17. RIVERINE ENVIRONMENT

17.1 PROCESSES

17.1.1 Cause

Little River and Bell River are the only two major tributaries that flow into the Macquarie downstream of Burrendong Dam and upstream of Dubbo. This is significant because these waters make up most of the stream flow in this section of the Macquarie River during the winter months when water is being collected for irrigation in the dam.

Riparian vegetation is particularly important to the overall health of a river. It provides a filter strip for protection of water quality, stabilises and protects riverbanks from erosion by high flows, acts as a wildlife corridor, and provides habitat, food and shelter for fish and other aquatic species and native fauna. Reduced buffering from vegetation removal between the watercourse and adjoining land use is contributing to increased nutrient, sediment and pesticide inputs to rivers.

Clearing and landuse practices are resulting in habitat loss and degradation. Riparian zone habitats are distinctive due to their high nutrient and water availability and play a significant role in maintaining regional biodiversity. However, the overall productivity of this zone makes it attractive to competing agricultural activities, which can favour pest species, such as unbalanced populations of native birds and animals (8).

Aquatic macrophytes (aquatic vascular plants other than microscopic algae and distinct from riparian trees and shrubs) have many useful roles in aquatic systems. They provide habitat for fish and other aquatic organisms, stabilise sediment, provide oxygen, and act as physical filters as well as nutrient sources and sinks.

River systems may also recharge groundwater systems and vice versa; however, it is unknown if there are any groundwater dependent ecosystems in the Little River Catchment.

Cold water pollution also damages the riverine environment. Water is released from Burrendong Dam from the bottom of the dam where water temperature and dissolved oxygen levels are low due to thermal stratification. The low dissolved oxygen levels can lead to chemical reactions, which release phosphorus, iron and manganese ions, raising the nutrient level in the bottom of the dam. Dam releases of cold, hypoxic (no oxygen) and nutrient enriched water impacts on fish breeding cycles and also affects aquatic plant health. It is suspected that the effects of cold water releases are felt as far down the Macquarie River as Warren (46).

Changes to land use practices have increased the potential for flood damage. These changes include grazing, dryland cropping, irrigated and intensive agriculture. Currently, floods do not have an extensive impact on the area because of the small number and size of floodplains. Floodplains are important habitats for aquatic fauna and flora when inundated, as nutrients are released, plankton blooms develop and aquatic invertebrates grow. During flushing of the floodplains wetland system, fish move in and out of the floodplain habitats and pollutants are also diluted and flushed away. Flood conditions also enhance successful fish recruitment (83).

On the Macquarie River, dam releases and weirs have altered wetting and drying cycles, resulting in bank slumping and erosion. Another cause of streambank erosion is undercutting and abrasion of the stream bank. Streambank erosion is also often increased due to the land use practices of adjacent land. Grazing by stock has prevented regeneration of the understorey and canopy species which can also lead to increased streambank erosion. Soil type and their chemical nature, moisture status, land use changes, river regulation and increased runoff due to land clearing are also causes and factors affecting streambank erosion.

Clearing of vegetation in the upper catchments has led to increased runoff, resulting in increased stream size to achieve a new hydrologic balance and further streambank erosion. The introduction of willows has also resulted in increased sedimentation, the formation of rafts of debris and the diversion of water, which can cause bed and bank erosion.

Sand and gravel are essential parts of the river system, and help to dissipate hydraulic energy. Gravel and sand extraction from river beds can impact on the stability of the river system. Removal of these materials results in the river trying to replace it with material out of the stream, leading to in-stream erosion. Additional problems caused by construction of access roads, alteration of the flow patterns and undermining can destabilise the stream banks and affect fish populations (8).

17.1.2 Upstream/Downstream Inter-Relationships

Clearing of vegetation in the catchment has resulted in dryland salinity and increased salt load in streams, leading to higher salt concentrations in the river systems affecting water quality, aquatic life and riparian vegetation. Agricultural landuse has increased available runoff, which in turn increases streambank erosion. Streambank erosion is a cause of increased turbidity and sediment loads and decreased capacities of drainage lines and watercourses, as well as eutrophication of the waterways. Other problems associated with agriculture include contamination of river water with chemicals and fertilisers and loss of flow in the river due to irrigation.

In high flood times, excess water in Little River can cause flooding in the Macquarie River. The Macquarie Marshes are also affected by upstream impacts because they act as a filtering and collection point for all contaminants.

