Natural Heritage Trust
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Rivercare

LANDCARE
NEW SOUTH WALES

Mid Wallamba River
RIVERCARE PLAN
including lower Firefly Creek & lower Khoribakh Creek

OUR ENVIRONMENT
it's a living thing
A NSW GOVERNMENT INITIATIVE

Hunter - Central Rivers
CMA CATCHMENT MANAGEMENT AUTHORITY

Department of
Infrastructure, Planning and Natural Resources

The preparation of the Mid Wallamba River (Including lower Firefly Creek and lower Khoribakh Creek) Rivercare Plan was funded by the:

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Acknowledgments
Components of the following Rivercare Plan Companion Booklet are based, with permission, on Taylor, M.C. (2004) *Mid-Ourimbah Creek (Including Canada Drop Down and Toobys Creek) Rivercare Plan Companion Booklet*, unpublished report for the Hunter Central Rivers Catchment Management Authority, Gosford.

I would like to thank the many landholders along the Wallamba River, Firefly Creek and Khoribakh Creek for welcoming me on to their properties, providing comments on the stream's behaviour, processes and management in recent and historical times. Thankyou also to those landholders for taking the time to reveal their thoughts on the issues and the management of their stream, their open-mindedness and genuine concern for the maintenance and improvement of the health of their catchment for the benefit of all.

Thank you also to Les and Alice Roberts, the members of Dyers Crossing Landcare Group and Upper Wallamba Landcare Group for supporting the Rivercare Planning project from the outset. Thank you also to Andrew Paget (HCRCMA) for assistance in the identification of vegetation specimens collected on riverwalks and report review.

Finally, a big thanks to the many landholders, and support staff from CDEP, DIPNR, HCRCMA, Landcare, Greater Taree City Council and Great Lakes Council involved in successfully initiating the Honey Locust (*Gleditsia triacanthos*) eradication project in the Mid Wallamba River area. Those people supervising and undertaking the removal of the Honey Locust as part of the CDEP Program coordinated through Purfleet Aboriginal Land Council deserve special recognition in doing the hard work that matters at the end of the day. This Honey Locust eradication project is proposed to run for several more years, however the gains already made have been extremely promising. The work to date could not have been achieved without the good cooperation of landholders. This positive relationship must be maintained for future success of Honey Locust eradication. The excellent coordination and enthusiasm by all involved over approximately a 20km length of river and tributaries has once again demonstrated the unique value of Rivercare Planning.

Cover Photograph
A successful project site for streambank rehabilitation on the Horman property, Firefly.

All photos in this report have been taken by G. Schneider.

PREFACE

The Mid Wallamba River (including lower Firefly Creek and lower Khoribakh Creek) Rivercare Plan has been produced to assist landholders with the conservation and rehabilitation of these streams.

The Rivercare Plan includes this Companion Booklet and six enlarged aerial photographs covering approximately 36km of stream length and surrounding land. Important information is collated and presented on these photographs, including infrastructure, stream information, areas of environmental or cultural significance and any perceived stream problems. The management actions and strategies for the plan are presented in two forms.

1. Recommendations for on-ground works identified for each property located on the aerial photograph enlargements. Most of these recommendations have been discussed with the relevant landholders during riverwalks. Copies of the aerial photographs are held with Dyers Crossing Landcare Group, Upper Wallamba Landcare Group and the Hunter-Central Rivers Catchment Management Authority.

2. Stream management strategies based upon conservation and restoration of physical and biological attributes. They give an understanding of how typical stream problems can be prevented rather than addressed once they have occurred. These strategies are put forward in this Companion Booklet.

The intent of the Rivercare Plan is to provide recommendations for actions to address existing stream problems present along the Wallamba River and provide landholders with information to make educated decisions regarding property management and stream health.

The plan is an important link between the community, state authorities and local government. All of these stakeholders have been involved in the preparation of the plan and hold responsibility for the implementation phase.

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1 INTRODUCTION

1.1 Aim of the Rivercare Plan

The aim of the Mid Wallamba River (including lower Firefly Creek and lower Khoribakh Creek) Rivercare Plan is to identify the strategies required to restore, rehabilitate and maintain the environment of the river and creeks (hereafter collectively referred to as ***streams***). The objectives to achieve this include:

- Mitigating the effects of active erosion;
- Identifying and conserving remnant riparian* ecosystems;
- Improving the riparian corridors to conserve and enhance streambed and streambank stability;
- Identifying appropriate weed control measures;
- Promoting healthy riparian corridors as a way of increasing farm productivity; and
- Improving water quality through the mitigation of erosion, stabilisation of riparian streambanks with vegetation, and interception and uptake of nutrients via improved vegetation "buffers" in the riparian corridor to benefit flora and fauna and water users along the creek.

* ***Riparian*** corridors are those adjacent to and including the stream zone.

The extent of the Rivercare Plan includes approximately 24km of the mid Wallamba River extending upstream from the tidal limit at Nabiac; approximately 4km of the lower reach of Khoribakh Creek; and approximately 8km of the lower reach of Firefly Creek. It also includes a Rivercare Plan Companion Booklet.

1.2 The Wallamba River Catchment

Much of the following background on the Wallamba catchment has been derived, with permission from Skelton, S. (2003) Lower Wallamba Rivercare Plan Companion Booklet. Unpublished DIPNR report prepared for Karuah Catchment Landcare Group, DIPNR and Great Lakes Council.

The Wallamba River catchment forms the major subcatchment (41%) of the Wallis Lake catchment, a major estuarine barrier-lake system located on the mid-north coast of NSW, approximately 250km north of Sydney. The Wallis Lake catchment itself covers an area of 1440km^2. It is bounded by the Manning River and Khappinghat Creek catchments to the north and west, the Kyle Range to the southwest and by the Myall and Smith Lakes to the south.

1.3 Climate

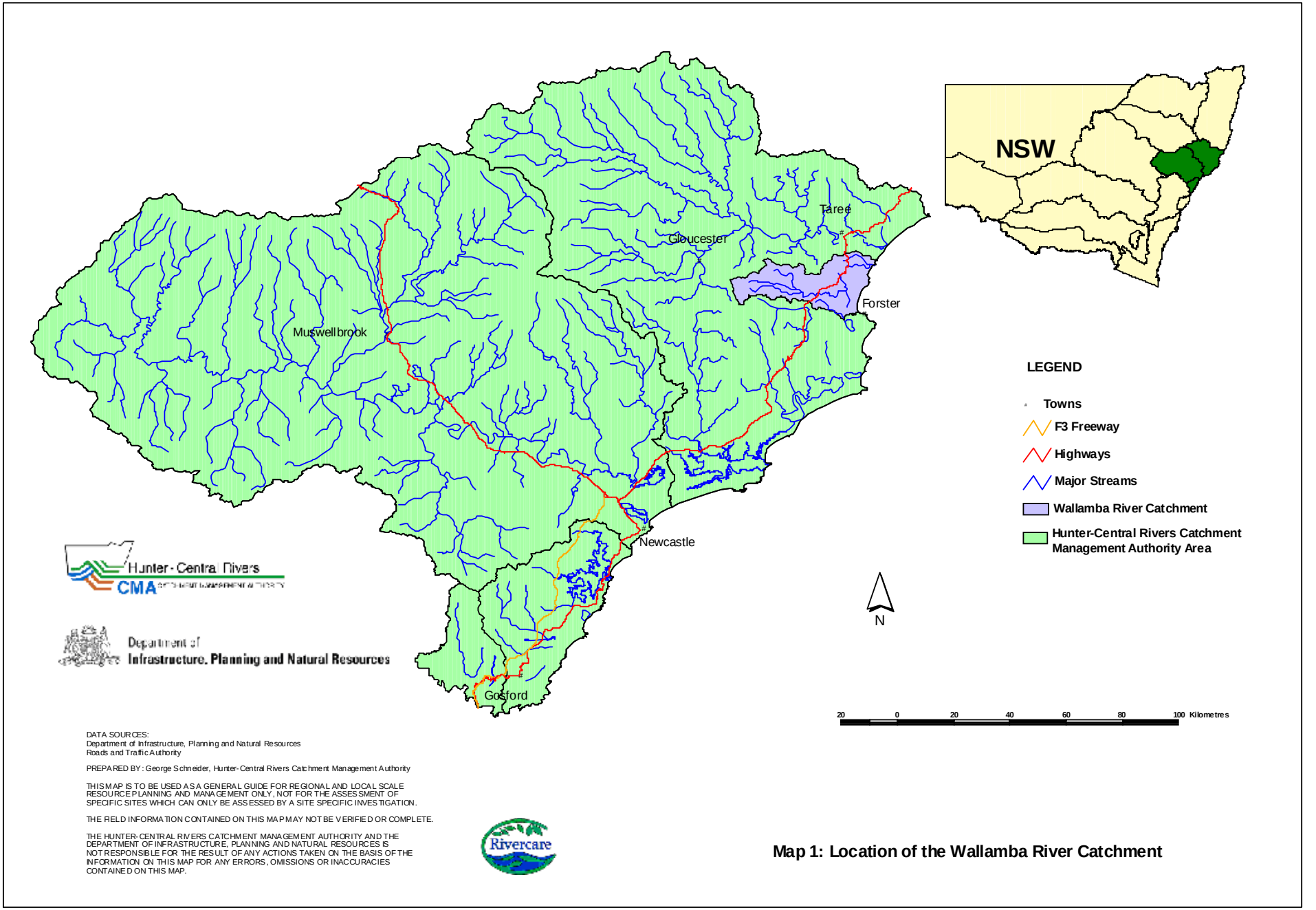
The climate of the Wallamba River catchment can generally be described as having mild to cool winters and warm to hot summers. The average climate variability of the catchment increases from the coast to the upper parts of the catchment. The coastal areas have far less variability in temperature, humidity and rainfall extremes than areas from the central and upper parts of the catchment.

The main weather station in the area is located on the coastline at Forster and has rainfall data for the past 100 years. This data is likely to be close to, but not truly representative of the climate in the Wallamba catchment. This is because the ocean greatly influences the climate at Forster, providing it with milder temperatures, increased wind activity and higher rainfalls than can be expected for the Wallamba River catchment.

Rainfall data from the past 20 years has also been collected at Bulby Brush, an area located on the catchment divide between the Wallamba River catchment and the Wang Wauk River catchment to the south. Because it is located approximately half way between the coast and the upper catchment, it is likely to be more representative of the average rainfall for the Wallamba River catchment. Unfortunately, temperatures for this area have not been provided.

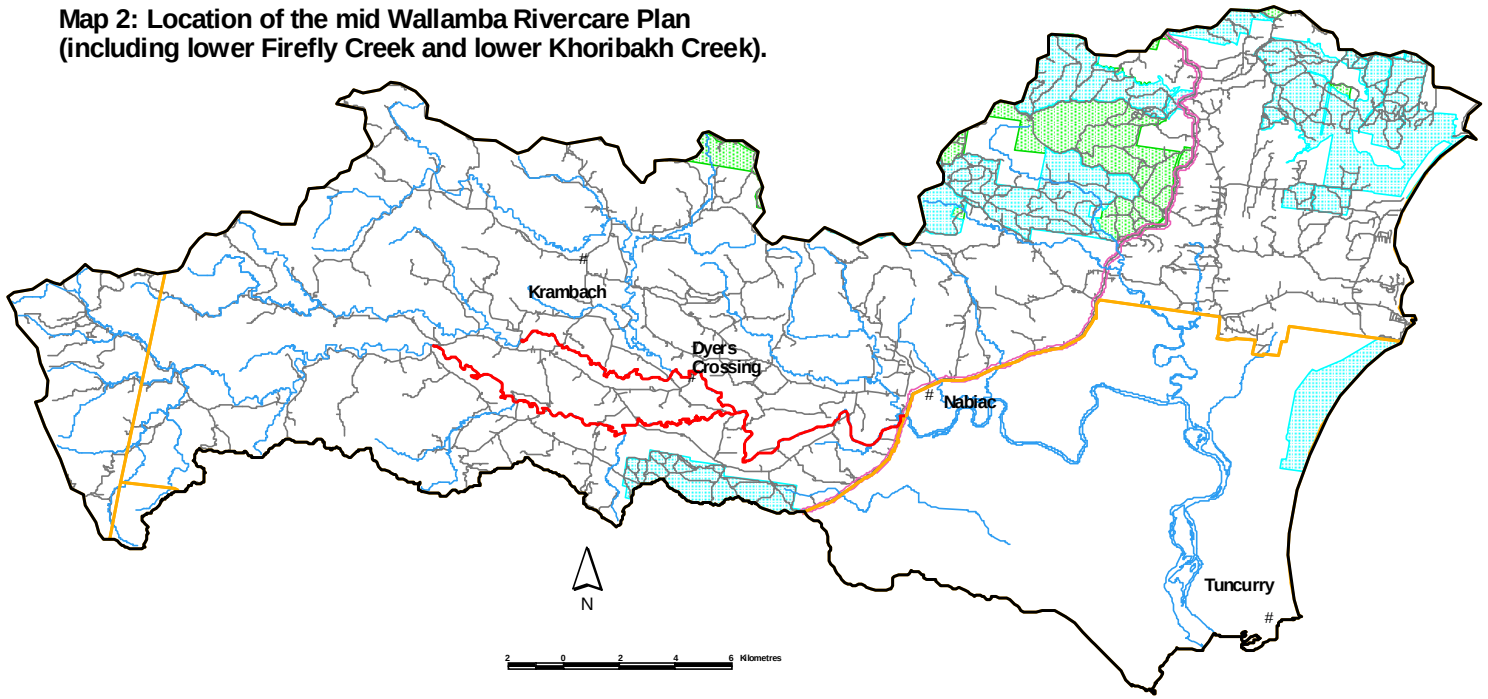
The Bureau of Meteorology (undated) in Wallis Lake Catchment Plan Steering Committee (2003) indicate that the average annual rainfall for Bulby Brush over the past 20 years is 982.2mm. They also indicate that the highest annual rainfall recorded is 1395mm and the lowest average annual rainfall is 535mm. These annual rainfall averages are all lower than those recorded at Forster over the past 100 years, with average annual rainfall at Forster being some 160mm greater than those recorded for Bulby Brush.

Webb, McKeown & Assoc. (1999) in Wallis Lake Catchment Plan Steering Committee (2003) indicate that the average daily maximum temperatures are around 27℃ in summer and 17℃ in winter. Average daily m inimums are 17℃ in summer and 8℃ in winter. These recordings are likely to h ave been taken from the Forster weather station on the coast. Further up the Wallamba River catchment, these average temperature minimums and maximums are likely to be more erratic and extreme than those recorded from Forster.



Map 1: Location of the Wallamba River Catchment

Map 2: Location of the mid Wallamba Rivercare Plan (including lower Firefly Creek and lower Khoribakh Creek).



1.4 Geology

The geology of the Wallamba River catchment can be summarised from the mapping work done by Engel *et al* (1991) in the Bulahdelah 1:100,000 scale map sheet (Geological Series 9333, edition 1). The landscape in the central and upper parts of the Wallamba catchment is dominated by sedimentary rocks of the Devonian period laid down some 400 million years ago. This geology consists of the Bundook Beds and Wallanbah Formation and includes lithic sandstones and siltstone, greywacke, limestone, mudstone and conglomerate.

Carboniferous geology including sedimentary, metamorphic and volcanic rocks of around 300million years of age exists as a north-west to south-east band on the south western boundary of the catchment and also as outcrops in the mid-catchment areas. This geology consists of the Boolambayte Formation, Nerong Volcanics and Booti Booti Sandstone. Rocks within these formations comprise lithic sandstone, conglomerate, siltstone and mudstone.

The valley floor areas surrounding the trunk streams and the lower catchment areas comprise quaternary sediments of recent geological age. These groups consist of Undifferentiated Quaternary Alluvium adjacent the trunk streams, and estuarine sand and mud deposits in the lower estuarine areas of the catchment.

1.5 Hydrology

Streams in Australia have the second highest flood variability of any country in the world and in the Hunter Region this variability is particularly high (Erskine, 1998). What this means in general terms is that the streams and creeks in the Hunter Region (including the Lower North Coast) have an extremely wide range of flood sizes compared to the rest of the world. One year there might be a flood that is the magnitude of the yearly average while the next flood may have a magnitude that is twenty times greater or more than the yearly average, for example the Wallamba River flood of 1978. This is not the case in most other countries (for example the United Kingdom) where the biggest flood in one hundred years might only be twice as big as the annual average and therefore not raise much of an eyebrow.

The Wallamba River is a relatively small stream compared to the main trunk streams of Australia's east coast however it does share similarities with the bigger streams in that it is characterised as having considerable flood variability. Australia being the second driest continent, it stands to reason that the Wallis Lake Catchment is prone to drought. Yet, it is characterised by a summer rainfall regime that can produce high magnitude floods, where flood forecasting has to be in the order of minutes to hours to be of benefit to emergency services. In short the Wallamba River exhibits highly variable discharges (see Figure 1) with the ability to cause severe streambank erosion as has been evidenced in the past.

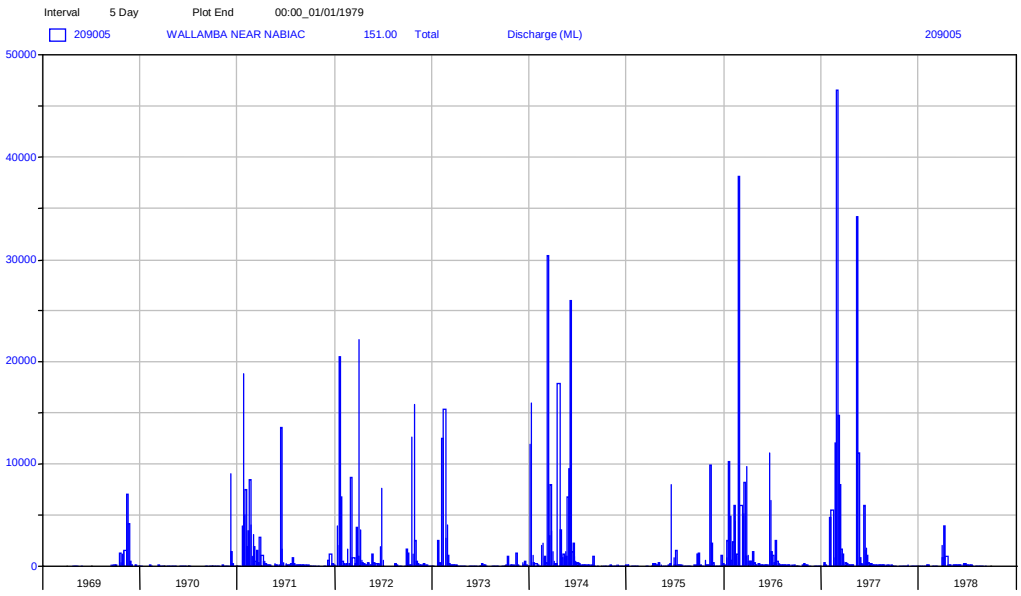


Figure 1: Flow / discharge hydrograph for Wallamba River near Nabiac (1969-78).

