places beyond the immediate riparian fringe. This needs further investigation and mapping.

Saltmarsh areas are included within the scope of the NSW Fisheries mapping which is currently under review.

Recommendation:
Establish a mapping program which builds on the current information and which targets clear identification of all listed 'endangered ecological communities' under the TSCA within the Macleay estuary and floodplain.

7a.2 Threatened Species Conservation Act - New Legislation on Wetland Communities as 'Endangered Ecological Communities'

Eight 'endangered ecological communities' relative to the Macleay estuary are currently listed in Part 3 of Schedule 1 of the TSCA. They are listed in the Table below and have been discussed in the preceding sections on SEPP #26 Littoral Rainforest and SEPP #14 and Wetland communities.

Table 12: 'Endangered Ecological Communities' relative to the Macleay Estuary

ENDANGERED ECOLOGICAL COMMUNITY *listed under the Threatened Species Conservation Act*	**HABITAT DESCRIPTION**
Littoral Rainforest in the NSW North-coast, Sydney Basin and South-east Corner bioregions	Closed canopy forest on sand dunes and on soils derived from underlying rocks. Stands on headlands exposed to strong wind action may take the form of dense wind-pruned thickets.
Lowland Rainforest on Floodplain in the NSW North Coast bio-region	Closed canopy forest on floodplains characterised by high species richness and structural complexity. Rainforest sub-alliances described by Floyd (1990) are included.
Coastal Saltmarsh in the NSW North-coast, Sydney Basin and South-east Corner bioregions	Intertidal zones on the shores of estuaries and lagoons including when areas are intermittently closed along the NSW coast.
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. Typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Generally occurs below 20m elevation.
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20m elevation (although sometimes up to 50m).
Subtropical Coastal Floodplain Forest on the NSW North Coast bioregion	Ecological community associated with clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50m elevation, but may occur on localised river flats up to 250m. This community has a tall tree layer of Eucalypts.
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.	Grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20m (rarely above 10m) elevation.
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50m elevation, but may occur of river flats up to 250m.

The following Table lists specific areas, identified within the scope of this Project, which are considered to contain 'endangered ecological communities'. This Table is limited by the scope of this study but provides important base data.

Table 13: Preliminary list of 'Endangered Ecological Communities' identified in the Macleay

Endangered Ecological Community	**Identified areas** *(polygons on rainforest Theme in ArcView)*	**Area within (ha)**
Littoral Rainforest in the NSW North-coast, Sydney Basin and South-east Corner bioregions	*24a*	32.064
	24b	0.226
	24c	0.667
	24d	0.485
	10a	1.082
	10b	0.320
	10c 0.228	*0.228*
	25	6.607
	26	20.914
	Total	**62.566 ha**
Coastal Saltmarsh in the NSW North-coast, Sydney Basin and South-east Corner bioregions		*Length of bank km NB This is deceptive as it only represents what Saltmarsh interfaces with the rivers / creeks it is not the area of Saltmarsh*
	(6102) Samphire – Sand Couch	*4.124 km*
	(6502) Maritime Rush and Sand Couch	*7.198 km*
	Total	**11.322 km**
Lowland Rainforest on Floodplain in the NSW North Coast bio-region	***Identified areas*** *(polygons on rainforest Theme in ArcView)*	*Area within ha*
	1	*1.918 ha*
	2	*1.657 ha*
	3	*0.858 ha*
	4	*1.617 ha*
	Total	**6.05 ha**
Swamp Oak Floodplain Forest of the NSW North North Coast, Sydney Basin and South-east Corner Bioregion		*Length of bank km NB This is deceptive as it only represents what Saltmarsh interfaces with the rivers / creeks it is not the area of Saltmarsh*
	77 and 100	**1.18 km**

7b SIGNIFICANT FAUNA

7b.1 Threatened Fauna Species *Known* and *Potentially* occurring in the Macleay Estuary

Appendix 4 lists species listed as threatened under the State Governments Threatened Species Conservation Act (TSCAct), the Commonwealths Environment Protection and Biodiversity Conservation Act (EPBCAct) which includes species listed under the Japan / Australia Migratory Birds Agreement (JAMBA) and China / Australia Migratory Birds Agreement (CAMBA) and regionally significant species (e.g. those at or near their geographical limits in the locality).