The presence of carp in the river has increased stream turbidity which in turn impacts on native fish populations and water quality. Carp may also be responsible for eating native fish eggs.

17.2 PRESENT CONDITION

17.2.1 Extent and Distribution

A Rapid Health Assessment of the Macquarie River and its tributaries has been undertaken by Tim Baker, DLWC, Orange. This study looked at bank erosion, bed stability, weed invasion and vegetation. The findings relating to Little River and its major tributaries are summarised below (See Appendix 12a for detailed findings) (85).

Little River itself varies in its health from its origin to its confluence with the Macquarie River. At its origin, the river has vertical banks, no understorey and weedy groundcover. Typha is present in the stream which stabilises the bed; however, it indicates salinity. Carp

are also present causing increased turbidity. Further downstream there are some isolated occurrences of bank erosion but generally the banks are stable. There is a number of introduced plant species, reduced vegetation, the river has wider channels and there is also sediment transfer.

Near Obley, there is a heavily forested section with good vegetation, stable banks and beds and coarse particles in the bed. Downstream of the confluence of Buckinbah Creek, where there is more agriculture, there is an increase in weeds and the bank scours and slumps in some areas. However, the bed is stable. As Little River flows past Bushrangers Hill, there is a defined bank and floodplain. The overstorey is good, however, there is a weedy groundcover. Where the river joins the Macquarie, it narrows and has steep, sloping banks which are in good condition. There are a number of weeds present.

Buckinbah Creek joins Little River north of Yeoval. At its origin, there is limited bank instability and good vegetation. Further downstream it becomes highly disturbed and there are carp and typha present, but no sediment transfer. North of Yeoval there is increased sedimentation, sand bars and highly disturbed vegetation. Phragmites grow on the sand bars.

Gundy Creek joins Little River in the Arthurville region. It features steep to vertical banks with abundant grass coverage. Typha, which may indicate high salt concentrations, maintains bed stability and there is a weedy groundcover. The lower part of the creek is highly disturbed. The banks have a reduced gradient; however, there is a deep channel.

Sandy Creek flows into Buckinbah Creek near Yeoval. There is extensive bank erosion due to clearing and poor stock management. Erosion in the degraded upper catchment has also led to sediment transfer. The banks of the river have steep sloping grassed banks. Typha is again present in stream. Closer to Yeoval, there is greater grass coverage on the banks. However, erosion is still present. Typha still grows there and vegetation is isolated (85).

Riparian vegetation in the catchment is made up of River She-oak (*Casuarina cunninghamiana*) and River Red Gum (*Eucalyptus camaldulensis*). The River She-oak forms single species stands along watercourses of the slopes and tablelands in the catchment. Very little understorey is present in most areas.

Carp and Red Fin are present in Little River and its various tributaries. Carp are seen to increase turbidity of the water, eat smaller fish and may also increase the risk of riverbank erosion.

The extent of floodplains in the Little River Catchment is limited due to the topography of the area, therefore, flood damage only occurs in the Little River Catchment when the river breaks its banks or reaches floodplains. Heavy rainfall events in the upper catchment above Burrendong Dam may result in flooding in the lower areas of the Little River Catchment.

17.2.2 Severity

Streambank erosion was mapped as part of the Landuse and Erosion Survey and the data is provided by DLWC (48). It affects a number of tributaries of the Little River and the Buckinbah Creek. Most of these areas are found in the Baldry subcatchment. There is approximately 100 kilometres of streambank erosion within the Little River Catchment. (See Table 20 and Figure 18 in Section 15.)

Table 20. Streambank Erosion (metres) in the Little River Catchment.

Streambank Erosion (metres)	Baldry	Yeoval	Cumnock (Little River)	Cumnock (Bell River)	Suntop/ Arthurville (Little River)	Suntop/ Arthurville (Bell River)	TOTAL
Streambank Erosion	63932	13808	4206	1296	16682	2780	102704

Little River is one of the best stocked rivers for native fish in NSW. NSW Fisheries have classified it as in good condition from a habitat aspect (comparable with streams in the Upper New England area). There is very little pumping or chemicals used and generally, cattle have not caused much impact. The river has some carp but also has very good stocks of cod, river blackfish, and silver and golden perch. Trout cod (an endangered species) are also thought to be found here.