The major flood events last century occurred in 1927, 1929, 1947, and 1978. The largest events were in 1927 and 1929 that saw major inundation of the floodplain including the township of Nabiac (PWD 1985). NB. Figure 1 did not record the true magnitude of the 1978 flood due to the recording station being damaged during the event!

1.6 Formation of Wallis Lake

Wallis Lake has evolved as a result of fluctuations in sea levels and the deposition of sand barriers following past ice ages. About 120 000 years ago, the sea level was about 3 metres higher than it is today and many of today's coastal beaches did not exist. The coastline at this time would have lay along the western side of the lake with Cape Hawke hills forming offshore islands (Melville in Webb *et al* 1999).

During periods of lower sea levels (approx. 17 000 years ago and up to 120m below present sea level) estuaries extended further seaward onto the continental shelf. During the period that followed the sea level began to rise, vast quantities of sediment was reworked and transported landward across the inner continental shelf as landward moving sand sheets and barriers (Chapman *et al* 1982). The lower coastal plain and the stream valleys were flooded and the main lake was impounded behind one such barrier, which was transported and deposited between Cape Hawke and Booti Booti by the rising sea. North of Cape Hawke, the sand from a previous ice age formed a series of dunes that developed eastwards to eventually occupy the embayment between Cape Hawke and Hallidays Point.

Throughout the north coast of NSW, two distinct barriers are apparent: the Outer and Inner Barriers. The Outer Barrier consists of a belt of beach, dune, estuarine and lagoonal sediments from the Holocene age (<10 000 years ago). The eastern edge

of the Outer Barrier forms the present day coastline of NSW. Landward of the Outer Barrier is a second belt of marine sediments, referred to as the Inner Barrier. Radiometric dating of the humus, corals and shell has indicated that these Inner Barrier sands are from Pleistocene age or 140 000 to 90 000 years before present. The Inner Barrier can be seen as sand deposits between Failford and Nabiac. The Outer and Inner Barriers are often separated by an inter-barrier depression, which can lead to the creation of such water bodies as Wallis Lake.

This evolution of the Wallis estuary has been determined by the degree of barrier formation. This has in turn, been determined by the inherited coastal topography. As the sea level reached today's point about 6000 years ago, extensive Outer Barriers were formed across the mouths of broad shallow embayments like Wallis 'Lake'. On the landward side of these barriers, estuaries were produced in the form of broad tidal lakes connected to the ocean by tidal inlets through the Outer Barrier.

In some estuaries, flows were insufficient to maintain permanent entrances. In deep narrow mouthed embayments like Port Stephens (Nelsons bay) and Port Jackson (Sydney), these barriers of sand where unable to completely fill the mouths. The barrier sands therefore remain as submerged bars, while the estuary developed as a drowned stream valley with a wide deep mouth.

Roy (1984) classified the estuaries of NSW into three main groups with four stages of maturity. They are as follows:

- Drowned stream valley estuaries;
- Barrier estuaries; and
- Saline coastal lakes.

The different stages of maturity within each estuary reflect the gradual infilling that began 6000 years ago. Infilling has occurred from marine sand moving into the estuary by winds and tides, by fluvial deposits from the upper catchment and from the accumulation of sediments and calcareous by molluscs, plankton and diatoms.

Obviously, infilling rates vary between estuaries because of catchment size, lithology, topography, coastal setting and the geographical location of upstream catchments. Therefore, despite the common age of NSW estuary systems, a diversity of stages of maturity exists.

Wallis Lake is classified as a Barrier Estuary in early stages of maturity. It is characterised by a small upper catchment area. Consequent sedimentation rates that have occurred since sea levels stabilised have been insufficient to infill the lake (unlike the Manning estuary for example).

1.7 Soils

The soil types in the catchment have been described as part of the soil landscape mapping for the 1:100,000 Bulahdelah Map Sheet (Murphy unpublished). The soil survey has been undertaken and final publication of the mapping and soil landscapes report is imminent.

The dominant soils in the steeper slopes to the north and west of the Wallamba catchment include lithosols, with other soils including red, brown and yellow podsolic

soils and soloths. Red and yellow earths are less widespread soil types in these areas.

The lower catchment areas in undulating country behind the coastal sediments include broad alluvial floodplains that contain red podsolic soils. Upper slopes of this undulating lower catchment area is dominated by lithosols, while the lower slopes yellow and brown podsolic soils and soloths dominate.

Coastal sediments dominate the lower estuary areas of the Wallamba catchment. These sediments are variable because they have developed in a wide range of environments. Podsols and calcareous sands dominate the well-drained elevated areas, while the low-lying swampy areas, calcareous sands / solonchalks, siliceous sands, peats and humic gleys are widespread. These lower catchment areas within the tidal reaches contain both potential and actual acid sulfate soils.

1.8 Land use history

1.8.1 Aboriginal land use

There is extensive evidence of Aboriginal settlement of the Wallis catchment with over 100 sites identified along the coast and lake foreshore. These include shell middens, fish traps, campsites, burial sites, scar trees, and numerous artefacts. Three main aboriginal groups utilised the Wallis catchment: Biripi, Wallamba and Worimi. The Biripi lived in the area between Tuncurry, Taree and Gloucester, while the Worimi occupied the area between Barrington Tops and Forster in the north and Maitland and the Hunter River in the south. These people moved inland during winter to hunt and then shifted back to the coast in spring and early summer to fish. Tuncurry is an adaptation of the Aboriginal word for the area 'Toone-coo-ree", meaning plenty of big fish.

The Wallamba people of Wallis Lake had a central camp in the area now known as Coomba Park. Indications from middens suggest that the Wallamba clan had a diet rich in various types of seafood including shellfish, prawns, various fish and crabs. Nets were used for prawning; women fished from bark canoes with hooks made from shells and men hunted mullet on the beaches with spears. They also hunted kangaroos, wallabies and echidnas, while water birds also provided meat and eggs. Yams, berries and fruit from Pigface, Plum pines, Black apple, Lilly Pilly and Geebungs were also an important part of their diet (Tobwabba & Morgan 2001).

It is not known how Aboriginal land use affected vegetation or other natural resources in the Wallis catchment. From early explorer descriptions, and the fact that large volumes of timber were cut from the area, we can assume that the catchment was heavily timbered and that Aboriginal communities tended to coexist with their environs. What we do know is that Aboriginal habitation of the catchment was drastically transformed following the arrival of Europeans and the consequent land use changes.

1.8.2 Land use since white settlement

Following John Oxley's exploration of the area in 1810, cedar getters set up temporary camps along the streams by the 1830's. The Red Cedar logs were snigged to the nearest waterway and floated to ships for transportation back to Sydney. As Red Cedar supplies became insufficient, other timbers like White beech, Rosewood and Coachwood were harvested. As well as depleting local rainforests,

these early settlers began the process of dispersing local Aboriginal clans, thus leading to the loss of tribal boundaries and lifestyle (Marr 2000).

In 1826, the Australian Agricultural Company (AA Co.) was granted a one million acre parcel of land that stretched from Port Stephens to the Manning River, inland to Gloucester and down the Karuah River. The AA Co. tried various agricultural activities with limited success with dairying, beef cattle, vegetables, poultry and pigs. The humid coastal conditions were not suitable for sheep or wheat, with footrot and liver fluke effecting sheep production, while the wheat was soft and prone to fungal attack and other diseases. The AA Co. surrendered the coastal portion of its grant, including the Wallis catchment, back to the crown in 1832 in exchange for more preferred land near Tamworth.

After the AA Co. surrendered part of their land grant, the first land grant occurred around Nabiac in 1855. Nabiac was established, along with another site near Coolongolook, as timber shipping yards. Huge quantities of timber were cut from the surrounding forest from 1860s to 1920s. As the forest was cleared, dairying gradually became popular, with milk being separated on-site. The cream was sold to Butter Factories at Darawank, Krambach and Dyers Crossing, while the skim milk was used to feed pigs. The Wallamba River was an important transport route utilised by cream boats to transport local produce. A large proportion of the catchment was cleared and replaced with pasture by the early 1900's. Clearing was concentrated in those areas with better agricultural soils, like the upper Wallamba. Access to freshwater and poorer soils, in the lower Wallamba could have limited major development of the floodplain. This can be evidenced by the legacy of farming activities on Gereeba Island and West Swamp.

Land grants occurred in Forster in 1856 and in Tuncurry in 1875. A punt service was established in 1890 to connect the twin towns (replaced by the current bridge in 1959). Early industry in the area focused around timber milling, shipbuilding, and fishing. More than 80 vessels were built locally providing boats for the coastal shipping and transport system. The Wallamba played an important role in this tale with timber mills and ship building yards at Failford (Mill Road and the Brackenridges Ship Yards), as well as Bullocky Wharf at Nabiac. This legacy can still be seen on paper with numerous foreshore reserves still dedicated for ship building purposes.

Harvesting of natural oyster beds growing in shallow water of the lake began in 1881, while commercial leases were established in 1884. During the first five months of the new leasing system there were 700 applications covering some 5500m of the foreshore. This system encouraged leaseholders to improve oyster banks that were destroyed by the earlier dredge harvesting (Wright *no date*).

1.8.3 The Present

The lakes and streams of the Great Lakes have been very important to the development of the area. Prior to European inhabitation, they possibly defined routes and boundaries of original Aboriginal clans. Then the timber getters came by stream to harvest the moist valley floors for Red Cedar and other valuable timbers. Before the road and rail network was established, early coastal transport was dependent on the streams and lakes. Today the streams and lakes are used mainly for fishing and recreation activities. Changing land uses have had dramatic impacts on the condition of our waterways and are now vastly different to what our ancestors experienced.

Today our most valuable industries are tourism, oyster production, fishing and agriculture. Beef and dairying are dominant land uses in the upper catchment while tourism, oyster production and fishing dominate the coastal and estuary sections. Other major land uses include forestry, conservation and urban development. Urban areas are confined largely to the coastal strip around Forster/Tuncurry.

Land use is changing with dairy deregulation, varying beef prices and rationalisation of the timber industry. It has resulted in the emergence of niche crops and freshwater aquaculture, a growing rural residential population dividing rural holdings, and the increasing awareness of the importance of the environment to all industries.

Oyster production in Wallis Lake is very important with about 2.5 million oysters produced every year (approximate value $8 million/year). Oyster production dropped dramatically in 1996, in not only Wallis Lake but also Australia wide, as a direct result of the Wallis Lake Oyster contamination crisis. Oysters are extremely sensitive to pollutants as they are filter feeders and require clean water in order to be fit for human consumption. Obviously, maintaining and improving water quality in the Lake system is paramount to the future viability of this industry and the local economy.

Wallis Lake also supports the second biggest estuarine fishery in NSW. This can be partly attributed to 20% of the States seagrass beds being located in the lake. These serve an important role as a food source and habitat for post-larvae and juvenile fish, and are subsequently known as ‘nurseries of the sea’. Unfortunately, surveys undertaken by NSW Fisheries (1997) indicated that vast losses in seagrass beds throughout Australia can be attributed to an increase in nutrients, turbidity, sedimentation, toxic chemicals and heavy metals.

Fish species like Sea Mullet, Luderick, Flathead, Whiting, Bream, and Garfish, along with prawns and crabs make up the annual catch. There is very little data as to the sustainability of commercial fishery in NSW. Commercial catch data suggests that Wallis Lake is among the most productive estuaries for fin fish. There has however been a gradual decline in the catch, as well as a change in target species to commercially exploit species that were once discarded.

NSW Fisheries suggests that the fisheries resource is now fully exploited in NSW. Most of the target species of commercial fishers is the same as recreational fishers. Some studies have suggested that the catch rate is equivalent for both commercial and recreational fishers in populated estuaries, although this has not been assessed in the Wallis.

Today, beef and dairy cattle are the main agricultural pursuits. Australia Bureau of Statistics indicates that beef production for the Wallis catchment contributed $1.5 million per annum, while the dairy industry was valued at $3 million per annum.

Within the Wallamba River catchment, there are now (in 2004) only around 10 dairy farms operating. This is down a considerable number following deregulation of the dairy industry. In 1999 there were 48 dairies operating in the Wallis catchment with a total herd size of 3050. Since deregulation in 2000 there has been a dramatic decrease in operational farms with less than 30 dairies by 2001 with a total herd size of 2550. From this you can interpret that, although farm numbers have decreased, the average herd size has increased. This intensification of farm practices, which has been market driven, obviously has implications for the environment due to increased pressure on natural resources. However, by 2004 the dairy farms in the Wallis catchment are likely to be approximately half this 2001 figure, with the total herd size also down. The challenges for farm managers is how to implement

environmental management systems that can reduce the impacts associated with increased herd sizes and stay viable, in a market that has seen milk prices reduce by more than half in less than 5 years.

Tourism is a major industry in the Great Lakes area, with an estimated 1.25 million visitors annually. This trend is expected to increase. Recreational activities are mostly water based and include fishing, boating, water skiing, sailing, surfing, and swimming. The tourism industry is a great promoter of the natural values of the catchment and, like all other industry, is reliant on the protection of these assets to maintain and provide for the expected increases in tourist numbers and the local population.

The Wallamba River is currently utilised by many locals and tourists alike, all of which come to experience and enjoy the ideal conditions of the lower Wallamba River for water skiing activities, and to a lesser degree fishing. Unfortunately, the past and current usage patterns is compromising the natural values of the Wallamba River through the degradation of streambanks. Given the predicted population increase on the mid-north coast and the ever-increasing popularity of the water sports like wakeboarding, aquaplaning and water skiing, these impacts could also be expected to increase.

2 STREAM FEATURES

Discussed below are the typical physical features of the Wallamba River and its tributaries in this part of the catchment and their role in maintaining stability and habitat features of the stream. The main difference between the stream and the adjacent landscape is the impact of floodwaters. The concentration and transport of catchment runoff in the stream has produced features unique to its environment. In most cases not only are the features formed as a result of floodwaters but they also act as flood mitigation measures. These positive feedback mechanisms are common throughout nature and are well represented on the Wallamba River.

2.1 Vegetation

In the Wallis Lake Catchment area, approximately 44% of the catchment has been cleared. In the Wallamba catchment this percentage rises to 69%. This has lead to the fragmentation of the natural landscape, disrupting the ecological processes that underpin the integrity and therefore the function of these systems. Vegetation in the Wallis catchment is highly variable and supports a high degree of biodiversity ranging from lowland wetland ecosystems to wet sclerophyll forests in the hinterland. A total of 51 vegetation communities have been identified making up eight major ecosystem types including:

- 11 rainforest communities;
- 10 swamp forest communities;
- 8 moist sclerophyll communities;
- 6 hinterland dry sclerophyll communities;
- 7 coastal lowland dry sclerophyll communities;
- 5 heathland communities;
- 1 sedgeland community; and
- disturbed vegetation communities.

The importance of native vegetation in the maintenance and improvement of 'catchment services' is well recognised. Native vegetation helps to bind our precious topsoil, filters run-off, sequests carbon, and provides habitat for wildlife that can reduce the effects of insect pests. Remnant vegetation found on private land is vital to the future health of our farming landscapes. Without a diverse range of vegetation communities or 'biodiversity', the natural checks and balances necessary for sustainable agricultural and fisheries based enterprises will cease to function, along with the other businesses that rely on these healthy ecosystems. These businesses would include for example, the Wallis Lake oyster industry and tourism industry.

The vegetation growing along this section of Wallamba River, Firefly and Khoribakh Creeks is defined as being a riparian rainforest association.

What then classifies a rainforest?
Floyd (1989) states that:

"Rainforest is defined as consisting of a closed canopy of trees that are mainly humidity dependent, usually with more than one tree layer and containing characteristic life forms such as vines and epiphytes."

In Figure 2 below we can see the distinction between the rainforest vegetation type growing along the stream and the sclerophyll forest growing on the valley slopes.

Why then do we have rainforest assemblages existing along the stream and not in other areas of the landscape?
It is due to the fact that the environment which exists along the stream is subject to a different set of factors which when combined allow for the growth of rainforest plant species.

On a catchment scale these factors include climate, topography, soil, fire and competition from other flora. Of these the most influential factor along the stream is the fire regime. By simply being located along the stream the fire potential within the existing vegetation is significantly reduced and the rainforest assemblages have been retained over time rather than being replaced by sclerophyll forest.

Figure 2: The distinction between the riparian rainforest vegetation in the foreground and the sclerophyll community on the valley slopes in the background.

Riparian vegetation plays a vital role in maintaining the health of the Wallamba River and its tributaries. The energy of floodwaters has always reduced the stability of the channel. The vegetation which naturally occurs on the streambank has evolved such a strong network of roots that it is rarely removed during even large floods.

Added bonuses for the stream as a result of the strong root networks are the binding of the soil in which the root structures are housed and the reduction in the velocity of floodwaters. A stroll along the streambanks of an intact section of the Wallamba River or its tributaries will reveal the dense nature and extensive distribution of the vegetation. Much of the root network of individual trees combines with that of others to produce an even stronger hold in the streambank thus providing excellent stability.

In order to provide adequate stability, riparian vegetation and associated root networks often have to extend up on to the floodplain. If the width of the riparian forest is reduced, the streambanks are more likely to erode. Grazing reduces the width of the forest either through clearing or because livestock eat and/or trample young seedling trees. Eventually, mature trees die and are not replaced.

Dense riparian vegetation, along with numerous snags in the channel (see Section 2.5), will reduce the velocity of high flows by anything up to half. They do this by impeding flow. Soils on a well-vegetated streambank may receive substantially less scouring water energy that the same streambank would receive if the vegetation were removed. By adapting to the flood regime, the vegetation which grows along the stream also ensures that the very same floods do not wash the streambank away. This is due to the soil binding and floodwater velocity reduction functions of vegetation.

Riparian vegetation also provides a specialised terrestrial and aquatic habitat. This is particularly so along the Wallamba River and its tributaries where the typical stream environment, complete with pools, riffles, established streambank vegetation etc, is formed within a rainforest setting. This is home to a particularly rich diversity of wildlife. A number of rainforest features are found along the stream. These include vines, epiphytes, palms, ground ferns and lichens, as well as a tree canopy layer which forms a shady stream environment. This environment sustains many floral species and aquatic fauna including platypus, bass, yabby, turtle and water dragon.

A healthy, visually attractive buffer of vegetation along the stream also provides landholders with a financial asset due to value added benefits to their property.

2.1.1 Lessons to be learnt from riparian vegetation

- The species of plants found growing along the stream possess stronger and more extensive root systems than those found elsewhere in the catchment landscape;
- The intertwining of these root networks provides stability to the stream during flooding;
- Flood velocity is reduced by the roughness provided by vegetation growing on streambanks, gravel bars and the floodplain;
- A healthy riparian vegetation canopy and regenerating riparian successional species generally suppress weed growth;
- The stream becomes more stable the wider the buffer of vegetation; and
- Stock grazing on seedlings can kill or reduce the rate of regrowth and potentially remove the ability of old, dying trees to be replaced by regrowth.