Table 14: Significant Fauna Species Summary

Number of Threatened Fauna Species *Known* to occur in the Study Area		
Status	**TSCAct**	**EPBCAct**
Endangered	7	5
Vulnerable	39	2

Number of Threatened Fauna Species *Potentially* occurring within the Study Area		
Status	**TSCAct**	**EPBCAct**
Endangered	8	2
Vulnerable	13	1

Number of Migratory Species *Potentially* occurring within the Study Area			
	EPBCAct	**JAMBA**	**CAMBA**
Birds	71	45	41
Mammals	6	-	-
Reptiles	3	-	-
Sharks	2	-	-

These lists have been derived from a compilation of information from existing documents, the NSW NPWS Database and local knowledge.

The following Tables show the threatened fauna species KNOWN to occur in the Macleay Estuary and the vegetation communities in which they occur or are considered likely to occur :

Table 15: Significant Fauna Species (Known) listed under Vegetation Communities

Vegetation Community (as mapped)	**Areas noted in mapping** (See Appendix 1 or ArcView Theme for details)	**Significant Fauna species KNOWN to occur in Macleay estuary area**
Littoral Rainforest		**Vulnerable** Queensland Blossom Bat *Syconycteris australis* (TSCA) Osprey *Pandion haliaetus* (TSCA) Barred Cuckoo-shrike *Coracina lineata* (TSCA) Marbled Frogmouth *Podargus ocellatus* (TSCA) Wompoo Fruit Dove *Ptilinopus magnificus* (TSCA) Rose-crowned Fruit Dove *Ptilinopus regina* (TSCA) Powerful Owl *Ninox strenua* (TSCA) Sooty Owl *Tyto tenebrisco* (TSCA) Hoary Wattled Bat *Chalinolobus nigrogriseus* (TSCA) Little Bentwing-bat *Miniopterus australis* (TSCA) Eastern Freetail-bat *Mormopterus norfolkensis* (TSCA) Grey-headed Flying-fox *Pteropus poliocephalus* (TSCA & EPBCA) Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (TSCA) Greater Broad-nosed Bat *Scoteanax rueppellii* (TSCA) Stephens' Banded Snake *Hoplocephalus stephensi* (TSCA)
Floodplain Riparian Forest Woodland		**Endangered** Swift Parrot *Lathamus discolour* (TSCA & EPBCA) **Vulnerable** Queensland Blossom Bat *Syconycteris australis* (TSCA) Square-tailed Kite *Lophoictinia isura* (TSCA) Osprey *Pandion haliaetus* (TSCA) Glossy Black-Cockatoo Calyptorhynchus lathami (TSCA) Barred Cuckoo-shrike *Coracina lineata* (TSCA) Marbled Frogmouth *Podargus ocellatus* (TSCA) Barred Cuckoo-shrike *Coracina lineata* (TSCA) Wompoo Fruit Dove *Ptilinopus magnificus* (TSCA) Rose-crowned Fruit Dove *Ptilinopus regina* (TSCA) Powerful Owl *Ninox strenua* (TSCA) Sooty Owl *Tyto tenebrisco* (TSCA) Hoary Wattled Bat *Chalinolobus nigrogriseus* (TSCA) Little Bentwing-bat *Miniopterus australis* (TSCA) Eastern Freetail-bat *Mormopterus norfolkensis* (TSCA) Grey-headed Flying-fox *Pteropus poliocephalus* (TSCA & EPBCA) Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (TSCA) Greater Broad-nosed Bat *Scoteanax rueppellii* (TSCA) Stephens' Banded Snake *Hoplocephalus stephensi* (TSCA)
Lowland Rainforest		**Vulnerable** Queensland Blossom Bat *Syconycteris australis* (TSCA) Osprey *Pandion haliaetus* (TSCA) Marbled Frogmouth *Podargus ocellatus* (TSCA) Barred Cuckoo-shrike *Coracina lineata* (TSCA) Wompoo Fruit Dove *Ptilinopus magnificus* (TSCA) Rose-crowned Fruit Dove *Ptilinopus regina* (TSCA) Powerful Owl *Ninox strenua* (TSCA) Sooty Owl *Tyto tenebrisco* (TSCA) Hoary Wattled Bat *Chalinolobus nigrogriseus* (TSCA) Little Bentwing-bat *Miniopterus australis* (TSCA) Eastern Freetail-bat *Mormopterus norfolkensis* (TSCA) Grey-headed Flying-fox *Pteropus poliocephalus* (TSCA & EPBCA) Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (TSCA) Greater Broad-nosed Bat *Scoteanax rueppellii* (TSCA) Stephens' Banded Snake *Hoplocephalus stephensi* (TSCA)