The numbers of carp present in Little River is reasonably low compared to other rivers in the surrounding area (see Figure 22 and Appendix 12b). Care needs to be taken to prevent the degradation of the aquatic environment in order to protect native fish stocks in Little River. Native fish appear to be acclimatizing to changes in the river. It is assumed that the fish are breeding because a range of sizes and ages has been found in surveys. Clarity of the water is reasonable even though carp tend to make the water turbid.

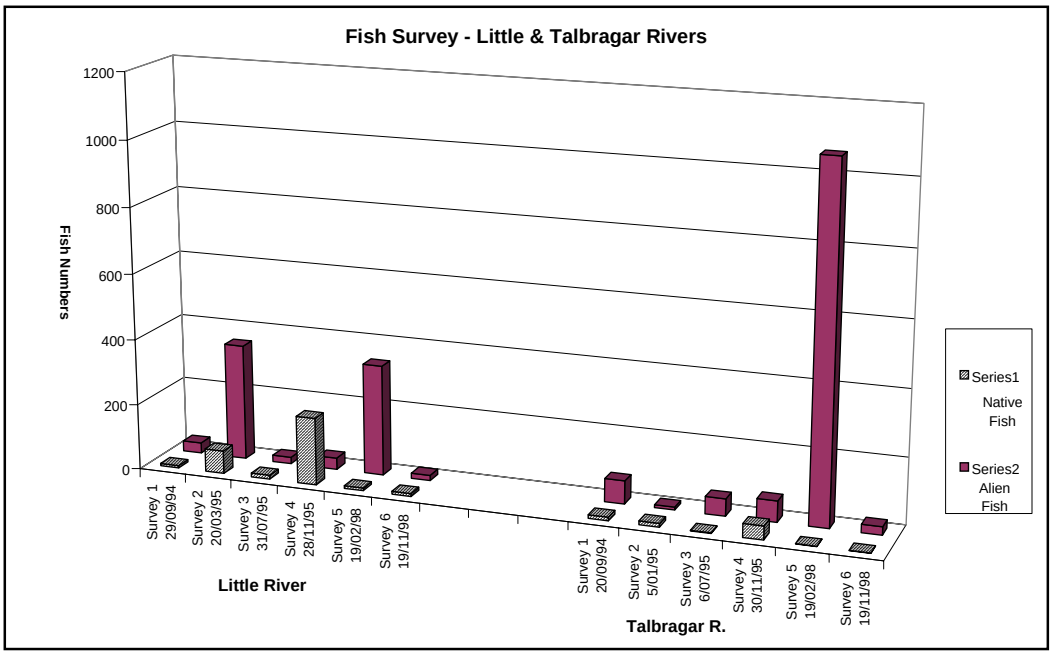

Figure 22. **Numbers of Native and Alien Fish in the Little and Talbragar Rivers.**

In 1955, the most extensive flooding recorded in the Macquarie Valley occurred on the floodplains near the confluence of the Little River and the Macquarie River. Another flood also occurred in 1956. These were such large floods that the design for Burrendong Dam was modified in the light of knowledge gained from these events. The townships of Wellington and Dubbo were badly affected in these floods.

17.2.3 Environmental Impacts

River and wetland health is detrimentally impacted on by agricultural landuse. Irrigators, graziers, the wetlands and urban areas all compete for water and are in some way are responsible for reducing water quality and quantity, increasing salt load and polluting the waterways. These impacts all accumulate to reduce river health.

17.2.4 Social and Economic Impacts

Using values worked out from the 1955 flood, it has been estimated that flood damage to crops from Burrendong Dam to Narromine would cost approximately $620 000 for a major flood and approximately $70 000 for a minor flood (1984 values) (1). Flood damage includes damage to fences, farm structures and irrigation systems.

Damage to the aquatic environment is unable to be valued due to a lack of economic tools to assess ecosystem values.

17.3 THE FUTURE

17.3.1 Trends

It is predicted that salt loads in the river systems will continue to rise over the next 100 years, so it can be inferred that river health may worsen. If river health is not addressed, there may be increases in the numbers of alien fish species in the river, decreased water quality and increased streambank erosion.

Changing landuse trends have seen the clearing of native vegetation and the removal of natural structures which previously slowed the movement of floodwaters across the floodplain. Landuse in the floodplains has changed from grazing to dryland cropping and now expanding irrigation.