2.2 Pools

Pools are a common feature along the stream that provide excellent habitat for aquatic flora and fauna. They are nearly always located along sections of the stream where the streambank is providing sufficient stability to withstand the erosive energy of floodwaters (see Figure 3). Rather than erode the stable streambank, floodwaters scour the streambed thus forming localised areas of deeper water.

Figure 3: A typical pool reach located on the Wallamba River.

Pools are typically located where bedrock lines the channel and on the outside of bends. Shallow, smaller pools can be found on the downstream side of large woody debris aligned across the streambed. These pools of varying size, shape and depth provide a range of habitats for fish and other aquatic animals and plants, helping to maintain a balanced, healthy riparian ecosystem.

2.3 The Floodplain

One of the most interesting features of the Wallamba River and its tributaries is the dynamic nature of its floodplain. A floodplain brings images of a flat landscape to mind. However, the floodplain located in this part of the catchment is typically undulating with deep depressions, raised ridges and numerous wetlands.

Such features are caused by floodwaters either eroding the floodplain, depositing sediment on it or creating an entirely new channel, leaving the previous one to be abandoned. Following are descriptions of the processes which form the three main floodplain features.

2.3.1 Chute Channels

In a large flood event the flow overtops the streambank and the floodplain provides a short circuit for the floodwaters. This flow can scour and shape the floodplain to produce a channel referred to as a floodchute. Once formed, chute channels become important features as they are able to transport a proportion of the water moving through the stream system during high flows thus reducing the amount transported within the channel. By splitting the flow, the amount of energy expended within the streambanks is reduced, thereby reducing erosion.

In other flood circumstances the flow may not concentrate in one section of the floodplain, but is spread out over its whole area. When this occurs, the energy of the floodwaters is dissipated, along with the capacity to transport sediment which is then deposited on the floodplain. The deposited material can either build up on the floodplain to produce a ridge, or it can fill or partially fill existing chute channels. This reworking of the floodplain (scour and fill) results in the undulating nature of the floodplain of the Wallamba River and its tributaries.

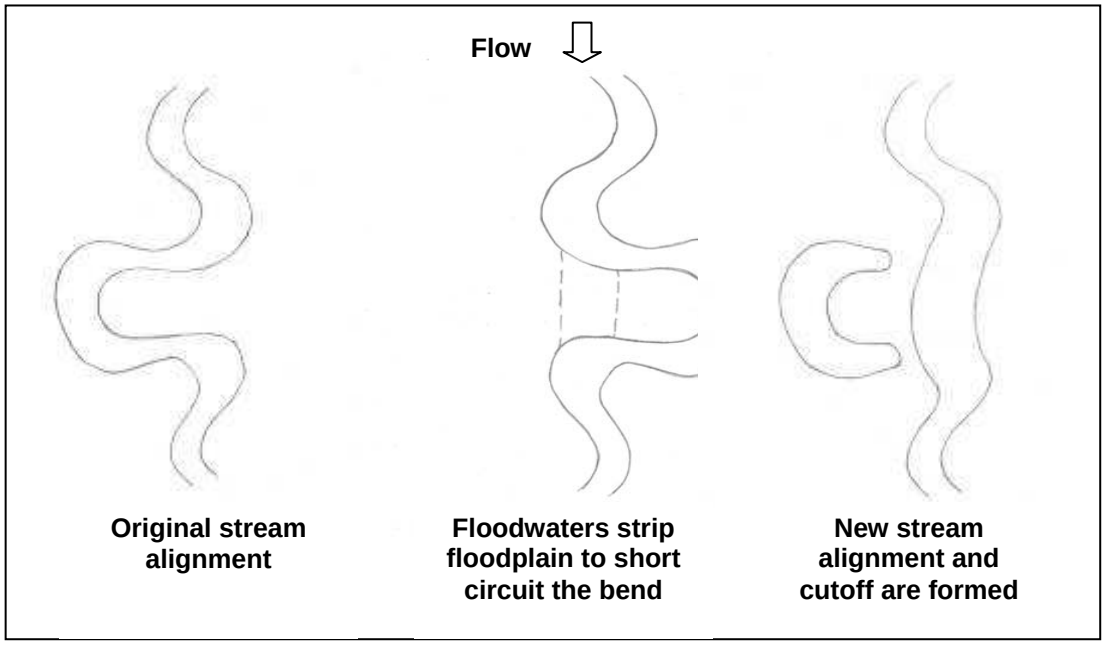
2.3.2 Abandoned Channels

If the energy of a flood is great enough, the entire alignment of the stream can be altered in a single event whereby the scouring of the floodplain is so extensive that a new channel is formed. This leaves the previous channel to become subsequently abandoned. Such sudden changes to the stream alignment are called ***avulsions***. Numerous abandoned channels are present along the floodplain. The more recent abandoned channels presently exist as wetlands, while older ones have been subjected to more floods and deposition and are thus shallower and less undulating.

Figure 4: A unique billabong / wetland in a terraced (ancient, disused) floodplain near Nabiac is an important refuge for native flora and fauna, especially in times of drought. This wetland is now used as a farm dam.

2.3.3 Channel Cutoffs

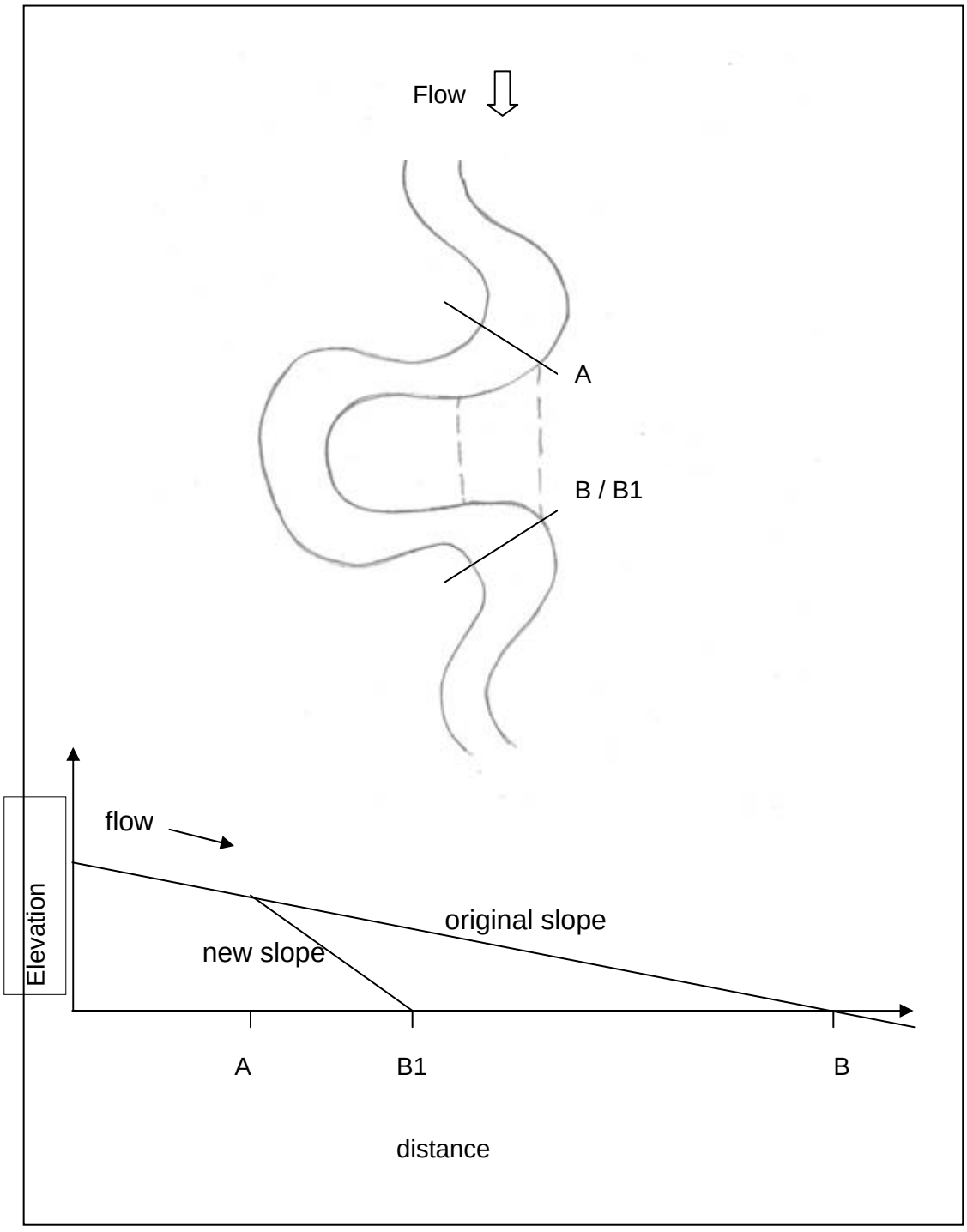
Yet another way in which the stream alignment can be drastically altered is through a channel cutoff. Cutoffs occur when a stream shortens its course, usually in a single flood event, by short cutting a bend in a process illustrated in the figure below.



(Source: Taylor 2004)

Figure 5: A diagram illustrating the process involved in the formation of a cutoff channel

When a channel cutoff takes place, the slope of the channel increases. This is a direct result of the reduction in channel length (due to the cutoff) over which the stream flows. Erosion is more likely to occur when the slope of the channel is increased as water flowing through has a greater velocity. Cutting through meanders is therefore not good for stream management.



(Adapted from Raine and Gardiner 1995)

Figure 6: Changes in the slope of the stream following shortening of channel length (known as a 'meander cutoff').

As can be seen in Figure 6, the new slope is steeper than the original. The velocity of floodwaters is therefore increased as is the potential for erosion of both the streambed and the streambanks. Subsequent erosion of the stream downstream of a cutoff is a natural process whereby meanders are reformed to reduce the velocity

of floodwaters. Essentially a bend is lost at one point and erosion must recreate another downstream.

However it should be noted that the majority of *major* stream erosion problems are caused by an inability of the channel to recover following disturbance. This is due to a combination of factors such as riparian vegetation clearing, livestock management along the streambanks and weed competition, all of which result in inadequate native vegetation cover and stability both prior to and following disturbance. The potential for recovery following disturbance is discussed in more detail in Section 3.2.

2.3.4 Lessons to be learnt from floodplain features

- Previous stream location and shape is recorded in abandoned floodplain channels;
- Their abundance is indicative of a stream type susceptible to change (erosion) and requiring adequate vegetation cover for stability;
- They transport a large percentage of floodwater and protect the main channel from erosion;
- They are responsible for the formation of wetlands;
- Cutting off a meander may give you extra land in the short term, but erosion will take it away again, either from you or your neighbour; and
- The spread of floodwaters over the floodplain reduces flood energy. This in turn results in the deposition of fertile sediment and the maintenance of high quality alluvial soil.

2.4 Large Woody Debris (Snags)

The process of streambed erosion occurs when the energy of floodwaters within the channel is great enough to pick up larger volumes of sediment than would normally occur. Under natural conditions the flood velocity is controlled by many factors. One of these is vegetation (the thicker it is the slower the water flows) and the amount of flow transferred to the floodplain.

There is however an even more important control operating in the stream which acts to reduce flow velocity and stabilise the streambed. This control is snags, otherwise known as large woody debris (LWD). Stability is provided when they are embedded in the stream during a flood and they take on a role similar to that of steel reinforcement in concrete. The erosion of streambeds can be offset by the presence of snags embedded in the streambed. When debris is aligned along the toe of the stream it can also act as buffering against the scour of floodwaters.

Figure 7: A typical section of the stream illustrating the heavy loading of large woody debris (snags) required to provide stability to the channel.

Large woody debris provides habitat for aquatic wildlife. A fallen tree provides shelter, shade and spawning sites. Water flowing over embedded logs maintains water quality by way of oxygenation. Additionally, water flowing over logs produces pools in the stream by way of localised scouring of the streambed.

The rough surfaces, hollow logs, differences in light and shade, flow regime and depth, all enrich the variety of habitats in a river. This diversity of habitat provides homes for many different animals, algae, fungi and bacteria. Snags also trap leaves and other small pieces of organic material, creating a maze of nooks and crannies and providing a variety of food sources.

Leaves and twigs washed into the stream get trapped behind snags, where they form rich reservoirs of food. These deposits of food become hotspots of microbial and animal activity. Fungi and bacteria living on the surfaces of snags contribute to its breakdown and in turn becomes food for other microscopic life forms.

Bacteria, algae and fungi form a slimy coating over the snag, called a biofilm. The biofilm provides a rich food source for many invertebrates while the snag itself is a source of food for wood boring beetles and some fungi and bacteria. As wood is broken down, carbon and other nutrients in the wood are eaten by microbes, algae and animals, which in turn provide food for other organisms in the foodweb.

The biofilm also uptakes nutrients needed for growth from water flowing past. It can rapidly remove nitrogen and phosphorus from the passing water. This reduces the supply of nutrients for nuisance algal and plant growth downstream. The removal of snags, and the loss of biofilm along with them, may severely reduce the capacity of a stream to transform and retain nutrients. Removing snags may increase the river's

susceptibility to high levels of nutrients and the resultant growth of nuisance algae and plants, such as blue-green algae.

Larger invertebrates (animals without backbones) such as beetles, bugs, shrimps, yabbies, molluscs and worms are used widely to measure stream health. Snags provide a home and food for many different types of invertebrates; the invertebrate communities of snags are often unique to that habitat. Studies the world over have shown a greater number and diversity of invertebrates in sections of stream with snags, than in sections of stream without snags.

The most important action is to protect the few remaining snags in the stream systems. Removing snags must be seen as an absolute last resort - for example, if they are immediately upstream and threatening an important asset such as a bridge. Even then, the snag can be removed and replaced downstream. The best policy is to leave snags where they are. Snag removal is likely to result in increased erosion and potentially greater flooding problems downstream. It is for this reason that for the removal or relocation of snags in any streams in NSW, a permit is required from the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR). Contact the Taree office of the Hunter-Central Rivers Catchment Management Authority (HCRCMA) for further assistance and advice if you have concerns about snags in your stream.

2.5 Gravel Bars and Benches

A bar is an area of sediment deposition within the streambed of the channel. Most bars are located adjacent to the streambank while others can be found within the channel with water flowing either side. They are formed when sediment from an upstream source is dropped out of suspension. Where does the sediment come from and why does it drop where it does? The sediment is sourced usually during a flood. Sediment comes from erosion of the streambed or can even be picked up from already existing bars.

The location of where a bar is formed is a direct result of the reduction in the energy of the carrying floodwaters. Once they lose their energy they can no longer carry sediment so it is deposited. The energy of floodwaters is reduced when the floodwater velocity is reduced. So wherever you see a build-up of sediment in the channel, you can assume this is where the velocity of the floodwaters was locally reduced. Some of these areas include among existing vegetation, on the inside of bends, or in front of large woody debris.

As the vegetation becomes more established its potential to further decrease the velocity of floodwaters increases. With this decrease in velocity there is also a decrease in the energy of the floodwaters. As the floodwaters possess energy they are unable to carry as much suspended load (fine sediments) and it drops out on the streambed of the channel. A bar with consolidated vegetation which continues to grow with each flood is referred to as a bench.

Once vegetation begins to grow on bars the fine sediments are held in place by the root network of the vegetation, reducing the likelihood of this sediment being re-mobilised in the next flood. Therefore not only does in-stream vegetation growing on bars reduce flood velocity and initiate formation of benches, it locks up sediment so that it is no longer mobile in flood and cannot fill in pools.

So in effect the sediment derived from an eroded streambank is used downstream to create benches. Where a streambank erodes, the channel widens at this point. Where a bench is formed, the channel narrows. A balance is achieved through the natural cycle of erosion and recovery. This cycle also contributes to the stream having numerous meanders.

2.6 Bedrock

Bedrock is located on hillsides (valley margins) and at varying depths beneath floodplains (i.e. beneath deposited alluvial soil). The channel of the Wallamba River, Firefly Creek and Khoribakh Creek encounters this bedrock when it flows adjacent to the valley margins. This is why we sometimes see bedrock lining one side of the channel when it flows up against a hill and why it is absent when its course runs through the floodplain.

At the top of the stream catchment the valley is very narrow and floodplains are non-existent or very small features. As such the stream abuts the valley margin regularly. This explains why most stream channels are made up of large amounts of bedrock at their headwaters. As the stream flows the valley widens, the floodplain area increases and the stream encounters the sides of the valley less and less. As such an increasingly smaller percentage of the stream channel is lined by bedrock.

When the stream meets the bedrock at valley margin it either makes an abrupt turn and heads back into the floodplain or runs along side the edge of the valley. This explains why we see bedrock only on the bends in the stream or where it hugs hillsides.

The 36km section of Wallamba River, Firefly Creek and Khoribakh Creeks focused upon in this plan of management is located in an area of the catchment where significant floodplain areas exist. For the majority of its course the stream flows through alternating sections of floodplain and valley margin. As such the material of which the streambanks are composed is mainly erodible, fine grained alluvial soil on the floodplain side of the channel and non-erodible bedrock on the opposite side.

The natural controls that exist along the stream to reduce erosion potential where it is not bedrock lined are provided by vegetation alone. The role of streambank vegetation is discussed in Section 2.1. The role of vegetation, once it falls or is removed from the streambank and becomes large woody debris or snags, is discussed in Section 2.5.

3 RIVERCARE PLAN RECOMMENDATIONS

The Rivercare Plan identifies the activities required to improve the condition of the Wallamba River, Firefly Creek and Khoribakh Creek. These actions vary from broad objectives to specific works and projects. The plan provides a sound basis on which to set priorities for managing the creeks. The more specific management recommendations on the aerial photograph have been prioritised based upon the potential to increase/reduce stream degradation in the short and long term, the concerns of the landholder and the ecological and economical importance.

The broader management actions in this Companion Booklet are aimed towards addressing the main issues described, both in the short and long term.

Some of the management options will be within the capability of landholders to achieve, while others will require financial and/or technical assistance. Advice of a technical nature and on funding assistance can be sought from:

- The Hunter-Central Rivers Catchment Management Authority (HCRCMA); and
- Karuah-Great Lakes Community Support Officer (CSO).

See Appendix 5 for contact details.

For landholders that own property within the Rivercare Plan extent, an aerial photo of the property outlining stream features as provided on the following page. Accompanying this photo is some specific recommendations for the property, focusing on the conservation or rehabilitation of the mid Wallamba River, lower Firefly Creek or lower Khoribakh Creek. Further details on implementation of the recommendations suggested for the property can be found throughout this Companion Booklet.