Vegetation Community (as mapped)	**Areas noted in mapping** (See Appendix 1 or ArcView Theme for details)	**Significant Fauna species KNOWN to occur in Macleay estuary area**
Dry Rainforest - Myrtle Scrub		**Vulnerable** Wompoo Fruit Dove *Ptilinopus magnificus* (TSCA) Rose-crowned Fruit Dove *Ptilinopus regina* (TSCA) Little Bentwing-bat *Miniopterus australis* (TSCA) Eastern Freetail-bat *Mormopterus norfolkensis* (TSCA) Grey-headed Flying-fox *Pteropus poliocephalus* (TSCA & EPBCA) Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (TSCA) Greater Broad-nosed Bat *Scoteanax rueppellii* (TSCA)
Saltmarsh / wetlands / mudflats		**Endangered** Jabiru *Ephippiorhynchus asiaticus* (TSCA & EPBCA) Painted Snipe *Rostratula benghalensis* (TSCA) **Vulnerable** Magpie Goose *Anseranus semipalmate* (TSCA) Sooty Oystercathcer *Haematopus fuliginosus* (TSCA) Pied Oystercathcer *Haematopus longirostris* (TSCA) Comb-crested Jacana *Irediparra gallinacea* (TSCA)
Mangroves		**Vulnerable** Sooty Oystercatcher *Haematopus fuliginosus* (TSCA) Pied Oystercatcher *Haematopus longirostris* (TSCA) Black Bittern *Ixobrychus flavicollis* (TSCA) Osprey *Pandion haliaetus* (TSCA) Grey-headed Flying-fox *Pteropus poliocephalus* (TSCA & EPBCA) Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (TSCA)
Open Forest / Sandhill Blackbutt		**Endangered** Swift Parrot *Lathamus discolour* (TSCA & EPBCA) Regent Honeyeater *Xanthomyza phrygia* (TSCA & EPBCA) **Vulnerable** Barred Cuckoo-shrike *Coracina lineata* (TSCA) Square-tailed Kite *Lophoictinia isura* (TSCA) Glossy Black-Cockatoo Calyptorhynchus lathami (TSCA) Squirrel Glider *Petaurus norfolcensis* (TSCA) Brush-tailed Phascogale *Phascogale tapoatafa* (TSCA) Koala *Phascolarctos cinereus* (TSCA) Eastern Chestnut Mouse *Pseudomys gracilicaudatus* (TSCA) Grey-headed Flying-fox *Pteropus poliocephalus* (TSCA & EPBCA) Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (TSCA) Greater Broad-nosed Bat *Scoteanax rueppellii* (TSCA) Stephens' Banded Snake *Hoplocephalus stephensi* (TSCA)

7c HABITAT CORRIDORS

There is a need to preserve and consolidate a diverse mosaic of vegetation types for the conservation of flora and dependent fauna species. Many species utilize a variety of vegetation communities habitat types for different parts of their lifecycles e.g. Blossom bats, Fruit doves, migratory waders.

Another important factor is 'altitudinal migration' for fruit and nectar dependent species – species of rainforest plants flower and fruit earlier at lower elevations than higher due to warmer conditions that prevail at low elevations or near the coast.

Hat Head National Park, Arakoon SRA, Fishermans Bend Nature Reserve and Yarriabini National Park and lands with remnant vegetation in between form a coastal corridor.

These areas are recognized within the NSW NPWS 'Key Habitats and Corridors' mapping in NE NSW as Key Habitat Areas and Regional Corridors. The identified Regional Corridor under this NPWS Project has been identified as the Fishermans Bend Nature Reserve Regional Corridor which links from Hat Head NP and Arakoon SRA through Yarrahappini Wetlands, Tamban State Forest to Fishermans Bend NR and Mt Yarrahappini and Yarriabini National Park and then westwards to Ngambaa NR. This corridor has a good deal of continuity of native vegetation cover and where gaps occur they are not large distances.