17.3.2 Projected Environmental Impacts

Environmental impacts may include loss of native vegetation, reduced channel depth, decreased water quality and quantity, reduced habitat for native fauna and loss of native fauna in the river systems.

Over the last fifty years the extent, frequency and duration of flooding has been reduced due to river regulation and water abstraction. Future environmental impacts will depend on future land use trends such as increased irrigation. Irrigation may increase if river improvements are undertaken. If irrigation were to expand, then there would be an increased potential for floods to spread across the plains. Alternatively, increased numbers of irrigation developments may lower the flow of the river and therefore reduce the potential for flooding. Irrigation developments will depend on water allocation and for this reason so too will the future environmental impacts.

17.3.3 Projected Social and Economic Impacts

If river health worsens, the social and economic impacts may be significant. The costs of providing suitable water to urban areas is likely to increase, and the opportunities and viability of certain enterprises and industry may be limited.

As there are no flood mitigation structures in place, it is not possible to estimate the future socio-economic impact. Problems may occur if the development of rural subdivisions continues on floodplain areas. If development continues, the cost of flood damage would dramatically increase because more infrastructure would be affected.

17.4 CURRENT ACTIVITIES

17.4.1 Consultation

This Catchment Management Plan for Little River is being developed in consultation with Landcare Groups and landholders within the catchment. The Macquarie Marshes Catchment Committee has been set up to provide a voice for the landholders in the Marshes area. There are five zones with two representatives from each zone. Working groups under the main committee have also been set up looking at erosion and water distribution, fauna, vegetation, water quality and tourism.

17.4.2 Planning

The NSW Inland Rivers Flood Plain Management Studies - Macquarie Valley was carried out in 1984 by Sinclair Knight and Partners Pty. Ltd. The study was funded by NSW and Federal Governments and supervised by a Steering Committee. The studies were required to report on flood plain management measures in operation including works in progress or completed, identify areas of continuing potential for flood losses and evaluate practical mitigation measures, and to recommend a program of short and long term proposals with descriptions and costs of the work required. Field work was undertaken and information was sourced from the then Water Conservation and Irrigation Commission of NSW (now part of DLWC), local government employees and maps, gauge heights, satellite imagery and specialist reports. This was a "one off" report so more recent/regular information is required.

Wellington Shire Council has developed a Floodplain Management Plan for the urban areas along the Macquarie and Bell Rivers. Dubbo City Council is developing a floodplain Management Plan for defined land along the Macquarie and Talbragar Rivers.

17.4.3 Research and Development

NSW Fisheries have undertaken some research using electro-fishing in Little River to determine what fish are present. A report of this research is available. A research unit has also been set up in the Department of Land and Water Conservation, Dubbo, which works with National Parks and Wildlife Services to look at vegetation studies and the extent of flooding in the Macquarie Marshes. The Bureau of Resource Sciences is also carrying out research into the effects and costs of carp in river systems.

Land and Water Resources Research and Development Corporation (LWRRDC) is making large investments in riverine environment health. They have a River Restoration and Management Program (incorporating riparian lands), National Eutrophication Management

Plan (NEMP), National Program for Irrigation Research and Development, National River Health Program, and a National Rivers Consortium. Environment Australia (EA) has a Wetlands Program.

17.4.4 Implementation

A low landholder awareness of riverine issues was apparent from the issues workshops held in the catchment, with carp being the only issue regularly mentioned. This may explain why there are so few Rivercare projects in the catchment, with just one being undertaken at Obley.

NSW Fisheries in conjunction with local government have a program to make landholders more aware of the impacts of infrastructure on fish.

17.4.5 Monitoring and Evaluation

The NSW Fish Survey was carried out between 1994 and 1998 to determine the numbers and species of fish (both native and alien) present in NSW rivers (see Figure 22). The project was undertaken by NSW Fisheries and the Cooperative Research Centre for Freshwater Ecology. The Macquarie Marshes Catchment Committee has organised an erosion and vegetation survey in the Macquarie Marshes. DLWC and NPWS are responsible for the monitoring of groundwater aquifers in the Marshes. This has been ongoing for four years in order to understand bore pressures and groundwater salinity. Monitoring and reporting on the health of waterways within the State is an ongoing part of the NSW Water Reforms.

A Rapid Health Assessment on riparian zones is being carried out by DLWC in the Macquarie Valley (85). This looks at bank erosion, bed stability, weed invasion and vegetation.