Map 1: Aerial photograph of the property and riparian management recommendations.

This section of the Companion Booklet aims to give landholders along Wallamba River, Firefly Creek and Khoribakh Creek strategies to tackle some of the issues raised in the stream planning site visits. The strategy identifies and discusses the issue, then suggests actions to be taken to address that issue.

The issues identified during meetings and site visits included:

1. **Weed infestations;**
2. **Threats to natural recovery processes;**
3. **Channel erosion;**
4. **Stock damage to streambanks and vegetation; and**
5. **Instream impediments to fish passage.**

3.1 Weed Infestations

Once weed species find their way into a particular area it is very difficult to completely remove them. If unchecked they can dominate entire landscapes including riparian corridors. When weed species become established the integrity of the stream is compromised and reductions in habitat representation and channel stability often take place.

One of the key messages for weed control in stream areas is that good canopy cover provided by native indigenous vegetation is one of the best methods for weed control. Many weeds are opportunistic in that they are to some degree colonisers of disturbed environments (for example an eroded streambank). The main reason behind this is that light is abundant. Therefore the principle behind utilising an established canopy for weed control is one of reducing light penetration to the ground, thus restricting weed proliferation.

This type of management does not take place overnight. Many weed control projects are long term and sometimes not as straight forward as just removing the infestation by cut and paint methods. If this mental leap can be made, the type of weed management options open right up. Sure, you can go in if you want and in a couple of days cut down every privet along your streambank, but will this approach work if you don't go back and maintain the site every day for the next 3 years? Do you have the time for such follow-up work?

Outlined below are some techniques currently being adopted by a number of landholders and managers along the creeks to tackle the species which pose the most serious threat to native vegetation regrowth or the health of the aquatic environment in the stream channel itself. These species are Wandering Jew, Small-leaved Privet, Broad-leaved Privet, Honey Locust, Canadian Pondweed and Lantana.

3.1.1 Wandering Jew (Tradescantia albiflora)

Wandering Jew forms a blanket along the ground. This blanket significantly reduces the number of native saplings, which would come up under normal circumstances. How does Wandering Jew achieve this? By limiting the amount of light which reaches the ground surface and producing a more moist, friable soil texture in which seedlings struggle to germinate.

Figure 8: Wandering Jew smothers the ground preventing germination of native seed.

Actions

- Within 20m of the top of the bank of 'Prescribed Streams', the removal (including cutting, poisoning or trimming) of any weeds not declared as 'noxious', require approval under the NSW *Native Vegetation Act 2003* from the DIPNR.
- Does not produce seed, reproduces entirely by vegetative means.
- Is easily hand-pulled from the soil or even raked up like a carpet.
- Can be piled on top of itself like a brush turkey's nest. It may subsequently grow on the surface of the pile but not if sprayed with glyphosate (eg. Roundup Biactive® at a rate of 15ml per litre of water).
- Remaining shoots can be managed by hand-pulling or spot spraying with glyphosate from a spray bottle (used like a water pistol).
- Its removal as a ground cover allows for significant increases in the rate of native vegetation regrowth.
- It is not as difficult to manage as is typically perceived, although follow-up weeding is essential.

3.1.2 Small-leaved Privet (Ligustrum sinense) and Broad-leaved Privet (Ligustrum lucidum)

Every property visited along the 36km section of the Wallamba River, Firefly Creek and Khoribakh Creek addressed in the plan had Privet growing somewhere along the streambanks. Such is the extent of this highly invasive species indigenous to China and Japan.

Small-leaved Privet is widespread along Firefly Creek, Khoribakh Creek and the upper Wallamba River to just downstream of the Wallanbah Road / Waterloo Road turnoff (just downstream of the Soper property). Small-leaved privet appears to be so widespread that its eradication is unlikely. Landholders do however have the potential to drastically reduce its density by incorporating its control as part of their wider property weed control program.

Broad-leaved Privet is less widely distributed, it is not as common in the upper parts of the Wallamba River or on Firefly Creek. It is however the dominant weed along the mid Wallamba River, particularly in the Waterloo Creek area from just downstream of the Wallanbah Road / Waterloo Road turnoff (just downstream of the Soper property), to just downstream of the Dargavilles Road crossing (near the Fresen property). The relative smaller distribution of this weed means that at the moment, it could potentially be significantly reduced from the local catchment. This would however require substantial government and community resources, which are unfortunately unlikely at this point in time.

Figure 9: A section of streambank lined with established Broad-leaved Privet near Barry's Road.

Actions

- Within 20m of the top of the bank of 'Prescribed Streams', the removal (including cutting, poisoning or trimming) of any weeds not declared as 'noxious', require approval under the NSW *Native Vegetation Act 2003* from the DIPNR.
- Use Roundup Biactive® on smaller plants (stem diameter up to 5cm) as per the directions on the label.

- Undertake stem injection with Round-up Biactive® on larger trees to reduce your workload as per the direction on the label
- Simple scraping of the thin (1-2mm) outer bark will stop a Privet in its tracks. This is similar to ringbarking a tree but much less work and can be done using a knife or even a pen lid! It is also a good idea to scrape the roots if possible, as they tend to sucker.
- Aim to gradually remove the foliage cover and increase light penetration. Increase your time frame. Multiple applications may be necessary.
- Aim to instigate successional regrowth of natives beneath established Privet canopies by way of multiple stem injections combined with piling of Wandering Jew. The poisoning of the Privet gradually removes the foliage which then falls to the ground to become part of the humic layer. Piling of the Wandering Jew allows for increased regrowth. Depending upon the seed source, large numbers of native saplings may shoot to compete with the dying Privet canopy. This type of management involves very little manual labour.
- Always retain stumps on streambanks. Alternatively, the removal of stumps also requires approval under the NSW *Rivers and Foreshores Improvement Act 1948*.
- Work your way through an area from the edge of the infestation.
- Be on guard if you are considering de-stocking a paddock. Infestation is almost a certainty if the previously grazed area is left to its own devices and there are existing Privet assemblages located alongside the creek. Evidence of this is abundant along Wallamba River and Firefly Creeks.
- To prevent large-scale re-infestation it is advisable to use mature existing Privet trees to your advantage as nurseries for rainforest seedlings. This technique can be practised in areas where Privet is occurring amongst established native rainforest assemblages and the rate of natural regeneration is still relatively high. In such instances a more efficient way of controlling Privet is to concentrate on the native sapling rather than on the Privet (or any other weed for that matter eg Wandering Jew). Spray with Roundup Biactive® around the native sapling to decrease competition for nutrient and water whilst retaining the Privet.

Retaining the Privet whilst increasing the survival of natives has three advantages. Firstly, the Privet canopy is not removed therefore the light regime remains unaltered. If the light regime is dramatically increased the likelihood of massive regrowth of Privet seedlings is almost guaranteed, thus eliminating the hard work undertaken to remove the initial tree or infestation. Secondly the nurturing of already existing native saplings and seedlings often removes the need for large-scale revegetation jobs to be undertaken following Privet stem injection projects. Thirdly, the Privet nursery protects against frost and scorching sun in similar fashion to the native riparian vegetation canopy.

Once the native undergrowth has reached a certain growth stage and they are providing a level of shade, then mature Privet trees can gradually be removed using stem injection methods.

3.1.3 Honey Locust (Gleditsia triacanthos)

Honey locust out-competes and replaces native vegetation growing along the Wallamba River by forming a dense monoculture with restricted habitat for wildlife. In areas where dense infestations form, they smother pastures and harbour vermin like cats, foxes and rabbits. The sharp barbs on its branches injure wildlife and livestock. These barbs can also puncture tyres on tractors, quad bikes, utes and other vehicles, restricting vehicle movement in areas where infestations occur.

The seeds of Honey Locust are hard coated, and therefore seeds from one season may germinate over a number of years. Follow-up control of seedlings must therefore operate over a similar time-scale to seed germination.

Honey Locust occurs over approximately 15km of the Wallamba River, with the heaviest infestation occurring over approximately 5km at the upstream extent of the infestation from the Kendall/Black property boundary as shown on the Rivercare Plan.

Figure 10: The distinctive trunk of Honey Locust.

Figure 11: The deciduous bright foliage and bean-like seed pods are a distinguishing feature of Honey Locust.

Actions

One of the main outcomes from this Rivercare Plan has been the initiation of a coordinated Honey locust eradication program. The Rivercare Plan provided opportunity to identify the extent of the infestation, to identify and engage landholders affected by the infestation, and to identify a strategic and coordinated control program.

This control program will now be supervised through the Mid North Coast Weeds Advisory Committee, in partnership with local landholders, Dyers Crossing Landcare Group and Upper Wallamba Landcare Group. Within 20m of the top of the bank of 'Prescribed Streams', the removal (including cutting, poisoning or trimming) of any weeds not declared as 'noxious', require approval under the NSW *Native Vegetation Act 2003* from the DIPNR.

The eradication program is proposed to involve contracting a team accredited in weed control and chemical use to start at the upstream extent of the infestation, and work their way to the downstream extent, killing all Honey Locust plants in areas where they are identified. The main method of control will involve basal barking.

Further details on Honey Locust and methods to be used for its control are detailed in a Fact Sheet produced by the Queensland Government shown in Appendix 8.

3.1.4 Canadian Pondweed (Elodea canadensis)

Canadian Pondweed is a submerged aquatic plant common in domestic fish tanks. In fact legend has it that this weed was purposely introduced to the lower Wallamba by people with interest in the aquarium industry which utilises this weed for planting in fish tanks. This weed is now choking the channel of the lower Wallamba in the fresh water section from the old Pacific Highway Crossing at Nabiac, to the pool just upstream of Clarkson's Crossing on Dargavilles Road. Fortunately this weed does not tolerate high salt levels in water, so it will not spread further downstream. This biggest threat at the moment is the spread of this weed further up the river and into other streams in the area by waterfowl and ducks. As this plant spreads vegetatively, fragments of this weed can potentially be carried to other areas literally on the back of ducks!

Actions

The large flood of October 2004 has shown that this weed can be reduced by high velocity flows, easily detaching it from its roots and washing it downstream. Unfortunately, this weed is unlikely to be eradicated by good flood flows alone.

The only realistic method of eradication of this weed in the lower Wallamba upstream of the tidal limit at the old Pacific Highway Crossing, is to re-introduce saline water to this reach for a period of time to eliminate it from this large pool. However, the Canadian Pondweed infestation also occurs above Clarkson's Crossing on Dargavilles Road, an area which is substantially higher than the area of tidal exchange. It is therefore unlikely that eradication of this weed in the lower Wallamba can be achieved by introducing tidal exchange to the long pool between these two crossings alone. Additional to this, now that the local ecology of these pools have fully adjusted to a predominantly freshwater environment, the reintroduction of salt to these pools is likely to negatively impact significant amounts of riparian vegetation and associated freshwater ecosystems in this reach over the short-term.

3.1.5 Lantana (Lantana camara)

Lantana was introduced from South America as an ornamental garden plant and now is estimated to cover over 4 million hectares in Australia. It spreads by seed.

A number of dense, impenetrable thickets have taken over the native riparian vegetation along the Wallamba River, Firefly Creek and Khoribakh Creek. It competes for resources with and reduces the regrowth of native species as well as contributing fuel to fires. It has no serious animal or disease predators in the local area and has a remarkable ability to regenerate, regrowing vigorously from root and stem suckers as well as seed dispersed by birds, foxes, wind and other vectors. It also has the potential to grow into the upper canopy of mature native trees. It is a serious threat to biodiversity in the Lower North Coast.

Figure 12: Lantana in flower

Actions

Pure stands of Lantana

If there are no other desirable plants in an area and soil disturbance can be tolerated, then Lantana can be cleared using machinery, manual labour or both. The alternative is to remove the Lantana (retaining roots in the ground if on the streambank) using chain or hand-saws in a staggered fashion, leaving some plants in the streambank to provide stability. Lantana can also be hand-pulled from areas in large clumps, as it tends to grow in a matted fashion. It is also a good idea to employ a mosaic removal of large stands of Lantana as a consideration of any native animals using it as habitat. Any areas of streambank cleared of Lantana should be revegetated with indigenous riparian plants.

Lantana mixed with native plants

Lantana competes successfully with native trees and shrubs and is a major cause of vegetation changing from a predominantly native community to one dominated by introduced species. Plants can be cut near the stump either with a bush saw or chain saw. The exposed stump then needs to be immediately treated with a registered herbicide, as this plant is renowned for its ability to re-shoot. To avoid contamination, do not spray herbicide within 2 metres of the water's edge. It is a legal offence to pollute waterways, and herbicide spray drift is classified as pollution! Aim to minimise damage to streambanks and riparian vegetation by seeking advice at the time of applying for the weed control approval.

Follow-up control after an initial effort may include any or all of the above methods. This may be done quarterly or when re-shooting and newly germinated Lantana occurs.

Note: The methods listed above are most effective in spring when sap is flowing.

Controlling of the species described above requires a permit under the NSW *Native Vegetation Act 2003* if they are located within 20m of the top of the streambank of these prescribed streams. Other approvals, such as a 3A permit under the NSW *Rivers and Foreshores Improvement Act 1948* may also be required. These approvals must be sought from the DIPNR.

Always seek advice from the NSW Department of Primary Industries (Agriculture) as to which herbicides are registered for use on any particular weed, and which herbicides are appropriate for use near streams. Further information on weed control can also be sourced from their website at http://www.agric.nsw.gov.au/reader/weeds.

Appendix 2 lists weeds declared noxious at the time of preparation of this report in the Greater Taree City Council Local Government Area. Landholders have a legal obligation to control these weeds on their property and are therefore encouraged to familiarise themselves with these weeds so that control can be initiated before it is too late and heavy infestation has occurred. Links to website information on weeds is also provided. Weeds not declared noxious (ie. they do not appear on this list) require a permit under the NSW *Native Vegetation Act 2003* for removal adjacent to the stream (See Appendix 3)

3.1.6 Herbicide Use Near Streams

When using herbicides near water, great care must be taken to avoid contamination of the water. To do so is an offence under the *Protection of the Environment Operations Act 1997*. The only herbicides that should be used near streams are Roundup Bi-active® and equivalents.

Generally, the preferred method for controlling regrowth or weeds near streams is the "cut and paint (poison)" method. There are two reasons for this. Firstly, to minimise the chance of polluting the stream. Secondly, when controlling weeds on streambanks, to avoid damage to valued vegetation and to prevent streambank instability.

Spraying in only recommended for growth less than one metre high. Spraying must be carried out in calm conditions and the spray directed away from the water. There must be no spraying within two metres of the normal flow water level. Any town water supply authority should be notified prior to spraying herbicides near streams.

3.2 Threats to Natural Recovery Processes

Following a flood, a section of your streambank may have suffered from erosion. You may be faced with a slumped streambank, a fallen tree or scour around a log jam. In an attempt to rectify the situation many landholders who manage a stream on their property may want to remove snags, place fill or even line the streambank with rock. However, erosion is a natural process and the stream possesses built-in

mechanisms to recover from such events. These natural mechanisms of recovery are driven by vegetation. They are cheaper to implement and more effective in the long term than more engineered approaches.

Since European settlement of the Wallamba River and its tributaries, the rate and extent of recovery following disturbance has been affected by two factors. These are livestock access to the stream and competition from exotic plants. Both factors undermine the role that native riparian vegetation plays in maintaining and restoring channel stability.

When the streams flood, a number of events commonly occur. These are discussed below, with actions for their management.

3.2.1 Full Natural Recovery

Prior to disturbance, the stream may be functioning naturally. Vegetation cover was well established, continuous along the streambank and floodplain and there were no weeds. Floodwater velocities were kept to a minimum due to the roughness provided by established vegetation and the abundance of snags. There was no livestock access to the channel and the roots of trees, shrubs and grasses would combine to bind soils together, significantly reducing erosion potential.

Following a flood or storm event, small isolated areas of erosion along the streambank or streambed may occur – possibly from a log that has been washed out, or from a tree along the streambank that has fallen into the channel. This can be considered a natural erosion event which would occur even without human intervention.

This section of streambank will undergo a phase of natural recovery. Vegetation will grow adjacent to the toe of the eroded streambank and form a bench of sediment. As the vegetation becomes more established, so too will its ability to locally reduce floodwater velocity resulting in continued sediment deposition until the bench replaces the eroded streambank. The native vegetation that will establish on the bench will be sourced from the existing surrounding populations. There will be no invasion of weeds in the disturbed area owing to the site history that is one of conservation of a natural setting absent of weeds.

Actions

Continue conservation management, which includes exclusion of livestock along the streambanks. This allows for natural recovery processes to take place through retention of native riparian vegetation. Recovery processes may include:

- in-stream bench development (bank replacement);
- stability and habitat restoration on the streambanks by vegetation growth and establishment;
- stability and in-stream habitat restoration by snag (LWD) recruitment;
- locking up of sediment mobilised in erosion events by vegetation establishing on benches and gravel bars.

3.2.2 Part Recovery

In many sections of the streams assessed by this Rivercare Plan, livestock access to the channel have reduced the width, type and density of vegetation on both sides of the creek. As a result, streambank stability is reduced, thus increasing the potential for erosion during high flows, particularly on outside bends with insufficient vegetation.

Following the removal of grazing pressure from livestock, bare or eroded streambanks that are left to recover without any restoration works quickly re-establish with vegetation through natural regeneration. Unfortunately this vegetation is often initially dominated by weed species such as Privet (*Ligustrum spp.*), Honey Locust (*Gleditsia triacanthos*), Wandering Jew (*Tradescantia albiflora*), Kikuyu (*Pennisetum clandestinum*) and Wild tobacco (*Solanum mauritianum*).

Native plants that are able to compete with the weed species include Brush Kurrajong (*Commersonia fraseri*), Wattles (*Acacia spp.*) and Bracken (*Pteridium esculentum*). These species are usually the first to colonise following disturbance and take the opportunity of freshly deposited sediment or exposed alluvium. Where dense stands of the weeds Privet, Honey Locust, or Lantana, or the native pioneer species like River Oak, Brush Kurrajong or Wattles are located on Wallamba River, Firefly Creek and Khoribakh Creek it is usually a tell-tale sign of prior disturbance.

Over time the ratio of riparian native to weed species may gradually increase or species such as Small-leaved Privet may dominate until manually removed. Examples of both scenarios can be found along the Rivercare Plan reach.

In any case a degree of stability and habitat is restored to the eroded streambank. However, the stability and habitat are not restored to the level which would be reached solely by established indigenous riparian vegetation. This is due to the fact that the prevailing vegetation cover is either partially or entirely provided by species which have *not adapted* over time to the physical and hydrological conditions of the creek, namely the soil type and flood regime. In other words, if a large enough flood occurs weeds will most probably be ripped out. If there are inadequate amounts and density of established native trees, shrubs and groundcovers, smaller native trees may also be ripped out.