See Plan 6 on the following page.

The Macleay River 'riparian corridor' is highly degraded due to the extent of clearing and the paucity of remnant pockets along the riparian margin or in pockets across the floodplain. Weed infestations are extensive. Nevertheless the riparian margin does act as a conduit for a variety of mobile species.

Recommendations

It is recommended that a two pronged approach be adopted:

- **The NPWS 'Key Habitats & Corridors' regional corridor, as identified above, be a priority for habitat protection and rehabilitation activities.** Lands within and adjoining the mapped areas should be targeted to maximize habitat opportunity. This corridor contains a diverse mosaic of vegetation types for the conservation of flora and dependent fauna species.
This should be considered as a high priority and integrated into landuse planning and development control processes and recognized as a priority to attract funding assistance for rehabilitation and extension works.

- **Floodplain and Riparian forest remnants should be targeted as part of a long-term 'Macleay Riparian Corridor Restoration Program'**. Actions such as:
  - undertaking **priority weed control** to promote natural regeneration and sustainability of the remnants;
  - **development of a seed bank and propagation program** to maintain genetic integrity and expand diversity of species for fauna foraging and extension of habitat area.

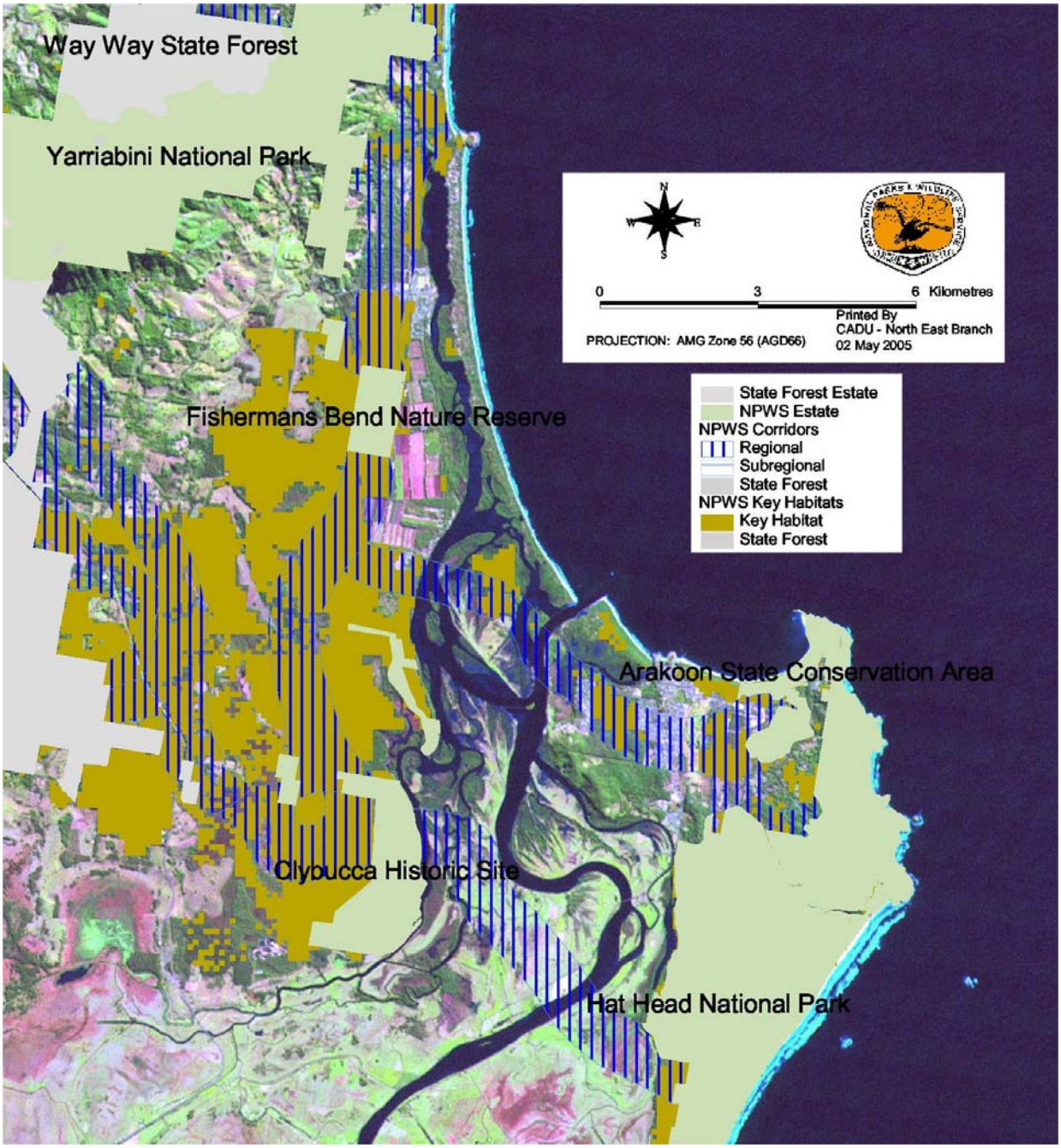
  - **establishment of revegetation areas in priority locations** and extension of works and areas over realistic period of time should be initiated as soon as possible as this is a long term strategic project. The 'Landcare' movement and Community Support Officers could play a vital role in this priority as ~90% of floodplain and riparian rainforest (subtropical) of the Macleay is within private land. However, a