17.4.6 Best Management Options (BMO)

LWRRDC has developed Riparian Land Management Technical Guidelines and Rivercare: Guidelines for Ecologically Sustainable Management of Rivers and Riparian Vegetation for the purpose of restoring, protecting and enhancing river landscapes. The Guidelines provide advice on techniques to control nuisance aquatic plants, managing snags and large woody debris, controlling instream erosion, using buffers to reduce sediment and nutrient delivery to streams, managing and rehabilitating riparian vegetation, managing riparian land for terrestrial wildlife and managing stock in the riparian zone (82, 93).

The sites of streambank erosion can be treated by:

- Preventing further clearing within the riparian zones
- Excluding stock from grazing along the streambanks and limit stock access
- Protecting actively eroding banks
- Removing obstructions in the river that are diverting water
- Leaving a buffer zone between the riverbank and the adjacent activities.

17.4.7 Identified or Perceived Barriers

Generally, landholders are very reluctant to fence off riparian zones because of cost, loss of access, and repairs after flooding. Most perceive that they will not be able to use the land at all, rather than seeing fencing as a way of managing the land according to its unique capability.

17.4.8 Institutional

There are a number of pieces of State legislation relevant to river health and floodplain management. Examples of these include the Catchment Management Act 1989, Crown Lands Act 1989, Environmental Planning and Assessment Act 1979, Local Government Act 1993, Native Vegetation Conservation Act 1997, Rivers and Foreshores Improvement Act 1948, Soil Conservation Act 1938 (Protected Lands), Water Administration Act 1986, Protection of the Environment Operations Act 1997, Fisheries Management Act 1994, Water Act 1912 and the Western Lands Act 1901 (81).

The NSW Water Reforms, introduced in 1997, provide for a Healthy Rivers Commission which looks at improving, maintaining and enhancing the health of the State's rivers, and has established River Management Committees (regulated and unregulated) in the Macquarie Valley to develop Water Quality and River Flow Objectives.

17.4.9 Investment

The New South Wales Government is providing $33.5 million in incentive funding over five years and $76.6 million for the implementation and support for regional community based committees. Water pricing is also being reviewed under the Water Reforms Policies to allow for a full cost recovery in rural water pricing. Cost recovery may allow for further funding to be allocated to improving the health of the State's river systems.

17.4.10 Cost Sharing

The NSW Rivercare program and MDBC 2001 provides money for Rivercare programs in the catchments of New South Wales.

17.5 ANALYSIS

17.5.1 Identified or Perceived Gaps

More recent information on studies on the floodplains of the Macquarie Valley is required. Information on developments such as agricultural and rural subdivisions is also needed to determine the effects of these developments on the rivers and floodplains. Currently there are no floodplain management plans or gazetted floodplain maps for the Little River Catchment area.

17.5.2 Key Stakeholders and Contacts

Renae Kidson, Macquarie Marshes Project, NPWS, Dubbo
Chris Clarke, Licensing Officer, NSW Fisheries, Wellington,
Patrick Dwyer, Conservation Officer, NSW Fisheries, Wellington
Tim Baker, Riverine Assessment, DLWC, Orange
Greg Brereton, Groundwater Services Manager, DLWC, Dubbo

References

(1) Sinclair Knight & Partners P/L (1984) *NSW Inland Rivers Floodplain Management Studies - Macquarie Valley*

(8) Donaldson Planning and Management Services (1996) *Namoi Community Catchment Plan - Stage 1 Situation Statement*

(46) Macquarie 2100 Salinity Task Group (1998) *Macquarie 2100 Information Sheet - Water Quality*

(48) Department of Land and Water Conservation Resource Information Unit (1999) *DLWC GIS Maps and Statistics*

(81) P. Price & S. Lovett (eds) (1999) *Riparian Land Management Technical Guidelines, Volume One: Part A - Principles of Sound Management, Part B - Review of Legislation Relating to Riparian Management*

(82) P. Price & S. Lovett (eds) (1999) *Riparian Land Management Technical Guidelines, Volume Two: On-ground Management Tools and Techniques*

(83) A.K. Smith & D.A Pollard (eds) (1999) *Policy and Guidelines Aquatic Habitat Management and Fish Conservation*

(85) T. Baker (1999) *An Assessment of Riverine Health in the Macquarie, Bogan and Castlereagh Rivers (DRAFT)*