Actions

If left to its own devices, increasing native vegetation cover combined with that of weed species may provide sufficient stability during medium flows (say 1 in 2-year flood events). For larger floods it is unlikely that the existing vegetation cover will provide adequate stability on alluvial outside bends of the stream and areas where floodwater flows are directly impacting on the channel. The potential for further erosion is therefore high. Considering the significant competition from weed species and the resulting lack of native vegetation cover, it is recommended that a project combining weed control (see Section 3.1) and revegetation be undertaken at such sites.

A study of the site history may also explain why full natural recovery has not taken place. Prior and/or continuing livestock access to the site may reduce the recovery potential of the eroded streambank. If so, a project of livestock access reduction incorporating alternative shade and watering is recommended to allow for the long-

term recovery of the streambank and / or to protect any revegetation works undertaken.

3.2.3 Ongoing Degradation

Ongoing degradation of the channel is typically a result of livestock access to the channel. Continual grazing and trampling reduces the effectiveness of native vegetation cover along the streambanks. In some cases, vegetation cover has been damaged and reduced to bare ground or sparse weed and grass cover as a result of livestock feeding and movement. Channel stability in these situations is often poor and the erosion potential is high.

Ongoing flood events and continued livestock access to some degraded sites have not allowed for native or exotic vegetation establishment on the streambank to the extent where it is providing a sufficient degree of stability and ecological habitat. Degradation processes, such as channel straightening have the potential to increase the velocity of floodwaters, causing flows to now pass over a shorter distance with an increased slope (see Section 2.3.3).

Bends may be eroded which has resulted from this increase in energy. The channel may be moving (eroding) into the floodplain in an attempt to increase its radius. The greater the meandering of the creek, the slower the flow will become. Therefore this erosion into the streambank is a recovery process of the stream to slow flows through steeper sections of the creek. The erosion of the bend will continue until it has reached an alignment which sufficiently reduces the amount of energy forced upon the streambank by floodwaters and the slope is reduced by the increase in channel length.

Actions

Even under natural conditions, in the event of a channel cutoff upstream, it is likely that downstream erosion of the streambank would take place to re-establish meanders in the creek. However, natural recovery would also occur and stability would be brought back to the channel.

In the scenario described above the accelerated rate and extent of erosion and loss of valuable floodplain soil could be reduced by reducing livestock access and increasing stability of the streambank by way of revegetation.

In extreme cases, it may be necessary to install streambed erosion control structures and undertake revetment of the channel using logs or large rocks secured to the toe of the streambank to reduce the potential for further undermining and slumping.

3.3 Channel Erosion

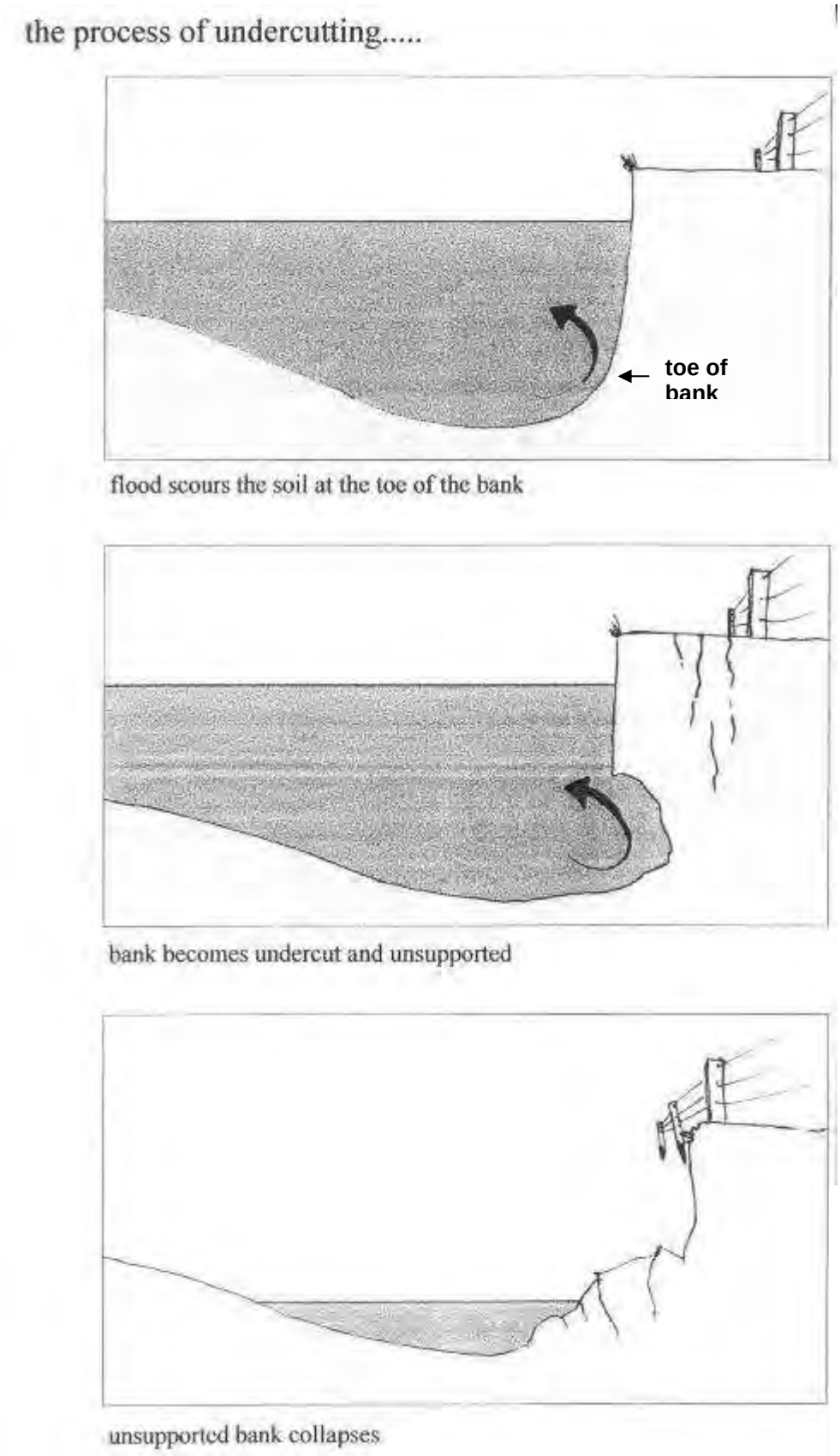
Streams are dynamic systems that change more quickly than other landscape features as they transport concentrated volumes of flowing water (catchment runoff). Along the Wallamba River, Firefly Creek, Khoribakh Creek and their tributaries, this rate of change over time is evidenced by numerous previous channel alignments found on the floodplain (see Section 2.3). What this tells us is that many years ago the stream was once located in a different position in the landscape and the process

by which it altered its alignment was through *natural rates* of erosion and deposition of the streambanks.

The rate of channel movement is relatively high along some sections of Wallamba River, Firefly Creek and Khoribakh Creek owing to a combination of the relatively steep slopes and the material of which the streambed and streambanks are composed, ie. gravels and fine-grained alluvium. These sediments are sourced from the weathering and erosion of siltstone, mudstone, lithic sandstone and conglomerate bedrock. Being fine-grained, they are more easily eroded. Two main types of erosion occurring along this section of the stream are streambank scour leading to undercutting and streambank slumping.

3.3.1 Bank Undercutting

The body of water flowing down the stream in a flood travels at varying velocities, depending upon its location in the channel. When travelling around a bend the floodwater velocity is greater on the outside than on the inside of the bend due to centrifugal forces. The higher velocity water has more energy which can more easily scour the face of the streambank. However the area where the greatest floodwater velocities occur is on the outside of bends along the *bottom* of the streambed. This causes undercutting of the streambanks. The flowing water erodes away the toe or base of the streambank, leaving the top section unsupported. When the streambank collapses, the floodwater continues to erode the fallen material eventually undermining the next section of streambank. This sequence of events is illustrated in Figure 13.

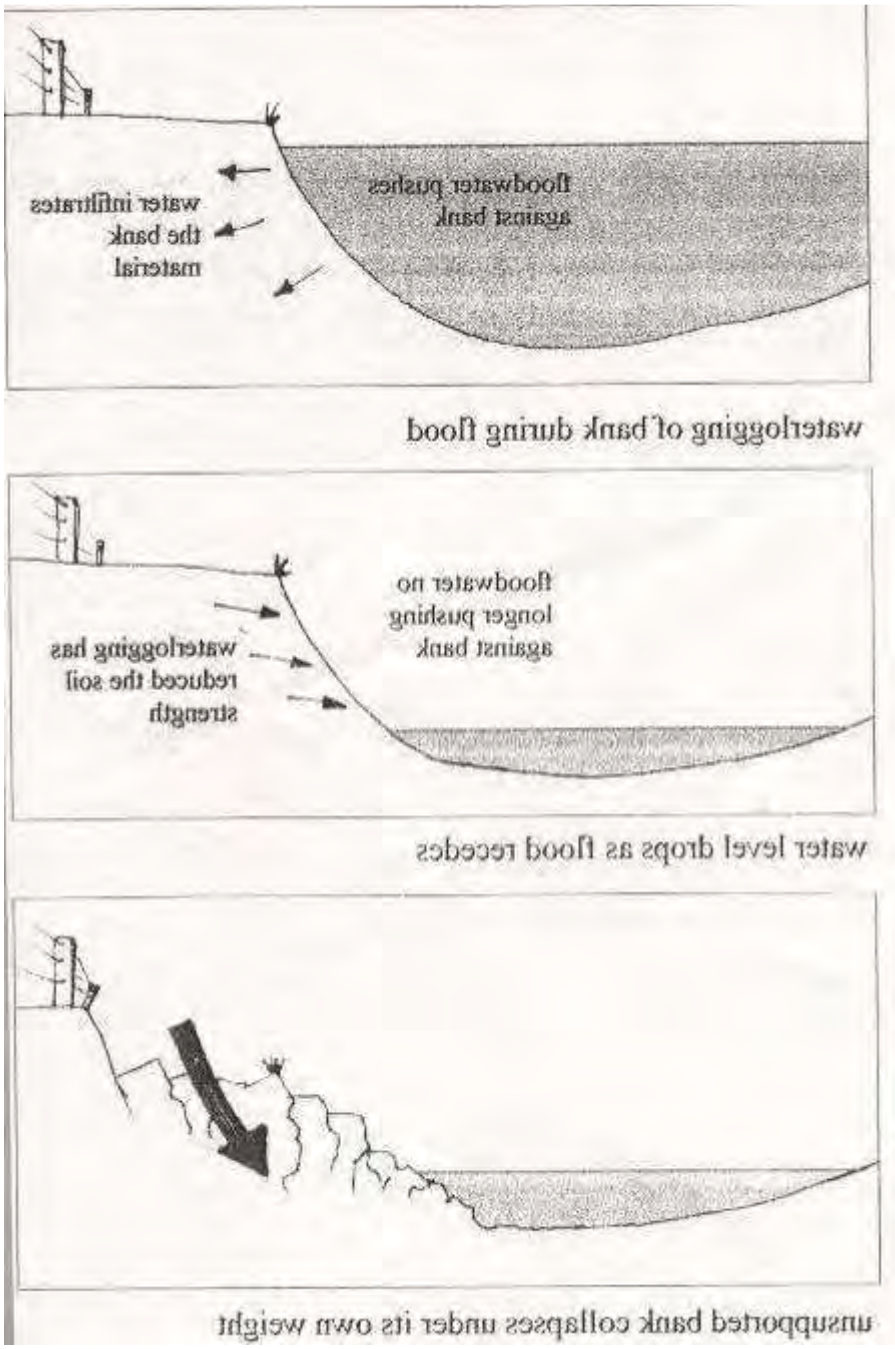


(Diagram, Johnson 2000)

Figure 13: The process of undercutting

3.3.2 Bank Slumping

During a flood, the streambanks are likely to become saturated. When the stream level falls, the saturated streambanks can then collapse under their own weight if they are not sufficiently supported by vegetation. This erosion type occurs where grazing has removed riparian vegetation, leaving shallow-rooted species, such as Kikuyu, Lantana, Privet or Wandering Jew, in their place. This type of erosion is referred to as streambank *slumping.*



(Diagram, Johnson 2000)

Figure 14: The process of streambank slumping

Actions

- Wallamba River, Firefly Creek and Khoribakh Creek all display sections where there is extensive, wide buffers of native vegetation. As described in Section 2, this vegetation provides stability to the channel and acts as the single most important control in preventing erosion.
- The existing vegetation should be managed with a view to long-term conservation of the streambank maintenance attributes it affords the channel.
- Those sections where the buffer is insufficient, regeneration of native vegetation should be encouraged. This should be undertaken by controlling livestock access along the stream to ensure that ongoing regrowth of the endemic vegetation takes place and is not eaten or trampled by feeding and movements. This may require undertaking of streambank fencing and/or installation of off-stream livestock watering and shade (wildlife corridors) projects. See Section 5.
- Weed infestations occurring within the riparian vegetation community should be controlled to maintain biodiversity, streambank stability and native regrowth potential.
- All large woody debris should be retained within the stream channel to provide stability to both the streambed and streambanks.

3.4 Livestock Damage to Streambanks and Riparian Vegetation

The effects of livestock on the streambanks was apparent whilst walking the river. Livestock can cause damage by grazing and trampling vegetation and by direct pugging and loosening of soil on the streambanks. On many properties, lack of livestock control in the riparian corridor has caused streambank erosion. This is due to livestock not allowing native vegetation to regenerate on streambanks which are bare or have a lack of streambank protecting vegetation.

3.4.1 Stock Management

Stock management along the stream allows for the conservation and/or enhancement of riparian vegetation. The ideal way to manage livestock is to exclude or reduce their access to the streambank by constructing a fenceline (see Figure 15). The design and nature of the fencing (electric, barbed etc) is dependent upon a number of factors namely, the type of livestock and alignment with the direction of floodwater flows.

Figure 15: The regenerative capacity along this section of stream (background) has been increased by limiting livestock access. Alternative watering has been supplied in the form of stream water pumped to a dam for reticulation to water troughs throughout the property.

Depending upon the condition of the streambank proposed to be fenced, a supporting project of revegetation may or may not be required. On nearly all of the properties where fencing is recommended along Wallamba River, Firefly Creek and Khoribakh Creek, revegetation would not be necessary due to the regenerative capacity of existing vegetation in the vicinity. Simply by excluding livestock from the streambank, indigenous vegetation will re-colonise from existing seed sources.

A number of logistical, often property-specific, problems are raised when considering the issue of livestock management along a stream. These include providing alternative watering, alternative shade, fencing requirements, their costs and the potential for subsequent weed invasion to name a few. These problems can in most cases be overcome in any river system, however the first step is to have an understanding of the role of vegetation in maintaining stability and habitat along your section of stream and why such vegetation should be protected or restored.

Actions

- Undertake livestock management at sites as recommended which are mapped on the Rivercare plan with advice from the HCRCMA Rivercare Officer (Taree office) as required. Funding sources available to carry out livestock control along streams, including streambank fencing are identified in Appendix 1.

- Stock control does not necessarily mean that total exclusion is necessary. Sufficient livestock control may be achieved through a combination of lower stocking rates to reduce grazing pressure on streambanks; controlled grazing; off-stream watering and off-stream shade to entice livestock away from the stream. Provision of designated watering points on inside bends of stream where erosion will be minimal is also good livestock management practice.

- When fencing streambanks, do not erect fences which are expensive if they are likely to be collected by the next flood. Consider simple "sacrificial" fencing such as using only one electric wire/tape with a solar electric fence kit if other sources of electricity for the fence are not available. Such fences are low cost and low maintenance if they are within flood reach. If the fence can be erected on a high streambank, do so. This will minimise the fence being taken by a flood, lowering costs and maintenance in the long run. If unsure about livestock control/streambank fencing, seek advice from the HCRCMA Rivercare Officer (Taree office).

- Identify livestock management proposals on individual Property Plans. Prioritise areas for management. The most densely vegetated sites should get highest priority – look after the best bits first! If landholders have no Property Plan, look at carrying out one through the NSW Department of Primary Industries (Agriculture) at Tocal.

3.5 Instream Impediments to Fish Passage

At the time of carrying out riverwalks for the Rivercare Plan, there were investigations by NSW Fisheries and the DIPNR into issues associated with the existing old Pacific Highway crossing at Nabiac. This crossing is believed to restrict fish passage in the Wallamba River in times of low flow. Being at the upper reach of the tidal channel, the structure has also controlled tidal waters entering the upstream pool, in all but the biggest of tides (king tides). Local Council has issues associated with the structure in terms of liability to people injured using or coming in contact with the structure. Additional to this, the prevalence of the introduced freshwater aquatic weed Canadian Pondweed in the upstream pool could be controlled to some degree by re-introduction of tidal exchange to the affected reach.

Concerns by the landholders upstream of the structure are mainly associated with the integrity of water quality for extraction licences. Removal of the structure would re-introduce tidal exchange to the upstream reach, making their modified freshwater pool more regularly saline again. It would also convert the existing vegetation which has adjusted to a freshwater environment, back to a salt tolerant riparian community. It is proposed that wider community consultation will be undertaken if further actions into the possibility of removal or modification of the structure are considered by NSW Fisheries, Greater Taree City Council and the HCRCMA.

Unfortunately, this structure is not the only one potentially impeding fish passage up the Wallamba River and the majority of its associated tributaries. There are another three major natural fish passage impediments, and another four constructed barriers in the reaches covered by the Rivercare plan alone. These structures are detailed in the table below.

Table 1: Location of impediments to fish passage on the Wallamba River and Firefly Creek identified in the Rivercare Plan.

Structure Type	Location	Comments
Natural bedrock outcrop/cascade	Firefly Creek on the Stevens Property upstream of Dyers crossing	This is a natural rock outcrop stepped in total to approx 1.5 to 2m in height.
Natural bedrock outcrop/cascade	Wallamba River just upstream of the Dargavilles Road Crossing	This is a natural rock outcrop stepped in total to approx 1.5 to 2m in height.
Natural bedrock outcrop/cascade	Wallamba River just downstream of the Woolnough dairy, Dyers Crossing.	This is a natural rock outcrop stepped in total to approx 1.5 in height.
Weir	Firefly Creek at Dyers Crossing	A man-made weir for the old butter factory. Approx 2m in height.
Road Crossing	Clarkson's Crossing at Nabiac on Dargavilles Road	A concrete causeway approx 0.5m above the existing bed level.
Road Crossing	Wallamba River on the Kneller property, Dyers crossing.	A concrete causeway approx 0.5m above the existing bed level.
Road Crossing	Wallamba River on Barrys Road (off Waterloo Road)	A concrete causeway approx 1.5m above existing bed level

Actions

Natural instream impediments to fish passage such as rock outcrops or cascades should not be considered for removal or modification. These are natural features to which stream ecology and geomorphological process have adjusted over millennia.