definitive 'Conservation and Restoration Plan' as a framework with specific goals and actions should be established early-on to guide activities to ensure long term aims are achieved.

This 'Conservation and Restoration Plan' would need to integrate resources from the community, NSW NPWS, DIPNR and the local aboriginal community.

Rehabilitation projects should also integrate Australian Bass habitat features identified in the NSW Fisheries documentation.

Plan 7 : Key Habitats and Corridors



Provided by Department of Environment and Conservation

8 Identification of Threats – Vulnerability Classes

The identification of threats, both current and potential, to the long-term sustainability of the identified flora and fauna habitat, is included for each mapped vegetation area.

The relative vulnerability of each site to these threats has been identified and grouped into 3 classes - High / Medium / Low.

Table 16: Definitions of Vulnerability Classes

Vulnerability Class	Definition
HIGH	High Conservation Value habitats of Low disturbance levels under threat from increasing or changing disturbance regimes E.g. Encroaching urban development, weed infestations, increasing bank erosion.
MEDIUM	Existing Agricultural / horticultural practices Existing Urban situations Native vegetation with no change in disturbance regimes anticipated.
LOW	Highly Disturbed lands with no change in the disturbance regime anticipated.

Table 17: Summary of Vulnerability Classes and length of riparian zone

Vulnerability Class	Length of Riparian Zone within each class	% of total length of riparian zone mapped
HIGH	**33.484 km**	**9.65%**
MEDIUM	**184.588 km**	**53.19%**
LOW	**129.004 km**	**37.18%**

6 Active Vegetation Management / Revegetation Projects in the riparian zone of the Macleay Estuary

Table 18: Active Riparian Zone Conservation Projects in the Macleay Estuary

Upstream from Kempsey

Project	Locality or Waypoints where available	Works Description	Funding Source ***Contact Person***
(#16)	E - 0481766 N - 6563197	Demonstration of 3 types of management	Older works ? NHT NLP landholder
Bass Kempsey - Voluntary Streamcare Grants Scheme *(#12/17)*	Riverbank opposite Mary Bay – Warneton Aldavilla	Bank battering, fencing, revegetation and weed control.	Bass Kempsey / Catchment Management Authority *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#1)*	E - 0478799 N - 6560500	Revegetation and riverbank fencing, floodplain scour stabilisation	Catchment Management Authority *Macleay Landcare*
Voluntary Streamcare Grants Scheme *(#3)*	E - 0475549 N - 6560300	Riverbank fencing 700m, revegetation 900 plants	Catchment Management Authority *Macleay Landcare*
Voluntary Streamcare Grants Scheme *(#6)*	E - 0480999 N - 6563550	Shade trees and 1 off-stream watering point	Catchment Management Authority *Macleay Landcare*
Voluntary Streamcare Grants Scheme *(#7)*	E - 0480700 N - 6563600	Weed control and revegetation on riverbank 145 plants	Catchment Management Authority *Macleay Landcare*
Voluntary Streamcare Grants Scheme	E - 0479200 N - 6561500		Catchment Management Authority *Macleay Landcare*