In contrast, there are a number of potential positive and negative factors associated with the removal of man-made structures impeding fish passage. Any future consideration to the removal of any of the man made structures to assist fish passage must consider:

- the potential for initiating streambed and streambank erosion;
- the potential for releasing large slugs of sediment trapped behind the structures to fill downstream pools;
- the degree of adjustment of channel morphology and ecology to the existing structure and the amount of re-adjustment required following structure removal;
- the benefits of structure modification or removal in light of existing structures and natural fish impeding features upstream and downstream;
- the effects of structure modification or removal on adjacent landholders upstream and downstream of the site;
- the benefits of removal of the structure to stream ecology and fish populations;
- the benefits of removal of these structures to the wider community, such as through commercial and recreational fishing.

4 STREAM REVEGETATION

When looking at an aerial photograph of the Wallamba River and its tributaries to determine the location of the channel, one can be excused for remarking - “Crikey, I can’t see the stream for all the trees”. Such is the regenerative capacity of the native riparian vegetation found along many Lower North Coast streams. How is this related to undertaking a project of revegetation along your section of the creek? Well, if stream vegetation regrowth has been occurring naturally for years it just may be the case that natural regrowth rates may be as good as or even better than any you could achieve by planting!

Take a stroll underneath the canopy of any remnant vegetation community shown on the plan (with landholder permission of course) and you will be astounded at how many saplings are racing upwards for a spot in the canopy. In most cases natural culling of many individual saplings will take place in these circumstances, as the existing community cannot accommodate such thick stands of trees.

Along a streambank, these high rates of regrowth take place following disturbance such as streambank erosion. One of the best ways to determine whether or not you will need to plant, as opposed to letting nature do the work, is to undertake a bit of investigation along your streambanks. What you are looking for is a section of streambank which has previously eroded. The easy ones to spot are those which took place recently - maybe in last year’s floods. The more difficult ones to distinguish are those that are older and now have vegetation growing on them.

Another way to tell if a streambank has eroded in the past 10 years is to look at the shape of the channel. Streambanks which have been stable for a long period are gently sloping with mature trees on them, whilst eroded streambanks are usually vertical with no mature trees on them. You may even know of an erosion site from a previous flood. Are there still weeds after 2 or even 5 years? Has Privet or Wandering Jew taken over the area? Is there just a layer of Kikuyu grass or is the erosion almost imperceptible due to a thick layer of native vegetation growing over it?

Once you have undertaken some investigation along your stream you will know whether planting is required or not. If you do need to plant, what steps can you take to begin a revegetation project?

The first task is to ensure that the correct species are being planted on the streambank. Always use indigenous plants grown from locally sourced (*local provenance*) seed. The survival of planting’s will be significantly increased by utilising indigenous provenance species, ie species that have adapted to local climatic, environmental and soil conditions, including flooding, droughts and insect attacks. Appendix 6 provides a basic list of plant species commonly growing along the stream which would be ideal for revegetation. This list is by no means exhaustive, but provides an indication of the common species which are local to the area.

Great Lakes Council and the NSW Department of Infrastructure, Planning and Natural Resources have also produced a revegetation guide for the Wallis Lake catchment, including the area covered by this Rivercare Plan. Copies of this revegetation guide can be sourced from your local Community Support Officers (CSOs) or from the HCRCMA office at Taree.

Tubestock required for planting may be obtained from your local nursery. Be sure to ask if the tubestock has been grown from local seed. It is advisable to contact one of the Karuah-Great Lakes Community Support Officers in the first instance as they may be able to provide information on how to grow your own tubestock. Additionally, the HCRCMA administers a devolved grant program, which has in the past provided funding for fencing, tubestock, off-stream watering troughs and wildlife corridors (including shade lots to replace shade previously provided by riparian vegetation) for riparian landholders. Before undertaking a planting project it is advisable to contact a Rivercare Officer from the HCRCMA who will be able to provide advice on revegetation techniques such as location of tubestock on the streambank, density of plantings, materials required and maintenance.

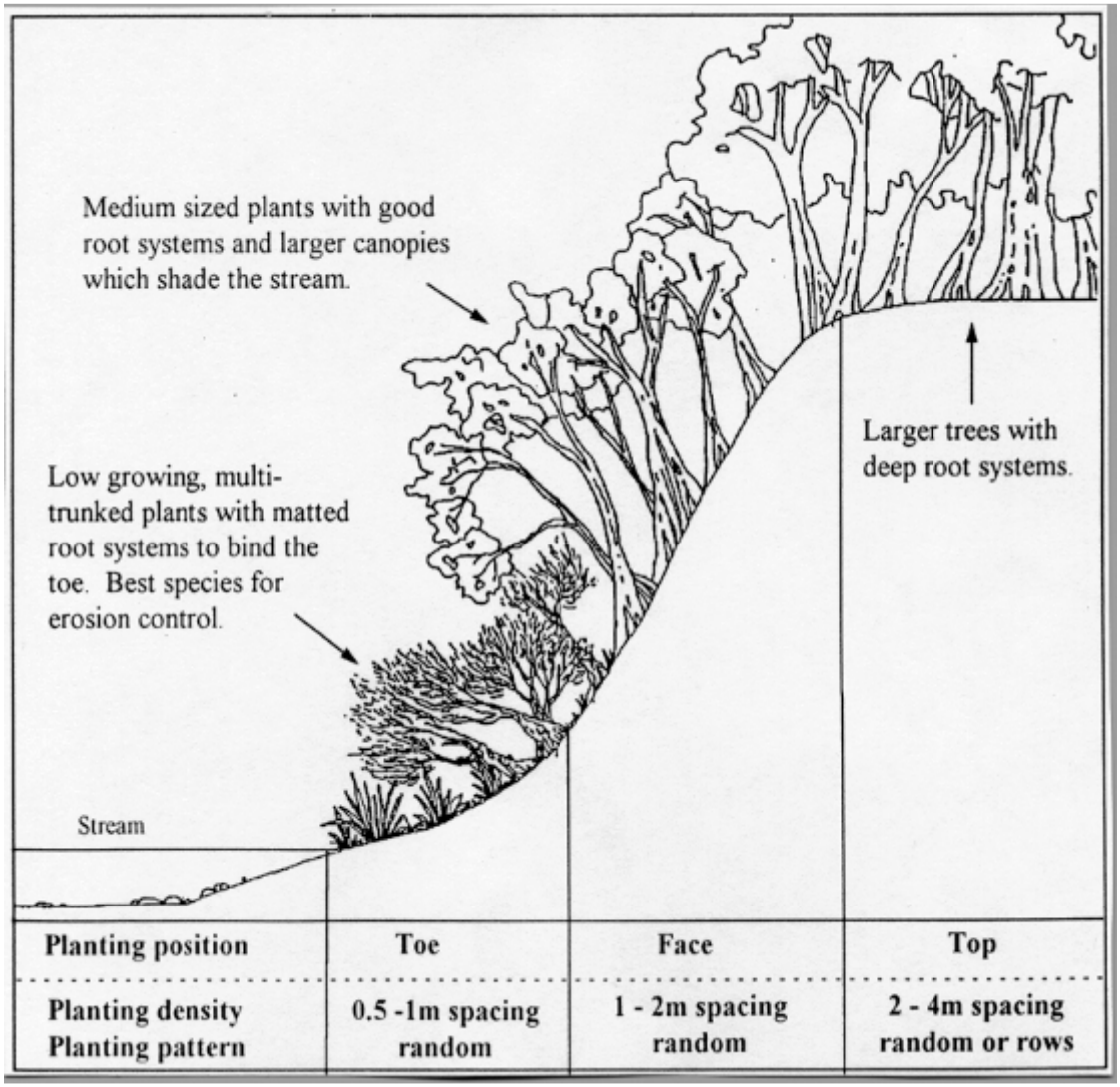


Figure 16: Plant species selection and planting position.
(Source: Raine & Gardiner 1995)

4.1 A note on stream restoration

The flood has receded and you stroll down to check the fences. Once you get there you discover a huge section of the streambank has disappeared. It looks like a bomb has gone off. Don't despair, it's happened countless times in exactly the same spot! Yes that's right, erosion is a commonly occurring process along the stream and it's restoration can be achieved cheaply without having to buy and install rock, hire excavators or drag logs out of the channel etc.

What is the key to restoration along these particular creeks? Allowing for the restoration of streambank stability. In areas where there are no weeds or livestock the solution is straight forward – sit back and watch. Nature will go through the processes of recovery regardless of your concerns. However two things need to be noted with regard to this type of recovery:

1. The rate of recovery will take place at the rate of vegetation regrowth, ie. it will not take place overnight as a rock job would.

2. The stream may adjust during its phase of recovery. Such factors as flood frequency, alignment of any large woody debris etc may determine whether or not subsequent erosion will take place during the recovery period.

If you have a weed and stock-free section of stream which has recently eroded, rest assured that recovery will take place.

Not all landholders along the stream are fortunate enough to have weed-free frontages or fencing to manage stock. Again, do not despair, recovery can and does take place, however it may take longer and not be up to scratch in terms of stability and habitat if weeds provide too much competition. Managing livestock and weeds at an erosion site allows for native regrowth to occur at a maximum rate.

5 SEEKING ADVICE – PERMISSIONS

You may require permission from one or more state government organisations before you can commence works identified on the Rivercare Plan. At the beginning of planning a project, you should seek advice from the relevant authorities to determine if approval and requirements are necessary. Although this plan has been endorsed, you may still require permission to do work.

What do I need to do if I want to clear vegetation?

You will need to determine whether your clearing proposal requires development consent under the *NSW Native Vegetation Act 2003*, and/or if other restrictions apply. Please read the fact sheet provided called The NSW Government's *Native Vegetation Act 2003* which gives an overview of the process for clearing applications under the *Native Vegetation Act 2003* (see Appendix 3).

What do I need if I want to undertake activities in or near rivers, lakes and wetlands?

You will need to determine whether your activity, for example excavation, building a structure or removing material from a river, requires a permit under the *NSW Rivers & Foreshores Improvement Act 1948* and/or if other restrictions apply. Please read the fact sheets provided, which provide guidelines to assist in determining the need for a permit (see Appendix 4).

Who do I contact?

1. Your local Department of Infrastructure, Planning and Natural Resources (DIPNR) at Newcastle, telephone 4929 4346; or
2. Your local office of the Hunter-Central Rivers Catchment Management Authority (HCRCMA) at Taree, telephone (02) 6552 2788.

Depending on the activities you wish to undertake, permission may also need to be sought from other government agencies such as the Parks & Wildlife Division of the Department of Environment and Conservation (DEC) or Fisheries Division of the Department of Primary Industries (DPI). So remember to consult early with the relevant government agencies to discuss your proposal.

6 INCOME TAX CONCESSIONS

The *Income Tax Assessment Act, 1936,* and relevant sections relating to Landcare deductions, have been replaced by the *Income Tax Assessment Act 1997*. Deductions are still available, and in fact may be enhanced under the revised Act. A general explanation of deductions is contained in a brochure produced by the Australian Taxation Office, titled *A Guide to Tax Incentives for Landcare*.

Please seek further advice from your accountant or the Australian Taxation Office before claiming any of these deductions.

7 IMPLEMENTATION

The implementation of the management options identified in this Rivercare Plan is the responsibility of individual landholders and groups with assistance from local and state government agencies. A stream management specialist is available for assistance with undertaking the property-specific recommendations outlined in the plan and can be contacted at the HCRCMA Taree office on (02) 6552 788. Your local Community Support Officer may be able to assist with more general advice such as showing examples of revegetation, techniques of seed raising, etc.

7.1 Funding Assistance

There are currently various funding programs available to assist groups and individual landowners in implementing on-ground works which have been identified in this management plan. Current funding sources are listed in Appendix 1.

7.1.1 Provision of Technical Advice

This plan refers to technical advice needing to be sourced from the HCRCMA. The HCRCMA will provide technical advice, as requested, but it should be noted that this will be subject to departmental resources available at the time of the request. Technical advice may be provided as printed material. Where technical resources are not available, landholders may be directed by HCRCMA to other technical providers and in some cases, fees may apply

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9 GLOSSARY

Aquatic Ecosystem
All living and non-living elements of a water-based environment and the relationship between them.

Avulsion
A process which occurs in an overbank flood situation where floodwaters scour a new channel in the floodplain.

Bank Erosion
Scour or slumping of the streambank caused by the energy of flowing water or collapse due to saturation.

Bank Sheer Strength
The force per unit area that must be applied to a streambank before it commences to erode.

Bar Stabilising Vegetation
Riparian vegetation that colonises point bars and mid-channel bars within stream systems

Bedrock
Solid rock as part of the underlying geological foundation.

Bed Lowering
Erosion of the streambed of the channel resulting in a lowered streambed and higher streambanks. Initiated by headcuts which move in an upstream direction.

Biodiversity
The variety of life forms, the different plants, animals and micro-organisms, the genes they contain and the ecosystems they form.

Catchment
The area of land drained by a stream and its tributaries.

Channel Roughness
A measure of the resistance to flow created by elements within a stream channel, such as vegetation and snags.

Channel Widening
A process whereby streambed lowering results in increased streambanks with increased heights which subsequently collapse leaving a wider channel.

Ecosystem
Communities of organisms and their physical environment interacting as a unit.

Environmental Weed
A weed species which has the potential to out-compete and replace native species.

Estuary
A zone of mixing of fresh and salt water in the lower reaches of a river, including mouths of rivers, bays, lagoons and wetlands.

Floodplain
The area of land located between the valley margin and the stream over which floodwaters flow when they have overtopped the streambanks. They are formed from deposition of sediment transported in floodwaters.

Groundwater
Water beneath the surface held in or moving through saturated layers of soil, sediment or rock.

Gully Erosion
The removal of soil by running water, resulting in the formation of channels sufficiently large enough that they disrupt normal farming operations and are too large to be filled by normal cultivation. Typically associated with erosion of the streambed of a trunk stream which leaves tributaries elevated and susceptible to erosion.

Headcut
The actively eroding point in the streambed of a channel or gully (usually a drop or waterfall) that initiates streambed lowering.

Indigenous
Has evolved naturally in the local area.

Landcare
Groups of people from the same area who join together to do things to benefit the environment. They are involved in activities as wide as erosion-control, planning, planting native vegetation and awareness raising. Dyers Crossing Landcare Group can be contacted on (02) 6550 2220 and Upper Wallamba Landcare Group can be contacted on (02) 6559 1719.

Large Woody Debris
The term used to describe wood or 'snags' within a stream channel.

Native Vegetation
Plant species originating in Australia.

Natural Recovery
The process whereby unassisted regrowth of vegetation re-colonises the streambed, bar or streambank of a stream to restore stability and habitat.

Natural Resources
The assets of land, water, plants, animals and air.

Noxious Weed
Weed species as listed in the NSW *Noxious Weeds Act*.

Palaeochannel
An inherited network of old, inactive channels, now partially or entirely filled. Includes more than one meander, thus differentiating it from a channel cutoff.

Pool and Riffle Sequence
Refers to changes in the long profile of a stream where it typically alternates between deep, still water (pool) and shallow, running water (riffle).

Property Management Plan
A plan developed by land managers for management of their business. Assistance may be provided by a government agency.

Remnant Vegetation
An area of vegetation that has a high conservation status owing to the fact that it was once more widespread on the catchment.

Revetment
Strengthening of the streambank by way of rock or log lining

Riparian Corridor
A riverine corridor consists of a stream, its streambanks, floodplain and the land immediately adjacent to those areas along the stream that is required for maintenance of the ecological functioning and human use of the corridor.

Riparian Livestock Management
Management of livestock along rivers and streams to reduce impacts upon habitat, water quality and stability.

Riparian Vegetation
Vegetation situated on or belonging to a streambank.

Rivercare
A program coordinated by DIPNR to develop and implement community-based plans for the improvement and stabilisation of the riparian corridor.

Sedimentation
The process whereby material, of varying size, is deposited away from its site of origin by the action of water, wind or gravity.

Valley Margin
The point where the bedrock slope of the valley meets either the floodplain or the channel.

Watertable
The level below which the ground is saturated with water.

Wetlands
Land areas along fresh and salt water courses that are flooded all or part of the time, leading to the development of a characteristic suite of plant and animal communities and determining the type and productivity of soils.

10 APPENDICES

APPENDIX 1: FUNDING SOURCES

SOURCE NAME	DESCRIPTION	APPLICATION DUE DATE	CONTACTS
National Heritage Trust Mark II	**Envirofund (see** http://www.nht.gov.au/envirofund/ **)** Community groups and individual landholders may gain access to individual grants through the local action component. These grants will provide small amounts of funding, up to $30,000, to address local natural resource management issues.	Ongoing	Hunter and Central Rivers Catchment Management Authority 98 Victoria Street (PO Box 440) Taree NSW 2430 (02) 6552 2788 – Tel (02) 6552 2047 – Fax Or contact Helen Marston Karuah / Great Lakes Community Support Officer (CSO) 6554 1655 – Tel. 0428 607 370 – Mob. or Email: kgl_landcare@telstra.com Or contact Peter Davies Wallis Lake Community Support Officer (CSO) (02) 6591 7306 – Tel. 0427 540 260 – Mob. or Email: peter.davies@greatlakes.nsw.gov.au
Hunter-Central Rivers Catchment Management Authority (HCRCMA)	**Incentive Scheme** This scheme is funded from NHT Mark II. It funds projects for improved land management, restoration and conservation of natural resources, including riparian areas, soils, vegetation and biodiversity.		
	Property Vegetation Plans (PVPs) A PVP is a legal agreement voluntarily negotiated between a landholder and their local Catchment Management Authority (CMA). The PVP process has been designed to support landholders in the management of their native vegetation, including to: • provide the basis for applying for financial incentives; • provide long-term security; • provide approval for broad-scale clearing if it improves or maintains environmental outcomes; • secure offsets associated with clearing proposals; • reduce the need for repeated development applications to manage native vegetation; • allow greater flexibility to propose management options for a property that complement the region's Catchment Action Plan.		
	Soil Conservation Projects **(Section 10 projects)** Facilitate the coordination of well-designed structural works and the adoption of sustainable land management practices to protect catchment health and minimise off-site impacts.		