Comparison of bank treatment in older Works upstream of Kempsey – showing fenced and revegetated (left), fenced with weed growth, no fencing.
(ArcView Site #16)

Bass Kempsey – Bank battering, revegetation works adjacent Mary Bay *(ArcView Project # 12 / 17)*

Downstream from Kempsey to Jerseyville

Project *(Arc View Project #)*	**Locality or Waypoints where available**	**Works Description**	**Year Undertaken Funding Source** ***Contact Person***
Polo Creek Bank Restoration – Kempsey Council *(#18)*	Polo Creek Bank	Active Floodgate management and vegetation rehabilitation	Kempsey Council 2005 Landholders and NSW Fisheries *Tim Morris , Ron Kemsley Kempsey Council*
Voluntary Streamcare Grants Scheme *(#14)*	E - 0497499 N - 6570100	Rock embayments to quell wave wash and revegetation using 220 plants	Catchment Management Authority *Macleay Landcare*
Private Landowner - Steve Green *(#19)*	Fattorini Island	Trialling different methods of wave barriers to protect banks from wave wash.	On-going Steve Green (landholder) *John Schmidt DIPNR*
Voluntary Streamcare Grants Scheme *(#9)*	E - 0500500 N - 6570300	Fencing of wetland and revegetation	Catchment Management Authority *Macleay Landcare*
Macleay Landcare Network *(#20)*	E - 0502800 N - 65 78700 South West Rocks Rd near Jerseyville Bridge	Slashing, spot-spraying weeds and planting 1600 lowland rainforest species Work Area - 2400m^2	2005 Envirofund $6,000 *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#10)*	E - 0500500 N - 6576000	Rock wave barriers to quell wave wash and to allow establishment of mangroves to help control erosion – 110m	Catchment Management Authority *Macleay Landcare*
South West Rocks Rotary Club *(#23)*	E - 0503500 N - 6577800 Rotary Park and Road Reserve - Jerseyville	Weed Control, mulching and planting 10,000 trees	2005 Envirofund $3000 Nestles $40,000 over 3 years *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#8)*	E – 0503350 N - 6576150	700m of fencing along river bank	Catchment Management Authority *Macleay Landcare*

Voluntary Streamcare Grants Scheme Project on the Macleay River. Rock wave barriers, planting and fencing. (E – 0497278, N – 6569866) (ArcView Project # 10 and 14)

Voluntary Streamcare Grants Scheme Project. Brush groyne erosion control works along the bank of Clybucca Creek. (E – 0500000 N – 6578100)

Rainbow Reach - Macleay Arm – Clybucca Creek

Project	Locality or Waypoints where available	Works Description	Year Undertaken Funding Source *Contact Person*
Voluntary Streamcare Grants Scheme *(#5)*	E – 0501350 N – 6579499 Pelican Island	1.7km of Wetland fencing	Catchment Management Authority *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#4)*	E – 0500000 N – 6578100 Clybucca Creek	Brush groyne erosion control works along bank, wetland fencing	Catchment Management Authority *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#15)*	E – 0500094 N – 6580209 Clybucca Creek	210m riverbank fencing and revegetation using 300 plants	Catchment Management Authority *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#2)*	E – 0499450 N – 6581700 Andersons Inlet	Weed control, removal of Lantana	Catchment Management Authority *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
(#21)	Pelican Island Boyters Lane	Tidal floodgate management and associated proposals fro Playing Fields and Wetland Management	Kempsey Council *Ron Kemsley Kempsey Council*
(#22)	Pelican Island	Fencing to exclude stock from wetland areas	Greening Australia and NSW Fisheries
Shark Island – Macleay Coastline Littoral Rainforest Regeneration Project *(#24)*	Shark Island	260 hrs of weed control undertaken between Feb 2002 and Feb 2004	Coastcare 2000-2001 South-west Rocks Dune Care and Kempsey Council *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#11)*	E – 0500349 N – 6581200 Clybucca Creek	Bank protection using rock rubble and riverbank fencing	Catchment Management Authority *Macleay Landcare Network Inc. Community Support Officer 02 65622076*
Voluntary Streamcare Grants Scheme *(#13)*	E – 0503000 N - 6579850 Pelican Island	Riverbank Fencing	Catchment Management Authority *Macleay Landcare Network Inc. Community Support Officer 02 65622076*