NSW Environmental Trusts	Administered by EPA. The Objectives of the Environmental Trust are: • to encourage and support restoration and rehabilitation projects; • to promote research into environmental problems of any kind; • to promote environmental education in both the public and private sectors; and • to fund the acquisition of land for the national parks estate.	Open May close July – August each year.	Environmental Trust PO Box A290 Sydney South 1232 Phone: (02) 9995 536 E-mail: envirotrust@epa.nsw.gov.au http://www.epa.nsw.gov.au/envtrust/index.htm
	Restoration and Rehabilitation (community and state and local government) $3.5 million	End of August each year	
	Protecting our Places (Aboriginal grants program) $500,000		
	Eco Schools 27 August 2004		
	Environmental Research (community organisations, universities and research institutes) $1 million	End of July each year	
	Environmental Education (community and state and local government) $1 million		
Greening Australia	**Green Corps** Involved with projects that significantly contribute to environmental and cultural heritage initiatives eg: bush regeneration, weed control, habitat restoration and protection, Landcare activities.	Ongoing	Greening Australia Wetlands Centre Australia Sandgate Rd (off roundabout) SANDGATE NSW 2307 Postal Address: PO Box 206 JESMOND NSW 2299 Phone: 02 4950 0055 Fax: 02 4955 0710 Email: gahunter@hunterlink.net.au Or Greencorps directly at 1800 077 700 http://www.greencorps.com.au

Conservation Volunteers Australia (CVA)	**Green Reserves** Training programs for adults, especially the unemployed, geared specifically for environmental restoration work. **Conservation Volunteers** Available to carry out short projects (e.g. 1 week). A minimum of 6 volunteers and a supervisor will provide labour at your site. You provide materials and specialised tools plus any accommodation cost. ATCV fee is around $400/day	Ongoing	www.atcv.com.au Ground Floor 518 Hunter Street NEWCASTLE NSW 2300 Phone 02 4926 2103 Fax 02 4926 4039 or Email: newcastle@conservationvolunteers.com.au
Landcare Australia Ltd	Can be contacted directly with specific requests. Usually involving the organising of sponsorship and support from the private sector. Usually help is in form of equipment, materials or cash. Some current initiatives include: **The Bundaberg Rum Bush Fund** Bundaberg Rum has joined forces with Landcare to support communities through the Bundaberg Rum Bush Fund, a new environmental initiative to help care for Australia's rivers and waterways. **Mitre 10 Junior Landcare Grants Program** Get your school or youth group involved in Landcare with the help of a Mitre 10 Junior Landcare Grant. **Westpac Operation Backyard** The offer of extra funding from Westpac Operation Backyard has been extended. The funding available for each approved project has been increased to 100% of the environmental costs. **Kennards Landcare Hire Gift Voucher Offer** Kennards Hire has announced a special partnership with Landcare Australia to assist selected Landcare Groups with 'free' hire of equipment and/or vehicles.	Ongoing	Landcare Australia Limited STREET ADDRESS 1/6 Help Street Chatswood NSW 2067 POSTAL ADDRESS PO Box 5666 West Chatswood NSW 1515 Toll Free 1800 151 105 Tel: 02 9412 1040 Fax: 02 9412 1060 inquiries@landcareaustralia.com.au

Threatened Species Network (NSW) Community Grants Program	Managed by the Threatened Species Network, the grants program encourages communities to take long-term responsibility for the ongoing health of our natural environment, specifically targeting the needs of species and ecological communities recognised as threatened by the Australian Government. Grants are provided for activities such as: • Habitat restoration • Weeding and feral animal control • Monitoring and surveying species populations • Fencing • Fire management	Ongoing	TSN Coordinator WWF Australia PO Box 528 Sydney NSW 2000 Toll Free 1800 032 551 Ph: (02) 8202 1222 http://www.wwf.org.au
EasyGrants	This is a consolidated, comprehensive grants information service which covers: • Federal, State and Local Government grants; • Philanthropic and corporate grants. It also provides information on when and how to apply for these grants. This information can be sourced through monthly Email at a rate of $45 per annum.	N/A	Our Community Pty Ltd www.ourcommunity.com.au National Headquarters: 51 Stanley St West Melbourne Victoria 3003 (PO Box 354 North Melbourne 3051 Victoria) Telephone (03) 9320 6800 Fax (03) 9326 6859 Email service@ourcommunity.com.au
NSW Agriculture (Department of Primary Industries) Property Planning Workshops	Landholders develop a whole farm plan, combining land and water management with business planning. The plans help landholders to: • Identify and understand the natural resources on their property and their potential. • Develop key goals in relation to the physical aspects of the farm. • Assess the capability of their land in order to evaluate suitable enterprises. • Develop a physical property plan using an aerial photo and a series of plastic overlays. • Understand CMA requirements for vegetation plans.	Workshops are held dependent upon interested landholder numbers.	CB Alexander Agricultural College Tocal Paterson NSW 2421 Call Fran on (02) 4992 2328 or Kim Griffiths on 1800 025520

National Parks & Wildlife Service of the Department of Environment and Conservation	**Voluntary Conservation Agreements** It is intended to provide permanent protection on private property for the special features of an area thus conserving the states native plants, animals and aboriginal heritage sites which exist outside the traditional park boundaries.	Ongoing	NPWS Booti Booti Office "The Ruins" Camping Ground Booti Booti National Park The Lakes Way Pacific Palms NSW 2428 (02) 6591 0300 – Tel (02) 6554 0489 - Fax

APPENDIX 2: NOXIOUS WEEDS FOR GREATER TAREE AND GREAT LAKES AREAS

Greater Taree

The following weeds are declared noxious in the Greater Taree control area. The 'details' link on each listing provides further information on the legal requirements of the weed's listing and any variation in status within the local control area.

Common name	Scientific name	Category
Alligator weed	*Alternanthera philoxeroides*	W1
Bathurst Noogoora Californian Cockle burrs	*Xanthium spp.*	W2
Bitou bush Boneseed	*Chrysanthemoides monilifera*	W3
Black knapweed	*Centaurea nigra*	W1
Blackberry	*Rubus fruticosus (agg. spp.)*	W2
Broadleaf pepper	*Schinus terebinthifolia*	W2
Broomrape	*Orobanche spp.*	W1
Cabomba	*Cabomba spp.*	W4g
Chinese celtis	*Celtis sinensis*	W2
Columbus grass	*Sorghum x almum*	W2
Crofton weed	*Ageratina adenophora*	W3
Dodder	*Cuscuta campestris*	W2
Giant Parramatta grass	*Sporobolus fertilis syn. Sporobolus indicus var. major*	W2
Giant rat's tail grass	*Sporobolus pyramidalis*	W2
Green cestrum	*Cestrum parqui*	W2
Groundsel bush	*Baccharis halimifolia*	W2
Harrisia cactus	*Harrisia spp.*	W4f
Hawkweed	*Hieracium spp.*	W1
Horsetail	*Equisetum spp.*	W1
Johnson grass	*Sorghum halepense*	W2
Karroo thorn	*Acacia karroo*	W1
Kochia	*Kochia scoparia*	W1
Lagarosiphon	*Lagarosiphon major*	W1
Lantana (Red flowered)	*Lantana camara*	W2
Mexican feather grass	*Nassella tenuissima syn Stipa tenuissima*	W1
Miconia	*Miconia spp.*	W1
Mistflower	*Ageratina riparia*	W3
Mother-of-millions	*Bryophyllum delagoense*	W2
Nodding thistle	*Carduus nutans*	W2
Pampas grass	*Cortaderia spp.*	W2
Parthenium weed	*Parthenium hysterophorus*	W1
Paterson's curse,Vipers Italian bugloss	*Echium spp.*	W2
Prickly pears	*Opuntia spp.*	W4f
Rhus tree	*Toxicodendron succedaneum*	W2
Salvinia	*Salvinia molesta*	W2
Senegal tea plant	*Gymnocoronis spilanthoides*	W1

Siam weed	*Chromolaena odorata*	W1
Spiny burrgrass	*Cenchrus longispinus*	W2
Spiny burrgrass	*Cenchrus incertus*	W2
Spotted knapweed	*Centaurea maculosa*	W1
St John's wort	*Hypericum perforatum*	W2
Water hyacinth	*Eichhornia crassipes*	W3
Water lettuce	*Pistia stratiotes*	W1
Willows	*Salix spp.*	W4g

Great Lakes

The following weeds are declared noxious in the Great Lakes control area. The 'details' link on each listing provides further information on the legal requirements of the weed's listing and any variation in status within the local control area.

Common name	Scientific name	Category
African boxthorn	*Lycium ferocissimum*	W2
Alligator weed	*Alternanthera philoxeroides*	W1
Bathurst Noogoora Californian Cockle burrs	*Xanthium spp.*	W3
Bitou bush Boneseed	*Chrysanthemoides monilifera*	W3
Black knapweed	*Centaurea nigra*	W1
Blackberry	*Rubus fruticosus (agg. spp.)*	W3
Broomrape	*Orobanche spp.*	W1
Cabomba	*Cabomba spp.*	W4g
Columbus grass	*Sorghum x almum*	W2
Crofton weed	*Ageratina adenophora*	W3
Dodder	*Cuscuta campestris*	W2
Giant Parramatta grass	*Sporobolus fertilis syn. Sporobolus indicus var. major*	W2
Green cestrum	*Cestrum parqui*	W2
Harrisia cactus	*Harrisia spp.*	W4f
Hawkweed	*Hieracium spp.*	W1
Horsetail	*Equisetum spp.*	W1
Johnson grass	*Sorghum halepense*	W2
Karroo thorn	*Acacia karroo*	W1
Kochia	*Kochia scoparia*	W1
Lagarosiphon	*Lagarosiphon major*	W1
Mexican feather grass	*Nassella tenuissima syn Stipa tenuissima*	W1
Miconia	*Miconia spp.*	W1
Mintweed	*Salvia reflexa*	W3
Mistflower	*Ageratina riparia*	W2
Mother-of-millions	*Bryophyllum delagoense*	W2
Pampas grass	*Cortaderia spp.*	W2
Parthenium weed	*Parthenium hysterophorus*	W1
Paterson's curse,Vipers Italian bugloss	*Echium spp.*	W3
Prickly pears	*Opuntia spp.*	W4f
Rhus tree	*Toxicodendron succedaneum*	W2

Salvinia	*Salvinia molesta*	W2
Senegal tea plant	*Gymnocoronis spilanthoides*	W1
Siam weed	*Chromolaena odorata*	W1
Spiny burrgrass	*Cenchrus longispinus*	W2
Spiny burrgrass	*Cenchrus incertus*	W2
Spotted knapweed	*Centaurea maculosa*	W1
St John's wort	*Hypericum perforatum*	W2
Water hyacinth	*Eichhornia crassipes*	W2
Water lettuce	*Pistia stratiotes*	W1
Willows	*Salix spp.*	W4g

Noxious Weed Categories

W1	The presence of the weed on land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
W2	The weed must be fully and continuously suppressed and destroyed.
W3	The weed must be prevented from spreading and its numbers and distribution reduced.
W4a	The weed must not be sold, propagated or knowingly distributed and any part of the weed must be prevented from growing within 3 metres of the boundary of a property.
W4b	The weed must not be sold, propagated or knowingly distributed and any existing weed must be prevented from flowering and fruiting.
W4c	The weed must not be sold, propagated or knowingly distributed and the weed must be prevented from spreading to an adjoining property.
W4d	The weed must not be sold, propagated or knowingly distributed and the weed must be fully and continuously suppressed and destroyed if it is: 3 metres in height or less, or within half a kilometre of remnant urban bushland, as defined by SEPP 19, and is not deemed by council as having historical or heritage significance or is over 3 metres in height and not included in a Management Plan approved by the local control authority.
W4e	The weed must be fully and continuously suppressed and destroyed. All reasonable precautions must be taken to ensure produce, soil, livestock, equipment and vehicles are free of the weed before sale or movement from an infested area of the property.
W4f	The weed must not be sold, propagated or knowingly distributed. Any biological control or other control program directed by the local control authority must be implemented.
W4g	The weed must not be sold, propagated or knowingly distributed.

For further information about weeds or weed control, visit the NSW Agriculture Weeds page at http://www.agric.nsw.gov.au/reader/weeds or send an e-mail message to weeds@agric.nsw.gov.au. Up-to date lists of noxious weeds in any control area can be accessed through this website.

Additionally visit the Weeds of National Significance website at http://www.weeds.org.au/natsig.htm

APPENDIX 3: THE NSW GOVERNMENT'S NATIVE VEGETATION ACT 2003

Some key questions and answers

The Native Vegetation Act 2003 has substantially reformed the law relating to the management of native vegetation in NSW.

The new Act sets a framework for:

- ending broadscale clearing unless it improves or maintains environmental outcomes;
- encouraging revegetation and rehabilitation of land with native vegetation; and
- rewarding farmers for good land management.

But weren't there rules governing native vegetation before this?

Yes. The *Native Vegetation Act 2003* will replace the *Native Vegetation Conservation Act 1997*.

The framework for the *Native Vegetation Act 2003* was developed by the Native Vegetation Reform Implementation Group, which included farming and environmental interests. This group, chaired by the Right Honourable Ian Sinclair AC, reported its recommendations to the Government in August 2003.

When does the new Act commence?

The NSW Parliament passed the *Native Vegetation Act 2003* but a supporting Regulation must be prepared and approved by the Minister before the Act can commence. The draft Regulation prepared in consultation with farming and environmental groups provides detail on how the Act will work on the ground. It is currently on public exhibition and will be finalised in light of comments received in order for the Act to commence in early 2005.

How will the new Act improve the management of native vegetation?

The new *Native Vegetation Act 2003* provides certainty and clarity to all. It delivers flexibility and incentives for farmers to manage native vegetation sustainably. It also gives effect to the Government's policy to end broadscale clearing unless it improves or maintains environmental outcomes. Healthy and productive landscapes are good for business and good for the environment.

Key improvements include:

1. Flexibility for landholders

The new Act provides greater flexibility for landholders by enabling them to:

- clear unprotected regrowth without approval;
- clear for routine agricultural management activities without approval; and
- continue existing cultivation, grazing or rotational farming practices where these activities do not involve the clearing of remnant vegetation.

2. Routine agricultural management activities do not need consent

Routine agricultural management activities are defined in the Act to include the control of noxious weeds and animals, the construction, operation and maintenance of rural infrastructure such as roads and fences, the clearing of vegetation planted for commercial purposes and the lopping of trees for stock fodder.

These activities can be undertaken on any part of a farm, including areas in which there are remnant vegetation and protected regrowth. If the clearing is no more than the minimum extent necessary to carry out the activity approval will not be required from either the Department of Infrastructure, Planning and Natural Resources, or the local Catchment Management Authority.

3. The introduction of financial incentives for landholders

Financial incentives may be available to landholders for the management of native vegetation on their land. Financial incentives for native vegetation management will be available through Catchment Management Authorities.
Landholders can apply for financial incentives by preparing a property vegetation plan with their local Catchment Management Authority.

4. An end to broadscale clearing

The NSW Government is committed to ending broadscale clearing (clearing of remnant native vegetation or protected regrowth). This does not mean an end to all clearing. The new Act protects the most important vegetation by limiting the circumstances under which clearing approval can be granted. Under the new Act approval for clearing protected regrowth and remnant native vegetation cannot be granted unless it can be demonstrated that the clearing will improve and maintain environmental outcomes.

5. The application process for clearing native vegetation has been streamlined

A landholder wanting to clear native vegetation now has two options:

- submit a development application, or
- request a property vegetation plan through their local Catchment Management Authority.

Both options require the Catchment Management Authority to assess the proposal under the new legislation. The Act has streamlined the assessment criteria and this will speed up the process. Also, it is anticipated that amendments to the threatened species legislation will reduce the need for approvals/licences under that legislation if a property vegetation plan is obtained.

6. Property vegetation plans provide certainty and flexibility

Property vegetation plans will give landholders greater certainty because they contain provisions allowing clearing for up to 15 years. Property vegetation plans enable landholders to propose offsets that may support a clearing proposal for the purpose of meeting the improve or maintain environmental outcomes test. Such offsets can extend beyond 15 years.

7. Clear definitions for different classes of native vegetation

The Act defines regrowth, remnant vegetation and protected regrowth as well as the rules that apply to the management of these different classes of native vegetation.

Regrowth: Basically, all vegetation that has regrown since 1990 - or 1983 in the Western Division - is regrowth. Regrowth does not include any vegetation that has regrown as a result of unlawful clearing or clearing as a result of natural causes.

There are no regulatory controls for native vegetation classified as regrowth. Farmers can clear this vegetation without approval. There may be some situations where these dates may disrupt existing farming rotations. Where this occurs, subject to appropriate evidence, a property vegetation plan can be prepared to vary these dates to allow existing activities to continue.

Remnant vegetation: Remnant vegetation is all vegetation that is not regrowth. Remnant vegetation cannot be cleared without approval (either through a Development Application or a property vegetation plan) except for certain circumstances like routine agricultural management activities and sustainable grazing.

Protected regrowth: Protected regrowth is regrowth that has been identified as protected in an environmental planning instrument, property vegetation plan or interim protection order. It must be identified based on the best available scientific evidence. Protected regrowth cannot be cleared for a new land use without approval (either through a development application or a property vegetation plan). Clearing protected regrowth for routine agricultural management activities does not require approval so long as it is limited to the minimum extent necessary. Similarly, clearing of protected regrowth associated with existing rotational farming practices does not require approval.

8. Local people involved in making decisions

The new arrangements for natural resource management will see more decisions being made by local people. Catchment Management Authorities will be the approval authority for clearing proposals and for provision of incentives through the property vegetation plans. Catchment Management Authorities will also be 'on the ground' to assist landholders through the process.

9. Certainty for private native forestry

The *Native Vegetation Act 2003* provides certainty for landholders and investors engaged in private native forestry, as the property vegetation plan or development consent required to carry out private native forestry can not be overturned by environmental planning instruments during the life of either agreement.

A draft Code of Practice is being developed to provide standards for private native forestry activities and will be released separately for public comment.

What do I do until the new Act commences?

The *Native Vegetation Act 2003* is expected to commence early in 2005. In the meantime, applications under the *Native Vegetation Conservation Act 1997*, which have been lodged before the exhibition of the draft Regulation, will be determined under that Act even after the new Act commences.

Applications lodged after the exhibition date will be considered if they meet the improve or maintain environmental outcomes test required by *Native Vegetation Act 2003*. Applications that do not meet the test will not be approved.

After commencement of the new Act, any such application that did not meet that test, could be negotiated with the Catchment Management Authority to use offsets

through a property vegetation plan. If such offsets, when considered together with the impacts of the proposed clearing, improve or maintain environmental outcomes, approval may be granted.

For more information

Contact your local Catchment Management Authority or Department of Infrastructure Planning and Natural Resources.
You may also:
Email nativeveg@dipnr.nsw.gov.au
Freecall 1800 671 093

Note: This information does not constitute formal legal advice. Please seek specific advice from the Department of Infrastructure, Planning and Natural Resources or your local Catchment Management Authority before undertaking any clearing.

APPENDIX 4: NSW RIVERS AND FORESHORES IMPROVEMENT ACT 1948

- design of proposed works and engineering details
- photos – panoramic (multiple frames) looking upstream, downstream and at the area covered by the proposal
- representative cross sections for existing and proposed profiles showing floodplain surface, top of bank, both banks, channel bed, changes in slope and 1% flood level
- extent of any excavations, including amount of material to be excavated, storage sites and disposal sites and any known contaminants (eg. acid sulfate soils).
- location, depth, volume and extent of any filling, including source of material
- proposed scour protection works for bed and banks
- stormwater discharge points
- description of the proposed riparian zone
- erosion control measures proposed during works
- environmental impact assessment (flood flows, storage and hazard on and off site, erosion, flora and fauna, water use, groundwater, contaminants, salinity, etc.)

Structural works are to be designed by a suitably qualified person. DLWC will assess environmental suitability but will not conduct an assessment of structural adequacy.
Council will need to supply DLWC with all documentation forwarded as part of the DA, including a copy of the completed DA form. Early discussions of proposals with DLWC, prior to lodging the DA, is strongly recommended, to avoid problems and delays with the project later.
Recommendations for all DAs
The following recommendations are relevant for all DAs in the vicinity of rivers, estuaries, lakes and wetlands, regardless of whether a formal approval is required from DLWC or not.

The NSW State Rivers and Estuaries Policy and the NSW Wetlands Management Policy provide general guidelines for DAs. The principles contained in these policies aim to protect, restore and enhance riparian and wetland ecosystems for the benefit of present and future generations. Consideration needs to be given to the biodiversity, water quality, the physical form and function of these systems.

All developments should employ effective methods to prevent the entry of sediments into waterbodies. Council guidelines, together with the Department of Housing's manual, Managing Urban Stormwater: Soils and Construction 1998 (the Blue Book), can be used to address this issue.

A riparian area of local native vegetation (comprising tree, shrub and groundcover species) should be maintained and enhanced wherever possible adjacent to rivers, estuaries and lakes. This riparian area will provide a natural filter for runoff, will stabilise stream banks and will provide habitat and corridor functions for flora and fauna. Generally, a minimum riparian area of 40 metres wide measured from the top of each bank is recommended for major watercourses and 20 metres for minor watercourses.

In all areas (especially new urban release and rural-residential areas) careful planning of rezonings and subdivisions is essential to ensure sustainability of riparian environments. Particular care is to be taken to identify riparian areas, and to avoid development within them. Ideally, riparian areas should be given an appropriate land use zoning reflective of its purpose of maintaining catchment health.

Identification of floodways is also necessary, to avoid unsuitable development in these areas. Streams are to be maintained in their natural state, although scour protection works may be required to manage existing catchment conditions. Flood detention and water quality control basins impact upon stream continuity and are to be located off stream. [It should be noted that Council is the authority responsible for the planning and approval process as it pertains to flood risk considerations].

Additionally, any instream proposals will require consultation with NSW Fisheries.

Approval Process

These guidelines have been prepared to assist in determining the need for an R&FI Act permit under IDAS and are intended as a guide only. For legal detail, readers are referred to the R&FI Act itself.

Upon receipt of development consent from Council, proponents need to submit a Part 3A permit application to DLWC.

Remember, consult DLWC early to discuss your proposal.

Newcastle	4929 4346
Gosford	4324 3844
Muswellbrook	6542 1222
Taree	6552 2788

LAND & WATER CONSERVATION

GUIDELINES ON INTEGRATED DEVELOPMENT AND THE RIVERS & FORESHORES IMPROVEMENT ACT 1948

For obtaining approvals for works in or near water bodies

May 2000

Note: These guidelines will apply until the introduction of an integrated package of water legislation. The new Water Management Act is proposed by the Government to be enacted in the latter half of this year.

Introduction

The Integrated Development Assessment System (IDAS) came into effect on 1 July 1998. IDAS is a joint development approval process usually involving council as the consent authority, and other approval bodies including the Department of Land and Water Conservation (DLWC), which administers the Rivers and Foreshores Improvement Act 1948 (R&FI Act). Under IDAS, council will refer the Development Application (DA) to DLWC when a permit is required under Part 3A of the R&FI Act. This is when the proposed development is in, or within 40 metres of the top of the bank or shore of, protected waters (except for protected waters administered by the NSW Waterways Authority).

What is the purpose of Part 3A?

Part 3A of the R&FI Act is designed to control activities that have the potential to cause adverse impacts such as:

- increased erosion or siltation of streams or lakes
- bed lowering and bank collapse
- diverting the course of a stream
- obstructing or detrimentally affecting stream flow
- ecological deterioration, leading to long term river stability problems

Where do the R&FI Act and Part 3A apply?

The R&FI Act applies to natural and artificial water bodies, which are known as ***protected waters***, and which include:

- all clearly defined drainage lines
- perennial (flowing) or intermittent (often dry) streams
- modified stream channels
- artificial channels diverting natural stream channels
- estuaries, coastal lakes or lagoons
- any perennial or intermittent lakes having a stream running into or from them and coastal lakes

Part 3A of the R&FI Act also applies to ***protected land***, which includes the bank, shore or bed of these water bodies, adjacent land within 40 metres of the top of their banks or shores, as shown in Figure 1, and associated deposits of material. However, Part 3A may also apply to land further than 40 metres from a water body, if an activity poses a threat to protected waters or protected land.

Figure 1. Protected land and protected waters under the R&FI Act.

How is Part 3A used to regulate activities?

A 3A permit is generally required for any excavation on, in or under protected land, or for removal of material (eg. soil or rock) from protected land, or to do anything that might obstruct or detrimentally affect water flow (eg. structures or fill). Each permit has **conditions** that are specific to the type of activity being undertaken to ensure there are no adverse impacts upon the riverine environment and to manage an environmentally acceptable outcome.

Activities that need Part 3A permits include:

- excavations
- sand, soil and gravel extraction
- dredging
- modification of stream channels (deepening, widening, diverting, piping, channelising or doing restoration works)
- erosion control works
- constructing retaining walls
- making stream crossings (bridges, culverts, causeways)
- doing subdivisions involving road works, drainage, stormwater collection, erosion control or other earthworks
- constructing some dams, weirs, stormwater basins and artificial wetlands
- laying cables or pipelines across streams
- building structures on freehold foreshore land (eg. seawalls, boat ramps, boat sheds, marinas, buildings, etc.)
- any works that may cause instability or may have a detrimental effect on river systems

In certain cases a permit may not be required. Exemptions apply to lawfully exercisable rights on Crown land or to mining operations and to public and local authorities. Table 1 summarises these exemptions.

Table 1. A 3A Permit is not required if a proposal is:

- more than 40m from the top of bank (refer figure 1)
- entirely on Crown Land and has a lawful approval under the Crown Lands Act
- undertaken by a council or a public authority (does not include business ventures such as state-owned corporations or commercial undertakings)
- authorised under any Act relating to mining

Regardless of who is carrying out the works, or whether a permit is required, Part 3A gives DLWC the authority to order remediation works if it considers an activity has or might damage, or detrimentally affect protected land or protected waters, or cause protected waters to change course. To avoid problems, it is always wise to **consult with DLWC first.**

Other DLWC approvals

In addition to IDAS approvals under the R&FI Act, DLWC is an approval body under IDAS for the Water Act 1912 (for the capture and use of surface water and groundwater) and the Roads Act 1993.

DLWC also issues approvals under the Crown Lands Act for works on Crown land, and under the Native Vegetation Conservation Act for lopping or clearing of certain types of vegetation. If a development proposes to use surface water or groundwater, requires vegetation clearing or involves works on Crown land (for improved access to a property, works on a Crown lease or licence area, a jetty in a tidal area, etc.), then **DLWC should be consulted before the DA is lodged.**

Information required for a 3A permit under IDAS.

The type of information required with the DA is dependent on the scale of works and may include:

- property land title details and boundaries
- plans of property showing existing and proposed development, including north point, scale bar and contour intervals, distance to all watercourses, direction of flow in watercourses, location of top of bank, ground levels, vegetation, surface features, etc., location of cross-sections, of photo points and the 1:100 flood line
- description of features on property and adjacent property (vegetation, wetlands, dams, bank condition, etc.)
- land ownership including ownership of adjacent land - if Crown land, provide any existing lease, licence or permissive occupancy reference numbers - include evidence of owner s

APPENDIX 5: CONTACTS

Contact Organisation	Phone / Fax	Address
Hunter-Central Rivers Catchment Management Authority (HCRCMA)	(02) 6551 8994 – Tel (02) 6552 2047 – Fax	98 Victoria Street (PO Box 440) Taree NSW 2430
Department of Infrastructure, Planning and Natural Resources (DIPNR)	(02) 4929 4346 - Tel (02) 4929 6364 - Fax	Suite 6 / 464 King Street Newcastle West NSW PO Box 2213 Dangar NSW 2309
Karuah / Great Lakes Community Support Officer (Landcare etc,)	6554 1655 - Tel 0428 607 370 – Mob. Email: kgl_landcare@telstra.com	C/o- Helen Marston KGLLMC PO Box 3 Nabiac NSW 2312
Dyers Crossing Landcare Group	(02) 6550 2220 – Tel Email: clondella@bigpond.net.au	C/o- Les & Alice Roberts Wang Wauk Road Dyers Crossing NSW 2429
Upper Wallamba Landcare Group	(02) 6559 1719 - Tel	C/o- Basil Schneider 'Apple Glen' Tipperary Road Firefly NSW 2429
Greater Taree City Council	(02) 6591 3399 - Tel	2 Pultney Street PO Box 482 Taree NSW 2430
Great Lakes Shire Council	(02) 6591 6222 - Tel	Great Lakes Council Breeze Parade PO Box 450 Forster NSW 2428
Greening Australia	(02) 4950 0055 – Tel (02) 4955 0710 - Fax Email: gahunter@hunterlink.net.au	Wetlands Centre Australia Sandgate Rd (off roundabout) SANDGATE NSW 2307 Postal Address: PO Box 206 JESMOND NSW 2299
National Parks and Wildlife Service of the Department of Environment and Conservation (DEC)	(02) 6591 0300 – Tel (02) 6554 0489 - Fax	NPWS Booti Booti Office "The Ruins" Camping Ground Booti Booti National Park The Lakes Way Pacific Palms NSW 2428
NSW Fisheries (Department of Primary Industries (DPI))	(02) 4982 1232 – Tel. (02) 4982 2306 – Fax	Port Stephens Office Taylors Beach Road Taylors Beach NSW, 2315
NSW Agriculture (Department of Primary Industries (DPI))	(02) 6552 7299 – Tel. (02) 6551 2253 – Fax	1 Macquarie Street PO Box 253 Taree NSW 2430
Department of Environment and Conservation (Environmental Protection Authority)	(02) 4926 9986 – Tel (02) 4929 6712 – Fax.	117 Bull Street Newcastle NSW 2300

APPENDIX 6: REVEGETATION GUIDE FOR THE WALLAMBA SUB-CATCHMENT IN THE DYERS CROSSING / FIREFLY AREA

Landform	River, creeks, etc.	Floodplain & lower country	Low hills & mid slopes	Upper slopes & ridges
VEGETATION TYPE	Riparian Rainforest	Coastal Dry Sclerophyll Forest	Coastal Dry Sclerophyll Forest	Coastal Dry Sclerophyll Forest
GEOLOGY AND SOILS	Mostly Alluvium	Mostly Alluvium		
LOCATION EXAMPLE	Wellers Lane, Wallamba River	Abbotts Road, Dyers Crossing	Nabiac Hill	Nabiac Hill
TREES > 8m	Ironwood *Waterhousia floribunba* Water Gum *Tristaniopsis laurina* River Oak *Casuarina cunninghamiana* Flooded Gum *Eucalyptus grandis* Forest Red Gum *Eucalyptus tereticornis* Blackwood *Acacia melanoxylon* Rough-leaved Elm *Aphananthe phillippinensis* Lilly Pilly *Acmena smithii* Red Ash *Alphitonia excelsa* Hard Quandong *Elaeocarpus obovatus* Brush Cherry *Syzygium australe* Cabbage Palm *Livistonia australis* Guioa *Guioa semiglauca* Cheese Tree *Glochidion ferdinandi*	Forest Red Gum *Eucalyptus tereticornis* Broad-leaved Apple *Angophora subvelutina* Swamp Mahogany *Eucalyptus robusta* Grey Gum *Eucalyptus punctata* Cabbage Gum *Eucalyptus amplifolia* Grey Box *Eucalyptus moluccana* Slaty Red Gum *Eucalyptus glaucina*	Spotted Gum *Corymbia maculata* Tallowwood *Eucalyptus microcorys* White mahogany *Eucalyptus acemoides* Red Mahogany *Eucalyptus resinifera* Turpentine *Syncarpia glomulifera* Bloodwood *Corymbia gummifera* Forest Oak *Allocasuarina torulosa* Stringybark *Eucalyptus globoidea* Brush Box *Lophostemon confertus* Grey Gum *Eucalyptus punctata* Rudder's Box *Eucalyptus rudderi*	White mahogany *Eucalyptus acemoides* Forest Oak *Allocasuarina torulosa* Grey Gum *Eucalyptus punctata* Grey Ironbark *Eucalyptus placita* Red Ironbark *Eucalyptus fibrosa* Northern Ironbark *Eucalyptus siderophloia* Spotted Gum *Corymbia maculata* Bloodwood *Corymbia gummifera* Tallowwood *Eucalyptus microcorys* Grey Box *Eucalyptus moluccana*
SHRUBS 1m – 8m	Green Wattle *Acacia irrorata* Pink-tipped Bottlebrush *Callistemon salignus* Tree Violet *Hymenanthera dentata* Sandpiper Fig *Ficus coronata* Native Frangipani *Hymenosporum flavum* Native Hibiscus *Hibiscus heterophyllus* Tree Lomatia *Lomatia arborescens*	Prickly Tea Tree *Melaleuca styphelioides* Pink-tipped Bottlebrush *Callistemon salignus* Willow-leaved Hakea *Hakea salicifolia* Narrow leaved Tea Tree *Melaleuca linearifolia*	Hakea *Hakea salicifolia* Banksia *Banksia integrifolia* Scrub Turpentine *Rhodamnia rubesens* Native Peach *Trema tomentosa* Cheese Tree *Glochidion ferdinandi* Orange Thorn-Bush *Pittosporum multiflorum*	Banksia *Banksia integrifolia* Pittosporum *Pittosporum revolutum* Geebung *Persoonia linearis* Hop Bush *Dodonaea triquetra* Blackthorn *Bursaria spinosa* Pinnate Boronia *Boronia pinnata*
GROUND COVERS <1m	Spiny Mat Rush *Lomandra hystrix* Mat Rush *Lomandra longifolia* Maidenhair Fern *Adiantum aethiopicum*	Kangaroo Grass *Themeda triandra* Wallaby Grass *Notodanthonia longifolia* Weeping Grass *Microlaena stipoides*	Guinea Flower *Hibbertia scandens* Flax Lily *Dianella caerulea* Flax Lily *Dianella longifolia* Glycine *Glycine clandestina*	Grass Triggerplant *Stylidium graminifolium* Forest Sedge *Carex incomitata* Riceflower *Pimelea linifolia* Slender Violet *Hybanthus monopetalus*

APPENDIX 7: WATER MANAGEMENT IN NSW

Frequently Asked Questions

Basic Landholders Rights (Sections 52,53,54, 55)

1. What are basic landholder rights?
They cover three types of rights:
1) domestic and stock rights which replace riparian water rights;
2) harvestable rights which effectively continue the old farm dams policy; and
3) native title rights.
For more details, refer to DIPNR's information sheet called 'What are rural landholder's basic rights to water?' available on this website.

2. Do I have a domestic and stock right?
If your land borders a river, creek, lake or wetland, or it is over a groundwater body, you are entitled to the domestic and stock right. That is, you do not require a water access licence and you will not require an approval (except if you take domestic and stock water under your basic landholder right through a bore or a dam that is not within the harvestable right for that property).

3. What is a harvestable right? How much water is this?
This right allows landholders to capture a portion (10%) of the runoff from their land. Your local DIPNR office can help you work out how much water this is for the size of your property and your area. You do not require a water access licence or an approval for a farm dam as long as it is within your harvestable right for your property.
Refer to the series of information sheets on farm dams on this website.

4. For what purposes can I use these rights?
Domestic and stock rights are for non-commercial use around your house and garden and for watering stock.
Harvestable rights can be used for anything including irrigation.
Native title rights are for customary use by Aborigines once this right has been legally established.

5. I have river frontage and draw water for domestic purposes, including watering my garden and keeping some stock for food. Do I need to apply for a licence under the new Water Sharing Plan arrangements?
No. Taking water from a surface water source in these circumstances is covered by basic landholder rights and therefore you will not require a water access licence or works approval under the *Water Management Act 2000*.

6. Can I still irrigate an area of land for fodder crops for stock under my Basic Landholder Rights?
No.

7. Are there any limits to the size of pump I can use to extract my Basic Landholder Rights?
No. DIPNR will be publishing 'Reasonable Use' guidelines however and has powers under the *Water Management Act 2000* to enforce these guidelines. These guidelines will be available in 2005.

8. Can I build a dam without a licence or approval under my Basic Landholder Rights?
It depends. A harvestable rights dam does not require a works approval. A dam for domestic and stock water where the capacity of the dam exceeds your harvestable right does require an approval.
If you are building any dam that is classified as being on a "river" (ie a dam that does not qualify for harvestable rights), then you must obtain a water supply works approval before commencing construction. For more information regarding where you can build a dam without a licence refer to the DIPNR information sheet Farm Dams - Do you need a licence?.

9. The new Act says I don't need a WAL for a basic landholder rights bore. Can I just hire a driller and commence work?
No. All bores require a water supply work approval, whether it is a bore for irrigation water or a bore used exclusively to exercise of basic landholder rights. The 'Application for approval to construct a basic landholder rights (domestic and stock) groundwater works' is available on this website.

10. How much water may I take for domestic and stock rights? Are there any limits?
There are no general volumetric limits under basic landholder rights, although you must be using the water for domestic consumption (non-commercial uses around the house and garden) and for stock watering. In addition, water restrictions under section 323 of the *Water Management Act 2000* may be in force in your area. Check with your local DIPNR office or call 1800 353 104. Reasonable use guidelines will be enforceable through directions when they are available.

11. If I take domestic and stock rights water, am I subject to daily flow sharing arrangements?
No.

12. My neighbour is taking so much domestic and stock water that I cannot get access to water for my domestic and stock basic rights. What do I do?
If your neighbour seems to be wasting water or using it for purposes that are not permitted under the domestic and stock right, DIPNR can take action against your neighbour. Contact your local DIPNR office.

13. I am subdividing my rural property. Will the domestic and stock right be subdivided along with the land? Are there any rules I should be aware of?
As of July 1, 2004, properties may be subdivided and each block will retain the domestic and stock right. In the future, regulations may be introduced to change this situation in some parts of the state.

14. I have owned my farm for many years. Recently there has been a rural residential development in my area and the subsequent growth in groundwater extraction for domestic purposes. This is impacting on my availability to access domestic and stock supplies under my domestic and stock access licence. What can I do?
Temporary water restrictions and prohibitions can be brought in under s.323 to protect downstream domestic and stock rights holders. Contact your local DIPNR office.